# PACIFIC GAS AND ELECTRIC MAGAZINE

## CONTENTS FOR JUNE



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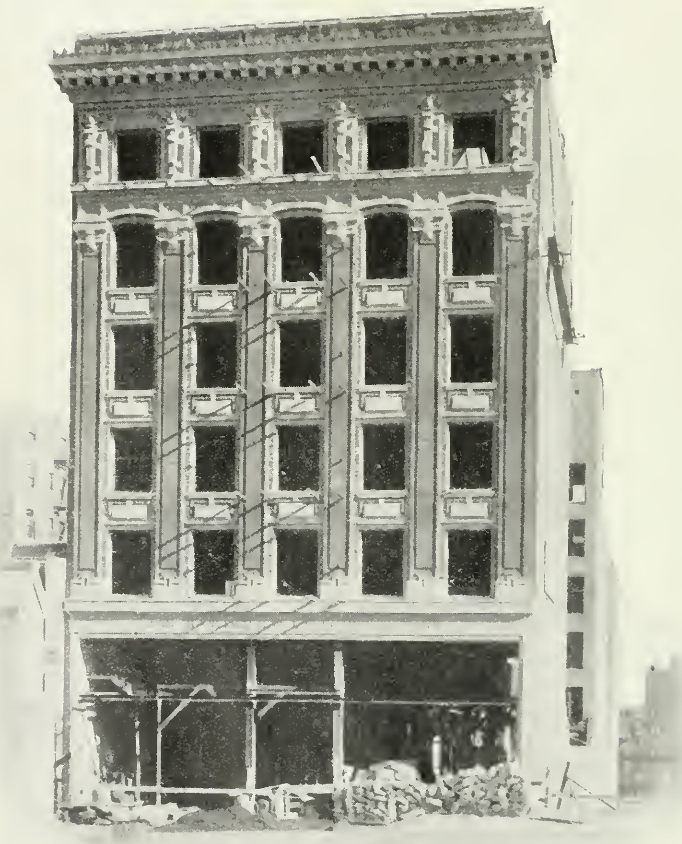

GENERAL OFFICES

San Francisco Gas and Electric Company and Pacific Gas and Electric Company, 445 Sutter St., San Francisco

# Pacific Gas and Electric Magazine

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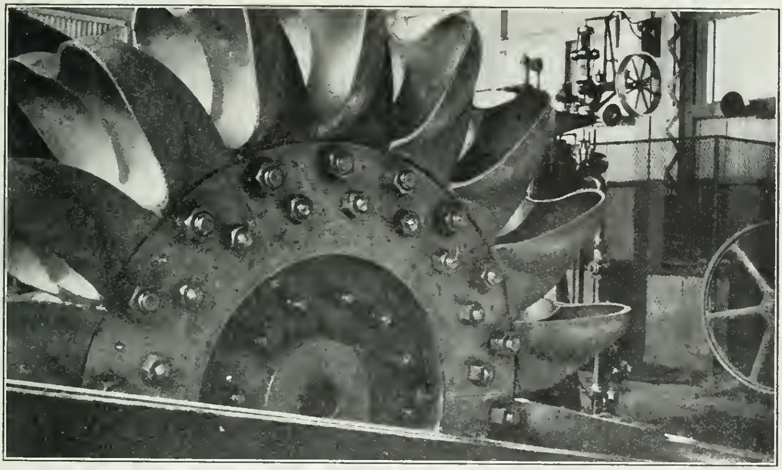


## Electra Water Wheel

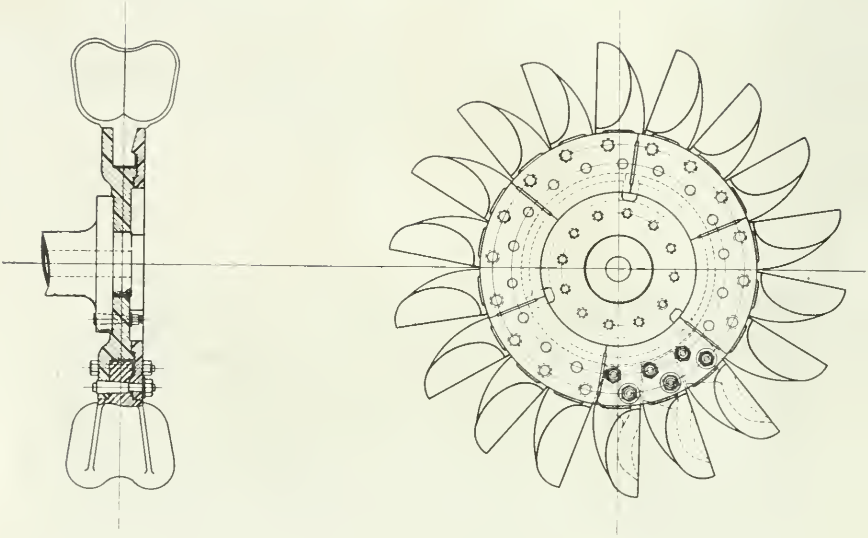
### Recently Designed for the Electra Power Plant


By C. F. Adams.
Engineer, Electric Construction.


SOME time ago one of the 5000 K. W. generators at Electra went out of commission. Certain bolts failed that secured a water wheel bucket to its disc. This machine is again in service, driven by a new water wheel in which the chance of a similar failure has been eliminated.

When the 2000 K. W. generators were first installed at Electra and Colgate, running at 240 R. P. M., conservative designers decided that a single wheel and a single stream were out of the question for such a large machine, and so two 1000 K. W. wheels were mounted on each shaft. These wheels, be it said, have run without trouble until the buckets literally wore out, after about seven years' service. Later a single wheel was designed for a 2000 K. W. machine, and placed in successful operation at de Sabla on an operating head of 1500 feet.

The success of the 2000 K. W. machines and the growing demand for increase of power-house output, led to the consideration of 5000 K. W. units to run at 400 R. P. M.

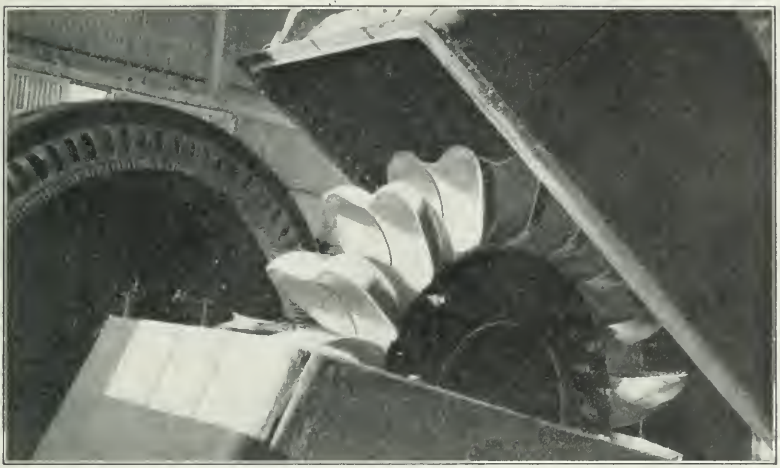


With the call for larger units and higher speeds, the water wheel designer proposed a single wheel and a single stream for this new 5000 K. W. machine. The result was the well-known two-bearing set with an overhung water wheel taking the enormous impact of a seven inch stream under 1250 feet head.

Experience has demonstrated that conservatism is of value, even in the designing of water wheels.

Our latest type of wheel, designed by Consulting Engineer W. R. Eckart, is the result of the practical experience gained through a lifetime observation of this class of water wheels.

The vital feature of the high power, high speed wheel, is the design of the



bucket fastening. The manufacturers of large wheels had all adopted a type of fastening which seemed to be final. Two heavy lugs forced over and bolted to a driving disc was the standard pattern of fastening.

In a 5000 K. W. wheel of eighty-eight inches diameter on the stream center line, driven at a speed of 400 R. P. M., each bucket in turn receives an impact of about twelve tons, delivered 6.6 times a second. Steel has its limits, and under these strains the bolt holes became enlarged and the occasional breakage of bolts was a source of anxiety.

New and stronger grades of steel were tried without much improvement. The duty required seemed to be greater than the design and material would permit without ultimate failure.

The emergency called for radical treatment and the designs finally accepted were of this order. The bucket fastening was obtained by a single lug or extension, dovetailed into two steel clamp rings. The through bolts were no longer the sole support of the bucket, but were mainly of service in holding the clamp rings in place. Each bucket lug fitted against its following bucket, and the entire structure became virtually a solid. The driving disks were forged from Government armor plate. Nickel steel taper bolts were the fastenings. The buckets are open hearth steel castings.

The work of machining and assembling this wheel was undertaken by a local manufacturer. The work required rigid precision and the utmost care, and the wheel when assembled is shown in the illustrations, which were taken at the factory and at the power house, after going into service. The design of this wheel is covered by letters patent, recently issued to its designer.

The wheel is of such robust construction that we are justified in the opinion that the final limit of power for a single water wheel has not yet been reached. The modifications in the water wheel itself were accompanied by changes in the shaft pedestals. An extremely heavy sole plate was designed for the shaft pedestal support. The pedestal was retained in position by heavy keys, supplemented by through bolts. The new bearing caps contain five babbitted semi-circles of ample width, to resist any upward movement on the part of the shaft. That a rotor weighing twenty tons should have any tendency to rise from its bearing might require explanation. This tendency does exist under certain accident conditions. The operation of this new machine is being observed with much interest and confidence.

# Landmarks in Nineteenth Century Progress

By John A. Britton.

WEBSTER defines the word invent as follows:

"To discover, as by study or inquiry; to find out; to devise; to contrive or produce for the first time."

Discovery or invention by any of the means outlined in the above definition may be divided properly into three classes—destructive, obstructive and constructive. In so far as history informs us the inventions of the centuries prior to the Nineteenth were of the destructive and obstructive type, rather than the constructive. It is undoubtedly true that we have much to learn of the ancients and that we are to-day applying largely the results of the researches made in gone by days, but there has been preserved to us but few of the really beneficial inventions. In matters other than the discovery or application of appliances in a mechanical way, it is undoubtedly a fact that we have as yet much to learn from our forefathers. Productions of genius in the arts, in literature and in architecture far surpass anything of modern times, and we are looking daily to the Old World for inspiration in others than the pure mechanical devices which during the Nineteenth Century have done so much for the uplift of man.

In literature we have but to think of those wonderful minds (to-day the guides of all students) who existed in the Homerian period, such names as Sophocles, Plato, Demosthenes, Simonides and Pindur, all of whom existed before the Christian Era, whose works have been handed down and are to-day the wonderment of man.

In architecture we have confronting us in the older worlds, and to the same extent in the newer, evidences of the wonderful skill and science of the men who designed the edifices that survive time itself. Students of architecture will bear in mind the following types which are still copied and reproduced in our modern structures: the Cyclopean, Babylon, Assyrian, Egyptian, Grecian, Roman, and last, the Renaissance. In the ruins that have been uncovered of these wonderful works of art, it is clear that methods and means of handling the massive stones which formed the structures must have been invented, and put into play, by the master mechanical minds of those ages, but the records of the means employed are unfortunately lost; they are, however, reflected in the Cyclopean type of architecture, the existence of which dates from twelve to fourteen hundred years before Christ. Massive stones, 9'x4'x8', were placed in buildings two hundred feet in height, and we cannot but wonder what mechanical appliances were used for such purposes. In the ancient ruins in Yucatan and Peru, large blocks of stone, some 27'x14'x12', were used, not only in the foundations, but in the superstructure of buildings. The Roman type of architecture was undoubtedly borrowed from the Greeks, as they are mere modifications of the Ionic, Gothic and Corinthian types so common in the Grecian temples.

While architecture brought about a certain amount of inventive skill, due to the necessity for the handling of the massive blocks that were used, it originally sprang from the modeling of wooden structures, when men were forced in the earlier days of creation to contrive means to protect themselves from the inclemencies of the season.

For the inventions that have been particularly beneficial to man we must look to the accomplishments of the Nineteenth Century, for in all of the centuries before we have no record of anything approaching the strides that have been made in useful and beneficial inventions for the betterment of man and his progress along the lines of our present better civilization.

The destructive and obstructive inventions of the centuries prior to the Nineteenth and those which have been preserved to us were possibly made necessary, because of the need in the ancient times in the greater portion of the world, eliminating the higher elegance and civilization of Greece and Rome, of the survival of the fittest. Men were taught the feat of arms; the capture and submission of countries other than their own was their principal thought; excursions and incursions of the Gauls into all parts of Europe, the over-riding of Great Britain, and the final peopling by the wild tribes of savages inhabiting the northwestern part of Europe of the Asiatic countries, made the presence of inventive minds in the matter of destructive implementes of warfare more necessary than for inventions for the uplift of mankind. One of the earliest inventions known was that of gunpowder, commonly attributed to China, and used many thousands of years before the birth of Christ.

To assume to recite the beneficial inventions of the Nineteenth Century would involve a reprint of the published reports of the Patent Office for the past sixty years.

The first in point of beneficial inventions, singularly enough, is illuminating gas. This was first discovered and applied by Wm. Murdock, a Scotchman, in 1792, but not until 1803 was it made a commercial possibility. Its first introduction into the United States of America was at Newport, Rhode Island, in 1813. Of the illuminating gas and its particular characteristics, methods and manufacture, I will later treat.

Next in point of importance to the masses of people was the discovery and application of steam for the operation of railroads. This dates from 1801, the first railroad being built in England. The introduction of railroads into the United States dates from 1828, when the Baltimore Ohio Railroad was incorporated and operated with twenty-three miles of track.

The next invention of general effect was that of telegraphy, dating from 1825 and made possible by Sturgeon's invention of the electro-magnet. The Morse system was not installed until the year 1836, the previous attempts at telegraphy being largely that of submarine, and on a limited scale. Submarine telegraph as a commercial success was made possible by the invention of Thompson of his deflecting galvanometer, which was perfected in 1858 and at that time applied to the first Atlantic cable.

In 1876 telephony was discovered by Dr. Bell, and its many and daily uses are of too common knowledge to require any further explanation.

Electricity, as applied to general uses for light, heat and power, was not developed until 1879 and 1880, when Edison and Brush together brought it out, although at different dates, the open arc direct current lamp and the carbon filament incandescent, and while these have undergone many changes in the past twenty-nine years, they are practically to-day what they were at the time of invention. Prior to that time the Jablakoff candle was a mere plaything or toy, not commercially possible.

In 1885 the Roentgen or X-ray was discovered.

In 1885 Auer von Welsbach invented the incandescent mantle, which is known by his name, which revolutionized the uses of illuminating gas and saved it from being absorbed by its competitor—electricity.

These practically constitute the beneficial inventions of the Nineteenth Century to the extent of listing those which are generally used and commonly known of. From each of them has sprung a thousand and one other inventions, allied and collateral, and daily new applications of these particular inventions are being made.

It would seem that of the beneficial inventions of the Nineteenth Century, electricity (both for transmission of sound, signal, light, heat and power) and the discovery of the manufacture of illuminating gas have been of the greatest benefit to mankind. Wireless telegraph, which is merely one of the adjuncts and collateral inventions of electricity, is the latest and newest of all, and promises to be of the greatest benefit. The recent experience in the saving of life on the S. S. "Republic" by the use of this weird control of nature is sufficient justification for placing it in the front rank of the beneficial inventions.

# Minimum Charges

By Geo. B. Furniss.

THE Boston Edison (Electric) Company appeared before the Massachusetts Gas and Electric Light Commission, April 15, 1909, on petition of consumers that the minimum charge of $1 per month be reduced or eliminated. The following costs were submitted (Electric World, April 22, 1909) and to which have appended similar costs for the Oakland District.

| Yearly Items in Meter Expense | Boston Electric | Oakland Electric | Oakland Gas |
|---|---|---|---|
| Interest on cost and depreciation, 6 and 14%—Gas 6 and 7% | 2.79 | 2.39 | 1.01 |
| | | | .57 } |
| Testing and repairing | .77 | .53 | .65 } |
| Cost of reading meters | .42 | .17 | .17 |
| Lamp depreciation and losses | .32 | .00 | .00 |
| Expense per bill rendered, or substantially per meter— | | | |
| Accounting | .66 | .49 | .49 |
| Billing | .75 | .09 | .09 |
| Collecting | .88 | .59 | .59 |
| Cashier's Department | .15 | .05 | .05 |
| Postage | .36 | .03 | .03 |
| Stationery | .15 | .07 | .07 |
| Armature loss, B40 023 K.W. @ 4c | (1.60) | .92 | .00 |
| Executive and General Fixed Expenses, Taxes, etc. | .00 | .00 | .00 |
| Total | 8.85 | 5.33 | 3.72 |

Should the executive, general and fixed expense, etc., of the corporation, and department costs incidental to meter service be proportioned to this item, which is proper, the above costs would be about doubled for Oakland, and probably the same for Boston.

The object of this article, however, is to show that the minimum charge is not a rental on the meter, but a basic cost of the installation. For instance, we might thus consider the cost for an electric meter installation in the Oakland District.

Presuming that a consumer used but $5.33 worth of current in a year, and paid for same at the regular rate of 9c (60 K. W. H.), then as a matter of fact the Company has only collected its absolute meter expense and furnished the current free. Should the Company collect $12 from this consumer on the basis of a minimum charge of $1 per month, then this same consumer has paid the difference between $5.33 and $12, or $6.67 for current, or 11c per K. W. H. This makes a period from 60 to 74 K. W. H., only where a consumer pays an "excess" rate, but reducing this to the monthly basis of $1, this small fraction disappears; figures 9c.

Again, had the consumer used $12 worth of current (133 K. W. H. @ 9c) then as a matter of fact he has had 133 + K. W. H. for $6.67 or 5c per K. W. H. In other words, he has had the same rate as a merchant who according to our schedule must use 1250 K. W. H. per month to obtain a 5c rate.

Had no current been used during the month, then the minimum appears as a bonus of 55c, which, however, is readily absorbed by general expenses and costs incidental to keeping a supply available.

Upon the consumer using the minimum amount, the Company assumes the meter costs, which is cared for in the base rate and which anticipates that the consumer uses or pays for at least 11 K. W. H. or $1 per month.

The electric costs for Oakland appear much lower than for Boston, due to handling the gas in conjunction with the electric meters in reading statements, accounting and collecting. As there is generally one electric meter to one of gas, the two should be added for cost per consumer, which will thus show an increase, due to higher labor and material costs on this Coast.

The minimum also serves to discourage people holding meters for possible use, "when company comes in," for instance, with little or no consumption. Otherwise, a large investment in meters would be required, which would increase the Company's capitalization, maintenance costs, and in turn affect the rate, rates being based on the investment. "Sets and Outs" cost 34c per year per meter installed. This, against $2.05 per year interest and depreciation on a meter, argues against leaving a meter lay without use.

Hence the layman's doctrine, "I will pay for all I use, but no more," is met by, "No bill is rendered for less than one dollar." This is to defray exactly what is used, viz., "Service."

# The Electric Meter Testing Department and Its Work

By S. J. Lisberger.
Engineer, Electric Distribution, Sec. II.

FOR a long time managers of central station systems contented themselves with the belief that in selecting a meter which had an average accuracy under wide ranges of load and of moderate initial cost they were properly taking care of the meter work of their system. Few seemed to appreciate the importance of the relation of meters to their revenue and to their prosperity. So-called motives of economy led many managers to spend practically nothing in the keep-up of their meters which in itself is the cause of much loss of revenue.

The more common mistakes may be classed as follows:

1. Failure to give proper attention to meters after purchase—i. e., insufficient or lack of testing when received in the storeroom before being set on the consumer's premises; of inspection after being set; of testing to check the accuracy of registration; and failure to clean or maintain after installation.

2. Improper metering; or, in other words, the installation of meters of size disproportionate to the consumer's service. The tendency is largely towards over-metering, resulting in improper registration, and, as a rule, loss to the company, as well as an excess investment in meters.

Systems grew and prospered; the plant increased in size; the distribution lines grew to cover more territory; the number of meters doubled in a few years; and yet the meters, or, as they were often called, "cash registers," were left to take care of themselves in the same old way.

Speaking now, particularly, of our own conditions, but little testing was done on the system generally as late as 1904, although some of the larger plants were paying some attention to their meters. Each department took care of its own meters as they saw best. There was no organized Meter Department, and consequently we were without standard methods of testing, forms of report, or standard types of testing instruments. The instruments that we were using were of the ordinary commercial type, and but few had been checked with so-called "standards" which might be relied upon. The problem, then, before the engineers of this Company was the organization of a Meter Department to take care of the meter work over the entire system.

In order to give an idea of the rapidity of increase of the number of meters on the system, it will be of interest to note that on January 1, 1906, there were approximately 28,500 electric meters in service in all of the properties now controlled by or affiliated with the Pacific Gas and Electric Company (inclusive of the San Francisco Gas and Electric Company). On January 1, 1909, in the same territory, there were in use approximately 50,000 meters, showing an increase of 21,500 meters in three years, or in other words, about 7,150 meters per year. These meters are scattered over twenty-four counties of the State in which the Company operates, embracing a territory of many thousand square miles.

About a year ago, a committee, comprised of Messrs. Holberton (chairman), Downing, Varney and Lisberger (secretary) was appointed to prepare a plan for handling the meter testing work of the system. An analysis of the territory showed that there were five geographical divisions of the territory covered by the Corporation which could be defined as meter testing districts. These districts are known as the San Francisco District, which embraces all territory within the City and County of San Francisco; the Peninsula District, which embraces all territory as far south as and including San Jose and Santa Cruz and up to Alviso; the Oakland District, covering all territory south of the Contra Costa County line as far south as Alviso; the Marin District, embracing the Marin peninsula, Santa Rosa, Napa, and all territory as far east as Napa Junction; and the Interior District, embracing all territory from Napa Junction as far north as Chico, to the east to Grass Valley and Nevada City, and including in general all territory not covered by the other districts. The segregation of the territory in this manner limited the amount of traveling that each meter tester would have to do.

Under the plan of organization, each one of the above territories was to be handled by one of the members of the Meter Committee, the committee as a whole having charge of all of the meter work on the system.

In the various territories, several

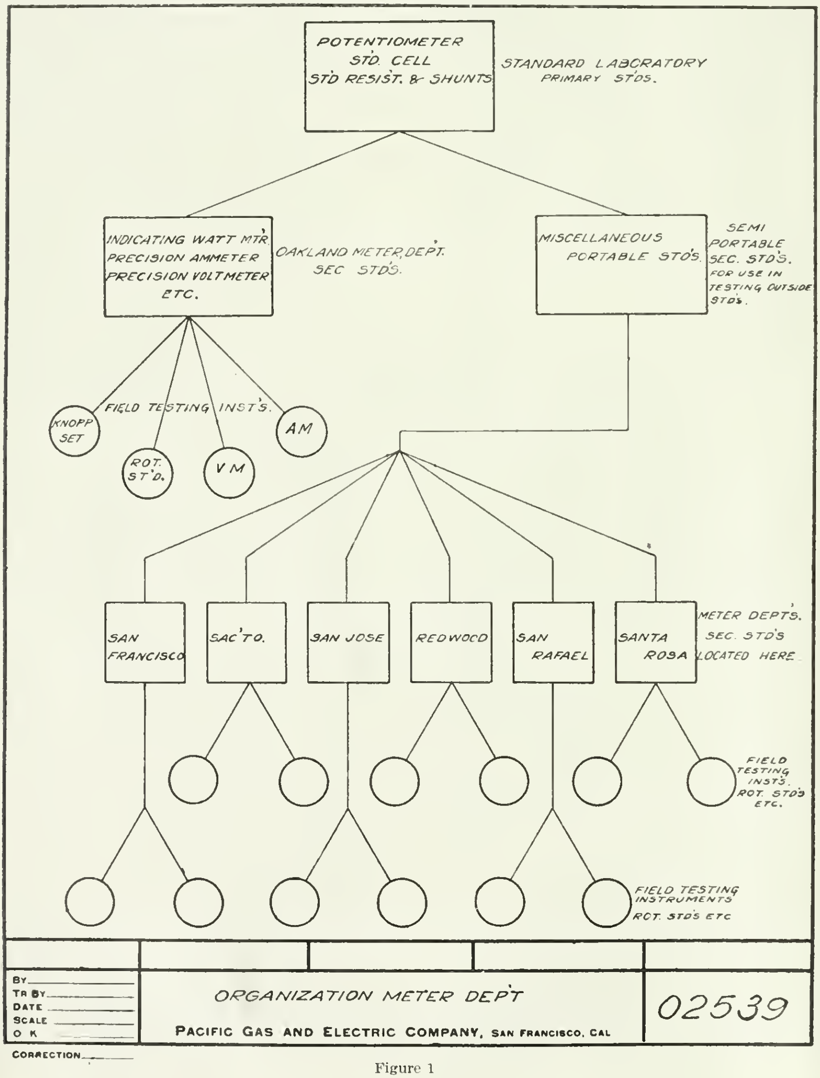



Figure 1

classes of work had to be undertaken. Power houses and sub-station meters, which included all switchboard instruments such as ammeters, voltmeters, power factor indicators, indicating and integrating wattmeters; and consumers' meters of the A. C. and D. C. types, of large and small capacity, installed on various types of load; all of which had to be tested and calibrated.

In addition to the above, it was necessary to select a standard type of testing instruments to be used by the field men. Certain so-called "meter centers" were to be established where the field meter testers might check their field instruments against secondard standards kept there, in order to save time and expense occasioned by sending the meters to and from a central laboratory.

Certain points were designated as "repair centers," to which meters in need of serious attention might be sent, so that the field men might devote their entire time to testing, rather than repairing meters.

And last, but not least, a central laboratory was to be established, where primary standards would be kept, and all standardization work done.

This organization is shown in Fig. 1.

Obviously, with the various types of meters installed on the Company's system, several methods of testing were necessary. For example, more care and attention should be given to a consumer such as an interurban railway or a cement mill than to the ordinary residence consumer who has only a nominal bill. This involved the selection of standards which should be used on the various classes of work, and designating the frequency of test for the various classes of consumers.

The Meter Department is now using a light portable set, known as the Knopp instrument, for testing residence consumers whose consumption is only nominal; rotating standards for testing consumers of the intermediate class, i. e., medium size power consumers and lighting consumers in a congested district where meters of large and small capacity are all mixed together—and indicating wattmeters and rotating standards for consumers where the consumption is very heavy.

Prior to the organization of the Meter Department there were no standard forms of test cards or reports in use. There were many conditions to be met on the system, and after much work the Meter Committee finally adopted a standard test card, the form of which

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PACIFIC GAS & ELECTRIC CO.

METER DEPARTMENT

*Register No.* ______ *Test No.* ______

*Consumer* ______ *Load* ______

*Address* ______ *Business* ______

*Date—This Test* ______ *19* ___ *Time of Test From* ______ *to* ______

*Date—Last Test* ______ *19* ___

STANDARDS: *Am. No.* ______ *Wm. No.* ______ *V. M. No.* ______ *Watch No.* ______

| MFG. METER NO. | CO. NO. | TYPE | VOLTS | AMPS. | WIRE | PHASE | DISC. CONST. | DIAL CONST. | INST. CONST. | RATED WATTS | Operating WATTS | READING | CORR. FACTOR FOUND | CORR. FACTOR LEFT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

| METER NO. | C. T. NO. | TYPE | AMPS. | RATIO | P. T. NO. | TYPE | WATTS | VOLTS PRI. | VOLTS SEC. | RATIO |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

*Why Tested* ______ *Tested* ______

*Tested with* *Portable Load* / *Consumer's Load* *Assisted by* ______

Fig. 2. (Front).

| METER No. | STANDARD | | | | | | METER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | VOLTS | AMPS. | WATTS | REV. | K CONST. | WATT HOURS | REV. | K CONST. | HOURS | WATTS | % LOAD | CORR. FACTOR | |
| | | | | | | | | | | | | FOUND | FEFT |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | |

| CONDITION | | |
|---|---|---|
| | *Sealed?* ______ | *Remarks:* ______ |
| | *Pivot* ______ | |
| | *Top Bearing* ______ | |
| | *Jewel* ______ | |
| | *Creeping* ______ | |
| | *Cleaned Brushes* ______ | |

Fig. 2a. (Back).

is shown herewith (Fig. 2 and Fig. 2-A) which is now used all over the system.

The next step involved a method for observing the results of the tests. From this much benefit is to be derived, as it is not only indicative of the benefits accruing from the meter tester's work, but it serves to show what type of meter is most accurate in service. Each month there is made up from each meter district a meter accuracy sheet, from which at a glance may be seen the results of the work of the month; and from this a total sheet is made up, showing the work of the testers all over the system. This accuracy sheet shows the number of each type of meters tested, the number and percentage of meters not correct, of meters not recording, and of meters slow and fast.

While these records have been in use only for a period of a few months, the results are most gratifying. The average accuracy of the meters on the system when the work was started, showed less than 60 per cent of the meters were recording correctly; about 22 per cent were running slow; about 10 per cent were running fast, and about 8 per cent of the total number of meters tested were not registering at all. Certain parts of the system showed up better than others. One case is brought to mind where the total number of meters not recording was as high as 29 per cent.

In several of the districts where we have had an opportunity to go over the meters that were tested a year ago, we have found that the number of meters running correctly is very nearly 90 per cent, as against 60 per cent when the present system was started.

In the organization of the Meter Testing Department, mention was made of the standard central laboratory. The Company has installed in Oakland, and will have in full working condition very shortly, a standard central laboratory for checking and standardizing all classes of instruments. This standard laboratory is equipped with a potentiometer, standard cells, standard resistances, shunts and precision instruments for checking ammeters, voltmeters, frequency indicators, and for undertaking all classes of work which must be done by the Meter Department.

In addition, there is installed a stor-

*Is the Meter Properly Leveled*............................*Fastened to Wall*............................

*Is the Wall* { *Stone*............................*Wood*............................
*or Partition* { *Brick*............................*Cement*............................

*Does Location of Meter Subject it to* { *Dampness*............................*Vibration*............................
*Chemical Fumes*............................*Damage*............................
*Dust*............................*External Magnetic Fields*............................

*WIRING:*

*Old or New*............................

*Are House and Service Wires in Proper Meter Terminals*............................

*Permit Illegal Use of Current*............................

*(Evidence of S. C. on Meter Cover.)*

*Starts on* ............................*Polarity*............................

*Creeping*............................

*Rate*............................ *Rev*............................*Min*............................*Sec.*

*Meter Left* ............................ ............................

Fig. 3. Inspector's Report

age battery, having a capacity of 2000 amperes at 4 volts, or 4000 amperes at 2 volts, for testing high ampere capacity meters; a small 50-volt storage battery of sufficient capacity to drive a small motor generator set, for generating steady currents, both A. C. and D. C., of any voltage from 0 to 750 volts and of any frequency between 0 and 100; and a very small storage battery (made up of lead strips placed in test tubes) having a capacity of .001 ampere at 500 volts, for use in checking 500-volt voltmeters on the potentiometer.

In addition, there is the necessary equipment of galvanometers and multiplying instruments.

I have endeavored in the foregoing to outline some of the problems that confronted the Meter Committee, and how they have been met. The work of the Meter Department is now well under way, and the various testers throughout the system are now testing about 3500 meters per month. Other problems are still waiting solution.

Attention is now being given to a standard set of specifications governing, in so far as possible, the meter installations for all classes of service, and specifying the size and types of meter to be set for various installations.

All new types of apparatus are tested in the laboratory before they go into use on the system, and the development and investigation of new meter testing or metering apparatus is receiving the attention of the department.

## RATHER SUSPICIOUS

Admiral Robley Evans tells the following story against himself. He had a Congressman for a guest, and, having run out of his favorite brand of whisky, made up with some he could not guarantee. He explained this, and added:

"Here, however, is some brandy that I've kept untouched for a good deal more than twenty years."

"Hand me over the whisky decanter," was the rejoinder.

"Why?" asked the Admiral. "What's the matter with the brandy?"

"That's what I want to know, Bob." said the guest; "but if you have had it untouched in your possession for more than twenty years, there must be something pretty bad the matter with it."

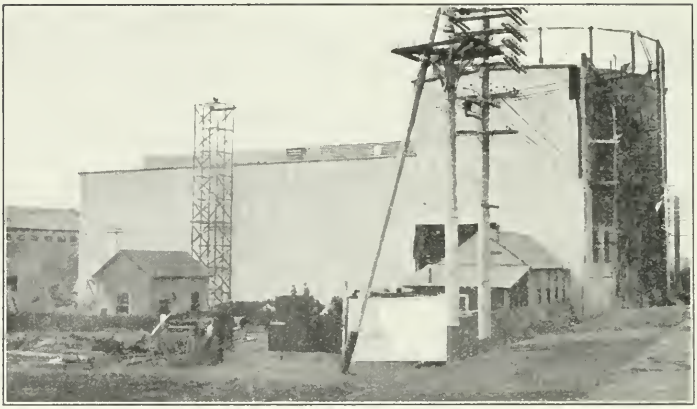

Fig. 1.
"Station "C," Oakland, Partially Completed.

# The Application of Reinforced Concrete Piling in the Foundations of Station "C," Oakland, of the Pacific Gas and Electric Company

By H. C. Vensano.
Engineering and Construction Department

IN CONNECTION with the construction of the new 9000 K. W. steam turbine station for the Pacific Gas and Electric Company recently constructed at First and Grove streets, Oakland, the use of reinforced concrete piling was decided upon as proper for the foundations of the buildings and machines.

While the use of concrete piling is not new and such piles had been used considerably in Europe and the East, yet at the present time very few have been driven in this part of the country. Therefore, the conditions which lead to their adoption may be of interest.

The building for which foundations were to be provided was to be 80 feet by 155 feet overall, divided into two sections: one 43 feet by 80 feet, 62 feet in height, in which were to be located the 9000 K. W. turbine and auxiliaries and to be equipped with a forty-ton bridge crane; the other section, 80 feet by 122 feet and 41 feet in height, in which were to be installed the boilers, eight in number. (See Fig. 1.)

This building was to have a steel framing and concrete roof. The walls were to be constructed of corrugated steel, but the foundations were to be designed to allow for the substitution of six-inch reinforced concrete curtain walls at a future time.

The property upon which this building was to be constructed is located upon the Oakland Estuary. The natural foundation in this location is a fill made a number of years ago upon the mud of the estuary bank. This layer of fill, consisting chiefly of cinders and ashes mixed with some earthy material, is about six feet thick and quite compact. Underlying this is a foot or two of black mud, then about three feet or more of a sandy blue clay, very wet and very soft. This is, in fact, a "quick" mud which flows into and fills any excavation made in it. Beneath this clay or mud is a yellow clay, regarded locally as the hardpan. This, although quite wet on top, is very compact. Wooden piles driven therein within a short distances of the new building site are claimed by the contractors who performed the work to have been driven practically to refusal at a depth of about twenty-five feet below the surface of the fill.

On the north end of the proposed building, the hardpan lay from eight to ten feet, and at the south end from twelve to fourteen feet, below the surface. From the general character of this material, it was the writer's opinion that it could have been safely loaded with about three tons per square foot. In fact, older buildings at present standing, whose foundations have been carried on this stratum, are loaded to about this amount.

In designing the foundations, there were three possible methods to be considered, i. e., To carry all the foundations to hardpan; to use wooden piles capped with concrete below the surface of the ground water; or to use concrete piles with concrete caps. The first method would have necessitated concrete piers and foundations varying from eight (8) to fourteen (14) feet deep, besides requiring expensive excavation and sheet piling work in keeping out the quick mud. This was at once discarded when considered from the standpoint of economy as compared with the other methods.

In considering the second method of wooden piles and concrete caps, it was found that the permanent level of ground water was from six to seven feet below the top of the filled surface, or about eight feet below the proposed finished building floor. Concrete foundations eight feet deep and supported on wooden piles would then be required.

The third method, involving the use of concrete piles, would allow the foundations to be made as shallow as consistent with strength regardless of the ground water level. It was decided, therefore, that with proper reinforcement capping piers about twenty-seven inches deep could be used.

The last two methods were then compared from an economical standpoint. As finally designed, 180 concrete piles were used in all. This included all piling, not only for the building, but also for the turbine and boilers. These piles were designed to support a maximum dead load of about twenty tons. While this load is actually carried by the piles of the boiler foundation at the present time, those supporting the building are, in general, loaded only to about twelve tons, due to the fact, as previously stated, that the building is at present covered with corrugated steel, though ultimately to have concrete walls. When these walls are finally constructed, the piles will be loaded as above stated. Those beneath the moving turbine, considered as a live load, were loaded to twelve tons.

The capping of these concrete piles, about twenty-seven inches deep, would require an excavation of only about fifteen inches, thus leaving the fill in a practically undisturbed condition. This fill having been tested with loads of two tons per square foot, it was decided that 1000 pounds per square foot could be safely carried by it. In the case of the turbine and boilers, where the piles were rather far apart (not closer than three to four foot centers) this pressure was allowed upon the fill and deducted from the load to be carried by the piles. For the building, the piles were assumed to carry the entire weight. For purposes of estimating, the allowable load on wooden piles was assumed at fifteen tons for dead and twelve tons for turbine loads. In this case, as the fill would have to be entirely excavated to the mud line in order to leave the piles low enough that they might be permanently moist, nothing could be allowed for the value of the soil in bearing and it was necessary to figure the piles as carrying the entire load.

Under these conditions, it was found that while 180 concrete piles were required, the number of wooden ones necessary would have been 347. This large increase is due not only to the somewhat smaller figured carrying capacity of the wooden pile, but in a large measure to the additional weight of concrete in the foundation. The additional amount of concrete required to extend the piers an added depth of six feet and to provide in a few instances for larger cappings to cover the additional piles amounted to 575 cubic yards. As a comparative cost, we then had:

| | |
|---|---|
| Cost of concrete piles in place (180 @ $41.10) | $7,400 |
| Cost of reinforcement in place (necessary for piers, etc., in connection with concrete piling) | 700 |
| Total | $8,100 |
| Estimated cost of wooden piles—347 @ $11 in place | $3,817 |
| Estimated cost of additional concrete @ $10 per cu. yd. (including forms) | 5,750 |
| Estimated additional excavation, 700 cu. yds. @ 50c. | 350 |
| Total | $9,917 |

These figures show a saving of $1817 in favor of the concrete piles, or about 20 per cent of the total cost. The cost of concrete as estimated compares very favorably with the actual cost of the material as actually placed. The price of $11 per wooden pile is a figure based on prices quoted by contractors for this class of work, so that the actual saving was very nearly as indicated. This cost of the concrete piles was also high, due to unfavorable conditions for their use. Under favorable circumstances, I believe a further saving of $1000 or more could have been made. The conditions producing this result were as follows:

The construction of this plant was undertaken on very short notice, due to the failure of certain sources of power upon which the Pacific Gas and Electric Company had been relying. The work was therefore undertaken in the latter part of July with the intention of having the plant in operation by December, if possible, to provide for the heavy holiday and winter lighting loads. This, of course, required every effort to be made in the line of speed. Wooden pile foundations would have been the quickest form of construction. This type would have been used in spite of the additional cost had it been found possible to obtain a quicker delivery upon the steel frame of the building. As the obtaining of structural steel is, in general, a governing feature as regards time in the construction of such buildings, this was the first item looked into. It was found that fifty working days was the best guaranteed delivery obtainable. This allowed about two calendar months for construction of the foundations. It was estimated that ten days would be ample for pouring the concrete after the last pile was in place. Allowing ten days for hauling and driving, and ten days for obtaining materials and fabricating the piles, left but thirty days for the setting of the concrete before driving.

Mr. L. J. Mensch, M. Am. Soc. C. E., because of his experience, was called upon for advice and it was decided that the piles could be driven at this early age provided proper precautions were used. Mr. Mensch was given the load to be carried per pile, and he, in conjunction with the Company's engineers, designed and agreed to furnish and drive them at the price noted under the comparative estimate. He was to be responsible for all piles destroyed in driving and to be prepared to furnish such extra ones on this account as might be needed.

Fig. 2. A Concrete Pile Under the Hammer.

Fig. 3. Pile Cap.

They were to be from 22 feet to 25 feet long, 12 inches square in cross section, reinforced with four 1-inch round or four ⅞-inch twisted bars spirally wrapped with No. 5 wire with 3-inch pitch and extra wrapping at the point and top.*

A mixture of concrete in the proportions of one part cement to one part sand and two parts crushed rock was decided upon and used. This rich mixture, together with the risk the contractor assumed by being responsible for all piles destroyed in driving, necessarily resulted in an increased cost. Had there been sufficient time (from sixty to seventy-five days for setting) to allow for the use of a 1:2:4 concrete mixture, the cost would probably have been $1000 or $1200 less. As an actual fact, only three piles were broken in driving, and at least one of these was defective before being placed under the hammer.

As time progressed, it was found that the structural steel would not be delivered as guaranteed, so that the starting of the driving was not begun until forty days from the time that the first

* A complete description of the piles and method of driving can be found in the Engineering News, Vol. No. 60, page 620, by Mr. L. J. Mensch.

Fig. 4. Pile Carrying Test Load.

pile was poured, instead of thirty days as planned.

A steam hammer was employed for driving and, to the writer's knowledge, these were the first reinforced concrete piles to be driven on this Coast by this method. Figure 2 shows a pile under the hammer. They were struck about 200 blows on an average, the final penetration being from ¼ to ¾ inch.

As a protection to the head of the pile during driving, a special casing, constructed of sheet steel, was bolted around it. This casing was made sixteen inches by sixteen inches in cross-section and wedges were driven between it and the pile. In this way a closer joint was obtained than by attempting to design a close-fitting cap to use without wedges. It was made twenty-four inches long and was arranged so as to project twelve inches above the top of the pile. In the space so left, sand was placed and upon this a steel block to directly receive the impact of the hammer. While this sand cushion worked satisfactorily, it was found later on that wooden plates could be substituted therefor with equally good results and with a slight saving of time. The accompanying cut, Fig 3, shows the cap in place ready to receive the sand.

A test pile twenty feet long was first put down. Its final penetration was 4/10 inches. The test load was placed on it during the two succeeding days and the results of the test are tabulated elsewhere.

The load consisted of sacked cement (Fig. 4 shows pile carrying test load). Twenty-five tons were applied the first day, when the noted settlement was 0.26 inches. This increased over night to about 0.31 inches. The next day the load was increased to thirty-five tons, when the settlement noted was 0.40 inches. After one hour's time had elapsed this had not increased. More load was then applied. At forty-three tons the pile began to settle quite rapidly and at forty-nine tons the settlement was 1.75 inches. This load was left on over night and the following morning the settlement was 2.62 inches. Upon removal of the load the pile rose .20 inches. This was taken to have been the elastic distortion of the ma-

terial in the pile itself and was very nearly equal to the entire settlement noted at twenty-five tons. It is the opinion of the writer that 35 tons was about the ultimate load of the pile.

Since the completion of the station, no apparent settlement has taken place in any of these foundations, and the piles seem to be doing their part efficiently. It may be noted in conclusion that the fill gives very little lateral support to the upper ten feet or so of the piles. The turbine when running at full load, however, produces scarcely any vibration in its foundation. It is very doubtful if wooden piles, even with their increased number, would have produced as rigid a foundation.

TEST OF PILE

Age, 40 days. Length, 20′. Number of blows to drive, 175. Penetration under last blow, 0.4″. Driven with steam hammer. Weight of hammer, 5000 lbs. Fall, 42″.

| Date | Time | Load tons | Elevation top of pile | Settlement in feet | Settlement in inches |
|---|---|---|---|---|---|
| Sept. 9 | 10:30 a.m. | None | 2.525′ | ........ | ........ |
| Sept. 9 | 10:45 a.m. | 16 | 2.525′ | ........ | ........ |
| Sept. 9 | 12:15 p.m. | 25.5 | 2.508′ | .017′ | 0.20″ |
| Sept. 10 | 8:00 a.m. | 25.5 | 2.499′ | .026′ | 0.31″ |
| Sept. 10 | 9:20 a.m. | 35.0 | 2.491′ | .034′ | 0.41″ |
| Sept. 10 | 10:30 a.m. | 43.0 | 2.470′ | .055′ | 0.66″ |
| Sept. 10 | 11:20 a.m. | 49.0 | 2.378′ | .147′ | 1.76″ |
| Sept. 11 | 8:00 a.m. | 49.0 | 2.308′ | .217′ | 2.60″ |
| Sept. 11 | 8:30 a.m. | 35.0 | 2.303′ | .222′ | 2.66″ |
| Sept. 11 | 9:30 a.m. | 3.0 | 2.319′ | .206 | 2.47″ |
| Sept. 11 | 10:00 a.m. | None | 2.319′ | ........ | ........ |

# Accidents and Their Lessons

By J. P. Coghlan

Manager, Claims Department.

Within the past year three linemen for the San Francisco Gas and Electric Company have been severely injured by falling from poles. Two fell because the buckles, or clasps, in their safety belts became unfastened; the third because the buckle snapped in two at the shank. In the first two cases the accidents could have been avoided had the buckles been secure against unclasping. In the other, a testing of the belt from time to time would have exposed its weakness.

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The Court of Appeals has reversed the judgment obtained by Matthew Ryan against the Oakland Gas, Light and Heat Company in 1905. Ryan was injured by the walls of a trench caving upon him. The Company showed that it had provided ample material with which to brace the walls of the trench and that Ryan and his fellow workmen were experienced enough to have properly used it had they so desired. This, the Court held, was sufficient performance of the Company's duty. The Court said: "It (the Company) discharged its duty when it furnished the material with which to brace the trench and competent men to put in the braces."

Recently an operator in the Sacramento Power Division, while shutting off a 5000-volt arc-light machine, accidentally touched the metal part of the switch at a time when his other hand rested on the frame of the machine. Both hands were badly burned. Had he kept his hand off the frame of the machine he would not have been injured.

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In the Woodland District a few weeks since a gasmaker stood in front of an open stack valve of a gas machine while another workman turned on the air blast. The blast threw a sheet of flame through the valve opening and burned the gasmaker's hands and face. A prudent man would not have put himself in such a position.

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In the Sacramento District a lineman, a short time ago, disobeyed his foreman's instructions to wear rubber gloves while working on primary wires on a green pole. As a consequence, current passed through him and the pole to the ground. He narrowly escaped being killed. As it was, both his hands were severely burned.

# The Gas Meter

By John Clements.

THE many complaints and charges against the gas meter would lead one to think and almost to believe that no reliance whatever could be placed in the service they are intended to perform. That is, if we take into consideration the opinions generally expressed by the consumer that usually makes the complaint, or in other words, registers the kick.

Of course gas men know that in, I may say, ninety per cent of the complaints of high bills, the cause lies with the user of gas, or it may be in a few instances due to faulty house piping or poor installation. A gas company, after installing a meter has nothing whatever to do with the amount of gas consumed, for this is positively under the control of the user of the gas.

In the course of many interviews with complainants, I have often explained the situation in this wise: Gas is on tap for your use, you are entitled to use much or little as you may choose or need, just as you do with the item of water. For instance, you go to the water faucet in your pantry to draw some water. If you draw a glass full that is all well and good. If you draw a tub full, no one is there to say you nay. So it is with the gas. If you simply wish to warm a pint of water you do this. If you desire to heat up your thirty or forty gallon boiler for a bath, you do this. No one is at hand to say that you shall not do so. The gas company is represented only by the gas meter **which tells you and them** at the same time, **just what you are using and just what it is costing you.**

The gas meter as in use to-day is the result of the efforts of men that have made a careful study of the measurement of this important and useful commodity for the past ninety years. In that time it has been perfected so that it is to-day an accurate and reliable instrument; as much so as the chronometer, thermometer, roadometer, or any of the many devices used for the measurement of standards. This device, the gas meter, has been so far perfected that in the past twenty years no material change has been made in its construction. The same may be said of the watch which you use every day and on which you rely.

Speaking of watches and gas meters, I have before me a report read by no less an authority than Emerson McMillin before, and by the request of, the Columbus (Ohio) Board of Trade in March, 1885—twenty-four years ago. In this report Mr. McMillin showed that a test had been made of 2122 meters. Of this total number, 33.9 per cent registered fast, 55.7 per cent registered slow, 12.5 per cent registered exact. The fast meters averaged 2.88 per cent fast; the slow meters averaged 2.76 per cent slow. There were eighteen meters out of this total of 2122 that failed to register, having holes through the diaphragms that allowed the gas to pass through without registering. These seem like a good showing. Then why should we not take a firm stand, and insist on our rights to collect the bills as shown by the meter statements, knowing after **careful test** that the meter is correct? To again quote Mr. McMillin, "Now may I ask would 2122 **first class** watches show a better record?" I ask you, myself, is there any other instrument used to measure standards that is more accurate? Is the grocer's scale more reliable? I think not.

The gas meter as made to-day is a device worthy of our confidence or the confidence of any one at all familiar with mechanical art. The best of material and the best of workmen are employed in its construction; besides all this, the gas meter is subjected to government test. No manufacturer sends out a meter until it has stood this test. What other instruments for measuring standards is subjected to more exacting rule or regulation. Again, before the gas company sends out a meter to be placed on a consumer's premises, it is tested by them by the best known and most modern methods. This test is the same as that made by the government agents in the original test.

So much for the new meter. Now for the meter that has been in service and has been taken out for any cause. Before it is reset it is again tested; a complete record is kept of all meters. A company with whom I have been connected had a daily report sent from the meter shop to the general manager's office, showing the result of the test of all meters handled by that department. Looking over an old report I find one in which the test of 425 meters was made; 234 were exact, 137 were fast, and 50 were slow, 4 were dead, or in other words, failed to register. The fast and slow meters were within the accepted limit and practice of all gas companies, with two exceptions, four being 10 per cent fast and two being 10 per cent slow. These were not meters that were taken here or there, which would have been the fairest test, but were meters that were supposed to be out of order because complaint was made against them.

# The Office End

YOU fellers that expect a disquisition from The Old Man on accountics, you 'uns of the green eye shade and the light shaded green, are goin' to be disappointed this time, for this, the initial squib in the last column of the very latest of late magazines, is what our friend, Ye Greek Prof., would term, a Paen of Welcome.

Here, then, is a right good toast to the new hot-air vehicle of the gas enthusiast: May its poetic effusions ever be in such harmonious meter as to stand the test desired by their most zealous adjuster, and fill the bill of its largest consumer, and to the end that its largest consumer may not be the waste basket, let each contribute so to the best of his ability as to cut out the "Slow" percentage and the "D. R." condition and make it show upon the proving table as we know the majority of our other meritricious measures do, strictly "O. K."

The Boss, in devising this small medium of defective grammar, really did not know that his small foot could step on so many people's toes at one time, and if he has not found it out by this time, I for one am not going to tell him. This being apropos of something obvious—what I want to advise is, that all you 'uns with the innate talent, the proven talent and the undisputed genius, get right down to work and second the motion in such right good earnest that our New Effort may be accomplished with such slight effort as to be noted in the world of the Public Utility Pamphlet as the Best Effort yet, and at the same time confer upon The Boss much deserved honor for another muchly thought out new Worry.

Getting down to "brass tacks," otherwise the title of this column, "Ain't it awful, Mabel," how The Boss can think out worries? Not content with makin' us put on a 5-o'clock-to-midnight crew to take care of that "rate-excess-green-ink-nightmare"; the determination of the power-load-revenue, goin "way back" to the "lay-down" point; the fateful monthly consumer's-balance-prove-out, and the other of the winter diversions, but here, right at the moment when a quiet peaceful summer lull promised, is sprung upon a trusting and trustful following, of all the most disrupting of disquieting argumentative things—BASEBALL. Yep, that most beaten-up national pastime is beginning already to suffer at the hands of some two, three or four corporation nines, with their accompanying umpires, and I look for results in the near future that will require the employing of several physicians upon the collection and statement-reading staff. I want you Boys to desist, however, in the fervor of the spirit of the game, from passing those consumer's ledgers with such well-judged out-curve and spit-ball effects that they are landed upon the lower vault floor in such generous confusion, instead of in their proper racks; at the same time I want you to take more minutes than two for your lunch, and not more than the balance of the afternoon for your lunch hour.

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The last preceding sentence brings to mind a recently discussed matter of much moment to us all who think they love the old Company and would do anything within reason for it, and that matter is the one of, punctuality in the morning arrival. While in the individual instance the loss of time in not arriving promptly at 8:30 is slight, in the aggregate of many instances daily. the loss to the Company is large. Consider this, O ye faithful, how it would feel to smite your own personal pocket in this regard were you employers, and score the shortcoming off with that often not seriously enough considered instrument, the Golden Rule.

Looking to that millenium condition of efficiency that a well-managed, large gas-electric office aspires to, and believing that in our new office building, just about being completed, the psychologicals will be more propitious than has yet been the case in the Company's history, I want to reiterate the slogan of our old comptroller, Mr. Conlisk, "DO TEAM-WORK!" You fellers know as well as anyone that this is the keynote to the more perfect manipulation of our 90,000 consumers' accounts, from the application moment to the collection of the final bill, and I want to impress on all of you in the Office End that alertness for information for the Company's good, and for the consumer's, during the whole twenty-four hours, properly reported to your immediate superiors, for action, will come nearer bringing about the above condition at the soonest possible moment, than any other method, and incidentally will ingratiate you with the powers that be and the

OLD MAN.

## LIGHTING TIPS

In San Francisco on April 17, 1906, the streets of the city were lighted by 5462 gas lamps and 1257 electric arcs (A. C. series), a total of 6719; after rehabilitation in May, 1906, there were 2229 gas and 984 electrics, a loss of 3133 gas lamps and 273 electrics. On May 1, 1909, there were in place, 5020 gas and 2350 electrics, a total of 7370.

## CHEER UP, GIRLS

### Woman to Manage Gas Works

Miss Ina Richmond has been appointed manager of the Magherafelt Gas Works in Dublin, Ireland. She is the first woman to hold that post. She first entered the postal service. Later she studied gas manufacture and distribution. She is said to be one of the best equipped experts in her line of work in Ireland.

## THE EXCEPTION PROVES THE RULE

San Francisco, Cal., May 19, 1909.

San Francisco Gas & Electric Co.,
City.

Gentlemen:—I am in receipt of your joint report of engineers regarding supply and charges for gas, etc.

Am pleased to say that I have no complaint of gas or charges for same at any time, but have always received courteous and fair treatment from you.

Yours truly,

WM. T. FONDA.

3011 Sacramento street.

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Some men are in such a desperate hurry to cut across to Leisure Avenue, that they get lost up some blind alley.—Crocker Quality.

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"Tell your troubles to the Gas Man; he will lighten them for you."

# Baseball News

Announcement is made of the organization of the San Francisco Gas and Electric and the Pacific Gas and Electric baseball teams.

Preliminary "try-outs" of hopeful applicants are now being held, and from all indications the two teams will put up some fast ball.

To stimulate interest and to make the boys stick to their practice, the Stationery Department offers a trophy to the winners of the first game, i. e., a large quart bottle (of mucilage).

Following is the line-up according to latest advices:

**Pacific Gas and Electric Company**

| | |
|---|---|
| Scanlon, C. D. . . . . . P. | Swan, Roy. . . . . . . S.S. |
| Hale, A. E. . . . . . . . . C. | Barthol, O. . . . . . . R.F. |
| Malley, R. (Mgr.) . 1st | Mensing, M. . . . . . L.F. |
| Barieau, J. . . . . . . . . 2d | Murphy, C. E. . . . C.F. |
| Trowbridge, A. L. . . 3d | |

**San Francisco Gas & Electric Company**

| | |
|---|---|
| Holt, C. E. . . . . . . Mgr. | Lally, R. E. . . . . . . . 3d |
| Feeney, J. . . . . . . . . . P. | Egan, W. (Capt.) . S.S. |
| Murphy, E. . . . . . . . . C. | Bennett, A. N. . . . R.F. |
| Cavanaugh, W. A. . 1st | Hanifin, H. L. . . . L.F. |
| Melbourn, L. A. . . . 2d | Mogan, F. . . . . . . . C.F. |

# Some Strange True Gas Stories

### A Suggestion to Our Gas Engineers—Being the Detailed Account of a Gas Miracle

Some years ago the Pacific Gas Improvement Company, which was absorbed by the San Francisco Gas and Electric Company, had a very troublesome consumer, an old Irishman, who kept a saloon on the waterfront. His bills for gas were largely in arrears, and he seemed to have the advantage of the situation, the meter being set in the rear of the saloon, and he defied any employee of the Gas Company to enter and shut off his gas. However, the collector was a man of fertile resource, and as the Irishman kept vigilant watch at the front door, he crept in under the wharf, thus securing access to the rear of the saloon, and shut off the meter, taking the precaution to insert a blind washer to prevent the gas being turned on again, departing as he had entered undetected. The Irishman, seeing that his enemy did not return, thought he had won the day, but when he prepared to light up that evening, he found he had no gas, although the stop cock was turned on. Nothing was left but to go to the Company's office and pay the bill, which he did the next day with very poor grace. He paid his bills promptly after that, remarking to the collector each time, "Pwhat kin a mon do whin they shut you off at the wurrks."

### The Meter-man's Proverbial Presence of Mind

A meter-man sent out to inspect a meter, set in a basement, was very much annoyed by a pet dog, which persisted in snapping at him to such an extent that he was being deterred in his work. As the dog made an extra vicious snap he struck out with his heavy pliers, catching him, with some surprise to himself, squarely on the head, ending his earthly career then and there. Alarmed at what he had done, with visions of dismissal from the Company's service flitting through his mind, he hastily dug a grave in the sand and gave his dogship a decent burial, after which he finished his job. As he left the premises, he met the lady of the house who was anxiously looking up and down the street for her doggie. She inquired if he had seen her darling Fido anywhere. Naturally enough, he knew nothing of the pet's whereabouts, although he opined he had seen a dog answering to the description disappearing around the corner as he had come in. To this day, no doubt, the pet's disappearance remains a dark mystery.

# Pacific Gas and Electric Magazine

PUBLISHED IN THE INTEREST OF THE EMPLOYEES OF THE PACIFIC GAS AND ELECTRIC COMPANY

JOHN A. BRITTON, - - - - - - - EDITOR
R. J. CANTRELL, - - - - - - NEWS EDITOR
A. F. HOCKENBEAMER - - - BUSINESS MANAGER

Communications containing items of interest to the members should be sent to the News Editor, R. J. Cantrell, 445 Sutter St., San Francisco, Cal. In order to appear in a certain issue these items must be in the hands of the News Editor by the twelfth of the preceding month.

VOL. I JUNE 1909 No. 1


## EDITORIAL

The main purpose of this publication is to bring into closer relation the three thousand or more members of the staff of the Pacific Gas and Electric Company, located from Fresno on the South to de Sabla Power House on the north, from Lake Van Norden on the summit of the Sierras on the east, to the City of San Francisco on the west, a territory embracing over 31,000 square miles, equal in area to the States of Vermont, New Hampshire, Massachusetts, Rhode Island and Connecticut combined.

It is believed that the result of the circulation of this magazine in all the districts and divisions of the Company will aid in giving to the employees a broader scope of the work of the Company, of which each one is an integral part; that each may become interested in the efforts of the other and that all will work towards a closer unison in establishing the fact that public service corporations are designed and controlled, not merely for the mercenary gain of dollars, but for the broader purpose of giving to consumers the best service possible and at the lowest prices. This cannot be accomplished without the entire co-operation of the staff of men who are really, in their individual positions, the controlling elements of those who have the executive control.

The publication of this magazine is not to be a mere sporadic effort, but it is intended to be as permanent as the structures of the corporation. It will seek monthly, not only to educate the men of the corporation, but likewise to educate the entire reading world, and it is hoped and expected that it will achieve a circulation finally which its position and reliability will deserve.

Within the staff of men and women constituting this great organization, there must exist latent talents, which, awakened by opportunity, would give expression frankly and freely to their thoughts, not only regarding the corporation itself, but regarding the masses of people who are contributors to the corporation.

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Let the motto of the men and women of the Pacific Gas and Electric Company be, "Solve all questions of doubt in favor of the Consumer."

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A smiling countenance will correct more troubles than bags of gold.

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The daily press print erroneous statements in bold type and on the front page, and correct them in agate in an obscure corner.

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While the tendency of the times for a decade past has been that of antagonism towards public service corporations, largely due to the attitude of corporations towards the public, of late there has been a marked change noticeable, which may be attributed to the fact that conservative management has seen the necessity in the preservation of capital invested, of making by price and quality, its commodities necessary and attractive, in being content with a reasonable and legitimate return on its investments, and by education, showing the extraordinary risks attendant upon service to the people, of transportation, light, heat and power.

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The following editorial from the San Francisco Chronicle of May 20, 1909, indicates the awakening of a sane and safe conservatism. The gospel therein enunciated has been preached from the housetops of the corporations ever since the adoption of the amendment to our Constitution in 1879, not however for the purpose of acquiring a monopoly, but for the prevention of the levying of tribute, and as more pronouncedly affirming that competition in service of public service corporations does not compete, and also that what is wanted by the public to insure low rates is proper regulation under guarantees of monopoly. Regulation and unrestrained use of public streets produce conditions of necessary protestation, resulting in combination eventually detrimental to the public good. The press seeking to serve the dissatisfied announces doctrines tending to throw all public service bodies into disrepute, forgetting in their campaign of uneducation, that the laws will fully protect invested wealth devoted to public use, and that such wealth if unhampered by confiscatory restrictions would aim to earn only that revenue which its risks and investments entitled it to do.

### *NEW GAS COMPANY THREATENED*

*If It Comes It Will Raise the Price of Light All Over the City*

All public utilities within a city should be monopolies, either public or private, as the people desire, for the worst conceivable monopoly is better than the best possible competition in such services as lighting companies, water companies and street railroads render. The reason is obvious. It is only the profits of a monopoly which will justify the extension of service into unremunerative territory. Unfortunately thirty years ago we did not know that and incorporated into the State Constitution a provision depriving every municipality in the State of control of its own streets by enacting that any one may open the streets to lay conduits for furnishing light or water unless the municipality is itself performing that service. The result, as we have repeatedly seen in this city, is that whoever desires and has the money may establish a plant to supply light to some congested section of the city, which it can always afford to do at a lower price than that for which any one can render the same service to the whole city. The intruding company never extends its service to unproductive territory, but leaves that wholly to the old company. The old company reduces its rates in the competitive districts, whose people profit by the transaction.

But the rest of the city loses. When rate-making time comes it is evident that the books will show less profit than would have appeared had the old company had all the business. Whatever the rate fixed, the courts will require that it be remunerative, and it is self-evident that the greater the ratio of unproductive, or slightly productive, territory the higher must be the rate to yield a reasonable income on the investment of the old company. That rate is fixed, either by the Supervisors or the courts, and fixed at such a figure that the people in the outlying districts pay a higher price than they otherwise would in order that the limited congested district may get a lower price. And that holds good whether the rate fixed be high or low. In any case the legal rate will be higher than it need be or would be if there were no competition. Usually in this city the result has been that the old company has bought off the new, paying, perhaps, double the cost of the new plant, for which bonds are issued, upon which consumers must pay interest forever. Sometimes the new companies seem to be formed solely for blackmail purposes.

It is announced that we are to have a new competitive gas and electric light company. If one comes, we cannot help it. The result will be unnecessary duplication of plant in the district occupied, whose cost will be paid by increased rates for light in the rest of the city.

# Question Box

All employees are urged to make free use of this department to ask questions regarding any phase of the Company's work on which they desire information. The same freedom should be used in answering questions. Address questions and answers to Mr. R. J. Cantrell, News Editor.

## PERSONALS

**Under this Heading a Full Page will be Devoted to Personal Items**

### Petaluma Loses an Old and Valued Employee

Mr. George A. Clark, accountant for the Petaluma Company since October, 1901, passed away in Petaluma recently. Mr. Clark leaves a wife and three children, to whom the employees of the Pacific Gas and Electric Company beg to tender their heartfelt sympathy.

Mr. Earl Henley, manager Land Department, has just left for an extended trip throughout the East.

Mr. Geo. H. Bragg and bride have just returned from a month's tour of the Hawaiian Islands. We extend best wishes for their happiness.

Miss Laura Seavey, who has been with the Petaluma Company since August, 1904, has just resigned her position to take up housekeeping. We wish her joy and great happiness. Miss Loretta Horwege succeeds Miss Seavey.

Vice-President and General Manager John A. Britton and Messrs. Lee, Hoekenbeamer, Downing and Lisberger have just completed an extended trip to the Northern Districts, including de Sabla, Centerville, Colgate, Folsom, Newcastle, Deer Creek and Rome power plants.

The Association of District Managers of the Pacific Gas and Electric Company met at Sacramento on Saturday, May 15th, in the rooms of the Sacramento Chamber of Commerce.

The regular monthly meeting of Division Superintendents was held at the Sacramento Sub-station on Saturday, May 29th.

Mr. Geo. J. Vincent, of the main office, is away on a leave of absence, account of sickness.

Johnnie Yablonsky, of the Collection Department, and ladies, spent Monday, May 31st, at Vallejo.

## LOCAL NOTES

**What of Interest Occurred in Your District or Division ?**

### Quick Action Saves Lives

(Chronicle, May 13, 1909.)

By rare presence of mind and quick action John L. Sullivan, a gas works employee living at 2120 Greenwich street, yesterday stopped a runaway team at Greenwich and Webster streets which threatened to place a score of lives in jeopardy. When Sullivan brought the foaming horses to a halt they were almost on the brink of a fire cistern in which a gang of laborers were at work twenty feet below ground.

Sullivan is a man of massive build and he hung to the horse while he was dragged along the street. Within a dozen feet of the cistern's mouth he brought the team to a standstill. He was badly bruised about the legs by being dragged along the street. Sullivan is a man of middle age. He has a wife and a large family of children.

The City of Gridley will endeavor to bond the town and purchase the Gridley Electric Light and Power Co., evidently not profiting by the errors of other municipalities.

Report from Marysville Power Division, under date May 21, 1909, gives cause of trouble on secondary oil switch as follows:

The trouble with the 4000-volt oil switch on Panel No. 6 was caused **by a rat getting in contact with the 4000-volt terminals.** The terminals were covered with about six thicknesses of empire cloth, covered with two thicknesses of linen tape and painted with P. & B. paint. The rat must have knawed the insulation off, causing an arc to start between one terminal and the switch frame. We had a similar accident on April 11, 1908 (see Accident Report of that date).

On Wednesday, May 26th, a fire destroyed the roof of the old power-house at Napa, now occupied by Briggs Bros. as a pump works.

## HOME AGAIN

By R. J. Cantrell.

Very few of us, in the hustle and bustle of the past three years, have realized that we, like many other business outcasts, have been without a home; that the largest corporation in the great West has had to seek shelter at the hands of others, to crave the privilege of a roof under which to carry on our gigantic affairs, and now that we look forward to the short time which intervenes, separating us from our new and permanent headquarters, comparisons loom up before us and we realize the magnificent strides that have been made by our company as a whole, and particularly by the chiefs who have guided us and brushed aside each obstacle as it confronted them, until at last we feel the gratifying sensation stealing over our senses that we are to have our own home again—our own roof over our heads, and all designed to fit our wants, our best desires and purposes.

In February of 1906 the Pacific Gas and Electric Company was proud; we walked with a strut into our new and beautiful offices in the Shreve Building, and smiled out upon the world with the feeling that none were better provided for than we. The San Francisco Gas and Electric Company was the possessor of a fine and handsome office building of its own, the best of its kind our City had ever known. Then came the fire—we were driven out, trampled in the dirt and dust, without home, without a place of meeting, scattered from Oakland on the east to the ocean on the west, and chaos reigned supreme.

Three days we groveled and stumbled in the dark, our spirits sunk down to the lowest degree, our hearts were torn and bruised and we staggered under the fearful load that had been thrust upon us, when the powerful minds which had dominated us and created and reared use from the very cradle, loomed up strong and confident with a nucleus in Oakland. Two days more only intervened when the home of one of our officers, in San Francisco, was chosen as an informal meeting place, and it was then and there decided that San Francisco should again be our field of action, with temporary headquarters at our branch at Haight and Fillmore streets.

Following this move in rapid succession two rooms in Haight street, near Fillmore street, were secured as a temporary meeting place, from which point scouts were sent out to secure larger and more comfortable quarters, where we might all be together again and better take up the broken strands of our business, which had been scattered far and near. The next move was to the corner of Franklin and O'Farrell streets, where we grew from two rooms to a dozen or more, but still we were not content, for some of our brothers in toil were still away from us, across the Bay, and we chafed and fretted until we could all be together again and form the same strong chain, without a break, that had existed before.

We won, the strong always win, and while we gained our end, we stand with heads unbared to the good Sisters who helped us to this end, by relinquishing in our favor the home which had sheltered them for many years, that we, in turn, might lessen the burdens of our afflicted neighbors and friends by shedding light and warmth among them and bringing them back to a realization that all was not lost, that we had been bruised but not broken, that we were still the indomitable, persevering and progressive race that history had reputed us to be.

And now we are going home again; we are not proud, we are grateful; we have fought a great battle, we have won; we are stronger than ever before, but we never rest, we are looking for new worlds to conquer, and always move onward, forward and upward.

[Editor's Note.—All of the above proves the old adage that, "A rolling stone gathers no moss." A careful scrutiny of our new building will fail to reveal any moss.]

### Learning

The chief art of learning is to attempt but little at a time.

Learning without thought is labor lost, thought without learning is perilous.—Confucius.

# BIOGRAPHICAL SKETCH

## CHARLES LELAND BARRETT

SECRETARY
SAN FRANCISCO GAS
AND ELECTRIC
COMPANY

*Charles Leland Barrett, the present secretary of the San Francisco Gas and Electric Company, was born in the City of San Francisco on the 27th day of March, 1860. He attended the grammar schools until June, 1875, and subsequently the St. Augustine Cadet Academy at Benecia, Cal. He is the son of Wm. Grout Barrett, who was secretary of the San Francisco Gas and Electric Company for over twenty-four years, and who was a truly representative gas man in every sense of the word. His mother was Sarah Cardy Sherman.*

*After leaving school Mr. Barrett took a position under his father as cashier's clerk of the then San Francisco Gas Light Company in 1876, remaining there until the year 1878, when he became agent of the Butterick Pattern Company, remaining with that firm for eleven years; in 1889 he took position as bookkeeper with the J. W. Girvin Company, agents of the Boston Belting Company, which position he resigned to accept that of bookkeeper with the San Francisco Gas Light Company, being steadily advanced by reason of his merits and abilities to office manager and cashier, and finally became secretary of the Company, which position he has since filled.*

*He was married to Olga Carola Block on the 14th day of November, 1900, from which union has resulted two children, namely, William and Theodore.*

*Mr. Barrett, in his connection with the San Francisco Gas and Electric Company, has endeared himself to all his employees, as well as to the public with whom he has come in contact, his natural cheerful disposition fitting him particularly for the responsible position he occupies.*

*It is not known that he is the possessor of any fads other than the desire for the briny deep, being a yachtsman of some renown, and through storm and calm sailing his boat into the inlets and outlets of San Francisco Bay.*

*The temperament and sterling honesty and integrity of his father is fully reflected in the son, and to those who know him best, the hope is expressed that he may be with us as he is for many days to come.*

## ADDITIONS TO LIBRARY

San Francisco, April 29, 1909.

Following is a list of books added to the Library of the Pacific Coast Gas Association since the publication of its last catalogue in 1908:

Modern Power Gas Producer Practice—Horace Allen.

Allen's Digest of U. S. Patents of Air, Caloric, Gas and Oil Engines and Other Internal Combustion Engines. Vol. I, Plates A. D. 1789-1905; Vol. II, Plates A. D. 1789-1905; Vol. III (2 parts), Claims A. D. 1789-1905; Vol. V, Index.

Report of Committee on Meters—American Gas Institute.

American Gas Institute Proceedings. Vol. III, 1908.

American Gas Light Journal. January-December, 1874; January-December, 1875; January-December, 1876; January-December, 1877; January-December, 1878; January-December, 1879; January-December, 1880; January-December, 1881; January-December, 1882; January-December, 1883; January-December, 1884; January-December, 1885; January-December, 1886; January-December, 1887; January-June, 1888; July-December, 1888; January-June, 1889; July-December, 1889; January-June, 1890; July-December, 1890; January-June, 1891; July-December, 1891; January-June, 1892; July-December, 1892; January-June, 1893; July-December, 1893; January-June, 1894; July-December, 1894; January-June, 1895; July-December, 1895; January-June, 1908; July-December, 1908.

A Bulletin on the Care and Operation of Recuperative Benches—W. A. Baehr.

Baldwin on Heating.

Electrical Illuminating Engineering—William E. Barrows.

Internal Combustion Engines—Rolla C. Carpenter and Diedrichs.

Annual Reports Chemical Society. Vol. I; Vol. II, 1905; Vol. III, 1906; Vol. IV, 1907.

A Practical Treatise on the Manufacture and Distribution of Coal Gas, 1868—Samuel Clegg, Jr.

Congress of Gas Associations of America Proceedings.

Electrical Engineer's Pocket Book—Horatio A. Foster.

The Making of Rates and the Additional Business System of Costs—W. H. Gardiner, Jr.

Gas Enrichment (From a London Standpoint).

Gas World. January-June, 1908; July-December, 1908.

Steam Power Plant Engineering—G. F. Gebhardt.

The Utilization of Wood Waste by Distillation—Walter B. Harper.

Analysis of Mixed Paints, Color Pigments and Varnishes—Clifford Dyer Holley.

Illinois Gas Association Proceedings, 1907-1908.

Air Compressors and Blowing Engines—Chas. H. Innes.

The Gas Engine—Forrest R. Jones.

Journal of Electricity, Power and Gas. January-June, 1908; July-December, 1908.

Journal of Gas Lighting. January-December, 1873; January-June, 1874; July-December, 1874; January-June, 1875; July-December, 1875; January-June, 1876; July-December, 1876; January-June, 1877; July-December, 1877; January-June, 1878; July-December, 1878; January-June, 1879; July-December, 1879; January-June, 1880; July-December, 1880; January-June, 1881; July-December, 1881; January-June, 1882; July-December, 1882; January-June, 1883; July-December, 1883; January-June, 1884; July-December, 1884; January-June, 1909; July-December, 1908.

Road Preservation and Dust Prevention—William Pierson Judson.

Fuel, Water and Gas Analysis for Steam Users—John B. C. Kershaw.

Steam-Electric Power Plants—Frank Koester.

Light. January-December, 1908.

Technical Methods of Chemical Analysis. Vol. I, Part I; Vol. I, Part II—George Lunge.

Development and Electrical Distribution of Water Power—Lamar Lyndon.

Production et Utilisation des Gaz Pauvres—L. Marchi.

Self Instruction for Students in Gas Supply—Mentor.

Notes on the Operation of Large Carburetted Water Gas Sets—W. Cullen Morris.

Municipal Reports, Lighting Streets and Public Buildings, 1898-1907, S. F. Gas and Electric Company.

National Commercial Gas Association New Business Report for 1909.

Nelson's Encyclopedia. Vol. I, A-Bedl; Vol. II, Bedm-Cent.; Vol. III, Ceve-Deeude.; Vol. IV, Dendr-Fern.; Vol. V, Fern-Gun; Vol. VI, Gun-Joan; Vol. VII, Joan-Mart; Vol. VIII, Mart-Numid.; Vol. IX, Numis-Presc.; Vol. X, Preser-Sax; Vol. XI, Saxo-Ten; Vol. XII, Tenn-Zym.

New England Association of Gas Engineers Proceedings, 1906-07-08.

Production of Gas, Coke, Tar and Ammonia at Gas Works, 1907—Edward W. Parker.

Compressed Air Plants for Mines—Robert Peele.

The Gas Engine—Cecil P. Poole.

Public Service Commission, 1st Dist., State of New York. Annual Report for year ending December 31, 1907. Vol. I and Vol. II.

Public Service Commission, 2nd Dist., State of New York. First Annual Report for year 1907. Vol. I and Vol. II.

Report of Board of Revision on Distribution of Gas.

Report of Commissioner of Corporations on the Petroleum Industry. May, 1907, Part I; August, 1907, Part II.

Report Electric Powers (Protective Clauses).

Report of the Public Policy Committee of the American Gas Institute. October, 1907.

Report on the Transportation of Petroleum, 1906.

Suction Gas Plants—C. Alfred Smith.

Statement of the Commissioner of Corporations in Answer to the Allegations of the Standard Oil Co.

Sugg's Photometers and Gas Testing Apparatus.
The Chemistry and Technology of Mixed Paints —Maximilian Toch.
Hydro-Electric Practice—H. A. E. C. Von Schon.
Western Gas Association Proceedings, 1906.
Wisconsin Railroad Commision Reports. Vol. I, July 20, 1905-July 31, 1907.
Hanns Juptner on Heat, Energy and Fuels.
Institution (The) of Gas Engineers Transactions, 1908.

E. C. JONES,
Librarian Pacific Coast Gas Assn.

### Hope for the Gas Man

St. Peter was sad and weary
For years he had stood by the gate.
He had listened to stories and pleadings,
Life stories of love and of hate.

He turned them all down in a jiffy,
All failed when it came to the test,
While many had lived fairly decent,
Yet no one had lived at his best.

The work for the day was near over,
St. Peter looked tired and thin.
He'd sent a multitude down below,
But nary a soul had passed in.

But hold, "How's this," St. Peter cried,
As a quiet soul stood trembling,
"What hast thou done of bad or good,
Of anything worth remembering?"

The spirit spake with husky voice,
"I know I cannot pass,
For I was called the meanest man,
I sold the people gas."

St. Peter stood silent and thoughtful,
But at last he said with a grin,
"You've had trouble enough for one poor soul,
So I guess I'll let you in."

—Chas. T. McKenzie.

### Welcome to Los Angeles

"I won't pay my bill. I don't have to; I moved from your old town. Nobody can not make a living there. I don't like your old town. I never come back any more. I never want to hear from you any more. I live in Los Angeles now. I tell you good-by for ever."

### "Only One of Our Troubles"

"I wish that you would send a gas leak at your meater."

### He Passed the Hat

The colored parson had just concluded a powerful sermon on "Salvation am Free," and was announcing that a collection would be taken up for the benefit of the parson and his family. Up jumped an acutely brunette brother in the back of the church.

"Look a-year,. pahson," he interrupted, "yo' ain't no sooner done tellin' us dat salvation am free dan you go' askin' us fo' money. If salvation am free, what's de use in payin' fo' it? Dat's what I want to know. An' I tell yo' p'intedly dat I ain't goin' to gib yo' nothin' until I find out. Now——"

"Patience, brudder, patience," said the parson. "I'll 'lucidate: S'pose yo' was thirsty an' come to a river. Yo' could kneel right down an' drink yo' fill, couldn't yo'? An' it wouldn't cost yo' nothin', would it?"

"Ob cou'se not. Dat's jest what I—"

"Dat water would be free," continued the parson. "But s'posin' yo' was to hab dat water piped to yo' house? Yo'd have to pay, wouldn't yo'?"

"Yas, suh, but——"

"Wal, brudder, so it is wid salvation. De salvation am free, but it's de havin' it piped to yo' dat yo' got to pay fo'. Pass de hat, deacon, pass de hat."

### The Perfect Man.

There is a man who never drinks,
Nor smokes, nor chews, nor swears;
Who never gambles, never flirts,
And shuns all sinful snares—
He's paralyzed!

There is a man who never does
A thing that is not right;
His wife can tell just where he is
At morning, noon and night—
He's dead!

### We Have Many Avocations

"My gas meter is out of order also my neighbor Mr. Schmitt. Will you please send somebody to fix them?"

There was a girl in our town,
And she was wondrous wise,
This learned lass blew out the gas,
She is now in Paradise.

# PACIFIC GAS AND ELECTRIC COMPANY

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# SAN FRANCISCO GAS AND ELECTRIC COMPANY

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BARRETT, CHAS. L.................Secretary

## HEADS OF DEPARTMENTS

GRAY, F. S.........Supt. Elec. Contract Dept.
BUTLER, J. D......................Auditor

# Municipal Matters

### San Francisco

The Board of Supervisors of the City and County of San Francisco are this year setting aside $340,000 for the lighting of the streets and public buildings.

The Board of Supervisors have just passed a new underground ordinance designating two additional districts from which the poles and wires must be removed in the years 1909-10 respectively.

They have also passed an amendment to the ordinances covering the opening of streets, which is somewhat novel in that all corporations are obliged to mark upon the curbstone a symbol which will fix the ownership of any service trenches in the streets. Each company is given a different symbol, so that an inspector seeing a trench leading to a premises has merely to look upon the curb where the trench enters to find out who constructed same.

### Oakland

Realizing the rapid expansion of Oakland's business district, the Company has just completed the building of conduits and manholes on Franklin street from Seventh to Fourteenth streets, tieing in with the old underground on the side streets between Broadway and Franklin streets, and the City of Oakland is now contemplating an underground ordinance which will make these underground districts by law.

The Company has now completed the work of removing the 60,000 V leads from Oakland and Berkeley, as was promised these cities some time ago.

### Sacramento

The City Trustees have passed an underground ordinance which requires that in three years all of our poles and wires must be removed from the waterfront to Twelfth street, and from I to L streets.

# PACIFIC GAS AND ELECTRIC MAGAZINE

## CONTENTS FOR JULY



*Terms—50 cents per year, Single Copies, 10 cents.*

General Offices, Pacific Gas and Electric Company, Southwest Corner Franklin and Ellis Streets, since June, 1906.

Annex.

# Pacific Gas and Electric Magazine

Vol. I | JULY, 1909 | No. 2

# The Steam Turbine Installation at Oakland

*By* F. H. VARNEY
Engineer of Operation and Maintenance

Station "C," Oakland.

On the 6th of July, 1908, the management requested that the matter of a 9,000 K. W. turbine installation in Oakland be given consideration and attention. The choice of a prime mover rested between two types of turbine, i. e., the horizontal and the vertical type, and after the question of prompt delivery and relative merits of both types had been fully considered, the Curtis vertical turbine, built by the General Electric Company, was determined upon.

This decision was reached about the middle of July, and orders were received to have the plant in operation for the Christmas load. The Engineering Department, therefore, had to undertake to design, construct and place in operation a complete turbine plant in one hundred and sixty-two days.

It is hard for those whose avocations lie in fields other than technical, to appreciate the immense amount of detail involved in an engineering problem of this nature. Preliminary surveys must be made; preliminary plans drawn and submitted for approval; then come the working drawings, and these in turn must be examined and any changes made before it is too late, for it must be remembered that once the engineer's thoughts have been translated into concrete, iron and steel, they cannot be revoked at any future session, and his work must stand as a monument to either his ability or his incompetency.

All branches of the department were now actively engaged in preparing their particular portions of the work. The preliminary work had been completed and approved; the finishing touches were being given to the working drawings; specifications drawn up, and many a tiny lamp burned long into the small hours of the morning in an earnest endeavor that no detail should be overlooked. In due time, therefore, all the plans and specifications were completed and approved, and the con-

Station under Construction.

Showing erection of Boilers, Steel and Concrete Roof going on at the same time.

tracts were awarded and signed. Some of the contractors, who were never known to make deliveries in less than nine months, fairly gasped when they were informed what was required of them, but on account of the heavy bonus and penalty attached to each contract, they determined to strain every effort to complete the contracts on time.

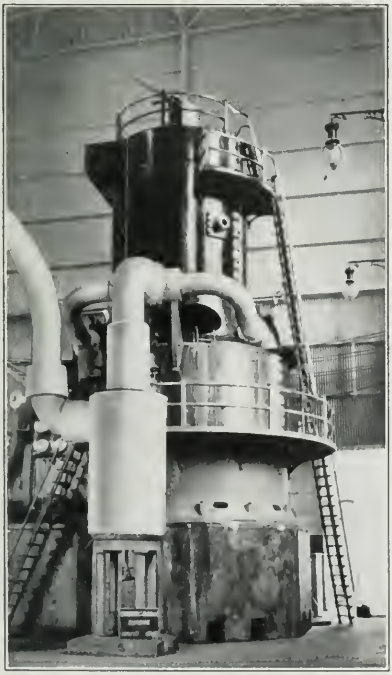
The engineer cannot lose sight of certain given factors, and while promises are made in perfectly good faith, their fulfillment may be indefinitely deferred on account of apparently insurmountable obstacles. An engineer in charge of work, therefore, must be everywhere; must anticipate delays, and be ready to step instantly into the breach with a solution; he must have an accurate knowledge of human nature, and be able to swing troublesome contractors into line; he must be, in truth, the coacher of the team. It is gratifying to know, therefore, that with our organization; the personnel of those in charge, both in the office and in the field, and the esprit de corps which makes possible the existence of that great fundamental principle of success — TEAM WORK — we were able to complete the turbine installation (from the first day of breaking ground to the time of actually operating the turbine under its own steam), in seven days less time than that set by the management.

While avoiding a purely technical discussion of our installation, it will be a matter of general interest to those of our readers who are meeting the public, or whose ledgers record the daily sale of many thousand kilowatt hours, to more clearly understand the many elements that are necessary to produce our salable product, i. e., electric energy.

Did you ever stop to consider what a mysterious and intensely interesting product our Company manufactures? Unlike that of any other manufacturing concern, none of our employees have ever seen our product, yet we handle it in quantities large and small, and upon receipt of an order from a customer we can instantly ship the goods to him—by wire. The manufacturer of some powerful locomotive could take you to his factory and trace the development of his product from the raw material to the high-speed express engine. We can neither show you the raw material nor the finished product, but we can take you to some rocky point overlooking one of our great reservoirs in the mountains, and tell you that there are untold quantities of our product under the shimmering surface of the water; or standing in front of our steam turbine in Oakland, we could tell you that our product is being manufactured at the rate of over two hundred thousand units daily.

The turbine plant in Oakland, known

as Station "C," is situated on a portion of the property of the Oakland Gas, Light and Heat Company, a subsidiary company of the Pacific Gas and Electric Company. The property is bounded by First street, Grove street, Jefferson street and the Oakland estuary. The steam turbine is the largest single driven unit on the Pacific Coast, and occupies about one-tenth of the space required for a corresponding reciprocating engine plant of the same capacity. The advantages of this type of prime mover over the reciprocating engine are numerous. An interesting incident occurred in this relation worthy of comment. One of the problems that the operating engineer has to contend with in the use of the reciprocating engine is in jacking over the engine by hand, when it is necessary to do any overhauling work. The matter of providing the turbine with similar apparatus for turning it through part of a revolution caused us considerable thought, but one day, during the assembling of the turbine, we were surprised to see one of the erecting men climb into the ventilator flue at the top of the turbine and revolve the turbine with one hand. Some idea of the perfect balance of the turbine may be gained when it is stated that the revolving parts weigh seventy-two tons. Another interesting feature is that this entire weight is carried on a thin film of oil which is forced into the step bearing under a pressure of more than half a ton to the square inch.



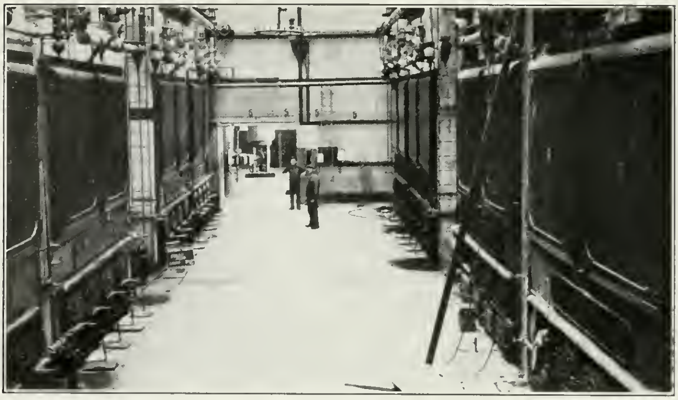
9000 K. W. Curtis Turbine.

The condenser, shown to the left of the turbine, is larger than the turbine itself, and if the tubes were withdrawn and placed end to end, they would extend for a distance of sixteen miles. A story is told of a certain marine engineer, upon his first visit to the station and viewing the condenser, he expressed his admiration for it, but was in doubt as to the use of the "small vertical thing" at the side of the condenser. This "small vertical thing," however, is capable of developing twelve thousand horsepower.

One of the greatest sources of worry to the engineer of the condensing plant is circulating water. "Losing the water," as it is termed, is a very serious matter, but owing to the precautions which have been taken at Station "C," this danger is far removed. A forty-two inch pipe has been laid to the pier head line in Oakland estuary, and at the time of the lowest tide we have a trifle over six feet of water over the intake. By keeping the mud dredged away from the pump suction, an ample supply of circulating water is assured.

This sturdy unit of twelve thousand horsepower is served by eight water tube safety boilers, with superheaters, installed in batteries of two, and four in a row facing each other, as will be noted in the photograph. Two sheet steel stacks, well guyed, rise to a height of one hundred and ten feet above the boiler room floor, with ample capacity for four boilers each. The Hammel type of furnaces with return flame oil burners are used throughout.

The visitor at Station "C" is impressed with the compactness of the installation. The turbine and its auxiliary apparatus is accessible at all points,



Boiler Room.

yet the amount of waste room has been reduced to a negligible quantity. The lofty effect of the turbine room, with its long, graceful windows, recall the days of the stately baronial hall, but the suppressed song of the busy little exciter engine, the hum of the turbine and the muffled roar of the oil burners all blend into that familiar sound of the well-ordered turbine room, and remind us that we are living in an intensely active and progressive age, and in the flushing dawn of that great To-morrow, we turn towards those phantom forms of the greater things that are to be, still draped in the veil of the Future.

Station "C" is entirely a generating station. The distribution station, with the necessary switchboards and high tension switches, is an entirely separate building, and will be known as Station "A." The transmission station will adjoin, and will be known as Station "B," thus giving us three distinct types of stations, i. e., generating, distributing and transmitting.

# Electric Distribution

*By* S. J. LISBERGER
Engineer of Electrical Distribution

The advent of the Tungsten lamp into the lighting field some time ago was received with a show of incredulity by many of the lighting men. Grave arguments against its first cost, its fragile filament, and its size were presented. The Tungsten lamp has, however, "made good," and is to-day recognized to have done for the electric lighting world almost what the Welsbach mantle did for the gas lighting industry.

The most recent development of the Tungsten lamp has been a sign lamp of 4 c. p., consuming 1 1-3 watts per candle-power, or a little more than 5 watts for a 4 c. p. lamp, operating on a circuit voltage of from 8 to 12 volts. This lamp should find most ready use in sign work, where it is possible, with the use of compensators, for the man using the sign to light his sign just three times as long for the same money.

Another argument raised against the Tungsten lamp was the inability of the manufacturers to make a lamp for 200 volts. This has been done and the 200-volt lamp is now a commercial product. The manufacturers are also making small compensators to screw into the ordinary socket, which reduce the voltage from 220 volts to 27 volts, which makes an ideal proposition for individual socket work. The same type of compensator is made for sockets transforming from 110 to 27 volts.

# The Lighting and Ventilating of Schools

*By* E. C. JONES
Gas Engineer

IN THE "Gas World," London, of February 15, 1908, the relative merits of the systems of gas and electric lighting in Council schools is considered in a letter from the Gas Light and Coke Company to the London County Council.

The gas company bases its claim that gas lighting is not less hygienic than electric lighting upon two principal sources of evidence—the results of investigations carried out altogether independently by two well-known scientific investigators, Professor Vivian B. Lewis and Dr. Samuel Reidel. The former, it is explained, conducted his investigations entirely on his own account, the latter at the request of the Metropolitan Gas Company. Dr. Reidel's conclusions as quoted in the company's letter are as follows:

Heating Effects.—The conclusion is that there is no marked difference in the heating effects under either illuminant. The temperature of the air of a room in which gas was allowed to remain burning for a considerable time was not raised to any greater extent than in a similar (uninhabited) room in which electric light was maintained for the same period.

Ventilation Effects.—The ventilation was determined before and after the evening's work, and it was found that the ascending currents of air from the gas burners had a marked effect in stimulating the ventilation of the room.

Sterilization of Germs.—The moisture condensed on a cool surface in a room in which gas had been burning for about three hours was entirely sterile, whilst such sterility was not noted under similar conditions in a room lighted by electricity. This is a most important fact, and it follows that the burning of gas must also produce sterilization of the air itself. Increase of ventilation causes a diminution in the bacterial contamination in most cases by influx of purer air, so that the mode of illumination which produces most efficient ventilation should, ipso facto, possess more hygienic character. On all points gas possesses a greater sterilizing effect than electric light on the air of the room.

Production of Carbonic Acid.—This gas is not an impurity but a normal and necessary constituent of the air, and is now recognized as harmless in much larger quantities than could result from any reasonable consumption of gas. In these experiments 50 parts of $CO_2$ per 10,000 were on some occasions (by design) exceeded, but no physiological effects were noted. This quantity of $CO_2$ was an exceptional one, and could never be reached in an ordinary ventilated room.

Medical Observations.—The average final frequency (of the pulse) was practically constant and nearly the same under both lights.

The average frequency of respiration decreased under both systems of lighting to very similar amounts.

A progressive decline was noted in body temperature, and the average falls per hour under both systems were very close indeed, the difference in the method of illumination being apparently quite powerless to affect them.

Interesting results were obtained as regards the action of the two kinds of light on the eyes of the subjects. The sensitiveness of the eye to the light was found to be appreciably diminished on exposure to electric light, an effect not noticed in the case of gas.

Three hours under electric light affected the motor muscles of the eyeball more than an equal exposure to gas. In short, all the experiments made on the eye were more favorable to gas, a conclusion which strongly suggests the necessity for further research under conditions more suitable to ophthalmic work. (This most important conclusion is confirmed by the observations of other independent and scientific authorities.)

The results of these experiments show fairly conclusively that under ordinary conditions either light can be used without the least prejudicial influence on health.

It remained to try the effect of a leakage of gas into a room. Coal gas contains certain poisonous constituents, the chief being carbon monoxide, and has in certain cases been inhaled with fatal results. With a view to studying the effect of coal gas when breathed in large quantities three subjects were placed in a room, the door and windows of which were closed and the fireplace blocked with a tight fitting screen. During the preceding eighteen hours gas had been turned into the room at the rate of 0.6 cubic feet per hour, or, say one-half of the consumption of one of the burners. When the subjects entered this rate was afterwards increased to 8.8 cubic feet per hour, equivalent to six burners, full on, the air being well mixed from time to time. The three men remained in this gas-laden atmosphere for four hours and twenty minutes, and beyond an increased rate of respiration and a few minor symptoms, no very marked physiological effects were observed.

It will be noted that this was no ordinary leakage, but a steady flow at the rate of three times the ordinary consumption, such, in fact, as could only occur through breakage or other accident. When it is borne in mind that an exceedingly small leakage of gas can be detected at once by its characteristic smell, it will be seen how difficult it is for a condition to be set up capable of affecting the health. This is borne out by the extreme rarity of cases of gas poisoning among the many milions of gas users in this country. It would be as unreasonable to condemn gas lighting on the score of such occurrences, as to treat a fatal fire from defective wiring as an ordinary incident of electric lighting.

The medical conclusions are in accordance with those arrived at from the chemical and physical data, and prove conclusively that the choice between the two systems of lighting does not depend upon hygienic consideration.

# At Your Service

"MRS. JONES! have you heard the latest, the fad that's now come in style?
For killing the blues it's a wonder and beats Christian Science a mile,
As a way to get rid of your troubles, to unburden your sorrows and cares,
It's the best thing that's yet been discovered to substitute laughter for tears.

"Go down to the Gas Company's Office with visage determined and grim,
You'll see a young fellow there smiling, then go tell your troubles to him,
Tell him your meter is leaking—your Gas Bill was never so high,
That the Company surely is cheating—it's the "hot place" for them when they die.

"That you closed up your house for the summer (nobody could get in)
But your Gas Bill kept on a'coming and you think it's a shame and a sin,
You never use Gas for lighting—you've just purchased oil lamps by the score,
But the size of your bill just for cooking is bigger than ever before.

"He'll listen with care to your story and will tell you they try to do right,
He may give you a 'bit o' the blarney,' explaining why you have such poor light;
Anyhow you can't help but be cheerful as your anger begins to subside
And you feel that the 'Gas Robber' story was written when 'somebody lied.'

"So when you feel blue and weary and the day's work seems awfully long,
The baby is cross with the 'teethin' " and everything seems to go wrong,
Then go down to the Gas Company's office—he's there to humor your whim,
What's the use of your having troubles—just go down and unload them on him."

—W. J. DRISCOLL.

# Notes on the Design and Construction of Riveted Steel Pipe Lines

By JAMES H. WISE
Civil and Hydraulic Engineer

IN THE installation of pressure pipe lines for hydro-electric plants, some interesting phases of design and construction occur, and it is the purpose of this article to give a few of the features which have arisen in the placing of three pipe lines belonging to the Pacific Gas and Electric Company, viz., at the Electra, Deer Creek and Centerville power plants; all pipes are riveted steel throughout.

The Electra pipe line is 3565 feet in length, varying in diameter from 36 to 40 inches and in thickness or metal from No. 6 B. W. G. to $\frac{13}{16}$ inches. It supplies water to a 10,000 K. W. plant with a total static head of 1466 feet, and has been in operation since the early part of 1905.

The Deer Creek pipe line is 5573 feet in length, 42 and 48 inches in diameter and varying in thickness of metal from $\frac{3}{16}$ to $\frac{5}{8}$ inches. The static head is 831 feet. feet.

The Centerville pipe line is 2580 feet long, 36 and 42 inches in diameter with metal from $\frac{1}{4}$ to $\frac{7}{16}$ inches in thickness and a static head of 580 feet.

The two latter pipe lines furnish water to 5500 K. W. units and have been in operation from one to two years; all three are giving satisfactory service.

The design of a pipe includes the choice of profile, the determination of the diameter, the thickness of metal and riveted joints for various lengths of the pipe and the location of angles, air valves and anchorages. As the last three depend largely upon the physical features and topography of the pipe line site, of these nothing will be said.

For a known quantity of water the determination of the economical diameter or diameters seems first in importance. It is, of course, obvious that for the same profile a pipe of small diameter will have a small first cost as compared with one of large diameter and consequent increased weight; on the other hand, the friction losses or reduced effective head at the water wheels is much greater for a small pipe than for a large one. Loss of head means loss of energy and revenue. Since we must have two losses, one interest on the investment, the other loss of revenue due to pipe friction, the problem resolves itself into a determination of the particular pipe which will make the sum of these two losses a minimum.

It was proved diagramatically by Mr. Arthur L. Adams and mathematically by the writer and others (A. S. C. E. Transactions, Dec., 1907) that a pressure pipe line fulfills the conditions of greatest economy wherein the value of the energy annually lost in frictional resistance equals four-tenths (0.4) of the annual cost of the pipe line. The mathematical proof of this statement is given below (see Footnote No. 1).

It is desirable that the pipe fulfill the foregoing conditions of economy when operated under average normal plant output. This is, of course, determined by a knowledge of the variations in load and quantity of water obtainable for the plant. The design of a pipe is governed largely by the profile as well as the length of line and static head. For example, referring to Fig. 1, profiles *I* and *II* are identical in length and total head, yet the economical diameter of *I* would be less than that of *II*, although satisfying the same conditions; for while *II* is nearly ideal, the greater length being of thin metal under low pressure, *I* has a long stretch of heavy pipe under almost static head.

Pipes *I* and *II*, if of the same length and diameter, would necessarily give the same losses, but as has just been pointed out, *I* will have a much larger first cost and consequent annual interest charge. The diameter should, therefore, be reduced at a sacrifice of some revenue in order to satisfy the conditions of economy as previously stated. We, therefore, have a definite rule governing the cost of a pipe line where the static head and quantity of water are known.

Passing to the other details of riveted steel pipe design it may be generally stated that steel of about 60,000 pounds ultimate strength and an elastic limit of approximately 30,000 pounds is customarily used. Safety factors of four or five are usual practice and the thickness of the steel plates for various pressures are determined accordingly. The longitudinal joints of $\frac{7}{16}$ inch metal or less are double riveted, developing about 70 per cent of the strength of the plate. For a heavy plate, that is $\frac{1}{2}$ inch or over, a triple riveted, double welt joint of about 85 per cent efficiency is used. The

**Footnote No. 1.**

Taking two familiar equations as a basis, viz:

$$P = Qwh = \text{power loss due to pipe friction}$$

$$h = \frac{flV^2}{2gd} = \text{head loss due to pipe friction}$$

where d = the diameter of the pipe; l = the length of the pipe taken as unity; f = the coefficiency of friction (assumed constant); w = 62.5 lbs., wt. of 1 cu. ft. of water; and V = velocity in the pipe of a known quantity of water.

We have by combination,

$$P = \frac{QwflV^2}{2gd}$$

but $Q = AV$ and $A = \frac{\pi d^2}{4}$

therefore $P = \frac{8Q^3wfl}{\pi^2 gd^5}$, substituting d in terms of V.

If e = unit value of energy per year

$$Pe = \frac{8Q^3wfl}{g\pi^2 d^5} \times e = L = \text{annual loss in dollars of energy consumed in friction.}$$

But as all terms in the second member are constant except d, we may write the equation

$$L = Pe = \frac{K}{d^5}$$

To obtain the annual interest cost of the pipe, the following assumptions were made:

t = thickness of metal
$\pi d$ = circumference of pipe
m = weight of metal per cubic inch
i = annual interest cost of metal per pound
I = annual interest cost of pipe

Therefore, $I = \pi dtmi$, but, for any pressure, the thickness of the pipe varies as the diameter, or, in the form of an equation, $t = sd$, where s is a constant depending upon head and safe stress assumed. Eliminating t, we have $I = \pi d^2 msi$, all terms in the second member of the equation are constant except d; the equation, therefore, may be expressed $I = Nd^2$, N being a constant.

The problem is to find the conditions under which the sum of I and L or the total yearly loss (T) expressed in dollars will be a minimum.

$$T = I + L = Nd^2 + \frac{K}{d^5}$$

The first derivation of T with respect to d gives us

$$\frac{dT}{dd} = 2Nd - \frac{5K}{d^6}$$

if the second member equals zero, the total losses are a minimum;

therefore $2Nd = \frac{5K}{d^6}$

multiplying both sides by $\frac{d}{5}$, we have $\frac{2}{5}Nd^2 = \frac{K}{d^5}$ or in terms we readily recognize.

The conditions are therefore satisfied when the yearly value of the energy lost equals $\frac{2}{5}$ or 0.4 of the interest on the investment in pipe.

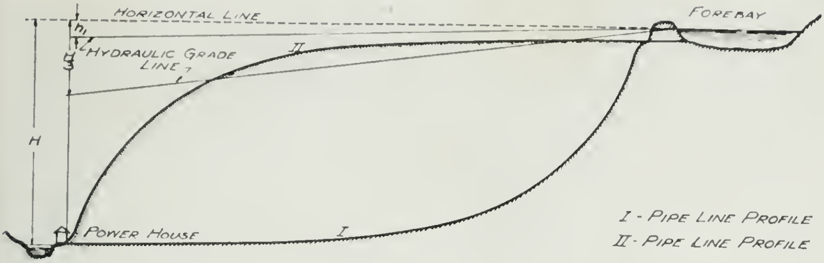



Fig. 1.

transverse seams are chiefly designed to secure watertightness. $\frac{7}{16}$ inch metal or less having single riveted and $\frac{1}{2}$ inch or over double riveted joints.

In the shop the plates are punched to templet, rolled and bolted up into sections. The punched holes, which are about $\frac{1}{16}$ inch less in diameter than the cold rivet, are then reamed out so that after assembling the holes are clean and fair and about $\frac{1}{16}$ inch larger than the rivet. The riveting is done with an hydraulic riveting machine or pneumatic hammer, the joints are then caulked and the metal cleaned of all rust and scale. The sections are then either dipped in a hot asphaltic compound or painted with a pipe preservative inside and out before shipment. For convenience in wagon transportation, as well as handling in the field, the sections are made up of from three to five courses from twenty-one to twenty-seven feet long.

The laying of the pipe is usually begun at the power house and carried up the trench or tunnel. The distinct operations of the field work are placing and bolting up, reaming, riveting, caulking and painting. After the sections are entered and bolted, the holes are reamed as shown in Fig. 2. The riveting gang then follows (Fig. 3), consisting of one rivet heater, one man inside the pipe with a pneumatic "holder on" and two men, on large rivets, handling the pneumatic hammer. Compressed air at from sixty to eighty pounds pressure is used for all purposes

Fig. 2. Reaming

Fig. 3. Riveting.

and usually supplied by a small pipe paralleling the trench. Following the riveting gang, one man (Fig. 4) caulks all the field seams as well as the shop joints, which may have opened up during transportation. After caulking, the pipe is given a second coat of paint inside and out, or if dipped, the pipe is gone over, touching up the spots which may have been bared in handling or transportation.

After a pipe is installed and in operation, the question sometimes arises as to the maximum amount of power a pipe will deliver. For instance, under conditions where a large quantity of water

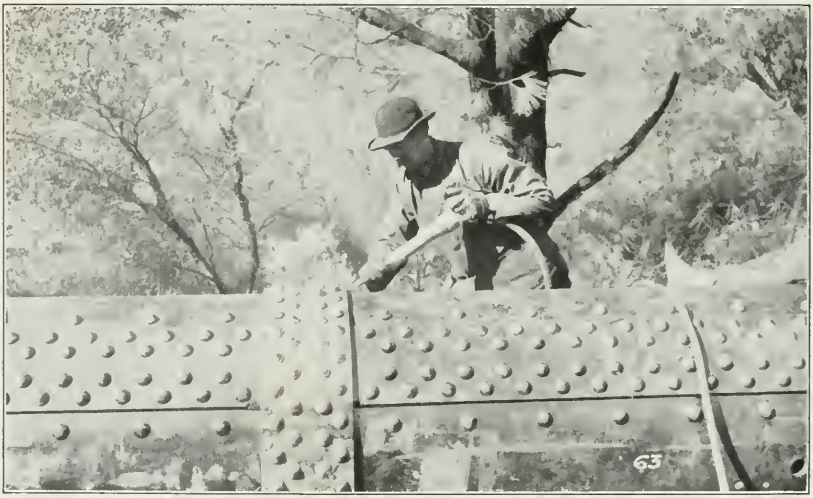



Fig. 4. Caulking.

is available during seasons of high run-off or where one of two or more pipe lines supplying a power house is being repaired, it may be desirable to get the maximum output from the pipe lines in use for a short period of time.

This question is also capable of simple mathematical proof (see Footnote No. 2) and it may be stated that a pipe line is delivering the greatest amount of power when the loss in head due to frictional resistance equals one-third of the total static head or the effective head is two-thirds of the static. This fact was recently born out at a test made at the de Sabla power house wherein one 5000 K. W. unit and two 2000 K. W. units were simultaneously drawing on pipe line No. 1. This pipe is 6080 feet long, 30 inches in diameter and under a total static head of 1530 feet. The three nozzles were opened gradually to full opening and gauge and watt meter readings were carefully noted up to a full load of 7715 K. W. At maximum output there was a total loss in head of 484 feet, or nearly one-third of the static head. This loss could not be further increased because the three nozzles were wide open, so that it was not possible to carry the test beyond the critical point where an additional discharge from the nozzles upon the wheels could give a drop in the watt meter readings. It is noted, however, that the output of 7715 K. W. was obtained before the nozzles were fully opened, showing that in all probability the critical point had at least been reached. The water wheels, however, are designed for a definite condition and there is therefore a drop in efficiency when the spouting velocity is decreased. The station or plant output, therefore, reaches a maximum before the point of greatest pipe line delivery is obtained, that is, under conditions of an increasing stream discharge.

Reverting to profiles *I* and *II* (Fig. 1), it may be at once stated that *I* is

**Footnote No. 2.**

That a pipe line is delivering its greatest output when the friction loss is equal to one-third of the total static head is proved herewith. In addition to the skin fricion loss, there are entrance, exit, angle and other losses, all of which are usually small in a properly designed pipe line; to avoid complications, therefore, only the first mentioned will be used in this deduction, though all losses could be expressed in terms of $\frac{V^2}{2gd}$

Using the well-known formulae:

$$P = Qw\,(H - h_1) = \text{power output}$$

$$h_1 = \frac{flv^2}{2gd} = \text{head loss in skin friction}$$

$$Q = AV$$

where $A$ = cross-sectional area of pipe
$V$ = velocity of flow
$Q$ = quantity discharged in second feet.

We have by substitution

$$h_1 = \frac{flQ^2}{2gdA^2} \text{ or } Q = \left(\frac{2gdA^2h_1}{fl}\right)^{\frac{1}{2}}$$

Since g, d, A, f and l are constant for a given pipe, we may write $Q = Ch_1^{\frac{1}{2}}$

Therefore $P = Cwh_1^{\frac{1}{2}}H - Cwh_1^{\frac{3}{2}}$

differentiating with respect to $h_1$

$$\frac{dP}{dh_1} = \tfrac{1}{2}Cwh_1^{-\frac{1}{2}}H - \tfrac{3}{2}Cwh_1^{\frac{1}{2}}$$

P is, therefore, a maximum when the right member equals zero or

$$\tfrac{1}{2}Cwh_1^{-\frac{1}{2}}H = \tfrac{3}{2}Cwh_1^{\frac{1}{2}}$$

Multiplying both sides by $\frac{2h^{\frac{1}{2}}}{3Cw}$ we have

$$\tfrac{1}{3}H = h_1$$

The conditions of maximum output exist, therefore, when the flow in the pipe is such that the effective head is ⅔ of the static or total head.

capable of maximum pipe line output while *II* is not, for the reason that with a friction loss amounting to one-third of the static head, the hydraulic gradient falls below the profile at the upper end of *II* and would endanger or collapse the pipe. In *I* every part of the line is at all times under considerable pressure. We could safely crowd the de Sabla or Electra lines to their greatest capacity, while with the Deer Creek line it would be hazardous to allow the hydraulic grade to approach the line.

The foregoing covers a few of the interesting phases of pipe line construction and operation and is intended to include only the most important questions which may arise.

# The Service Connection Charge

*By* GEORGE B. FURNISS
Oakland District

THE charge for connecting the consumer's premises with the Company's gas or electric main is one that occasionally meets with opposition. The applicant for service says that he cannot use either commodity unless it is brought to him; he is willing to pay for what he uses but not for the Company's plant.

There are two ways of selling goods: f. o. b. at factory, or the place of storage, or f. o. b. destination. Where the purchaser pays for the delivery of gas, or electricity, that is the conveyance, connections, then the price rate is based f. o. b. at the main (measured on the consumer's premises for convenience). The pipe or wire connecting the premises becomes a fixture to the property. It is of no value to the Company excepting upon there being a consumer on the premises, and then it becomes as much a part of the premises as the piping or wiring within the house.

Should the Company assume this connection expense, then by caring for this in its operating costs, or plant account, every consumer would have to pay his pro rata of this in the commodity rate, rates being based on the costs of operation and interest on capital invested. By the consumer paying outright for his service connection, the direct expense which he occasions by taking service, then this expense does not become a continuous tax on all the consumers, as would be the case if the commodity rate had to provide for this outlay.

The question of delivery is becoming a serious one in all lines of business. Eastern factories were the first to quote prices subject to purchaser paying freight. Then lumber yards quoted prices at the yard, adding "cartage" for delivery. This has become a general practice among wholesale houses. Grocery "package" stores followed with "cut" prices because purchaser took his goods at the store; no wagon delivery. Furniture houses advertise "specials" on small articles because "none delivered." Ice cream concerns advertise bricks "50c at the store; 85c delivered," and so on.

For years dry goods houses maintained extensive wagon delivery service. We now find these concerns transferring their deliveries to package express companies. In other words, for every package delivered, there is an express charge paid, so that the firm either stands so much loss on each delivery, or an undue profit on the purchaser who carries the package home.

The logical conclusion is that where delivery costs can be economically separated from the commodity cost, that same should be done so as to give the purchaser a net price free from the pro rata of an expensive delivery maintenance cost.

# A Few Words About Accuracy of Measurement

*By* OTTO A. KNOPP
Oakland District

IN EVERY walk of life we come in touch with the question of accuracy. If we purchase a piece of property the accuracy of the location is questioned; if the woman bargains with the grocer the accuracy of his scale is doubted. The gas consumer says, "I did not burn 1000 feet," or the consumer of electricity claims to have burnt only half as much light as in the previous months, and his meter showed twice as much as usually. The policeman claims the automobile was running at the rate of fifty miles an hour, but the chauffeur emphatically denies having exceeded the eighteen miles an hour speed limit. Your friend asks you to wait a second, and returns after half an hour without excuse. In all these cases the question arises: How accurate was the measurement, and how accurate can we measure under different circumstances; and when shall we call a measurement correct? The last question should be answered with: Never—as no human measurement is correct, but is only approaching correctness within certain limits; and here we come to the other question: How accurate can we measure under different circumstances?"

The most accurate results in measuring are obtained with the balance and pendulum clock. The most accurate balance in the possession of the French Bureau of Weights and Measures is able to detect a difference in weight of less than one part in a hundred million. The scale is so accurate, as stated by authorities, that it will indicate a difference, if two counter weights, balancing another weight, are placed side by side or on top of each other, because the weight which is on top of the other is farther away from the center of the earth than the other. Therefore the sum of both is lighter than if placed side by side. The best pendulum clock can be relied upon to one-half of a second in one month, or less than one part in five millions.

Through astronomic measurement we are in the position to determine the time of one day to an accuracy of 1/300 of one second or one part in twenty-five millions.

Through optical measurement we are able to determine the length of one meter within less than one part in ten million. All these extreme accuracies are obtained under the most favorable circumstances with the most delicate instruments and the most ingenious methods human skill can produce.

In practical or commercial measurement all circumstances affecting the accuracy are not always known. Instruments have to be rugged and simple; methods have to be quick and sure. All this tends to introduce a certain degree of uncertainty, and lowers the accuracy of the measurement. When we speak of 1000 cubic feet, we seldom mention the pressure of the gas nor the heights above sea level at which we supply the gas. One thousand cubic feet at the meter will be some 1030 or 1040 at the burner when the gas escapes into the air. The same 1000 feet will be no more than 300 to 400 feet in the high pressure main of the supply system. But this is not the worst uncertainty. One unsatisfied customer claiming he did not get 1000 feet of gas, put the accent on gas, and here we are up against it with our measurement, as the meter, says the customer, measured the air in the gas, too.

Similar trouble we experience when we supply electric lighting current. A customer claims he got half the light, but the meter showed twice as much. The meter is found correct, and the customer's statement, too, after we allowed duly for exaggeration.

The commercial measurement of the products of a business firm is in most cases an easy matter, as our methods of measuring are in most cases far in advance of practical requirements, but in case of gas and electric companies the difficulty is, as above mentioned, great. We have no meter yet to measure the heat units of a certain amount of gas supplied, and have no meter which will measure the electric candle power hours.

# The Load Dispatching System of the Pacific Gas and Electric Company

*By* P. M. DOWNING
Engineer of Operation and Maintenance

IN THE operation of an electrical system the objects first to be considered are continuity of service and regulation of voltage. With a system having but few sources of supply, and these located near together, the problem is a comparatively simple one, but as the number of generating stations is increased, and lines are added until they form a network extending for hundreds of miles, the problem becomes more complicated.

The system of the Pacific Gas and Electric Company is unique in that it has a greater mileage of high voltage lines receiving power from a larger number of sources than any other system in the world.

Not only do the ten hydro-electric power houses of this company, aggregating an installed capacity of approximately 67,000 kilowatts, all run in parallel, but they are connected in with and receive power from the Northern California Power Company, the Great Western Power Company, the Stanislaus Power Company, the Snow Mountain Water and Power Company, the steam stations at Oakland, San Jose, San Francisco, and the gas engine station at Martin.

On first thought it would seem that the regulation and handling of load under these conditions would be a difficult matter. On the contrary, it is very simple. The present method of operation has been a gradual development. It was early found that in order to operate successfully under these conditions, two things were essential:

First. That so far as handling the load and regulation of voltage was concerned, there should be but one person in authority.

Second. That there should be a perfect telephone service between the principal power houses and the important switching stations.

The Bay Counties Power Company was the nucleus of the present system, and for several years Colgate was considered the master plant. From this point was handled not only the speed and voltage regulation, but also the line switching of the entire system. This arrangement continued in effect until the extension of lines brought the important center of switching near Davis, and for a time the operators at that place, acting with Colgate, handled the work which had formerly been controlled entirely from Colgate.

With the taking over of the Standard Electric Company and the operation of that system in parallel with the Bay Counties, it became necessary to control the two systems from some point, so far as possible common to the two. By virtue of its location, South Tower was selected as being the most suitable place, and from that point the load dispatching was handled until about a year and a half ago, when it was found advisable to relieve the regular station operators of this responsibility, and to create the position of load dispatcher. Thus has the load dispatcher's office come to be the center of the operation of the entire system, from which every power house, switching station, etc., receives orders.

On the load dispatcher rests the responsibility of keeping the voltage normal and seeing that the fluctuations of load are properly taken care of among the different power houses. To do this requires not only a thorough knowledge of the power house conditions, but a knowledge of the character of the load on the system throughout the day, as this has a decided effect on the regulation of the lines.

A superintendent cannot take out of service a power house, transmission line, or any other part of the system which would affect the operation of the whole, without first receiving authority to do so from the load dispatcher's office. However, the division of load and regulation of voltage is by no means the most important part of the load dispatcher's duties; that of re-establishing service after an interruption, without unnecessary delay, is a far more difficult problem, and very often calls for quicker and more decisive action. Operating as we do with everything running in together on a common network consisting of approximately sixteen hundred miles of sixty kilo volt lines, trouble on any line will affect the entire system. Then it is that the load dispatcher is busiest. The trouble must be located and the particular section of line on which the trouble occurs must be cut out. The different generating stations may be thrown out of synchronism, or the trouble may even be so severe that the different machines in the power house may be thrown out of synchronism. If the trouble is far enough removed from the station, the generators will not be thrown out, and the interruption is therefore only momentary; nor is trouble on one part of the system always noticed over the entire system. This is taken care of by the system of switching in use, whereby immediately when trouble occurs the different power houses are separated, leaving one or more running together with such lines and load as they can conveniently carry.

An experienced operator can, from the sound of a transformer, motor, or regulator, at once tell when trouble occurs. If the station be a switching point, he should be able to handle the switching quickly enough for the trouble to show only as a slight momentary drop in voltage on the unaffected section of line. This condition is possible by reason of the inductance and capacity of the line and would not obtain on shorter lines of higher conductivity.

Immediately after the operation of any high tension switch, either on a direct order from the load dispatcher's office, or during trouble when the regular routine tests are being made, such action is immediately reported to the dispatcher. In this office is located a board showing diagramatically every generating station, transmission line, sub or switching station, also every switch in any of these different stations or on the lines. Stations and lines are represented by being painted on the board, but the switches are represented by dummies which can be adjusted to show the switch open or closed. The particular kind of switch, i. e., whether oil or air, is shown by the shape of the dummy; the oil switches being circular and the air rectangular.

The advantages of a board of this kind will be appreciated when one considers that there are in service on the entire system, approximately one hundred and twenty-five oil and three hundred and fifty air switches, the position of every one of which must be known by the load dispatcher.

When an order is given to operate a switch no change is made on the board until the operator to whom the order is given reports that the order has been carried out, when the dummy switch is set accordingly. In this way a load dispatcher coming on watch can tell at a glance what lines are out of service and what switches are open or closed.

Thus will be seen the importance and necessity of reliable telephone communication, particularly between the dispatcher's office and the principal switching points.

Telephone circuits are run on all high voltage transmission lines and ordinarily these give very satisfactory service. Very often, however, they are of high resistance and not suitable for use over long distances on account of inductive troubles from the high voltage wires, which during times of trouble on the transmission are great enough to make the telephone entirely inoperative. They are, therefore, used only for the local service on that particular section of line, the more important business being carried over a line leased from the Pacific Telephone and Telegraph Company.

The leased line extends from the general office in San Francisco to the load dispatcher's office in Oakland, thence to South Tower, Stockton, Sacramento, Marysville and Chico. From Oakland a branch runs to Mission San Jose where connection is made to a leased line of the Stanislaus Company. Branches run from South Tower to North Tower, from Stockton to Electra and from Sacramento to Davis. At Marysville our own private line from Colgate connects to the leased line and at Chico connection can be made to the private line from de Sabla and Centerville.

In the dispatcher's office is kept a careful record of the energy delivered from the different generating stations, and daily load curves are plotted showing (a) the load generated at our own water power plants; (b) the load generated at our own steam plants; (c) the power purchased, and (d) total load on system.

This information is completed between midnight and 8 a. m. for the twenty-four hours ending at midnight, and shown in the form of a daily service report which reaches the general office by 8:30 each morning.

In addition to showing the load conditions, this service report gives the time and duration of interruptions to service at any sub-station, weather conditions, rain or snowfall, depth of snow at different gauging stations, depth of water in storage reservoirs, amount flowing in ditches or over diverting dams, and such other information as may be of interest and importance.

This very important work is in the hands of three dispatchers, a dispatcher being on duty at all times. Mr. Fred R. George is Chief Dispatcher, and to him has fallen much of the development of the dispatching system. He is assisted by Messrs. C. P. Pierce and W. D. Skiner, as Assistant Dispatchers.

# The New Stenographer

I HAVE a new stenographer—she came to work to-day,
  She told me that she wrote the latest system.
Two hundred words a minute seemed to her, she said, like play,
  And word for word at that—she never missed 'em!
I gave her some dictation—a letter to a man,
  And this, as I remember it, was how the letter ran:
"Dear Sir: I have your favor, and in reply would state
  That I accept your offer in yours of recent date.
I wish to say, however, that under no condition
  Can I afford to think of your free lance proposition.
I shall begin to-morrow to turn the matter out;
  The copy will be ready by August 10th about.
Material of this nature should not be rushed unduly,
  Thanking you for your favor, I am yours, very truly."
She took it down in shorthand, with apparent ease and grace;
  She didn't call me back all in a flurry.
Thought I, "At last I have a girl worth keeping 'round the place;"
  Then said, "Now write it out—you needn't hurry."
The typewriter she tackled—now and then she struck a key,
  And after thirty minutes this is what she handed me:
"Dear Sir, I have the Feever, and in a Pile I Sit
  And I exeept the Offer as you Have reasoned it,
I wish to see however That under any condition
  can I for to Think of a free lunch Preposishun?
I shall be in to-morrow To., turn the mother out,
  The cap will be red and Will cost 10, about.
Material of this nation should not rust N. Dooley,
  Thinking you have the Feever, I am, Yours very truely."

—Granite Cutters' Journal.

# Cumulative Dividend Claims of Preferred Stock to be Liquidated

## COMMON STOCK REISSUED

### Last Step in Financial Work of Rehabilitation Is Now Accomplished

THE last step in the financial operations extending over three years, by which the Pacific Gas and Electric Company has re-established its position subsequent to the disaster of 1906, was taken June 22nd.

At a meeting of the directors of the company an arrangement was perfected whereby the claims of the preferred stockholders for cumulative dividends will be liquidated by a reissue of common stock, now held in the treasury of the company. One full paid share of common stock is to be given on each two shares of preferred stock, in consideration of a release by the holders of the latter of their rights to the 6 per cent cumulative preferential dividends unpaid from April 1, 1906, to August 1, 1909.

LAST OBLIGATION WIPED OUT.

This wipes out the last obligation against the company, and places it in what is claimed to be a dividend-paying position.

The last dividend on the preferred stock was paid a few days before the fire. Thereafter an assessment of $10 a share was levied on both the preferred and common stock. That on the former was paid in full, while the entire issue of $20,000,000 of common stock was turned back into the treasury by its holders. Since $15,000,000 of this was afterward reissued by the company in the process of its its work of rehabilitation.

In the meantime no dividends were paid on the preferred stock. As these dividends were cumulative, the claims of the holders of the preferred stock had aggregated a total sum of $2,000,000, or $20 a share, up to August 1st.

REISSUE COMMON STOCK.

To meet this claim, the directors of the company decided to reissue the common stock in the treasury, turning it over to the owners of the preferred on a basis of one share of common for each two shares of preferred held by them. As the cumulative dividend claims on the preferred are $20 a share, this transaction is on the basis of a valuation of $40 a share for the common stock. It was recently quoted in the market at $44.

The result is that the company now has a clean financial slate, and it is presumed that it will be in a position to resume its dividends of 1½ per cent quarterly on the preferred, beginning from August 1st, to which date the dividend claims on this stock will have been liquidated.

It is reported at the offices of the company that this offer has already been accepted by the holders of more than 72 per cent of its preferred stock. It is also stated that those who accept the offer will be required to present their certificates to the secretary who will note on them the fact that the release from the accrued dividend obligation has been executed.

LAST STEP COMPLETED.

"This is the last step in the financing of the company since the fire," Cyrus Pierce said. Outlining the different transactions in the refunding bonds and the turning back of the common stock into the treasury he said: "The company is now one of the strongest concerns on the Coast. It is controlled by local capitalists, and San Francisco should take a pride in the fact that it re-establishes itself in a secure financial position."

There are 100,000 shares of the preferred stock of the company, and the present transaction involves the reissue of 50,000 shares of the common stock, the par value of which is $5,000,000 and the present market value $2,200,000.

—S. F. Chronicle, June 30, 1909.

## WHAT'S IN A GAS PIPE?

*By* W. R. MORGAN, Gas Department

What's in a gas pipe? The answer seems a simple proposition. Experience proves, however, that almost anything in the universe may be found in a gas main, as well as gas.

Regarding the normal contents of a gas main, opinions differ according to the point of view from which the subject is considered. The scintillating intellects employed in supplying information through the medium of the daily newspapers would have us believe that "the mains are filled with air, and a substance that would make good roof paint, but which cannot be extracted even with a corkscrew" (an all-powerful instrument in the estimation of a reporter).

To the complaining, gas consuming public, the mains exhale a mysterious, awe-inspiring vapor, more effective as a motive power in the meter, than as a heat producer in the gas stove.

To the weather beaten veterans, who have spent their lives laying 526 miles of pipe throughout San Francisco streets, these mains contain at one and the same instant, a docile servant, a stern master, and a treacherous enemy.

The scientifically trained gas engineer draws recklessly upon the alphabet, and states that the mains are filled with $N_2$, $CH_4$, $CO_2$, $C_2H_4$, $O_2$, CO, and $H_4$, which to him spells GAS; a mixture of hydrocarbons; a thing of heat units, candle-power, and specific gravity; the result of 117 years of untiring research and inventive effort on the part of master minds in the fields of chemistry and mechanical engineering; it means light, heat and power, and satisfies three of the vital requirements of civilization: it lights our streets, warms our houses, cooks our food, saves our time, preserves our tempers, and prolongs our lives inasmuch as by its use, the available length of each day is increased by half. It is the life-blood of the company and together with its complement, Electricity, has called into being an organization that is one of the most inspiring examples of magnificent teamwork to be found in the modern industrial world.

## "OVERHEARD ON THE FERRY BOAT."

*By* J. D. BUTLER, Auditor

(Time: Early morning—arrival of cars at ferry boat.)

New Resident, noting the mad rush of some of the passengers from cars to the boat, inquires of Old Resident: "Why are some of the passengers hurrying on to the boat with such unusual speed?"

Old Resident: In a hurry for breakfast.

New Resident: That is strange, why do they not get breakfast at home?

Old Resident: The reason why they do not get breakfast at home is that they are pressed for time.

New Resident: That is strange, why do they not take time?

Old Resident: It is simply this way—the one who prepares the breakfast tries to make a fire in the coal stove, but it takes so long to start the fire and to cook a meal that valuable sleeping time is wasted and the first instructions that are called out to the one preparing to start for San Francisco are, "I will not have time to get your breakfast, you will have to get it on the boat." After a time it is considered final. Now, if these misguided individuals would use gas as fuel in preparing breakfast as I do, same would be ready for them in a short time.

New Resident: That is a fine idea. I will adopt it at once. We were up this a. m. a full hour and I just about made the train. When I start using gas as you do I will then commence to enjoy suburban life.

Old Resident: I see you are modern. It would be a good idea to tack up a sign at each station, "Cook with gas and enjoy your breakfast at home"; or have a "spieler" with a megaphone call out on arrival of cars at the boat, "Cook with gas and save time and eat breakfast at home."

## KNOWLEDGE

When you know a thing, to hold that you know it; and when you do not know a thing, to allow that you do not know it; this is knowledge.—Confucius.

# "Men Must Work"

By FRANCES STEVENSON DOWNING

IN THE magazines devoted to electrical engineering we read of the latest inventions along the engineering line, the newest and most efficient type of generator and transformer, "the why our scheme failed," or "had such and such concrete been used"—all of which to the engineer is interesting and profitable reading.

Stacked on the library table in the home of an engineer I know, and conspicuous in their green and yellow coverings, the engineering magazines have a prominent place. The files of A. I. E. E. are complete, and a glance at bookcases shows Alternating Currents, Dynamo Electric Machinery, Lead Storage Batteries, etc., and last, though it should have been mentioned first, Conic Sections—Calculus, etc. Isn't this a forbidding list for a family library?

It is laughable, the alacrity and zeal with which I have learned to grasp one of the weekly contributions. For after years of association it has become a part of the operation—and I know a part of the maintenance of the home.

Situated as the plants are, away from the disturbing elements of city life, the boys perform their duties with great precision, and their leisure time is spent in healthful exercise. After a snappy game of ball, they enjoy the magazines with their up-to-date bits of fiction, or the engineering magazines provided by the corporation. This is money well invested, for to get the best results from these boys their minds must be filled with something other than the routine of their work. For what machine can be run without oil? And the cooling process must be used on tired minds.

After an accident to a machine at one of the largest plants, I was talking to one of the operators of his narrow escape. "Well," he said with a smile, "some one had to do it and it was up to me to throw the switch." So you see there are heroes hidden deep in the canyon that the city office seldom hears of.

I have listened to the arguments of engineers—theoretical and practical. I have lived and loved the life of an operator's wife—and have known the details of the division superintendent's office, and am now watching with interest the details of operation and maintenance of one of the greatest power systems of the world. Through these periods of evolution I have tried to cooperate and have always given a cheery good-bye to an engineer I know when I am left alone with a leased line and A. C. volt meter for companions, all of which teaches me that

"Men must work."

# Old Nag and His Works

By F. E. CRONISE
Comptroller's Department

THE thief who makes a restoration is bargaining with his conscience—he has more to restore if he would. This is the idea of a well-known, quick-paragraph man. Lately this office has had a case in point.

Out in the Mission there is a two-story house covering a small lot and containing many apartments, the rooms can hardly be called rooms, and the narrow halls are dark even in the morning. A clerk from the Gas Company was admitted there one evening by a hospitable small boy, who ran shouting, "Papa, papa, there's a man who wants to see you" A red-whiskered, middle-aged German, shrewd enough in looks and businesslike, came quickly from the kitchen, and led the visitor into a small, clean bedroom, with one little window opening into the back yard, and carefully closed the door. "I've come to ask for particulars about the refund you left for the Pacific Gas and Electric Company the other day," said the clerk, "the incident is somewhat unusual, and it would be interesting to know what the amount covers."

With the fluency and earnestness of a professional exhorter came the reply:

"I was employed by your Company and was discharged. On leaving I took several paint brushes that did not belong to me. As a counter claim, I might rely on the fact that the Company retains several brushes which really belong to me, but no—I will not do so, that sin rests entirely with the Company, and is its own lookout—that wrong does not decrease my sin, for which I now pay."

"Was that all?" asked the questioner. The returned sum was over generous.

"Well, during my employment, I received from the foreman scraps of iron, window glass, pieces of lumber, all of which would probably have gone into the ash-barrel."

"And was that all?" insisted the questioner, with a half-remembered quotation from the well-known paragraph man in his thoughts.

"No," hesitatingly, his smoothness of oratory and English deserting him.

"Out with it."

"I—drunked some alcohol."

"How much?"

"I cannot tell the quantity, but I believe not more than—a gallon. It happened in 1905, I was a most fearful sinner, the devil was in complete control of my body. But I have since repented and believe that, if I am to hope for arrayment like the sun, moon, and stars, I must atone, and pay for all I have taken. I feel now that I am entitled to the order of the moon. The millennium will soon come, a thousand years, during which we are to be ourselves, with no influence either of God or Old Nag (the devil), and thus may be judged justly."

Not being up on the different brands of religion, the Gas Company's representative began to feel very inadequate, and sought the door-handle. The refunder's calm manner was changing to the wild and fervid.

"Before you go," he demanded, "tell me, what would you do if you had failed to pay your poll-tax back in 1893?"

The Company's agent only blushed, guiltily.

Continuing the repentant said, "I lived in Illinois for six months; then, just before the poll-tax was collected, I moved into another State, where I was not asked to pay. Now, where would you send the money?"

The visitor insisted on escaping.

The next morning, however, he returned, carrying with him the conscience money. He handed it to the wife, a forlorn looking woman, who had her story too, brief, but, like her husband's, full of torture and conflict. "He would give all of the good money he earns away, he would send every cent here and there to make up for things." As the messenger was turning from the door, the oldest child, a girl of thirteen, opened her mother's hand and murmured, "FIFTEEN DOLLARS!" and the two boys, six and five years old, insisting on a sight.

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Religious text-books are published at a rate of seventeen cents per volume, there are five hundred in the set, better printed than one would expet, and bound in cloth. They come from Pennsylvania, but bear no label of author or compiler, so that investigation would be required to show whether so much active and inconvenient atonement comes from enthusiasts of one of the old Dutch sects or some publishing house that can make money by putting out books at any old rate to influence repentant sinners.

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## NOT FOR HIM

"Sir," said the youth, as he entered the private office of the busy merchant, "I am looking for a situation."

"Nothing doing, young man," replied the b. m. "Had you wanted a job I might have been able to do something for you, but I have too many people on the pay roll now who occupy sit—uations."

# Steps in the Moving of a 10,000 Barrel Oil Tank from San Francisco to Sacramento

*By* W. B. BARRY
Gas Department

THE necessity for a larger oil storage tank in the Gas Department at Sacramento became apparent a few months since, and it was decided to take a 10,000 barrel tank from the North Beach Works, place it bodily upon a barge and transport it to Sacramento.

The tank is 56 feet in diameter by 25 feet high, weighs about 51 tons, and was in a hole 13 feet deep with a brick wall around it, reaching from the bottom of the hole to a height of 13 feet above the ground.

The contractor chosen to do the handling was one who had had previous experience in moving a much larger tank about a year ago, when a 30,000 barrel tank was moved from the Pacific Gas Improvement Company's Works in San Francisco to the works of the Oakland Gas, Light and Heat Company in Oakland.

The wall was first leveled on one side. As soon as this was finished, jacks were inserted under the edge of the bottom flange and the tank lifted clear of the foundation. Small timbers and ordinary housemover's blocks and jacks were then placed underneath, and it was by these means raised to a level with the ground.

As soon as a proper height was reached, the clearance being then such that the use of larger timbers was possible, these were placed underneath with rollers between them, and the tank began its first land journey, a horse and windlass being used for motive power.

In preparation for loading, the barge was tied as close as possible to the shore, long timbers placed between the shore and the barge and the tank rolled aboard, an operation which required but twenty-five minutes.

The barge was one used for carrying grain on the river, and though it was of ample length, the tank was over the water on either side about five feet.

Sacramento is over 125 miles from San Francisco by water, but the trip was made without incident in tow of the river steamer San Joaquin No. 4, Captain Lowry, and in a convoy, and the barge with its load was finally tied at the bank of the river near the gas works of the Sacramento Electric, Gas and Railway Company, ready to be unloaded.

# Irrigation Notes

Several thousand carloads of South Yuba Company's water finds its way to Chicago, New York and other Eastern cities yearly, and is there sold at a very high price per pound. (Drupaceous fruits are not sold by the miner's inch.)

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The South Yuba Company is expending this year about $100,000 on betterments in the Auburn Irrigation Division. Four regulating reservoirs are being constructed and one large storage reservoir (Lake Valley) is to have its capacity increased nearly 50 per cent. Canals are being enlarged and new pipe lines are being installed.

The fruit growers in the vicinity of Auburn, Newcastle, Penryn, Rocklyn and Loomis are already taking advantage of the expansion of the Company and are almost daily applying for additional water for land which is being opened up.

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It is interesting to note that of all the water stored in the South Yuba Company's reservoirs such as Fordyce, Lake Van Norden, Spaulding, Meadow, Sterling, Rucker, Feeley and others, the proportion diverted to the Auburn Division has increased from one-third to one-half in the past ten years.

# Concerning Municipal Ownership

## WEIGHING THE BURDEN

(Editorial in the Detroit Free Press.)

There are two ways of showing success or failure of municipal ownership in England, the country now most frequently chosen as an example for American communities to follow.

One of the ways is to select some isolated venture and from its reports to cull such facts as will seem to bear out the claim that the municipally controlled enterprise is proving highly successful. This is the method commonly adopted by the zealous advocates of municipal socialism on this side of the Atlantic. Such facts as go to prove that "municipal trading," to use the English term, is a miserable failure can be easily suppressed, and the difficulty in securing promptly at this distance the official report thus garbled sometimes saves the advocate from immediate exposure.

Another way of getting at the truth of the case is by referring to unbiased government reports or to standard authorities. The figures found in these volumes are compiled without regard to controversy. They are reliable and deductions from them can be trusted.

One such volume is the "Statesman's Year Book," which for forty-five years has been carefully revised from official returns and is accepted as authoritative upon the matters of which it treats. There is a flood of light to be found in its pages by the reader who will compare its statistics in the latest volume with those contained in the publication of former years.

One of the most obvious objections to municipal ownership is that it tends to increase at a tremendous rate the burden of taxation and the indebtedness of local communities. What has the Year Book to show on this point?

Under the head of Local Taxation, the Year Books for 1895 and 1908 respectively, have the following paragraphs:

The total amount raised for local expenditure was as follows (in England and Wales):

| | |
|---|---|
| 1891-92.......... | £ 63,328,895 |
| 1904-05.......... | 143,594,317 |

Here is an increase of more than 100 per cent in the total amount of money raised and spent by English municipalities within fifteen years. It means that the taxes of rich and poor have been more than doubled. This must largely be due to municipal ownership in England, for it is within that period that the country has entered upon its vast plans of public ownership.

The Year Book for 1895 does not give the debt of local communities, and it is necessary to go to the volume for 1903 to find data on that point. What has been the growth of these liabilities as a consequence of acquiring and operating public utilities in England during the last five years? The figures are fairly staggering. They follow:

At the end of the financial year 1899-1900 the outstanding local debt of England and Wales amounted to £293,864,224.

At the end of the financial year 1904-1905, it was £466,459,269.

The debts of the municipalities increased 60 per cent, the taxation increased 125 per cent! Could there be a more telling proof of the frightful cost of municipal socialism than is given in these official figures?

A comprehensive policy of municipal owership involves, even under the most favorable view of it, a tremendous burden. It is not a policy into which a city should be plunged light-heartedly without consideration.

When a city is staggering under such a tremendous burden, a brief interval of general financial disturbance, a few seasons of bad management, a year or two of the reign of graft, and municipal bankruptcy follows.

## AS USUAL

Because of the oversight of its city officers, in failing to provide for the item of depreciation, in their management of the municipal lighting plant, Lowell, Mich., is forced to consider the advisability of selling out the plant to a private corporation. The plant originally cost the city $28,700, and the investment now has reached $35,000. No provision has been made for depreciation, and now it is estimated that it would cost at least $8,000 and perhaps $15,000 to put the plant in good condition. The money is not available, and the city officers are considering a proposition from the Grand Rapids-Muskegon Power Company to buy the plant for $32,000.—Public Service.

## CITY VIOLATES ITS OWN LAWS

The City of Seattle has been caught in the act of violating its own ordinances again. This time the complaint is made against the Lighting Department, of which L. B. Youngs is superintendent, and the violation was reported to the Board of Public Works by Superintendent A. V. Bouillon. At a corner on King street the Lighting Department strung overhead wires and replaced several transformers. Under a ruling of the Board, all public service companies must first obtain permits. An inspector from the Department of Public Utilities ordered the work stopped, the employees of the Lighting Department giving him the laugh and the work was finished.—Municipal Journal and Engineer.

Municipal ownership is the finest thing in theory and the worst in practice of anything we have in this great country—Lawrence, Kan., Gazette.

## THE NEW WATCHWORD

According to Professor Meyer, of the Railroad Commission of Wisconsin, one of the chief aims of a public utilities commission should be to bring about a hearty co-operation between the cities and the utilities companies which serve them, the ultimate purpose being to secure for the consumer the best service at the lowest price compatible with a fair return upon the capital invested. According to his view the commission is not merely on the one hand to protect companies from the open attack of demagogues and the insidious attacks of grafters, and on the other to protect cities from the rapacity of corporations whose motto is "charge all the traffic will stand." It is beyond and above this—to bring the two parties to a franchise agreement into a spirit of cordial and intelligent co-operation.

## DECEIVING THE PEOPLE

Most of the arguments in favor of municipal ownership and operation are based on the financial reports of municipalities where no allowance is made for depreciation or taxes and many other items which should be figured as a part of the business. Deficits are saddled on to taxpayers under other names, and while the reports look fine, they are worthless for any purpose of comparison. England has waked up to the fact that in addition to false bookkeeping to make a good showing by municipalities owning public utilities, more than $25,000,000 annually has been added to the national budget to help them make both ends meet.

## SPECIAL MUNICIPAL BOND ELECTION AT PETALUMA

Proposition No. 1: Shall the City of Petaluma incur a bonded indebtedness of $19,000 for the cost of a bridge over the Petaluma River?

Proposition No. 2: Shall the City of Petaluma incur a bonded indebtedness of $10,000 for the cost of a rock-crushing plant or works?

Proposition No. 3: Shall the City of Petaluma incur a bonded indebtedness of $25,000 for the cost of additional fire apparatus, consisting of certain extensions and additions to the present fire protection system of said city?

The foregoing propositions were all answered by the citizens of Petaluma in the negative on June 17, 1909.

# Pacific Gas and Electric Magazine

PUBLISHED IN THE INTEREST OF THE EMPLOYEES OF THE PACIFIC GAS AND ELECTRIC COMPANY

JOHN A. BRITTON, - - - - - - - EDITOR
R. J. CANTRELL, - - - - - - NEWS EDITOR
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Communications containing items of interest to the members should be sent to the News Editor, R. J. Cantrell, 445 Sutter St., San Francisco, Cal. In order to appear in a certain issue these items must be in the hands of the News Editor by the twelfth of the preceding month.

VOL. I JULY 1909 No. 2


## OPPORTUNITY

In an organization as large as that of the Pacific Gas and Electric Company, each issue of the magazine will, of necessity, meet new readers in those who have recently come among us, and it is to these men (and women, too) that this is particularly addressed, although they apply to all in the company's employ.

OPPORTUNITY comes regularly to all, but few of us recognize it, since it is usually in very modest guise—sometimes only a simple message to be delivered, and at other times a really difficult undertaking to carry out. A simple undertaking, well carried out, is generally a safe indication of an ability to undertake greater things.

Promotion in a large corporation is based largely on past work and, of course, seniority; but of the two, past work is usually the determining factor. Often, too, opportunity does not appear in attractive form. Work is offered which may not be as attractive as that which at the time is in hand, although of greater importance to the Company, and may involve more or even harder work in less congenial surroundings, or perhaps a combination of all, but, nevertheless, the man who sidesteps is neglecting opportunity, and is pretty sure to have an increasing difficulty in connecting with another chance. Moreover, it must be apparent that the only type of man on whom a corporation can rely is one who can be depended upon at all times to do what is required of him in any sphere within the limits of his capabilities.

A new man, starting on a lower rung of the ladder, has a not unnatural feeling of being a rather insignificant unit, but if he will only think awhile he will recognize that the organization is made up of a large number of such individual units, and its success or failure is largely governed by their proper coordination.

In each individual group these units are thoroughly understood and their capabilities known and appreciated by the superintendent or foreman in charge. The superintendent or foreman in charge, as the case may be, in turn is known and judged by the engineer or head of the department as much by the work which his men are doing as by his own work, and in a like way the head of the department is known to the executive of the company. It will be obvious, therefore, that no matter how far down the line, or how insignificant the unit may appear to be, he is actually very close to the management, who can at any time find out, by inquiry through regular and direct channels, what men are available for work to be undertaken. Were this not the case, it would be almost impossible to operate successfully any large organization.

Looking, then, at the situation from the broad viewpoint outlined, it should be at once apparent to all that opportunity, and with it advancement, is more likely to be met with in a large organization than a small one and is largely in the hands of the men themselves. It is true that there are instances where a man's talents are not recognized as quickly as they deserve to be, but these are far enough apart that they can fairly be taken as exceptions to the rule.

In a recent address given to some young engineers about to go out in the world, it was said that "excuses are poor substitutes for results." This very short and pertinent piece of advice is one that can be profitably remembered by all. To this may be added one other word, and that is that we should always try to do whatever is asked of us as best we can, without regard to our own feelings in the matter, remembering always that the ability to do what we *want* usually comes only after a long apprenticeship of doing what we *can*.

## ON GENERAL INSTRUCTIONS

In the several departments of this Company, standard methods of accounting, of procedure, or of construction, are from time to time adopted and issued by those in authority. These instructions are sent out to the various superintendents, managers and others, for their guidance, in order that the work upon the system may be uniform. In many cases, there are some very natural criticisms of the instruction or standard, but the criticisms, as a rule, are the result of their having been considered simply from a local viewpoint. General instructions on accounting or procedure, in all cases before they are issued, are given very careful consideration, with a view to their effect upon the whole system and as to the attainments of the results desired. Standards of electrical construction usually originate in the Engineering Committee, where all the physical departments are represented, and are only adopted after they have been thoroughly discussed and determined upon by the committee as being the best practice for the system as a whole. If, therefore, the employees upon whom the duty falls to carry out the instructions issued will only bear this in mind, there will probably be less occasion for criticism.

Free criticism is, at all times, invited and can be made either by letter to the head of the department or can be brought up for discussion at the monthly meeting of managers or superintendents. The instructions, however, should in all cases be followed, unless it seems to the manager or superintendent that the interests of the company will suffer in consequence of their being literally obeyed, in which case the matter should be immediately brought to the attention of the head of the department.

## ACKNOWLEDGMENT

The launching of a new enterprise is, as a rule, accompanied by some misgivings on the part of its sponsors, and the first issue of the new magazine was no exception to the rule. While the editors had no doubt of its ultimate success, at the same time the appearance and the reception of the first number can fairly be said to have been beyond their most sanguine expectations—a result which was almost entirely due to the prompt support given by those who were asked to contribute, and the painstaking work of all of those employees who devoted their spare time to the work of preparing the magazine and getting it out.

The measure of its success has not been determined entirely from our own viewpoint, but rather from the many kind words which we have received from the editors and publishers of similar magazines, as well as from the engineering fraternity at large; and to all of those who have sent us their good wishes and words of appreciation, as well as to the initial contributors, we extend our thanks. We now feel justified in saying that this magazine is a success, and with the liberal support which we know we have both in and out of our company, it will so continue. This number, we think, is an improvement upon the first, and we hope to improve each one until we arrive at that perfection to which all editors look forward, but few attain.

## EDITOR'S NOTE

The Magazine looks to the entire personnel of the company for contributed articles. The fact that you may not have been called upon specifically does not indicate that your contributions are not desired. The contrary is true and articles are solicited from all employees of the company.

Some of you may not consider that you have the necessary literary ability to write for publication; in such cases the Editor will be only too glad to put contributions submitted, in proper form. If you have not the time to write a complete article, send in the data from which an article may be prepared. This is your magazine, and it is up to you to do your share in providing material and making it what it is intended to be—an employees' magazine.

# BIOGRAPHICAL SKETCH

## EDWARD CAMPBELL JONES

GAS ENGINEER
PACIFIC
GAS AND ELECTRIC
COMPANY

*Edward Campbell Jones, who is known to the gas engineering world, not only in the United States of America, but on the Continent as well, deserves the distinction of being at the present time the only gas engineer resident upon the Pacific Coast.*

*He comes from a family of gas men, his father, Mr. Edward Jones, having built the first gas works in Lowell, Cambridge, Worcester, Providence, Richmond and other cities in the New England States.*

*He was born in Boston, Mass., on February 8, 1861, and at the age of sixteen entered the employ of the South Boston Gas Light Company. Being of a natural mechanical and inventive turn of mind, his rise in the intricacies of coal gas making processes at that time was very rapid, and within two years he had invented the "Jones Photometer," an instrument of such surprising simplicity that it not only sprung into use as an invaluable adjunct to every gas plant throughout the world, but more than that, it made a name for its inventor, which will go down in perpetuity in the annals of gas engineering.*

*At twenty years of age he was Secretary of the corporation which employed him, and at twenty-two he was appointed Assistant Superintendent of the South Boston Gas Light Company, which position he retained until 1885. He became Superintendent of the Boston Gas Light Company on March 8, 1889, and on January 27, 1890, was appointed Assistant Engineer of that company.*

*In 1890, the San Francisco Gas Light Company desiring some one to take charge of the construction of the large installation at their North Beach works, called him from his labors in the East, and on May 1, 1891, he assumed the duties and responsibilities of Assistant Engineer of that company, and when, later, the Edison Light and Power Company merged with the San Francisco Company, Mr. Jones became Engineer of both the Gas and Electric Departments. Looking for a larger field for his work, on March 1, 1902, he accepted the position of Chief Engineer of the California Central Gas and Electric Company, and upon the absorption of that company by the California Gas and Electric Corporation, he became Chief Gas Engineer of all of its plants, and on January 1, 1906, again returned as Chief Engineer of the San Francisco Gas and Electric Company, at the time of the purchase of that company by the Pacific Gas and Electric Company.*

*It would be impossible to recapitulate the number of valuable inventions and improvements of gas making apparatus which can be credited to Mr. Jones.*

*His particular field of work in later years has been the development of the crude oil water gas process. In 1906 he undertook the erection of a plant for the San Francisco company for the manufacture of gas by that process, which called for a high degree of ability, original thought, and in many ways a daring experiment, namely, that of building generators which would have a daily capacity of four million cubic feet. The result of his efforts have been shown in the plants of the San Francisco company and that of the Oakland company.*

*He has been largely instrumental in the development of high pressure gas distribution in all of its phases. He has been the father of out-of-door gas works, defying old time principles, by building purifiers and gas works without any other covering than the blue dome.*

*In literary work he has found time from his many onerous duties to write many interesting and instructive articles for technical magazines and for the several technical societies of which he is a member, prominent among them being "An Experience with Napthalene Deposits," "The Relation of Intensity of Light and Visual Perception," "Leakage and Condensation," "Purification of Gas." Particularly to the Pacific Coast Gas Association has he contributed yearly at its meetings, articles for which he has become famous and which have given him a world-wide reputation for a thinker and observer. His paper upon the restoration of the gas department of the San Francisco company, following the earthquake of 1906, indicates more clearly than anything he has done the sturdy character of the man and earned for him the gold medal presented by the Pacific Coast Gas Association for the most meritorious paper read at its session held in September, 1906.*

*His affiliation with organizations allied to the industry in which he has given the better part of his life are many. He was a member of the American Gas Light Association from 1879 until its absorption by the American Gas Institute, of which latter society he is a charter member. He is also a member of the New England Association of Gas Engineers, an Honorary member of the Guild of Gas Managers, Mass., a member of the Western Gas Association, a charter member and Past President of the Pacific Coast Gas Association, a member of the Massachusetts Charitable Mechanics Association, a member of the Technical Society of the Pacific Coast and of the American Society of Mechanical Engineers, in all of which societies he is by no means a drone.*

*Mr. Jones is the proud possessor of three sons, Edward Stratton, Leon Barrett and Dwight Williams. The two former are already following in their father's footsteps, and under his direction and tuition bid fair to become as prominent in the gas world as he has become.*

*Of fads and fancies, Mr. Jones is the possessor of but few, being of that temperament that application to his work has left him little or no time for indulgence in other pleasures or pursuits.*

*He has of late, however, turned to be an agriculturist, which, as has been happily said by some one, is differentiated from that of the farmer, because a farmer makes his money in the country and spends it in the city, while Mr. Jones, a true agriculturist, makes his money in the city and spends it in the country.*

*He has recently possessed himself of a happy home in the Portola Valley, where free from the cares and anxieties of city life, and the particular and peculiar annoyances of a gas man, he can while away the leisure hours beneath his own vine and fig tree and under the shade of the magnificent redwoods which dot his happy home.*

## CALCULATION FOR THE FOCAL DATE

The determination of the focal date is absolutely necessary where meter statements are taken on various days during the month, if the station delivery is to be accurately compared with sales as shown by the consumers' meters. During the fall months, if statements are not read on the last few days of the month, it will be found that the station delivery for the calendar month far exceeds the total monthly sales to consumers. This is due to the fact that delivery is increasing as each day grows shorter, while if a route of statements were read on the 15th day of the month, the consumption on that route would have no opportunity to show its share of the increased delivery, as it relates to the last half of the previous calendar month as well as to the first half of the next calendar month. This is reversed in the spring months, as the days of the last of each month are longer than the first days of the month, and the station delivery may be less than the sales.

There is much economy in having the statement reading, billing and collecting divided throughout the month, and not having all of this come on the few last overcrowded days of the month. This can be done and the proper comparison made between station delivery and sales, by determining the focal or average date of statement taken as follows:

RULE.

Multiply the consumption of each route by the date on which the statements were read, divide the total of these products by the consumption of all routes, and the result will be the average or focal date. For example, the territory is divided into four routes, date of statement taking and total consumption of each route being as follows:

| | | | |
|---|---|---|---|
| 1. | 236,000 cu. ft. × | 8th = | 1,888,000 |
| 2. | 324,000 cu. ft. × | 12th = | 3,888,000 |
| 3. | 256,000 cu. ft. × | 16th = | 4,096,000 |
| 4. | 267,000 cu. ft. × | 20th = | 5,340,000 |
| | 1,083,000 cu. ft. | | 15,212,000 |

The total product, 15,212,000, divided by total consumption, 1,083,000 cu. ft., gives 15— as the average or focal date. If we will compare this total consumption by consumers' meters, with our station delivery, from the 15th to 15th of month, we find that we have an accurate basis on which to figure our loses by leakage and broken-down meters.

## TRANSMISSION LINE CALCULATIONS

A very few years ago the calculation of a three-phase high tension line was a matter of some considerable difficulty, involving, as it did, a long calculation, both mathematically and graphically. This for the reason that all units had to be taken in their primitive form and a number of complex equations solved. In a recent article published in the "Electrical World" of June 10, 1909, p. 1454, Mr. Harold Pender has simplified the calculation by the careful preparation of a number of line constants, worked out for various frequencies and spacing of wires. These constants, in the form of tables, are not very extensive, and are, it is claimed, exact. By their use the calculation of the high tension line becomes comparatively simple, involving but very few minutes' work, whereas under the old order of things, the complete solution involved a good many hours' work for the average engineer. From time to time, time-saving methods have been developed, both graphically and algebraically, but it is believed that Mr. Pender has put the matter in its simplest form, both as regards the expenditure of time and energy.

## JUST IN TIME

A German shoemaker left the gas turned on in his shop one night, and upon arriving in the morning struck a match to light it. There was a terrific explosion, and the shoemaker was blown out through the door almost to the middle of the street.

A passer-by rushed to his assistance, and after helping him to arise, inquired if he was injured.

The little German gazed at his place of business, which was now burning quite briskly, and said:

"No, I ain't hurt. But I got out shust in time. Eh?"

## NEW BUSINESS

*By* S. V. WALTON, Commercial Agent

The Standard American Dredging Company, which has a contract for dredging out Lake Merritt, in Oakland, began the work with a gasoline driven suction dredger, but owing to the great length of delivery pipe was unable to handle the required amount of material. To overcome this a large electrically driven booster pump was installed on the pipe line about midway between the dredger and the delivery end. This pump practically doubles the capacity of the dredges. Current is delivered to the pumping station by a lead armored cable, extending from the Twelfth-street dam, and is carried on the trestles that support the pipe line.

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A large gold dredger of a type slightly different from those in use in the Oroville, Yuba River and Folsom districts was started recently on Butte Creek, in Butte County, a short distance below our Centerville Power House. The dredger has an installation of about 400 horsepower in motors and is supplied by a line direct from the Centerville Power House. The current is delivered at 2300 volts and transformed down to 440 volts, by a bank of transformers installed on a barge alongside the dredger.

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The plant of the Pacific Fruit Cooling and Vaporizing Company, at Newcastle, was recently connected to our lines. These people expect to cool the fruit down to about 35 degrees Farenheit before it is loaded on the cars, and that by doing so they will require less ice and will reach its destination in much better condition than by the present system of refrigeration. The plant is driven by a 100-horsepower induction motor.

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Outside of the City and County of San Francisco, and exclusive of the lighting load, there is at the present time connected to the systems of the Pacific Gas and Electric Company 105,411 horsepower in motors, covering all phases and grades of power, from a coffee grinder to the largest dredgers in the world.

The contract with the town of Yuba City, covering service to a 75-horsepower pumping plant, was signed during the month, and the work of installing the line is being rushed along by us. The pumping plant will be ready in a short time. It is owned by the town and is being built in a thoroughly modern and up-to-date way.

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## THINGS THE GAS COMPANY IS BLAMED FOR BY THE CONSUMER

**When** he mails a check in payment of his bills without furnishing his address, and is very much incensed because his account is not credited therewith.

**When** he moves out and does not notify the company, somebody else moving in after him and using the gas in his name, he being generally very much surprised and grieved when a bill is rendered him long after his vacating.

**When** his cook is so much interested in Laura Jean Libby that she keeps all the burners of the gas stove going at full tilt when one would be sufficient. While kicking about his high bill he invariably praises his cook's carefulness and economy.

**When** he tries to locate a leakage of gas in his house pipes with a lighted match. The sudden surprise resultant therefrom being only equaled by the shock he receives when he learns that the gas company is not liable for damages and strangely declines even to make allowance for the gas that he caused to be lost.

**When** he thinks it essential, in order to get a good light to have the gas blow like the exhaust from a steam boiler. The unoffending collector, when presenting his bill, being the visible embodiment of the company, is generally called upon to do vicarious atonement.

**When** he rents out rooms and includes the gas and electric bills with the rent until he learns that people are not, as a rule, economical with commodities that are furnished free; he invariably condemns the meters, but it is observed that he never repeats the experiment.

# Our First Match Game

ON a quiet sunny morning in the merry month of May,
The "Has-beens" formed a ball-club, and declared that they would play
Any set of would-be artists of the diamond and the bat,
And beat them out at any game from "sides" to "one o' cat."

Their challenge was accepted, and at length arrived the day
For the testing of the merits of these gallant old birds gay.
Proudly marched they to the diamond, these mighty men of brawn,
And on their younger rivals cast they withering looks of scorn.

"Pop" Yablonsky holds the first base, mighty Butler's in the box;
While Quigley fastens on the mask and shakes his tawny locks,
And swears by forty kilowatts and a jug of good old rum,
That the Kid who makes a run that day will certainly "GO SOME."

"Spike" Angelo is playing "Short" while Gus (ye tribe of White),
Lightly two-steps down the field and takes his place in "Right."
Cunningham's on "Second," and Oldis holds down "Third"
While young Joe Walsh and Bowman tightly on their harness gird.

The Company's Queen of Beauty, surrounded by her Court,
Thrice waves her wand, and then she smiles bewitchingly at "Short."
The megaphones and cow-bells join in a mad refrain,
As the umpire quickly takes his place and calls out loudly, "GAME."

Joe Butler takes the base-ball, and rubs it on the ground,
Expectorates upon it, and waves his arms around
In mystic evolutions; while before the gazers' eyes,
His body takes on shapes of most peculiar form and size.

Suddenly his body straightens, and as from a ten-inch gun
Shoots the spheroid toward the batter, and the umpire calls, "Ball One."
Hotly waged was this great battle of the boys against the men,
For at the ending of the sixth the score stood ten to ten.

The youngsters now come to the bat, their last chance of the day;
But the old men make it "one, two, three" on a classy triple play.
"Now or never we must beat 'em," cries Frank Oldis from the bench,
"If we don't," quoth shifty Bowman, "no more beer my thirst will quench."

Cunningham raps out a single, and takes "Second" on a balk,
White and Angelo retired are, Oldis is allowed to walk,
Walsh is hit and takes a bag, Cunningham goes down to "Third"—
Two men out, three on bases, "Our last chance" is now the word.

Forward proudly steps Yablonsky, head erect and eyes aflame,
For he knows that on him now rests all the winning of the game;
Two "Balls," then two "Strikes" are called, his face is getting very pale
While his team-mates whisper 'mongst them fears that he's gone somewhat stale.

Now he grasps the "scantling" firmly, and assumes a graceful pose,
And when the pitcher throws a "spit-ball" hits it fairly on the "nose."
Swiftly speeds the hard hit pellet almost to the pitcher's box,
While Johnny quickly sprints towards first base, and with cheers the grand-stand rocks.

"Cunny" races for the home-plate, while the youngsters chase the ball,
His wind is broken, still he speeds in answer to his team-mates' call.
With one last effort leaps the pitcher forward toward Yablonsky's fly,
And it falls into his left mit, and the great game ends a "TIE."

**AFTERMATH.**

Johnny's muscles are much stiffened, Oldis' face is nicely tanned
Cunningham eats off the mantle, Joe Walsh sports a crippled hand.

But it was a well-fought battle, and we'll say to one and all
If you're not, you might once have been, CRACKERJACKS AT PLAYING BALL.

—C. S. BREARTY.

# Baseball News


Subsequent to our last issue the Pacific Gas and Electric Company has played six games of ball, and the San Francisco Gas and Electric Company two games with score as follows:

| | | |
|---|---|---|
| May 16 | Pacific Gas & Elec. Company... | 12 |
| | Mercantile Trust Co. .......... | 6 |
| May 23 | Pacific Gas & Elec. Company... | 11 |
| | Eastman Kodak Co. ........... | 4 |
| May 30 | Pacific Gas & Elec. Company... | 11 |
| | Southern Pacific Co. ........... | 7 |
| June 6 | 60th Company of Artillery...... | 12 |
| | Pacific Gas & Elec. Company... | 5 |
| June 13 | Pacific Gas & Elec. Company... | 24 |
| | Juveniles ..................... | 1 |
| June 20 | Pacific Gas & Elec. Company... | 2 |
| | Standard Gas Engine Co. ..... | 1 |
| | | |
| June 12 | Post Team (Presidio).......... | 5 |
| | San Francisco Gas & Elec. Co... | 4 |
| June 19 | Post Team (Presidio).......... | 6 |
| | San Francisco Gas & Elec. Co... | 5 |

Saturday, June 26th, the first game of a series of five to be played by the Pacific Gas and Electric Company and the San Francisco Gas and Electric Company, was pulled off at St. Ignatius College athletic grounds, with the result that the Pacific Gas and Electric Company employees have changed their colors from blue and white to black. The score was 7 to 3, favor of the San Francisco Company.

Vice-President and General Manager John A. Britton umpired the game and, while not in the hospital, experienced many close shaves during the skirmishes following some of his raw decisions—notably when he called Hall, of the Pacific team, out at home when the catcher (Murphy) missed him about a mile. Another riot was barely averted when Bill Cavanaugh, in sliding to sec-

ond, was put out when two feet off the bag and the umpire called him safe.

Sullivan must have been near-sighted when he tried to slide home in the first. Mensing, playing left field for the Pacific team, was the star of the day and is credited with a double play with a man out on a fly and straight drive for first. Arthur Hall made a sensation in the fifth when he got a fly after making three complete revolutions round a mud scraper. Scanlon's three-bagger was the best strike work of the day. Did you hear Gus White holler when the San Francisco boys were at the tail end? When Brarity caught the fly in center, who was the most surprised, he or the fans? The first of the ninth, with the San Francisco team to the bat, is too sad to relate. Sullivan started the slide with a bingle at second. The Pacific pitcher blew up and the team went to pieces—the score jumped from 3 to 1, favor of the Pacifics, to 7 to 3, favor of the San Franciscos.

Wilcox has succeeded to Baricau's former title of "String Bean."

The "Boss" can never umpire again.

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Sunday forenoon, June 20th, at 10 o'clock at Adams Point, Oakland's public baseball grounds, witnessed a very spirited ball game by players of the Oakland Gas, Light and Heat Company. The players gathered punctually and the class exhibited was largely in excess of the manager's expectations. Fast ball was a feature of the game, and three-bag hits were of common occurrence, while on the contrary many strike-outs were credited to both batteries. The players have expressed a desire to form a team from among best material and present themselves for challenge against any of the organized teams of the Pacific Gas and Electric Company's offices.

On June 27th, according to schedule, the players will gather for a sociable game, but more purposely of trying for special positions. Enthusiasm prevails and the boys are now anticipating a desire to obtain ball suits, towards which end several projects have been cited.

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## WIRELESS

In all its purity
  Leaving no mark
Out of obscurity
  Only a spark
Flashed into futurity
  Cleaving the dark.

Lightning's celerity
  Swifter than wind
Harnessed in verity
  Caught and confined
Boon to posterity
  Help to mankind.

—Frances Livingston Montgomery.

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## The Way He Resigned from the Montana Central Railroad

I'm getting tired of these barren hills,
No place to go but the tank.
The mosquitoes are hell, the sheep pens smell, and the grub is awfully rank.
I've worked like a slave till I'm near my grave for the "Monkey Central Pike."
I've a notion I deserve promotion and I'll get it or go on the hike.
On receipt of this letter if you've nothing better to offer a man of my stamp,
Than O-S ing trains on this dismal dump
And running a worn out six horse pump,
I think I'll go on the hike.

Yours truly,

OPERATOR.

Virgelle, Montana.

# Local Notes

On May 17, 1909, during a storm in the northern part of the Sacramento Valley, the Centerville-Nicolaus line, one of the main 60,000-volt pole lines belonging to the Pacific Gas and Electric Company, was struck by lightning near Shippee Station on the Northern Electric Railway.

Five of the 40-foot poles were struck by lightning and badly splintered. In two cases large slivers, nearly the entire length of the pole, were torn out.

The most remarkable part of the incident is that not one of the 14-inch four-part California type insulators were injured.

About one mile north of these five poles, the top 4/0 aluminum cable was cut clear in two about four feet out from the insulator and the other two cables of the three-phase line only had one strand holding.

A sheep herder who happened to be near the line at the time, saw it struck by lightning.

C. E. YOUNG.

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The current thief has always been regarded as a contemptible type; but when the thief not only steals the current but the meter in addition to the current, the language does not provide words adequate to express an opinion of him. A theft of this kind recently occurred in one of the districts of the Company.

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The City of San Jose is having installed some ornamental iron posts for the support of arc lamps for street lighting. These posts are of very neat and simple design, and present a very handsome appearance. The city is to be congratulated on its taste in the selection of such posts.

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The townships of Ross and San Anselmo have recently entered into contracts with the Company for the instalation of over three hundred incandes-lights and twenty-five arc lights, for a period of several years. This system was completely built in a little over forty working days, and was put into operation early in June. This will supply lighting to over fifteen miles of streets in these two towns.

# Accidents and Their Lessons

*By* J. P. COGHLAN
Manager, Claims Department

Henry Rogers, an apprentice electrician, was drowned in the South Yuba river, near the Nevada Power House, on June 3d. He and three other boys were playing with a fire hose on a bridge in front of the power house. The hose was under heavy pressure and at a moment when it was being handled lightly flew out of Roger's grasp. As it freed itself it hit him in the chest, knocking him off the bridge into the river. The boy made a brave effort to swim ashore, but the current overcame him and he was carried down stream to his death.

Rogers was at the threshold of his career. He was only eighteen years of age, but had entered his chosen employment with enthusiasm and ambition. He had a pleasing personality and the industry and character that make for success. His death was a distinct loss to the Company and an immeasurable sorrow to his family.

## PERSONALS

The following circular letter to heads of Departments, District managers and Division superintendents was issued from the office of the Pacific Gas and Electric Company on July 10, 1909:

"It becomes my sad duty to advise you of the death at San Jose, on Saturday, July 10th, of H. J. Edwards, District manager, of the United Gas and Electric Company.

"Mr. Edwards has been associated with the gas industry on this Coast for over thirty years last past, occupying positions of importance and responsibility with several companies operating in the gas and electric field in San Jose, and has since 1904 been the active manager of the San Jose District.

"His genial manner and charming personality, together with his sterling integrity and native honesty, made for him a name and reputation in San Jose that will be hard to equal. By his masterful control of men and opportunities, he earned for himself the sobriquet of 'The King,' which he justly deserved.

"His loss will be a great one, not only to the people of Santa Clara County, but to the corporation which he served so valiantly and so well.

"It is fitting that a man, who has always done his duty and never shirked a responsibility, and who earned the admiration of all, should be remembered, especially by those with whom he was so closely associated."

"After life's fitful fever he sleeps well."

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Mr. A. E. Gilkey, an electrician in the Marysville Power Division, and Miss Anna Murshel, a popular telephone operator of Marysville, were married in Sacramento on Monday, June 14, 1909. Mr. and Mrs. Gilkey will reside in Marysville. Their many friends extend best wishes.

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Joseph Kline, the father of Tax Agent W. H. Kline of this Company, died in Vallejo, June 3d, aged 82 years. Deceased was an old resident of this State, having crossed the plains from Iowa with an ox team in 1856. In 1860 he settled in Solano County where he resided until his death.

Chas. L. Frechette, a counter clerk of the San Francisco Gas and Electric Company, was drowned on Sunday, June 27th, at Tennessee Cove, Marin County, on an outing with a number of other employees of the Company.

While engaged in gathering mussels, he lost his footing, slipping into the surf. J. Judge and W. Webber, two of his fellow employees, plunged in after him, and in an heroic attempt to bring him ashore nearly forfeited their own lives, as he had already lost consciousness and all three were weighted with clothes and heavy outing shoes. Judge was, fortunately, thrown on a rock, where he clung until he recuperated, but Webber, although a strong swimmer, was pulled out just as he was completely exhausted, and on the point of giving up the struggle.

Chas. L. Frechette was with the Company for nearly six years and on account of his bright, sunny disposition was a general favorite, and his unfortunate death has thrown a gloom over the entire office. He was 27 years of age, and although not married he leaves a mother and sister to mourn his loss.

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On Saturday, June 19th, a joint meeting of the District Managers and Division Superintendents of the Company was held in Santa Rosa. The meeting was attended by all members with the exception of Mr. H. J. Edwards, San Jose, and Mr. O. E. Clark, Napa, who were ill, and Mr. H. B. Heryford, of Colusa, who was detained at home on account of being on the committee in charge of the Water Carnival held at Colusa June 19th and 20th. The meeting at Santa Rosa was voted as being one of the most enthusiastic and live meetings yet held.

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A. G. Stayart, operator on the 12 to 8 a. m. watch at Station "D," San Francisco, was married on June 5th to Miss Lucile Loux. After a week's absence on a honeymoon he has returned and is at his post.

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Mrs. Daisy M. Finely, wife of W. C. Finely, Superintendent of Sacramento Power Division, died on July 3, 1909, after a lingering illness extending over two years.

# Question Box

All employees are urged to make free use of this department to ask questions regarding any phase of the Company's work on which they desire information. The same freedom should be used in answering questions. Address questions and answers to R. J. Cantrell, News Editor.

Question.—What is a miner's inch of water? R. S. S.

Answer.—Prior to March 23, 1909, the term "miner's inch" as an absolute measure of water was somewhat indefinite. The head under which a miner's inch was measured, namely 4 inches, was definitely stated, but the size and shape of the orifice was a matter of conjecture. On the above date, however, by California statute, a miner's inch was defined as one and one-half (1.5) cubic feet of water per minute. This does not involve head, size or shape of orifice, and it is, therefore, specifically defined.

J. H. W.

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Question.—How do you reduce quantity of water stored in a reservoir when given in cubic feet, to miner's inches per twenty-four hours? L. R. T.

Answer.—The term "miner's inch per 24 hours" is a convenient unit of measurement, especially in plant operation, because by this means the capacity of a reservoir can be readily converted into days or hours run for the particular plant under consideration. The quantity of water stored by the reservoir in cubic feet divided by 2160 gives the capacity in miner's inches per day. The 2160 is the quantity of water in cubic feet that one miner's inch would deliver in twenty-four hours.

J. H. W.

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Question.—Will you please tell me in your Question Department of the Pacific Gas and Electric Magazine, the time that intervened from the shutting off of the gas from San Francisco on April 18, 1906, and the date on which the gas was again turned on to the city. Q. C.

Answer.—The gas was shut off from the city at 7:27 o'clock on the morning of April 18th, and turned into the mains again on May 7th at 9:47 a. m., nineteen days later. The work of repairing the mains was commenced on the morning of April 18th, and we were ready to turn gas into them within nine days, but on account of the lack of water for fire protection, it was not deemed advisable to do so until the later date.

A very interesting and instructive paper by Mr. E. C. Jones upon this subject, entitled "The Story of the Restoration of the Gas Supply in San Francisco after the Fire," will be found in Volume 6 of the Proceedings of the Pacific Coast Gas Association.

---

Question.—When does the new State demurrage law become effective, and what are its principal provisions? K. D.

Answer.—This law became effective June 19, 1909. Twenty-four hours, computed from 7 a. m. of the day following delivery of freight, is allowed for unloading. Demurrage thereafter is at the rate of three dollars for the first day, and six dollars per day thereafter.

Forty-eight hours are allowed for loading cars. The railroad company is allowed to collect six dollars per day after the expiration of this time, and such additional damages as the railway company may sustain through failure of the consignor to load cars within the forty-eight hours. This time is computed from 7 a. m. of the day following delivery of cars.

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Question.—When do accounts become outlawed under the laws of California? W. D.

Answer.—Book accounts, two years; notes, four years from maturity: other amounts due under contracts executed in the State of California and payments under which are to be made in this State, four years from due date.

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Question.—(a) How many city arc lamps are there in San Francisco?

Question.—(b) How many miles of wire does it require to furnish service to them?

Question.—(c) Is it true that the Company furnishing light loses the revenue for the whole night, even though the lamp is out but a short time? M. J. B.

Answer.—(a) 2580 lamps.

Answer.—(b) 414 miles of wire; 4¾ miles of cable.

Answer.—(c) Yes.

---

If a woman's a rag and a bone
and a hank of hair.
Then man is a jag and a drone
and a tank of air.

—"Trunbull Cheer."

# PACIFIC GAS AND ELECTRIC COMPANY

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BRITTON, JOHN A.
CROCKER, W. H.
DE SABLA, E. J., JR.
DRUM, F. G.
DRUM, JOHN S.
FOOTE, D. H.
HOCKENBEAMER, A. F.
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WEEKS, GEORGE K.

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Britton, John A. .......... Vice-Pres. and Gen. Mgr.
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Hockenbeamer, A. F. .......... Treas. and Comp.
Foote, D. H. .......... Secretary
Barrett, Chas. L. .......... Asst. Secretary
Bosley, W. B. .......... Attorney
Love, J. C. .......... Auditor
Kline, W. H. .......... Tax Agent
Cantrell, R. J. .......... Property Agent
Walton, S. V. .......... Commercial Agent
Coghlan, J. P. .......... Claims Agent
Hunt, I. H. .......... Purchasing Agent
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Jones, E. C. .......... Engr. Gas Dept.
Downing, P. M. .......... Engr. O. & M. Hyd.-Elec. Sec.
Varney, F. H. .......... Engr. O. & M. Steam & Gas Eng. Sec.
Wise, J. H. .......... Civil and Hydraulic Engr.
Adams, C. F. .......... Engr. of Elec. Construction
Holberton, Geo. C. .......... Engr. of Elec. Distrib'n (Sec. 1)
Lisberger, S. J. .......... Engr. of Elec. Distrib'n (Sec. 2)
Robb, Geo. C. .......... Supt. of Supplies
Bostwick, H. .......... Secretary to President

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Florence, E. W. .......... Chico "
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Kuster, J. D. .......... Fresno "
Werry, John .......... Grass Valley "
Poingdestre, J. E. .......... Marysville "
Foster, W. H. .......... Marin "
Clark, O. E. .......... Napa "
Werry, John .......... Nevada "
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Newbert, L. H. .......... Redwood City "
McKillip, C. W. .......... Sacramento "
Edwards, H. J. .......... San Jose "
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Scarfe, Geo. .......... Nevada "
Eskew, W. E. .......... Standard "
Hall, J. W. .......... Stockton "
Adams, I. B. .......... Colgate Power Division
Young, D. M. .......... De Sabla "
Eskew, W. E. .......... Electra "
Young, C. E. .......... Marysville "
Scarfe, Geo. .......... Nevada "
Clark, C. D. .......... North Tower "
Hughes, W. .......... Oakland "
Finely, W. C. .......... Sacramento "
Hansen, J. O. .......... San Jose "
Burnett, A. H. .......... South Tower "

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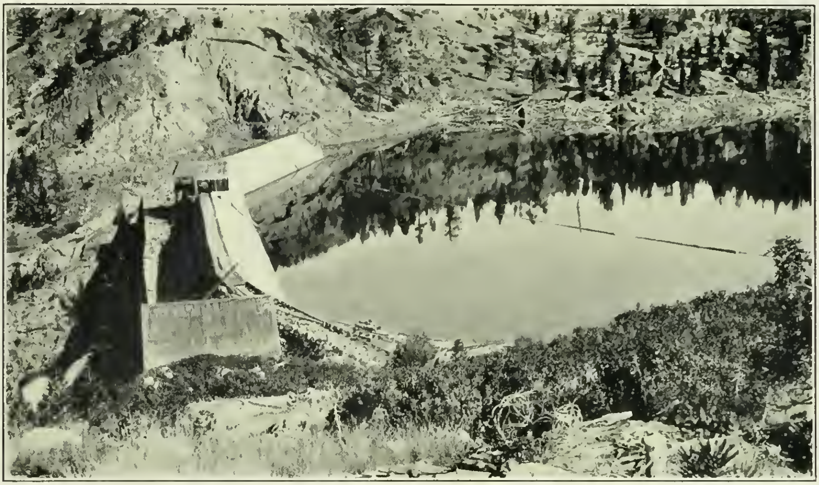


THE DAM AT LAKE FORDYCE

DOWNSTREAM FACE OF FORDYCE DAM

Pacific Gas and Electric Magazine

VOL. I AUGUST, 1909 No. 3

# The History of Gas Lighting in San Francisco

*By* E. C. JONES, Engineer, Gas Department.

SAN FRANCISCO was incorporated in the year 1850. This city was the largest and most important in the State of California, which was admitted into the Union September 9, 1850. At that time coal gas works were being built in many of the older and larger cities of the eastern states, and gas was being introduced as a lighting agent for the first time. It was in keeping with the progressive spirit and indomitable will of the early San Franciscans that this city should consider the introduction of illuminating gas during the first year of its corporate existence.

Peter Donahue, a pioneer and one of the builders of San Francisco, was then engaged in the foundry business. He and his brother, James, were the first iron founders in California, and their shop at the foot of Telegraph Hill was the nucleus from which grew the present Union Iron Works.

PETER DONAHUE

One Sunday in 1850, Peter Donahue, while strolling over the sand hills south of the town, climbed to the top of one on Bush street. Looking down from the top of the hill, he was impressed by the rapid growth of the town, and remarked to his friend, Martin Bulger, "Bulger, this is going to be a great city at no distant day. There will have to be gas works and water works here, and whoever has faith enough to embark in either of these enterprises will make money from them." San Francisco at that time had more the appearance of a straggling country town than of a city. Montgomery street was occupied from Washington to Sacramento streets, and there were buildings of a temporary character scattered as far as Pacific street on the north, and California street on the south. Washington, Clay, and Sacramento streets had buildings as far west as Kearny street, with an occasional dwelling house farther out toward Stockton street. A few dwellings on Stockton street and Dupont street marked the limit of city settlement. Kearny street north of Sacramento street, with the cross streets, furnished dwellings to most of the inhabitants. The business streets of the town were Sansome and Battery, with Clay, Sacramento and Commercial streets east of Montgomery. Montgomery was the busiest of them all, as it led down to "Long Wharf," then the general point of landing and embarkation for all water craft. South of California street were enormous hills of drifting sand. In the neighborhood of Third and Howard streets was Happy Valley, having a small population, while Turk street in the vicinity of Mason and Taylor streets was called St. Ann's Valley, where a small stream of very pure water supplied the water used for domestic purposes in the neighborhood. There was also a settlement at the Mission Dolores, reached by a road winding through the sand hills north and west of Market street.


JAMES DONAHUE

At this time it was doubted by many whether San Francisco was destined to be the future metropolis of California, owing to the great number of high hills and the absence of any natural supply of water or wood. Even the bracing west winds from the ocean, which now make San Francisco attractive as a summer resort, were urged against it.

Under these circumstances, it required courage to propose the investment of money necessary to construct a gas works. Peter Donahue had faith in the ultimate success of his undertaking. He knew little or nothing about the manufacture of gas, but proceeded to study everything on the subject obtainable. The brothers, Peter and James Donahue, then had in their employ a young man named Joseph G. Eastland, who, encouraged by them, took a great interest in gas matters and made a study of the business, with the assurance that the gas works would be built and that his studies would bear fruit.

A franchise was obtained, and the San Francisco Gas Company was incorporated August 31, 1852. The original officers were Beverly C. Sanders, president, and John Crane, secretary. James Donahue was elected president in 1856, and continued in office until his death in 1862. The beginning of the gas business in San Francisco was fraught with difficulties, owing to the distance from source of supplies. The Donahue Foundry had but one cupola, containing only enough iron to pour a single gas re- from Philadelphia, round Cape Horn, and they were laid aside as completed until enough was made to build the works. There was difficulty in obtaining cast iron pipes for street mains, but these were finally shipped from Philadelphia, around Cape Horn, and were laid in the city streets.

The original works of the San Francisco Gas Company was built on the lot of land bounded by First and Fremont, Howard and Natoma streets. The reason for selecting this site was the fact that it was located on

GAS WORKS AT FIRST AND HOWARD STREETS

tide water, there being a sharp indentation of the bay at that point. Lighters containing construction material and coal for gas-making were landed directly on the beach at the gas works. The site is at present writing six blocks from tide water.

The gas was made from coal brought from Australia and distilled in iron retorts set in benches of three retorts each. The gas was purified by wet lime purifiers, using lime in solution in water.

On the night of February 11, 1854, the streets of San Francisco were for the first time lighted with gas, and in commemoration of the event, a banquet was given at the Oriental Hotel. Following is a copy of one of the invitations to this banquet:

Office of the
San Francisco Gas Company

February 8, 1854.

Sir:—The Trustees of the San Francisco Gas Company request the honor of your company at the Oriental Hotel, from 7:30 to 9 o'clock, on Saturday evening, the 11th inst., on the occasion of their introducing Gas Light into the streets of San Francisco.

Very respectfully,

John Crane, *Secretary.*

In 1855, the company had 12 miles of street mains, and its storage capacity consisted of two gas holders at First and Howard streets, with a combined capacity of 160,000 cubic feet. The price of gas at this times was $15.00 a thousand cubic feet.

In 1856, Joseph G. Eastland became secretary of the company, and filled this position through successive years until 1878.

The printed rules of the company in 1855 read as follows:

Gas will be supplied by the meter at the rate of Fifteen Dollars per thousand cubic feet, and where there are no meters, the calculation will be made from the size of the burners.

All Bills are payable weekly. Consumers are respectfully and particularly requested to pay their Bills promptly. In default of payment of Gas consumed, within three days after presentation of the Bill, the flow of Gas may be stopped until the Bill is paid. Service pipe from the main to the Service Cock, will be furnished free of charge, in houses where more than four burners are used. The Company, or its authorized agent, shall at all times have the right of free access into the premises lighted with Gas, for the purpose of examining the whole Gas apparatus or for the removal of the meter and service pipe.

On May 2, 1862, the Legislature granted a franchise to the Citizens Gas Company of San Francisco for the full term of fifty years. Two 100 varas at Townsend and Second streets were purchased as a site for the new works, and John P. Kennedy, a gas engineer of New York, was employed to erect the works. Construction work was begun in the fall of 1863, but gas was not furnished to the general public until January, 1866. The franchise limited the maximum price that might be charged for gas to $6.00 a thousand cubic feet. In less than two years, as soon as it was ready to deliver gas, the Citizens Gas Company sold out to the San Francisco Gas Company.

In April, 1870, the City Gas Company was organized. Four blocks of land were purchased at the Potrero, and work was begun June, 1870. When completed the works had a capacity of 1,500,000 cubic feet daily. The maximum price for gas was fixed at $4.50. This company had a short life, and was purchased by the old company.

The Metropolitan Gas Company was organized in March, 1871, and began furnishing gas in April, 1872, at a maximum price of $3.50. The plant was located on Mission Block, 43 Channel street, southwest of Ninth street. Gas was made from petroleum, distilled in iron retorts, but it was not a success. The company, shortly after its start, was purchased by the San Francisco Gas Company.

On April 1, 1873, the San Francisco Gas Light Company was formed, with increased capital and the merging of properties and stock of the San Francisco Gas Company, the Metropolitan Gas Company, and the City Gas Company.

During the year 1882, the Central Gas Company came into the field as an opposition company, and subsequently took on the name of the Central Gas Light Company. In the competition which followed, the rate for gas went as low as 90 cents a thousand cubic feet. Between 1882 and 1884, the Central Gas Light Company was leased by the Pacific Gas Improvement Company. This last company existed until it was merged into the San Francisco Gas and Electric Company September 1, 1903.

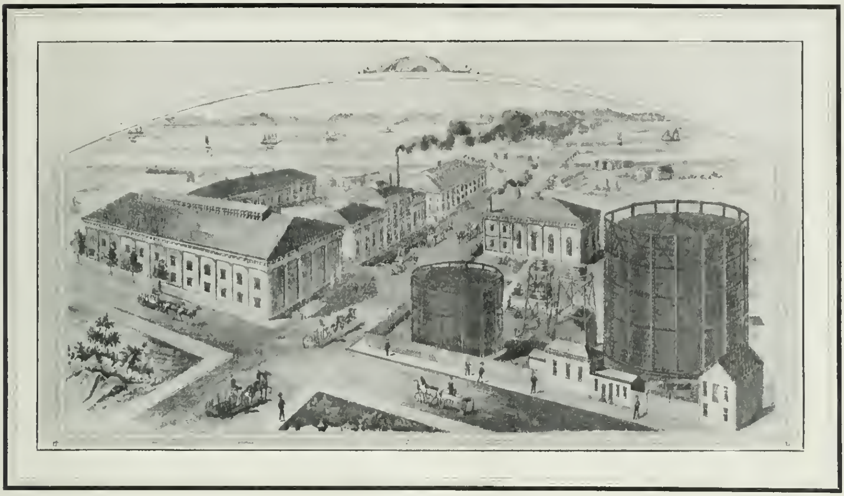
During all these years coal gas was manufactured by the San Francisco Company, and improvements in the art were adopted as fast as they made their appearance. Clay retorts were substituted for those of iron, and improved furnace construction increased the yield of gas made from a pound of coal.

In 1888 the production of crude petroleum in California warranted the introduction of the manufacture of water gas, then in general use in the eastern and middle states. During the year 1888, 690,333 barrels of oil were produced in California. It will be interesting to compare this with the production in 1907, amounting to 40,311,171 barrels.

This gas was made from anthracite coal brought round Cape Horn from the Port of Swansea in Wales, and enriched with California petroleum.

The first water gas plant in San Francisco was built at the Potrero Gas Works. The plant consisted of two Springer generators. At this time the gas was supplied to the city by the old Howard-street works, then making coal gas, and the works at Potrero. The King-street works had been shut down. The manufacture of water gas proved such a success, owing to the increased amount of petroleum produced and the lessening of the cost, that it was decided to construct a modern gas works, including all of the new improvements in water gas making, together with a modern coal gas plant as a protection against a failure or shortage in the supply of oil.

Joseph B. Crockett was then engineer of the company. He had entered the employ of the City Gas Company in 1873, and was engaged at the Potrero during the construction of the works. When that company was merged with the old company he was employed at the Howard-street works under James and William Beggs. William Beggs was the first gas superintendent on the Pacific Coast. By industry and fidelity Mr.



THE NORTH BEACH STATION

Crockett was advanced rapidly to the position of assistant engineer and then engineer, until he filled the position of president-engineer before he was twenty-eight years old. He had an ambition: he conceived the idea of constructing a thoroughly modern gas works on lines intended to care for the city's gas demands well into the future. With this in view, the company secured land at North Beach, between Bay street, Laguna and Webster streets, and the Bay of San Francisco, and under his direction the North Beach Gas Works was built. It was his pride and was recognized for many years as the finest gas works in the world.

It was the good fortune of the writer to become connected with the San Francisco Gas Light Company in 1891, and to have charge of the construction of this new works under Mr. Crockett. At this works what was then the largest gas holder in the United States west of Chicago was constructed. This holder had a capacity of 2,000,000 cubic feet.

Construction work was begun on this new plant in May, 1891, and the water gas portion of the plant was completed and started making gas in six months. On the completion of this work, the old Howard street plant was dismantled.

On December 11, 1896, the San Francisco Gas Light Company extended the scope of its business by merging with the Edison Light and Power Company under the new title of the San Francisco Gas and Electric Company. The San Francisco Gas Company continued its corporate existence until December 7, 1903, when it was dissolved.

The Equitable Gas Light Company was incorporated February 2, 1898, to make "dollar gas" under a method called the Hall Process, which was never a success, and resulted in the installation of a regular water gas plant during the year 1900. In August, 1903, this property was sold to the San Francisco Gas and Electric Company.

The Independent Electric Light and Power Company, incorporated March 29, 1899, and the Independent Gas and Power Company, incorporated January 5, 1901, were started by Claus Spreckels. These companies entered into active competition with the old company in both gas and electric business.

The gas works of the Independent Company was constructed on land adjoining the Western Sugar Refinery at the Potrero, and consisted entirely of water gas apparatus. Four sets of what is known as the double superheated system were first installed, and to these have later been added two more water gas sets. This company constructed a 500,000 cubic foot relief holder, and a 1,000,000 cubic foot storage holder.

In November, 1903, these properties were merged into the San Francisco Gas and Electric Company by purchase.

In 1902 the manufacture of crude oil water gas, using petroleum solely as a material for gas-making, was being developed in some of the smaller cities of California, and its manufacture and use were so successful and satisfactory that the attention of the larger companies was attracted. In February, 1906, a single gas oil unit, having a daily capacity of 4,000,000 cubic feet, started operation at the Potrero Gas Works of the San Francisco Gas and Electric Company. Previous to this, a similar unit had been constructed at the works of the San Mateo Power Company, at Martin Station, in Visitacion Valley, and this works had been connected to the Potrero Gas Works by a 12-inch steel high pressure pipe, suitable compressors for pumping the gas had been installed, and some of this gas was used in San Francisco. Preparations were under way for increasing the number of oil gas units at the Potrero Station when, April 18, 1906, San Francisco was visited by the greatest earthquake in its history. This earthquake completely destroyed the North Beach Station of the San Francisco Gas and Electric Company and the works of the Pacific Gas Improvement Company. The works of the Equitable Gas Company were also destroyed. At the time of the earthquake the North Beach Station was the only plant of these three in operation. A portion of the city gas was being made in its water gas works. The works of the Independent Gas and Power Company and the Potrero Station were not injured by the earthquake, and the fires in the generators were not drawn, but had it not been for the oil gas installation at the Potrero Station, it would have been impossible to have supplied the city with gas without constructing a new gas works.

When the supply of gas was resumed after the fire the Martin Station was then called upon to furnish oil gas up to its capacity.

The oil gas unit at Potrero and the water gas plant of the Independent Gas and Power Company supplied the rest of the gas needed. After the fire the company added three more 16-foot oil gas units to the Potrero plant, so that at the present writing the gas supplied to the Potrero Station, reinforced by water gas manufactured at the Independent plant from lampblack (recovered as a residual from oil gas making).

Following is a complete list of officers of the San Francisco gas companies from 1852 to the present time. The list contains many names that are dear to us in memory, names of men who have made the history of the gas business in San Francisco. Notable among these are two secretaries of the San Francisco Gas Company, the San Francisco Gas Light Company, and the San Francisco Gas and Electric Company—Joseph G. Eastland and William G. Barrett. Each of these men occupied the position of secretary for twenty-two consecutive years.

PRESIDENTS.

*San Francisco Gas Company*
(Incorporated August 31, 1852)
1852-1855—Beverly G. Sanders
1856-1862—James Donahue
1863-1865—J. Mora Moss
1866-1867—Peter Donahue
1868-1869—Joseph A. Donohoe
1870-1873—Peter Donahue

*San Francisco Gas Light Company*
(Incorporated April 1, 1873)
1873-1883—Peter Donahue
1884 —Eugene P. Murphy
1885-1896—Jos. B. Crockett

*San Francisco Gas and Electric Company*
(Incorporated December 11, 1896)
1896-1901—Jos. B. Crockett
1902-1905—Wm. B. Bourn
1906 to date-John A. Britton

SECRETARIES

*San Francisco Gas Company*
1852-1855—John Crane
1856-1873—Joseph G. Eastland

*San Francisco Gas Light Company*
1873-1878—Joseph G. Eastland
1879-1896—William G. Barrett

*San Francisco Gas and Electric Company*
1896-1901—William G. Barrett
1902 to date-Chas. L. Barrett

LAKE ALTA, IN PLACER COUNTY

# The Storage System of the South Yuba Water Company

*By* H. M. COOPER, Auburn Water District.

THE denudation of the forests of California since its settlement in 1849, more particularly in the middle central section of the State, has made the conservation of water a difficult problem. The United States Government realizing the necessity for the preservation of the forests, primarily for water conservation, has, within the last decade, established stringent regulations, and has, at certain vital points of the State, established forest reserves for the purpose of protecting the remaining trees, and aiding thereby the protection of the watersheds, that, in the future years, will be invaluable to the industries of the Coast. Within the northeasterly regions of the South Yuba system little or no timber ever grew, the granite walls of the Sierra Nevadas affording little foothold for foliage.

The high altitudes precipitate large quantities of snow during the winter season and the run-offs from the watersheds controlled by the South Yuba Water Company, following the average winter, more than provide for the needs of the company in its supply of water for mining, irrigation, and domestic purposes. The watersheds, particularly of Lake Fordyce, Lake Spaulding, Meadow Lake, and the chain of lakes known as Felley, Culberton, etc., would provide, with additional storage, more than sufficient water to supply not only the needs of the South Yuba water system as at present developed, but also the entire Sacramento and San Joaquin Valleys with water for municipal purposes, and there would then be a sufficient quantity left to supply the entire City and County of San Francisco.

LAKES OF LAKE VALL

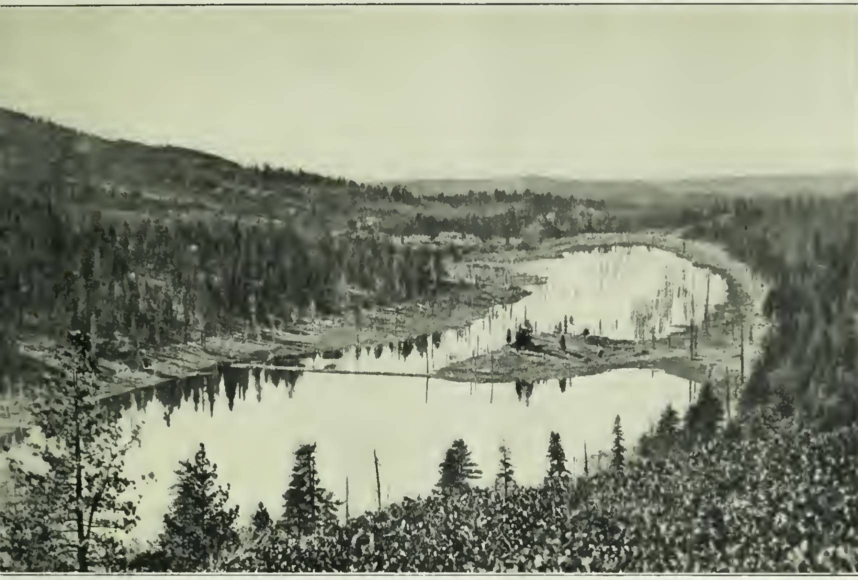
Many opportunities are presented for the utilization of the waters stored at the higher altitudes for the generation of electric power, particularly in the canyons of the Yuba River, and on the South and Middle Forks are splendid reservoir sites as yet undeveloped. The dams at Lake Fordyce and Lake Spaulding could be materially increased in height to afford additional storage.

The following is a brief description of the present storage capacities possessed by the South Yuba Water Company generally, giving the character of dam, structures, and capacities of present available water.

Few people, aside from those directly interested, realize the importance of an efficient water storage, and the great cost and many details necessary to conserve a portion of the winter floods for use during the dry or irrigating season.

The South Yuba Water Company diverts from storage alone, into the canals about 1,000,000 miner's inches; this is the amount of water in reserve and is not drawn upon until all overflow or surplus water has been consumed. The present season storage was drawn upon on July 20th, and with reasonable care on the part of consumers the amount should be sufficient to keep up the supply during the dry season.

As early as 1850, ditches were constructed to supply water for miners using "long toms," although it was not long before the system of hydraulic mining was introduced, necessitating more ditches and an increased water supply; later all hydraulic mining was enjoined, which decreased the demand for water to such a degree that improvements in the system came to a standstill. Within a few years the consumption began to increase, due to the rapid strides in electricity requiring hydro-electric generating stations, and the development of deep-mining using water to operate pumping plants, hoist, etc.,



ING 106,500 MINER'S INCHES

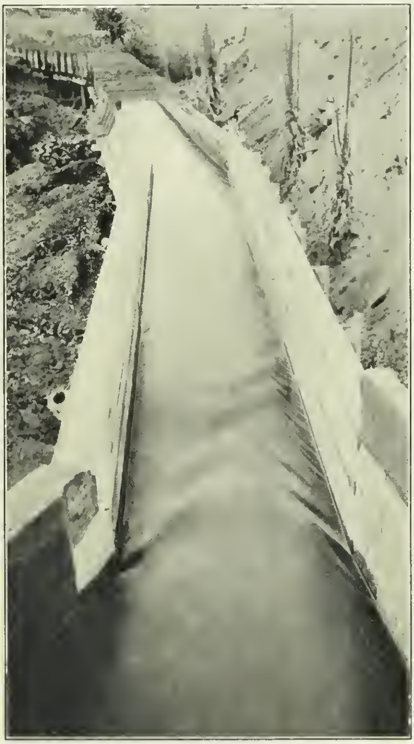
and the planting of extensive orchards which depend entirely on storage water for irrigation, until today the water requirements are much greater than ever before.

To meet the almost continuous growing demands, a series of lakes has been and is now being constructed for storage purposes. At present this system comprises 23 lakes and reservoirs, which have a combined holding capacity of 48,700 acre feet, or 1,227,000 miner's inches, equivalent to 2,122,022,000 cubic feet, or 15,915,165,000 gallons.

The above figures represent the total amount of stored water. Absorption, which is the combined action of evaporation and percolation, represents the loss of a large amount of water. However, the loss from deep lakes is much less than from shallow ones having the same surface area, where climate and altitude are identical. The evaporation is least when the air is quiet, the temperature of water low, and the atmosphere moist. When brisk winds are blowing which disturb the water surface, on a hot day, the evaporation is greatest, as the unsaturated air readily absorbs the vapors arising from the disturbed water. Naturally, the deeper the lake the less water is exposed to the sun, holding the water at a lower temperature than otherwise. The cool water tends to condense the moisture from the warm air, which is a gain, rather than a loss as many would suppose. In a shallow lake with the temperature of the water higher the evaporation is greatest, therefore, when conditions permit, it is desirable to draw off the small and shallow lakes during the early part of the season, thereby preventing a considerable loss due to evaporation. The deep water lakes are held intact until the latter end of the season.

The largest and most important storage is Lake Fordyce, lying in portions of sections 25, 26, 34, 35 and 36 T. 18 N., R. 13 E., with a small part in section 3, T. 17 N., R. 13 E., covering a flooded area of 510 acres,

BEAR VALLEY LAKE



WATER LEAVING ALTA POWER HOUSE

with a capacity of about 400,000 miner's inches. The dam was built in 1871 and 1872, and is composed of solid masonry, 75 feet high and 645 feet long. It has a catchment area of 30.15 square miles, a maximum capacity of 875,000,000 cubic feet, which is equivalent to 20,090 acre feet or 404,166 miner's inches in 24 hours. Elevation at crest of dam, 6294 feet; at bottom outlet, 6225.

The dam is of earth and rock fill, faced with 3-inch x 8-inch plank on inner side, with a maximum height of 92 feet, and length of crest 800 feet; the width of crest 5 feet, and the maximum width of base 139 feet; the inner slope is 1:1, and the outer slope $\frac{1}{2}$:1 and $\frac{1}{4}$:1.

The spillway is 99 feet wide x 3 feet 7 inches deep, with checking planks bringing high water to crest of dam.

The outlet pipe is 36 inches in diameter, of $\frac{1}{4}$-inch iron, surrounded by 4-inch concrete. Flow controlled by a slide gate of cast iron, 3 feet 6 inches x 5 feet $2\frac{1}{4}$ inches, placed at upper end of pipe, and operated from crest of dam by mechanism and stem on face of dam. There is also a 30-inch gate valve at the lower end of outlet pipe.

DAM AT LAKE SPAULDING

The work on Fordyce was started by the South Yuba Water Company in 1875. During the years 1874 and 1875 a large force of men was employed, and the dam was completed to a height of 55 feet. A masonry wall of two tiers of rock was built to form lower face. Then the body of the dam was built up of loose rock, hand placed; inner slope of dam was then formed by layer of rock and earth and faced with boards. In 1881, another tier, 16 feet high and 5 feet wide at the crest, was added, bringing the dam to its present height. It is estimated that the run-off is sufficient to fill the reservoir at least twice during the driest year.

The following list gives a detailed account of each lake:

| *Name of Lake.* | *Elevation at Crest of Dam.* | *Capacity, Miner's Ins.* | *Water Depth Ft.* | *Ins.* |
|---|---|---|---|---|
| Sterling .... | 6700 | 33,220 | 19 | |
| Spaulding .. | | 117,600 | 51 | |
| Lake Valley. | 5846 | 106,500 | 55 | |
| White Rock. | 7752 | 13,500 | 9 | |
| Meadow ... | 7249 | 92,620 | 30 | |
| Bear Valley | 4365 | 6,500 | 24 | |
| Van Norden | 6770 | 106,500 | 25 | 4 |
| Upper Peak | | 33,200 | 37 | |
| Lower Peak | | 10,600 | 26 | |
| Kid Peak.. | | 32,300 | 28 | 6 |
| Lost River.. | | 5,000 | 7 | |
| Blue ...... | | 23,900 | 24 | 4 |
| Rucker .... | | 9,600 | 15 | |
| Fuller ..... | | 19,400 | 27 | |
| Upper and Lower Rock | | 26,000 | | |
| Upper Feeley | | 6,000 | 11 | 9 |
| Upper Middle and Lower Lindsay | | | | |
| Culberson | | | | |

With the exception of Lake Valley, the whole of this water comes from the watershed feeding the South Yuba River, and with the exception of Bear Valley Lake and Lake Valley, the storage water is controlled by Lake Spaulding, where it is drawn from the outlet gate into the river to be again diverted to the Main Canal leading to the lower country. At Bear Valley a certain portion of the water is turned out of Main Canal into the lake, which is used for a combined storage and regulator, from where it is drawn into the Boardman ditch, which in turn connects with the Lake Valley water at the head of the Alta Power House pipe line. After leaving the water wheels at the Power House the water is again taken up and flows as far west as Roseville, Placer County. The Main Canal, after leaving Bear Valley, continues its course as far west as Grass Valley, Nevada County.

# The Ridge Substation at Berkeley

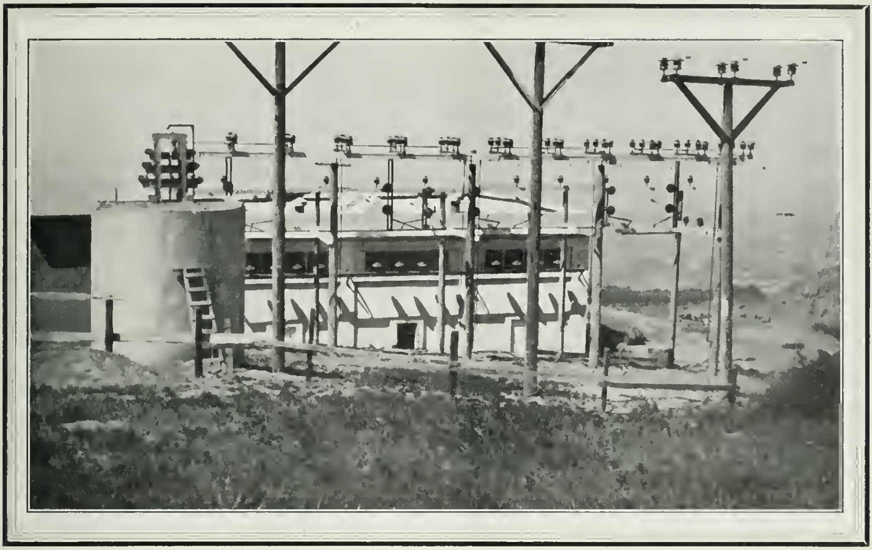
By C. F. ADAMS, Engineer, Electrical Construction.

(Fig. 1) The Ridge Substation

TO PERMIT the removal of high tension wires from the cities of Oakland and Berkeley, the Ridge Substation (Fig. 1) was constructed. It is located a little east and south of the quarry of the Spring Construction Company, and is now the terminus of the 60,000 volt lines from South Tower and Elmhurst, and also of one of the branches of the Great Western Power Company. The low tension feeders, 11,000 volts, running from this station supply current to Berkeley and Oakland, and entirely replace the 60,000 volt lines which formerly passed through Berkeley and Oakland. The station is constructed entirely of concrete, steel, and glass, and is designed to withstand any of the troubles and fire risks which are incident to high tension switching stations.

Back of the station are located the air break disconnecting switches (Fig. 2), the concrete reservoir and water cooling tower, and the 60,000 volt potential transformer, used for synchronizing purposes.

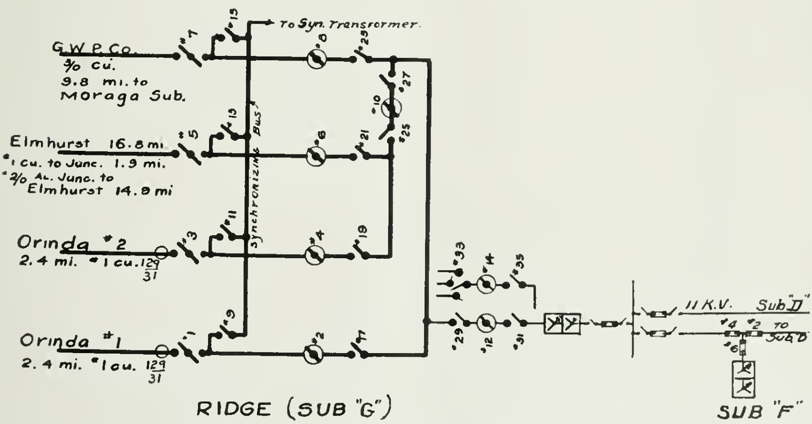
The air break switches are of the standard horizontal double blade, rotating type, shown on drawing No. L-2134, the only new feature being the substitution of angle iron frame for the previous all-wood construction. Switch frames also support a line short-circuiting device, and a set of disconnecting



(Fig. 2) Air Switches

switches attached to the synchronizing bus. The entire structure is clearly shown in Fig. 1. Fig. 2 gives a view also of the rear of the station, 60,000 volt inlet windows, etc. The general arrangement of circuits leading to and from this station is shown on the condensing wiring diagram (Fig. 3).

The building itself is divided into two main sections by a fire wall. The east section contains the 60,000 volt oil switches and

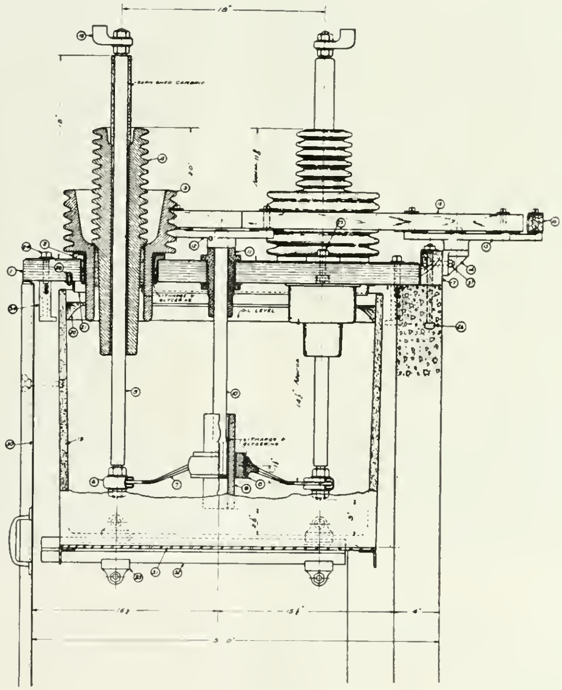



(Fig. 3) H. T. Switching Diagram

wiring. The west section contains the transformers, the 11,000 volt oil switch compartments, and the switch board and operating devices for the entire station.

treme trouble conditions, and possible ignition of oil.

The oil tub rests on a metal shelf and is removed for inspection by means of a small



(Fig. 4) 60 K. W. Switch

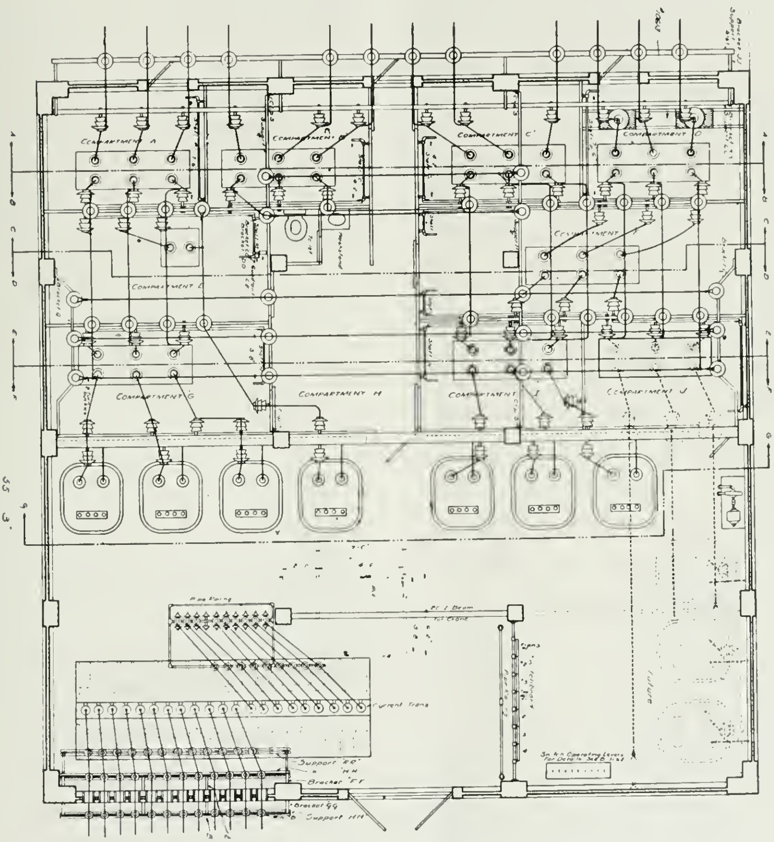
Referring to the high tension switches (Fig. 4), some feature of their mounting are novel. The switch itself is of the horizontal two-break type, the contacts being immersed in coil held in a wood fibre container. The switch top is of Catalina marble. Each pole of switch is mounted in a concrete cell with sheet iron doors. The height of this cell places the conductors out of reach of the attendant. The cell is designed to resist ex-

truck with a screw elevator. Each complete three pole switch has its own concrete compartment, and the walls of these compartments support the single pole disconnecting switches used on each side of the oil switches.

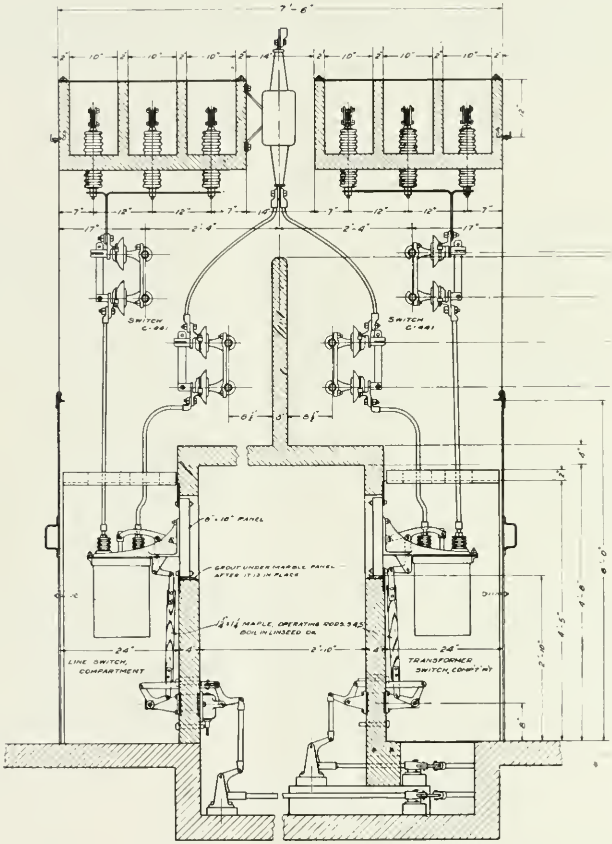
In the transformer room are located four 1500 K. W. transformers, and space has been provided for six more when required.

The transformers are of the water-cooled type, the circulating water being handled by a small motor-driven centrifugal pump. The water drains into a concrete sump, and thence is elevated into the concrete reservoir and cooling tower. It is fed by gravity through the transformer cooling coils.

The 11,000 volt oil switches are mounted in a reinforced concrete structure, a cross-section of which is shown in Fig. 6. These switches are the S. P. K-2 type of switch, manufactured by the General Electric Company, and each pole of the switch is enclosed in a separate compartment. The operating mechanism for the three switches is connected to a single operating shaft and released by a single trip.



(Fig. 5) Plan of Station



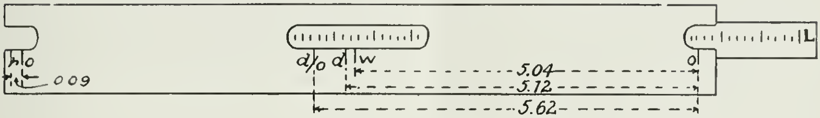

(Fig. 6) Section of 11 K. W. Switch Cells

The operating mechanism, disconnecting switches, etc., were constructed by the Sacramento Supply District. The switchboard is built of ebony asbestos wood, mounted on a pipe frame and braced to the concrete walls and columns.

The illustrations cover fully the details of this station. At the present time but two sets of 11,000 volt feeders are carried from this station. These feeders will be increased as the growth of business may demand.

# The B. & S. Gauge and the Slide Rule

*By* RICHARD C. POWELL, Oakland District.




POWELL B. & S. GAUGE

Back of rule. Dimensions to scale of L scale.

IN the last six or seven years, a number of articles has appeared giving applications of the slide rule to wiring problems. Most of these, however, presuppose the diameter as known or the rule as marked. This is true of the following: Tidd *(Electrical World*, April, 1901), Falch *(Electrical World*, August, 1907) and Howard *(Electrical World*, January, 1908); also, in Pickworth's "Slide Rule," 10th Ed.

Sakai *(Electrical Journal*, Oct., 1905) finds the resistance from the formula, log. (10R) = n/10, and Nachod *(Electrical* World, Sept., 1907) gives a method for finding the diameter from the gauge number. The writer ("Tables for Engineering Calculations," 2d Ed.) finds the diameter( area, resistance, and weight from the formulæ

$$-\log d = \frac{10+n}{20}.$$

$$\log a = \frac{50-n}{10},$$

$$\log r = \frac{n-10}{10},$$

$$\log w = \frac{25-n}{10}.$$

The formula for resistance is, of course, the same as that given by Sakai. These formulæ give the complete logarithm but only the mantissa, or decimal part, is to be set off on the L scale on the back of the rule. The characteristic, or integral part, merely gives the decimal point for the sequence of figures which are read off on the C and D scales on the front of the rule. For sizes up to No. 16, the resistance and weight will be found accurate within about 1%. The diameter and area are quite accurate for the smaller sizes, but are in error about 3% and 5%, respectively, for No. 4/0. More accurate formulæ of the same form can be written as is seen later, but perhaps the extreme simplicity has some advantages, and it is easier to remember the error than the more exact formulæ.

The A. I. E. E. Committee on "Units and Standards" states that the diameters of the B. & S. or A. W. G. are obtained from the geometrical series in which No. 4/0 =0.460 inch, and No. 36=0.005 inch. Hence, there must be a logarithmic relation between the gauge numbers and the diameters, since we have an arithmetical series (the gauge numbers) related to a geometrical series (the diameters). As this relation is a somewhat complicated one and involves incommensurable quantities, the properties of the gauge numbers are not readily inferred from the gauge numbers themselves, as is the case with the Edison gauge. Hence the necessity for a table.

Since the diameter of No. 0 is not unity and the diameters decrease as the gauge numbers increase, the equation for the diameter is of the form

$$d = \frac{k}{r^n},$$

the numbers 4/0, 3/0, and 2/0 being regarded as −3, −2, and −1, respectively. To find the constants k and r we may substitute the two sets of values, $d=0.460$, $n=-3$, and $d=0.005$, $n=36$. Or, merely substitute one set, remembering that k must be the diameter of No. 0. The equation then reduces to

$$d = \frac{0.3249}{1.12293^n}$$

From this the area in C. M. follows, since $C. M. = d^2.10^6$, or

$$a = \frac{105500}{1.26098^n}$$

Taking logarithms,

$$\log d = 0.51175 - 0.05035n - 1,$$
$$\log a = 0.0235 - 0.1007n + 5.$$

The intergers, −1 and +5, are placed by themselves since they merely indicate the decimal point, which is probably known beforehand. Hence, neglecting these integers and writing to only three decimals, we have

$$\log d = 0.512 - 0.0503n,$$
$$\log a = 0.0235 - 0.1007n.$$

Since we may add and substract any integer we please, the equation can just as well be written

$$\log d = 2.512 - 0.0503n - 3,$$

and it is seen that substractions are to be taken in the algebraic sense as indicated by the order of the equation. For example, if $n=20$,

$$\log d_{20} = 0.512 - 1.006 = 0.506$$
$$\log a_{20} = 0.0235 - 2.014 = 0.01.$$

By introducing values for the resistance and weight per thousand mil-feet, we deduce the equations

$$\log r = 0.1007n + 0.993 - 2,$$
$$\log w = 0.504 - 0.1007n + 2,$$

where r and w are the resistance and weight for copper per thousand feet. Similarly, for aluminum

$$\log r^1 = 0.1007n + 0.208 - 1,$$
$$\log w^1 = 0.981 - 0.1007n + 1.$$

These formulæ will give results agreeing very exactly with those of the tables. Ordinarily, however, such accuracy is not required, and only the sizes from 4/0 to 12 are needed.

The exact formulæ can be simplified and made to cover approximately a range of twenty gauge numbers with an accuracy well within 1%, excepting in a very few cases. The accuracy is greater for the larger sizes. These approximate formulæ are

Diameter,

$$\log d = 0.51 - \frac{n}{20},$$

Area in C. M.,

$$\log a = 0.022 - \frac{n}{10},$$

Resistance of copper per 1,000 feet,

$$\log r = \frac{n}{10},$$

Resistance of aluminum per 1,000 feet,

$$\log r^1 = 0.212 + \frac{n}{10},$$

Weight of copper per 1,000 feet,

$$\log w = 0.502 - \frac{n}{10},$$

Weight of aluminum per 1,000 feet,

$$\log w^1 = 0.98 - \frac{n}{10}.$$

Resistance of copper per mile,

$$\log r = 0.72 + \frac{n}{10}.$$

Resistance of aluminum per mile,

$$\log r^1 = 0.934 + \frac{n}{10}.$$

Weight of copper per mile,

$$\log w = 0.224 - \frac{n}{10}.$$

Weight of aluminum per mile,

$$\log w^1 = 0.602 - \frac{n}{10}.$$

In these equations the right hand member is readily obtained mentally. The decimal part only of this number is to be set off on the L scale on the back of the rule. The sequence of figures for the desired quantity is then read off on the D scale on the front of the rule, the decimal point being known from experience. Negative logarithms present no difficulty since the negative logarithm of a quantity is arithmetically equal to the positive logarithm of its reciprocal. Any number on the C scale above 10 on the D scale is the reciprocal of the number on the D scale below 1 on the C scale. Then, for example, in finding the resistance of 4/0, set off 3 on the L scale on the back and read the answer on the C scale above 10 on the D scale.

The approximate equations also give the following rules which may be more easily remembered than the equations:

*Diameter.*—Set off on the L scale one-half the gauge number. The diameter will be found on the C scale above 32.4 on the D scale. When n is negative, read on the D scale below 32.4 on the C scale.

*Area.*—Set n on the L scale and read C. M. on the C scale above 1.05 on the D scale. When n is negative find C. M. on the D scale below 1.05 on the C scale. Also, the area in C. M. may be gotten by reading off the square of the diameter on the A or B scale.

*Resistance.*—For copper merely set n on the L scale and read answer on the D scale under 1 on the C scale; and when n is negative find on the C scale above 10 on the D scale. For aluminum, set n on the L scale and read result on the D scale under 1.62 on the C scale; when n is negative read on the C scale above 1.62 on the D scale.

*Weight.*—Set n on the L scale and read weight of copper on the C scale above 32 on the D scale; for n negative find on the D scale below 32 on the C scale. For aluminum use 96 in place of 32.

By cutting an opening through the back of the rule and marking both the L scale and the back, the slide rule can be made to give the properties of the B. & S. wire gauge with the greatest accuracy and convenience.

The gauge numbers are multiplied by 1.007 and these points marked off on the L scale. If one wishes to carry these marks to give sizes smaller than No. 10, he will have two marks near a given number. For instance, near the two he will have 2.01 for No. 2 wire and 2.08 for No. 12 wire. All these marks, however, will be so near the number on the L scale that no new designations are necessary, with the exception of 4/0, 3/0, and 2/0, which are placed at 7, 8, and 9, respectively.

An opening is cut through the back exposing the L scale and the set marks placed as shown in the figure.

To find the diameter set at d the mark on the L scale of half the gauge number. Read the diameter on the C scale above 1 (or 10) on the D scale. For 4/0, 3/0, and 2/0 use the set mark d/o. The area in C. M. is found on the B scale under the 1 (or 10) of the A scale.

To obtain the resistance of copper per 1,000 feet, set the gauge mark on the L scale opposite r and read on the D scale under the 1 (or 10) of the C scale.

For weight of copper per 1,000 feet, set the gauge mark opposite the set mark w and read on the C scale above the 1 (or 10) of the D scale.

For the size necessary to give a certain drop in volts V, we have

$$\frac{n}{10} = \log \frac{5V}{Id},$$

where I is the current in amperes and d is the distance in *thousands of feet* to the load. The quantity $\frac{5V}{Id}$ is found on the D scale in the usual manner and n/10 is read off the L scale on the back. It is to be remembered that when 5V/Id=1, we have No. 0 wire, since the logarithm of 1 is zero. Also when this quotient is less than 1, that is a fraction, the necessary size is larger than No. 0, and we read 7, 8, and 9 for 4/0, 3/0, and 2/0, respectively. Should the quotient be less than unity and the number on the L scale less than 7, we must use a cable larger than No. 4/0. In this case the C. M. usually near enough to determine the size of cable to be used will be found on the C scale above 10 on the D scale. The exact C. M. is this number multiplied by 1.05.

The safe carrying capacity in amperes for numbers 4/0 to 14 may be found from the equations

$$\log I = 2.266 - 0.076n \quad \text{(weatherproof)}$$
$$\log I = 2.103 - 0.073n \quad \text{(rubber covered)}$$

Or, for weatherproof, set off 0.076n on the L scale and read I on the C scale above 185 on the D scale. When n is negative find I on the D scale under 185 on the C scale. For rubber covered take 0.073n and 127 instead of 0.076n and 185.

The ordinary formulæ for reactance and capacity per mile of single wire are (where a is the distance between wires in inches and d is the diameter)

Reactance for one cycle per second

$$x = (0.00465 \log \frac{a}{d} + 0.0019) \text{ ohms,}$$

$$\text{capacity } c = \frac{0.03895}{\log \frac{2a}{d}}, \text{ in microfarads.}$$

Substituting the logarithmic expression for the diameter in the above, we obtain

$$x = 0.00465 \left( \log a + \frac{n+18}{20} + \frac{0.007n - 0.063}{20} \right),$$

and

$$c = \frac{0.03895}{\log a + \frac{n+16}{20} \quad \frac{0.214 - 0.007n}{20}}.$$

If we neglect the terms containing 0.007n we see that the greatest error will be for the smallest value of a and the largest negative value for n. Ordinarily, this will be for a = 12″ and n = −3, that is, No. 4/0 wire. In this case x will be found in error about one-fifth of one per cent and c about two-thirds of one per cent. Therefore, we may correct the formula for c to give an error not greater than one-third of one per cent.

The final equations then read

$$x = \frac{\log a + + \frac{18+n}{20}}{215.5},$$

$$c = \frac{0.0392}{\log a + \frac{16+n}{20}}.$$

For any given frequency f the reactance is fx and is read off without any additional setting by moving the runner to f, which accomplishes the desired multiplication. Or, instead of 215.5 in the denominator, we would have 215.5/f. It is to be noticed that (18+n)/20 and (16+n)/20 are gotten at once, mentally.

## What's the Use

After making a long trip on the train and being worn out, and after making preparations for a nice trip and figuring on covering much country and feeling that your "Peerless" (No. 528) is a trusty old buggy, when you get out about six miles from the nearest town the tire blows out and you have to get out in the sand on a sweltering hot day, with black gnats thicker than hair on a dog's back, to make repairs—What's the Use of having an Automobile?

## Why, Mary!

"Now remember, Mary," the teacher said just before the school exercises, "if you forget some of the words when you are singing your song, don't stop. Keep right on. Say tum-tum-tummy-tum or something like that, and the words will come back to you and nobody will know the difference. Now don't forget."

On exhibition day little Mary edified her audience with something like this:

" . . . . and she wears a wreath of roses Around her tummy-tum-tum."—*Everybody's.*

# SHORT CUTS

*Under this title, it is hoped each month to include a number of handy formulae, simple and approximate methods, in all branches that we may run across or use in the day's work, so that we may all reap the benefit of the combined experience of those in the employ of the company.*

*The editor requests all employees having data of the kind to kindly submit same for publication. The fact that a man may feel that he has not the necessary literary qualifications should not discourage him. Send the salient features to the editor and it will be put in convenient form and published with proper credit. Everybody get in and help.*

## CONVENIENT HYDRO-ELECTRIC POWER FORMULAE

*By* JAMES H. WISE, Civil and Hydraulic Engineer.

Formulae for quickly determining approximate results in all branches of engineering work are quite essential not only for making rapid mental determinations, but for checking more precise calculations which are not infrequently of many operations and are thus subject to error.

Knowing the quantity of water and static head in feet, four very simple rules for determining the hydro-electric output of a power plant have been developed and are herewith also expressed as equations. It will be noted that three units of water measurement are embodied and the output can, therefore, be calculated direct without conversion.

A miner's inch is taken as 1.5 cu. ft. of water per minute.

(a) 1 M. I. will develop 2 H. P. with 1000' head
(b) 1 Min. Ft. " " 1 K. W. " 1000' "
(c) 1 Sec. Ft. " " 8 H. P. " 100' "
(d) 1 " " " 6 K. W. " 100' "

(a) Q (Miner's inch ) × H (feet) × .002 = H.P.
(b) Q (cu. ft. per min.) × H (feet) × .001 = K.W.
(c) Q (cu. ft. per sec. ) × H (feet) × .08 = H.P.
(d) Q (cu. ft. per sec. ) × H (feet) × .06 = K.W.

The conversion of K. W. to H. P. or *vice versa*, can readily be made in the usual manner.

The value of the above equation lies in the fact that losses such as friction or head loss in the pipe, generator, water wheel, and transformer losses are all taken into consideration, i. e., as usually occur in high head installations of western practice.

Assuming a pipe line efficiency of 95%
a water wheel " 80%
a generator " 96%
a transformer " 98%

we have a plant efficiency of 71.5%. Allowing a still further loss of 1.5% to 2% for inefficiency in regulation nozzle losses, etc., we obtain a switchboard output of 70%.

Assuming well known constants, the following deduction of one of the formulæ is given herewith:

w = 62.5 lbs. wt. of one cu. ft. water
1 H.P. = 33,000 ft. lbs. per min.
1 M.I. = 1.5 cu. ft. of water per min.
Q = quantity of water
H = static head from forebay to center of nozzle for impulse wheels and from surface of head water to tail water surface in the case of turbines.

From the well known equation

$$P = QwH$$

we have

$$\text{P. or H.P.} = \frac{1.5 \times 62.5 \times 1000'}{33{,}000} \times .70 = 1.990$$

or practically two H. P. The approximation being large by one-half of 1%, the other formulae are obtained directly or deduced from the foregoing.

A practical application of the formula is as follows:

Assume the Chalf Bluff ditch is furnishing the Deer Creek powerhouse continuously with 3500 M. I. of water, the head is known to be 830'.

Therefore

$$3500 \times 830' \times .002 = 5{,}810 \text{ H.P.}$$

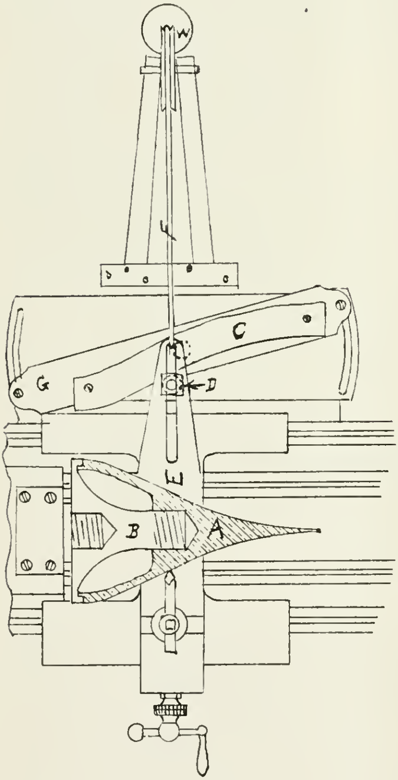
or

$$= 4{,}360 \text{ K.W.}$$

# MAKING AND REPAIRING NEEDLE AND NOZZLE TIPS

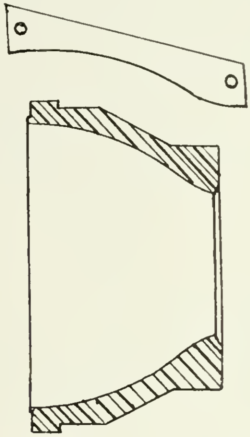
*By* L. L. FLAGG, Electra Power Division.

A simple method is used very successfully at Electra for making new needle and nozzle tips and repairing old ones that have become worn and leak. The method is used for all sizes of nozzles from ½″ to 7½″ and gives fine and accurate work.




(FIG. 1)

Figure 1 shows a needle tip, A, in section screwed on a mandrel, B, that is fitted to screw on to the lathe spindle. Take out cross feed screw and fit cross feed slide, E, so that it slides freely on ways. Take a piece of ¾″x2″ steel and shape one edge exactly to the shape of needle or nozzle, but leave it ½″ longer at each end. C on Figure 1 shows a piece fitted for needle.



(FIG. 2) NOZZLE AND GUIDE

Take off top slide on taper attachment and fit a piece, G, of ¾″x4″ steel in its place. This is to screw guide, C, on to and also to set it to the right taper.

Bolt a roller, D, to cross feed slide, E, so that it will come against finished face of guide of C. Attach a rope, F, to cross feed slide, E, and run it over a sheave on the same level with E, to a weight, W, which will need to be about 200 lbs. Feed the tool to the cut with the compound cross feed and run carriage so that it feeds down the slope on the guide. The accuracy of the finished work will depend entirely on the accuracy of guide C.

Figure 2 shows a 6½″ nozzle and a guide for it.

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"No man has yet reached so high on the ladder of fame that he is justified in calling for more ladder."

*Hindoo Proverb.*

# Autobiography of an Atom of Oil

IN the Pliocene age I was a stalwart limb of a grand old oak growing upon the mountain sides of a beautiful country reaching down to the ocean. A huge glacier, on its onward progress to the seas, buried me many thousands of feet in the earth. There I lay in peaceful contentment for ages, while the slowly increasing heat of the ground transformed me into particles of liquid matter. From time to time the earth was rent with great shocks, and seams opened up so that faint streams of a new light came to me. Portions of the trunk and limbs off the tree of which I was a part, having undergone the change to liquid, began to ascend to the unknown world above me in a vaporous form. Finally strange and awful sounds were heard, and an opening appeared; with bubbling joy I leaped to the surface, to find myself caught by strange hands and stranger people, and was at once locked in the cavernous depths of what seemed to be a huge cylinder, moving along with terrific power, bumping over uneven surfaces, stopping, halting, until at last one day I was permitted to escape, only to be again imprisoned, and I then felt myself moving along, drawn by a power over which I had no control, until I learned from the general conversation of those about me (whose language I commenced to understand) that I was going to be made into an article which the inhabitants of the earth, under which I had so long been buried, used to supplement the God of Light—the Sun, and the following is as near as I can remember the conversation which took place. The names of various parts of wonderfully made machinery through which I passed on my subsequent voyage again to be returned to the elements from which I came, I learned from overhearing directions from a gruff man with a harsh voice, who seemed to preside over the destinies of this peculiar world.

"My, but it is getting warm," said the *Generator*, a tall, rotund piece of insensate matter located under a canopy which prevented the light of heaven from coming in, to a whizzing, whirling piece of apparatus called the *Blower* (I have since learned the appropriateness of it as applied to some humans), as it went at break-neck speed and blew its breath into the face of the *Generator*. "All right," said the *Blower*, "I'll slack up in a minute," but he did not slack up until the face of the *Generator* blushed and glowed like the rising of the sun in the early morning. Then I heard a low voice call out, "Wait for me"; and *Steam* came puffing along, driven with an intense force and joined me in my onward march, as we forced ourselves into the presence of this rotund body. "Let me out," I cried, as I puffed and boiled, "you are burning me up." "Cool off," I heard the *Wash-box* say in a limpid tone, and the Lampblack bade me "good-bye" as he drifted off to a bottomless pit. I am glad to say that we also parted company with a very disagreeable chap called *Napthalene*. "I will give you a lift," said the *Holder*, and from there I was passed along to the *Scrubber*. "You are very dirty," said he, "and need cleaning badly," and after completing his herculean task, he sent me rejoicing to his neighbor called the *Purifier*. "I don't like some of your company," said *Purifier*, "that fellow sulphuretted-hydrogen is no companion for you; leave him with me, and I will take care of him," and then I heard a low, sweet voice from the *Fan* saying, "Hurry along," but was stopped on my onward progress by the *Governor*, who cautioned me to "Be quiet," and not to take on so much speed. After I parted company with the *Governor*, the roaring and howling of *Mr. Main* and *Mr. Service*, (and they were very unsociable) admonished me to part company with them, and

I was arrested by a little fellow who said his name was *Meter*, and who insisted upon measuring me in every part before he would permit me to proceed. I then entered upon a zone of intense heat, compared to which my experience with the *Generator* was as a cool summer's breeze. I asked who the chappie was that was making me so uncomfortable. He replied that his name was *Welsbach*, and I can assure you that I was effectually done up by him. A peculiarly garbed individual, whom I afterwards learned to be the housewife, remonstrated that I possessed too large a bill, and I have since found that this is a common complaint against me in this form, though for the life of me I cannot see why. After getting away from *Welsbach*, I found myself once more communing with Dame Nature, and wonder if I will again have to undergo the same amount of burying and resuscitation that brought me into such warm company as *Old Welsbach*.

## THE MERCURY RECTIFIER

The Mercury rectifier, as developed for automobile and other battery charging, has reached a stage of development hardly predicted some years ago. One of the difficulties with the rectifier was due to the fact that it had to be watched. If the current went off, the battery ceased to charge; if the rectifier was left on the circuit all night, it was likely to overcharge. Rectifiers have now been developed to such a point that they are automatically started. Dial switches are set to a suitable point, and the rectifier does the rest. As the battery is charged, the charging current is decreased as the battery voltage increases. The rectifier cuts itself out of the circuit as soon as the battery is charged, and thus no current is wasted; and, to the user of an electric machine, the automatic rectifier is indeed a valuable asset, owing to its simple operation.

## STOCKTON WATER CO.

### Descriptive Data on Well No. 3 at Pumping Station No. 2

Began setting up, April 1, 1909.
Began boring, April 10, 1909.
Finished boring, June 19, 1909.
Finished well, June 30, 1909.
Total depth, 961 feet.
Depth cased, 926 feet.

262 feet 14-inch double well casing at top of well, of No. 14 gauge. 676 feet 12-inch double well casing for balance, No. 14 gauge. The 12-inch casing laps 10 feet inside of the 14-inch, having been cut off at 252 feet from surface and the upper part removed.

The 12-inch casing is perforated at all the sand strata but one, at 767 feet, this one being considered too much like quick sand. The perforations are ½ inch x 1½ inch, made in four tiers, one perforation above the other, and put in plentifully. Forty-three strata of sand were penetrated, varying in thickness from 1 to 12 inches. The total thickness of the 43 strata was 190 feet.

Below 700 feet there were 13 strata having a total thickness of 77 feet. Nearly all the strata of sand were what we call "coarse sand," with more or less small gravel. They all showed an abundance of water, but there was no very unusual strong flow until 948 feet was reached, when the water flowed slightly over the top of the casing, even with the pumps operating heavily on near-by wells.

Several wagon loads of sand were sand-pumped from the bottom of this well before the sand stopped running up into the casing. This well penetrates an unusual number of water-bearing sand strata, it not being usual in this locality to find more than half that number in 1,000 feet.

We think this well good for one and one-half million gallons in 24 hours, with our centrifugal pumps.

# QUESTION BOX

*All employees are urged to make free use of this department to ask questions regarding any phase of the company's work on which they desire information. The same freedom should be used in answering questions. Address questions and answers to R. J. Cantrell, News Editor.*

Question.—Have variable speed motors been used in this State with any marked degree of success, and if so, where and what do they operate? CHICO.

Answer.—There is a large installation of 5 H. P. single-phase, G. E. Co. Type "R-I", variable speed motors in a printing establishment in San Francisco. Their operation has been very successful. There is also a large number of polyphase, variable speed motors in use in the mines of this State and Nevada. Variable speeds are obtained by varying the resistance in the rotor by means of a drum controller. The operation of these motors is quite successful.

S. J. L.

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Question. — Are there any single-phase, A. C. motors used in elevator work in this State? If so, how do they operate?

CHICO.

Answer.—The single-phase motor is not suitable for the above type of work, and there are practically no installations where the same is used. Polyphase motors of special type are used successfully for elevator and hoist work.

S. J. L.

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Question.—How much distillate or gasolene a horse power is required to operate an engine of 20 H. P. or less, operating at full load? G. R.

Answer.—An oil engine when given the best of care and running under good conditions as regarding load, etc., will use slightly less than one-tenth gallon of 53° distillate a horse power hour, and a slight increase over this of gasolene. It is not safe, however, to guarantee the foregoing quantities for average conditions, as the consumption will be more nearly $\frac{1}{8}$ gallon, or one pint, a horse power hour, which is a safe and sane figure for both.

W. B. B.

Question.—Tables are obtainable giving capacity of wire for transmission of electrical energy. Can similar tables be had giving capacity of pipes for conveying gas at various pressures? If so, where? A. C.

Answer.—In Newbigging's "Handbook for Gas Engineers and Managers", pages 258 to 268, there is a number of tables giving the capacity of various sized pipes at different lengths and pressures. All are calculated from Poles formula for low pressures.

$$Q = 1350\, d^2 \sqrt{\frac{h\,d}{s\,l}}$$

Q=cu. ft. per hour.
d =diameter pipe in inches.
h =pressure in inches water.
s =specific gravity.
l =length of pipe in yards.

W. B. B.

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Question.—What is the longest high tension line under the control of the Pacific Gas and Electric Company? R. M.

Answer.—The longest possible transmission of power over the lines of the Pacific Gas and Electric Company is from the de Sabla Power House to San Francisco, via Nicolaus, Elmhurst, and Mission San Jose—a distance of, approximately, 250 miles.

P. M. D.

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Question.—It has been frequently noticed that an induction meter installed on a motor load will be found "stuck." What is the cause and remedy? B. K.

Answer.—An induction motor, in starting, takes from two to three times its normal full load current. This heavy current rush causes the disk to be attracted toward the magnets, causing the shaft to jump off of the jewel, or sometimes out of the top pivot bearing. The remedy is to set the pivot bearing and the jewel so that the shaft will have an easy movement, but not to leave so much play as to allow it to jump out of the bearings when this heavy current rush takes place. X Y Z.

# Commercial Development of Mechanical Drawing

*By* JOS. P. BALOUN, Chief Draftsman.

MOST men and women, even as children, have made drawings, or rather pictures as they called them, and I venture to assert that they were very creditable and that parents were fonder of them for the humble efforts shown. Before those days, when they were mere tots and comforted their mother by struggling to move, crawl, and finally walk, they also found unmeasured pleasure in taking a piece of white chalk or crayon and using it on the wall or floor. The total intrinsic value of all this "chalk talk" of babyhood days was really without any positive denomination, quite to the contrary; we mechanically damaged more than was necessary. Now many were unfortunate enough to have the playful marking of a white wall or tablecloth suddenly come to an end by the upsetting of father's or Jack's ink well. You all know the sequence of such accidents from mother's hands. So you may gather from some early reminiscences that efforts at picture making or drawing were not always appreciated by the elder members of the family. Later on, when we were well in our teens, preparation for academic work taught the use of the dividers and compass, straight edge, ruler, and a sharp pencil. You will note that I said "SHARP" for a purpose; for next to a dull knife, and a dull conscience, give me a dull student and he will have a dull pencil.

How thoroughly the keen, alert teacher of our drawing class of those preparatory days insisted on us drawing fine lines and finally co-elaborating the finished work with arduous and pretentiously executed border lines and a configuration of several minor designs in order to develop a complete set of corners to match, or more truthfully, to emphasize the drawing proper. We all remember how we were criticized for not shading our drawings sufficiently or correctly, also for coloring with too much haste. A lot of time was always wasted on the "frills instead of on the main garment."

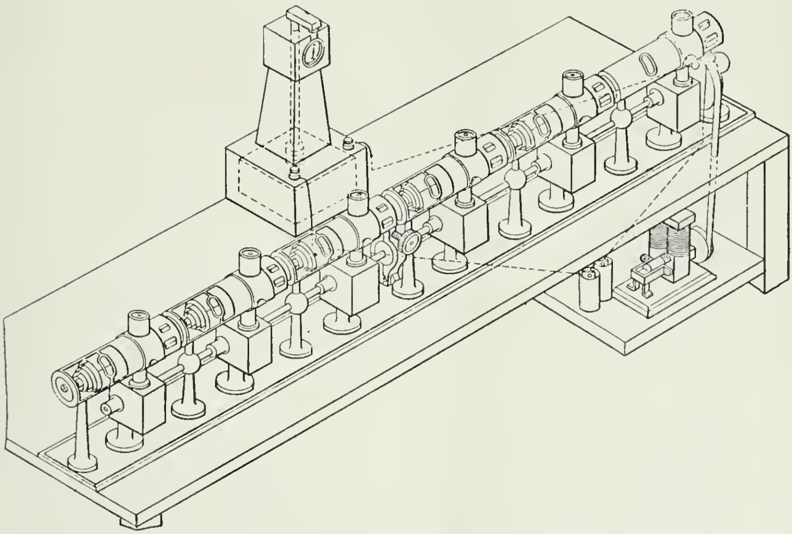
But, to-day, compare the modern evening technical schools both in this country and abroad, their methods and results, with the public and private pedagogical endeavors of a few years ago. For example, the young apprentice shipbuilder, machinist, electrician, plate worker, pattern maker, boiler maker, or blacksmith, or the technical salesmen such as are now in great demand in our large manufacturing concerns, all these young men can to-day, both in the large cities on this Coast and throughout the United States, secure instructions in the subject of mechanical drawing absolutely free to themselves and at the expense of the city or county. Moreover, the practical value of such an efficient course of instruction is due to the present standards such technical schools and colleges are endeavoring to maintain. Many of their tutors having been in the rank and file of the apprentice mechanics for some time at least, such experience, combined with a theoretical knowledge of the subject, places the teacher of today in a position to direct the training of young men.

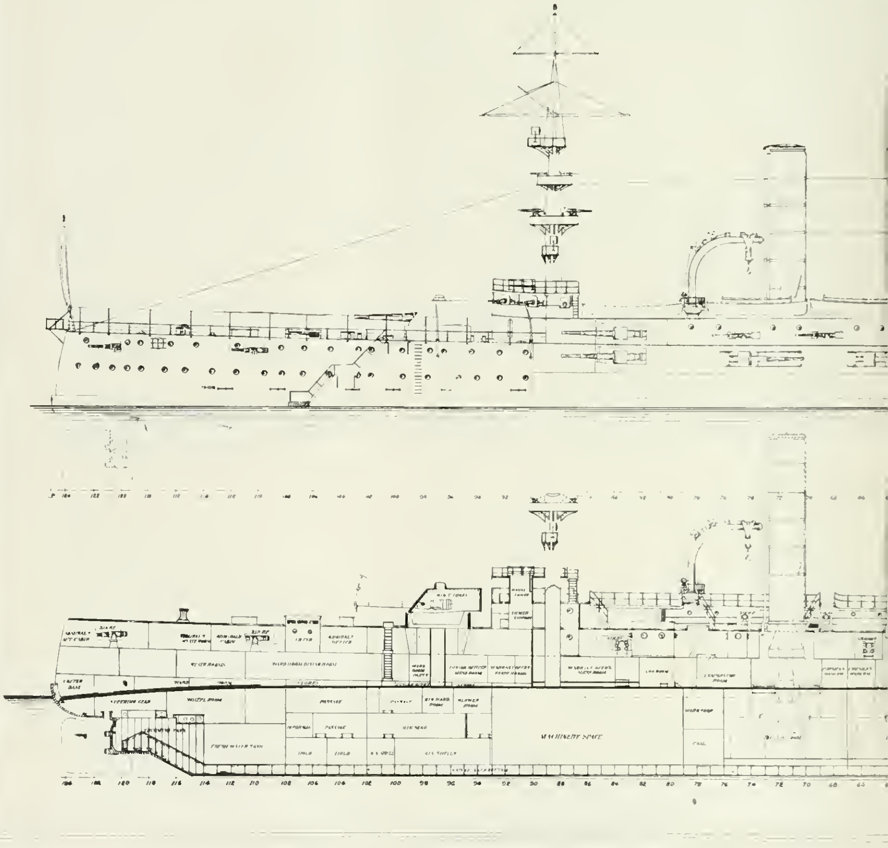
The attempts to develop an international conversational language are well known, and probably the nearest approach to this at present is the complete drawing showing to the trained mind and eye of every nationality the finished results as indicated in a mechanical drawing. Our combination of lines and circles and parts of them is infinite and equally so in our numerical designation of each integral part. The general use of such a mechanical language must ever remain in vogue for all transactions between artisan and the commercial world. That expression of thought and demand, representing the world's smallest or greatest function or detail, can not be explained and executed more quickly or correctly than by the drawing completely dimensioned, and representing to some scale the correctly proportioned outlines of the completed structure or one of its integral details.

Thus we all acquire a conventional habit of speaking by pictures, for with the aid of a pencil we can easily follow a verbal description of a complex detailed piece of mechanism, when the correct sketches are produced as they are described. The eye always perceives the actual detail of construction much quicker than the elaborate verbal description of the same.

The ability to make good sketches is of great value and importance in the mechanical world, and the more so if they be made with especial regard to correctness of the proportional parts. A little care in the execution of one's first practical sketches will exert a guiding influence on all future work. It unquestionably requires considerably more patience to place an idea on paper than to enlarge and reduce the proportional parts carelessly, but such an acquired ability will be an asset well worth the short apprenticeship necessary.

With the practice of sketching mechanical details and suggestions comes a valuable adjunct to the successful business man's needs, and that is to present a given detail to him in the form of a perspective. There are those who are so busy in other lines that it is not at all surprising that plans, elevations, and sectional views do not immediately appeal to them. At this period the commercial end of our manufacturing interests finds it is expedient to have a mechanical perspective, such as an isometric projection, presented for consideration, its valuable feature consisting in showing three sides of a detail or structure at the same time, the angles of such a projection, as the name indicates, are equal to one another, namely 120°. A glance at the accompanying illustration will show this noticeable fea-





OUTBOARD AND IN

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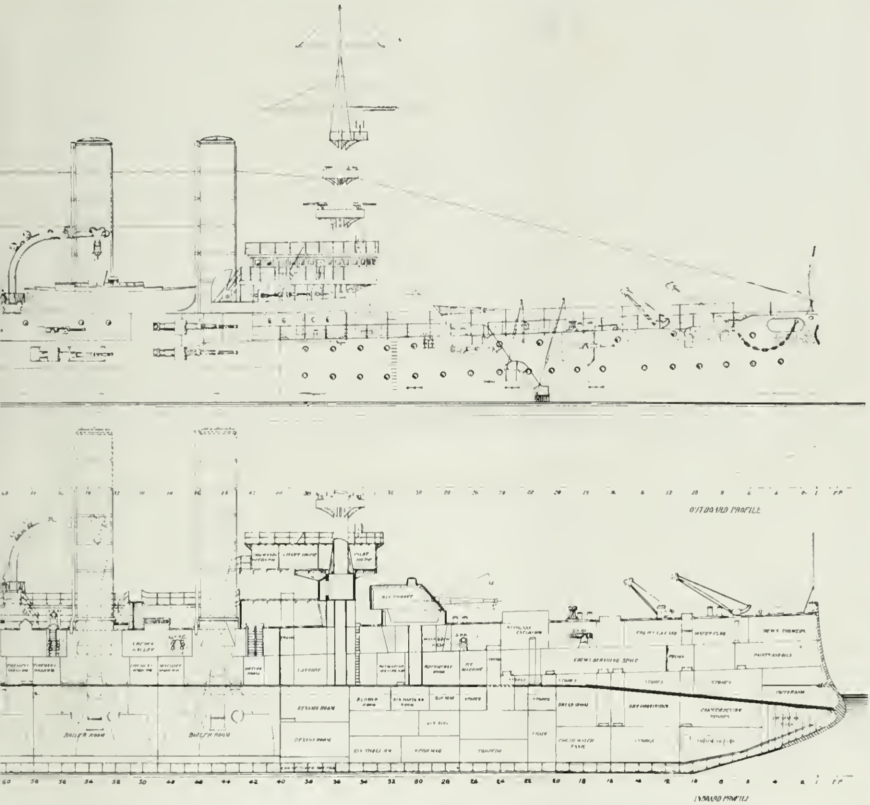


ARD PROFILE OF

# H DAKOTA

AIL OF A MODERN CRUISER

RKS COMPANY, SAN FRANCISCO

ture, and as the draughtsman can readily prepare a projection of this nature from the usually obtainable plan and elevation of the given design, the effect produced by a mechanical perspective drawing at such an early stage is similar to a photograph of the same structure after completion.

A book on history, art, science, or language expresses a "volume of thought"; just so does the complex set of drawings of a battleship, power generating station, lumber mill, skyscraper, factory, machine shop, a printing, binding, or folding press, or a watch; any of these and a million more ideas are to-day being developed on paper in drawing form first before a single detail is manufactured. The larger of the elements of these architectural, mechanical, or electrical developments are designed and drawn to smaller scales in absolute proportion to the finished element. The smaller details, such as some automatic mechanism, are schemed and completed in drawing form many times the size of the resultant; for example, a watch two inches in diameter can better be developed to the finished requirement when made in drawing form, twenty-four inches in diameter, or expressing it technically, to a scale of 12 to 1.

Our grand specimens of naval architecture known as first-class battleships of to-day could not have their $5,000,000 value of hull and equipment with all main and auxiliary machinery, ordinance, and details of every nature from the wireless telegraphic installation on the mast top to the steel rivets in the keel, properly detailed to the practical working drawings of the shop on less than 5000 standard 30″ x 42″ sheets. Thus the attempt to build any such enterprises as these magnificent, valuable masterpieces of our present day without a most complete set of drawings would be a dismal failure. A glance at the accompanying longitudinal section of one of Uncle Sam's recently constructed vessels satisfactorily illustrates the internal organism and exterior detail.

True, our linotype machine does not need drawings to make the type, but the machine before completion and as now in the market needed many sheets of them for its manufacture. The rivet and bolt machines seem to get along without drawings to make their output—quite so, but the experienced operator well knows how sensitive the various adjustments are to get longer and larger bolts and rivets; these required innumerable drawings and sketches. The conductor and motorman handle their cars to the satisfaction of the company without drawings, but that same company knows that their rolling stock, from the trolley support to the powerhouse and the transmission system beyond that, required a volume of drawings for their construction.

The advance of the world to-day is due to the invaluable drawings of its wonderful enterprises, and to the skillful ability of our presidents, managers, superintendents, foremen, mechanics, and apprentices of each and every one of our industrial institutions and their various departments in being able to read and discuss the merits of the engineering constructions in their respective lines through the medium of mechanical drawing.

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## A Receipt for Sanity

Are you worsted in a fight?
Laugh it off.
Are you cheated of your right?
Laugh it off.
Don't make tragedy of trifles,
Don't shoot butterflies with rifles—
Laugh it off.

Does your work get into kinks?
Laugh it off.
Are you near all sorts of brinks?
Laugh it off.
If it's sanity you're after,
There's no receipt like laughter
Laugh it off.

Henry Rutherford Elliot.

# Poe and the Gas Trust

By JAMES MONTAGUE.

Gas has been put into the Poe cottage at Fordham. Such an alleged improvement in the poet's time would have made it impossible for him to write "The Raven," but his thoughts might, nevertheless, have found some equally metrical form, like this for example:

In that capital of Boredom, which is known to fame as Fordham,
  Where the brawling Bronx breaks bravely on its shingly, shelving shore,
Once—Oh, recollection bitter!—came a gruff and grim gasfitter,
  Knocking with a pair of pipe-tongs—knocking on my chamber door.
"Wretch!" I savagely inquired; "don't you see that I'm inspired;
  Don't you see I'm writing poems like no man has writ before?"
"Say, I've come to set a meter!" said the man, and I, discreeter,
  Let him in, although I mumbled as he stumbled through the door:

"Set a meter? Why in thunder do you set one here, I wonder?
  That's my business, setting meters, I have set them by the score.
All my plagaristic brothers borrow mine and use no others,
  That is what, in their opinion, I invent my meters for."
But the man with tongs and hammer, fell to work amid a clamor,
  Breaking pipes, while his apprentice sauntered to the shop for more,
And in eight distracting hours, said "She's finished, be the powers!"
  And, departing, left the meter perched above my chamber door.

"Troth," I said, "a merry meter, how could anything be sweeter?"
  As I listened to the whirring of the wheels that raced and tore.
And I left the jets all burning so the wheels could keep on turning,
  And, inspired by their music, reeled off poetry galore.
But ere long a bill collector came around to nag and hector
  Me for money, and I learned from him a thing whereat I swore—
Every single revolution forced from me a contribution
  To the Gas Trust of the magnitude of ninety cents or more.

"Turn it off!" I shrieked in terror. "Better is the gloom of error.
  Better is the deepest pit upon the night's Plutonian shore
Than this light, whose gloom-dispelling my expense account is swelling
  So that even Rockefeller would go broke against the score."
But, though no more gas was burning, still the meter kept on turning,
  Churning, easy money earning, for the Trust's o'erflowing store,
Still it sits there ticking, clicking, and whenever I go kicking
  To the Trust to choke it off, they calmly answer, "Nevermore!"

# Pacific Gas and Electric Magazine

PUBLISHED IN THE INTEREST OF THE EMPLOYEES OF THE PACIFIC GAS AND ELECTRIC COMPANY

JOHN A. BRITTON, - - - - - - - Editor
R. J. CANTRELL, - - - - - - News Editor
A. F. HOCKENBEAMER - - - Business Manager

Communications containing items of interest to the members should be sent to the News Editor, R. J. Cantrell, 445 Sutter St., San Francisco, Cal. In order to appear in a certain issue these items must be in the hands of the News Editor by the twelfth of the preceding month.

Vol. I AUGUST, 1909 No. 3


## EDITORIAL

INGRATITUDE has been defined from time immemorial as the greatest of sins, and with it can readily be classed DISLOYALTY.

Loyalty is a characteristic which should govern the acts of every man who occupies a position in life in which he is dependent upon others for a livelihood. It is not a mere return for daily, weekly, or monthly wages for a man to fulfill the duties allotted to him of time serving, within the hours of his employment or of those prescribed by regulations of organized labor. The man who occupies any position, from that of laborer to the highest office in the gift of his employer, should devote, not only his actual physical and mental energies to its employment during hours prescribed, but should at all other times be eager and willing to do everything that will tend to the betterment of the company by which he is employed. The man who does otherwise is to a degree disloyal to the interests which he serves, and, unless he can devote his entire energies and abilities to do of that which makes for the betterment of his employment, should not, under the cloak of being a mere attache, remain in the employ of the company.

The Pacific Gas and Electric Company expects from every employee that same meed of loyalty that the employee himself would expect and does require from those with whom he associates. It is unfair and unjust for any man not to give all that he possesses, within reasonable limitations, to the interests which are helping him to gain a livelihood.

The editor feels that a more loyal band of willing workers does not exist than those on the roll of the company, and it is the desire of this magazine to instill into the minds of all of the men and women employed, that their interests and their welfare, not only physically, but mentally, is of paramount importance to the management.

Let loyalty, therefore, to the interests for which you are laboring, be the one leading idea in your minds, so that the success and increase of prosperity of the corporation will be assured not only to yourselves, but to those who are directly, financially, interested in the corporation.

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WITH THIS NUMBER of the magazine is a large view of the 250 men and women comprising the general executive and local forces at headquarters in San Francisco. The photograph was made one noon hour in the back garden of the old convent that was leased and occupied for office purposes from the time of the fire until the removal, August 20th, to the company's own, big, new office building downtown. Although the group is a large one it shows but one-sixteenth of the army of 4,000 people that comprise the constant working force of the company's entire system, which is spread as a mighty network, connecting cities, towns, and power plants, over all that immense central third of California from Chico to Fresno and from the Sierras to the sea. But from individual elements in this group radiate the personal influences that control, unify, and coordinate the connected parts of the widely spread plan and make of seemingly scattered interests one great commercial enterprise.

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WHAT THE EDITOR most desires is plenty of raw material,—not too raw, of course,—and then the chunks and screenings from all the mines of personal information can be converted into illuminating gas or into electric energy that may reach its readers through a live wire, but without shocking them.

THE MEN AND WOMEN BEHIND THE GUNS OF THE PACIFIC GAS AND ELECTRIC COMPANY AND THE SAN FRANCISCO GAS AND ELECTRIC COMPANY.

# BIOGRAPHICAL SKETCH

## PAUL MILTON DOWNING

### ENGINEER OF OPERATION AND MAINTENANCE HYDRO-ELECTRIC SECTION

PAUL MILTON DOWNING

As illustrative of what pluck and energy will accomplish, the gradual rise of Paul Milton Downing, Engineer of Operation and Maintenance of the Hydro-Electric Section of the Pacific Gas and Electric Company, will prove interesting.

He was born at Newark, Mo., on November 27, 1873, and like all others, native of his State, he has had "to be shown" during the whole of his life. He graduated from the grammar school in May, 1889, and took the degree of B. S. from Washington College in 1891, thereafter entering Stanford University, from which he graduated with the degree of A.B. in 1895. During his college career he took a particularly active part in athletics and was a feature of the football team in all of the years in which he was connected with Stanford University, becoming captain of the team in his year of graduation. The victories earned by that team are of record and are a tribute to the determination of the man which has marked his career ever since.

He was first employed by the Tacoma Light and Power Company, Tacoma, Wash., as a dynamo tender. Seeking for other worlds to conquer and dissatisfied with the position of unimportance in the electrical engineering field, he became the assistant motor inspector and power house operator of the Market Street Railway Company, San Francisco, during the years 1896-7. In the latter year, the Blue Lakes Water Company began the operation of the old power houses at Blue Lakes City, Cal., and, his merits being recognized by the promoters of this industry, he was offered and accepted the position of station superintendent. This was one of the first hydro-electric plants operating in California and had 1800 K. W. capacity at the time operating at 10,000 volts, stepped up from 2300 V. generating rating, and the current was principally used for the supply of mines in and about Jackson and Sutter Creek in Amador County.

In 1898 he became associated with John Martin, at that time agent for the Stanley Electric Mfg. Company, in the installation and operation of electrical apparatus, especially in connection with long distance high voltage transmission systems. During his connection with Mr. Martin he installed the hydro-electric plant for the Tuolumne Light and Power Company. His restless nature at that time forbade limiting his capabilities to mere installation of apparatus, and in 1900 he became the chief electrician for the Standard Consolidated Mining Company at Bodie, Cal. As indicative, in a measure, of the versatility of the man, he subsequently became the manager of the Colusa Gas and Electric Company, Colusa, Cal., and had, while with it, charge of the installation of the electric distribution system, and also rebuilding the gas works and managing both branches of the industry.

In 1901 he became the division superintendent of the Bay Counties Power Company at San Francisco, handling all work in connection with the transmission and distribution of power generated from hydro-electric stations and transmitted at that time—what was deemed a few years before impossible—45,000 volts.

Since 1903 he has occupied the position of superintendent of the sub-stations of the California Gas and Electric Corporation and operating engineer of that corporation and the Pacific Gas and Electric Company, and is in a way, illustrative of the magnitude of the work under his immediate construction and control. There are at the present time dependent upon his oversight five hundred miles of ditches and flumes; eleven hydro-electric power houses, ranging in capacity up to 20,000 K. W., and having a total capacity of 50,000 K. W.; 800 miles of three-phase transmission lines carrying voltages up to 60,000; he has charge of a hundred sub-stations supplied from the above lines, these sub-stations having installed a total rated capacity of 90,000 K. W.

In charge of this great division of the Pacific Gas and Electric Company, he has endeared himself to all of the employees under his charge. He has a most attractive personality, and is able to accomplish, without friction, the work of supplying more than one-third of the State of California with electric light and power.

No better evidence could be given to the rising young man of today of the good results which must follow from strict attention to duties imposed upon one. As he progressed from a college graduate, he was quick to grasp every opportunity that presented itself for his betterment, and showed by his untiring devotion to duty, coupled with the physical ability of his own, ability to withstand the shocks of the very requiring obligations, and so has worked into a position as great in importance as that occupied by any man in the United States of America.

A smiling countenance and quick perception of right and wrong, a fairness of action, and with all, a temperate mind and body, are not only good things to possess, but they are excellent examples for the rising generation.

## Reading Gas Meters

"I once had a most peculiar case," said a celebrated oculist. "Every time this patient started to read he would double——No, he was a sober man!"

"Poor fellow!" remarked a listener. "It must have interfered sadly with his progress in the world."

"Not at all," responded the oculist. "A gas company gave him a lucrative post—he went round checking the meters."

*Grand Rapids, Mich., July 28, 1909.*

*Editor, Pacific Gas and Electric Magazine,*
*San Francisco, California.*

*Dear Sir:—We have received a copy of your publication, the second issue of Volume One, and we would like to subscribe to it.*

*Enclosed herewith please find fifty cents for which you will kindly send us the publication for one year.*

*Permit us to congratulate you upon the variety and value to gas and electric men of the articles published in this issue. This magazine should unquestionably be of value to your organization. It will be a pleasure to receive it each month.*

*Very truly yours,*

CHILD, HULSWIT & CO.
*By* M. S. Child, *Secretary.*

# In Memoriam—Harry J. Edwards

THE announcement in the July issue of this magazine of the death of H. J. Edwards, District Manager at San Jose, was but a brief epitome of the man.

Of all the various records of his life, as printed in the daily press, there is none that more fully and feelingly illustrates the man as he was than the following editorial from the *San Jose Mercury and Herald*, published on Sunday, July 11, 1909:

*By John E. Richards.*

"Years ago, when Harry J. Edwards was in the prime of life and when we were associated in business engagements and enterprises which called for the most strenuous exercise of our diverse abilities and out of which grew a relation of personal friendship and confidence which will ever remain a treasured memory, he asked me to write his obituary, and I promised so to do. I am impelled tonight to fulfill that promise by the spirit of my dead friend which calls to me from beyond the veil.

HARRY J. EDWARDS

"I shall not deal in dates, nor in family records of births and marriages or movements from place to place. 'We live in deeds, not years; in thoughts, not breaths; in feelings, not in figures on the dial.' I shall, however, refer to the stock from which he sprang. He was a direct descendant of Jonathan Edwards, that rigid old Puritan theologian and the foremost reasoner of his time; though his descendant was not a theologian, he had that stern sense of the real right of things and clear, practical insight into the simple facts of our human life and nature which marked him as an Edwards by right of birth. It would seem strange to call Harry Edwards a Puritan, but that is because the real Puritan character is so little understood. Beneath the hard crust of the conditions and age in which Puritanism was developed, there flowed through the hearts and lives of the New England forefathers a very warm current of humanness. They lived close to Nature's heart, and the intensity of the human qualities which they there developed are easily discernible in their descendants of today the world over. So Harry Edwards, in his very marked characteristics of interblended strength and weakness; in the intense humanness of his many-sided character, was a Puritan at heart; a true type of his ancestry.

"I dwell upon this side of his nature because by it he was best known and will be longest remembered. I could cite numberless instances illustrating these striking traits of his character from the first time I ever saw him, when he risked and almost lost his own life in rescuing a workman of his company from asphixiation, and came to with a joke on his lips, down to the last time I saw him, a few days ago, when he shook his head gamely and told us he was 'still in the ring.' Who but the sturdiest kind of a genuine man could have fought and won the battles of the last quarter of a century during which he rose from the position of a collector of the old gas company to be and to remain the local head of the greatly increased and diversified energies of that institution in the face of persistent and intense antagonism? Who else among us could have retained throughout this struggle a perfectly imperturbable good nature, have made friends of his antagonists, have won every battle of his life save the final one by sheer force of personal character, and have gone down to his grave at last without an enmity and with a smile on his face? Who else could have originated that delicious fiction of 'The Royal Family' round which many of the jests of his every-day intercourse with men were woven, and have ruled his subjects with an unquestioned scepter until the title of 'The King' became his by general acceptation? Dispute however we may about the rules and proprieties of our social life, we must all agree that it took a man, a genuine man, a large-hearted and many-sided man, a King among men, to take the place and play the part in life which Harry Edwards, 'The King,' took and played successfully for the past twenty-five years in San Jose.

"There is another side of his nature of which I should speak. Harry Edwards was a Puritan in the strictness of his views regarding the character and exalted place of woman in society, and the sacredness of home. And this, considering his strongly marked physical characteristics, is no slight praise. Among his thousand jokes and sallies, no one ever heard or saw him take pleasure in the merely gross. He bore a strong likeness to Lincoln in the play of his humor; but, like Lincoln, he had no relish for vulgarity. Those who go to his home today to look their last upon his face will find in that home, and its occupants, ample proof of his fidelity to our best ideals of what a man's home life should be.

"Finally, as to his friends, their name is legion, and they are to be found in every walk and condition of life. Every man of his acquaintance is his friend. Every man who now is or ever was in his employ is his friend; and his best friends are those who know him best. Friendship has many degrees, and there are many men who, from their own coldness of heart or fickleness of temper, never come to realize, in this life, the Divine quality which true friendship between man and man can attain. But Harry Edwards did realize and experience in his relations with no small circle of his fellow-men the best and noblest that there is in human friendship. His friends were 'grappled to his soul with hoops of steel.' Hundreds of them today will stand with tear-wet cheeks about his grave and testify that this is true. By these his friends Harry Edwards will be more missed and mourned and will also be longer and more affectionately remembered than any other man who has recently, in this community, passed from this to another life.

"A word as to that passage. For three years we have watched his struggle in the grasp of the dread destroyer, going gamely on; have seen his form distorted and his visage changed by the intensity of the duel between himself and death. But he did not change. The same dauntless spirit, the same indomitable will, the same cheerful nature which had faced every other issue of his strenuous life, looked with clear and fearless eyes into the face of his unconquerable adversary; and through it all and down to the very final moment of the struggle for life, yes, and beyond it, we saw that Harry Edwards was, every inch of him—a man. 'After life's fitful fever he sleeps well.' "

To this, the writer can add but little. From a personal acquaintance with Harry Edwards extending over a period of twenty-five years, emphasis can be laid upon the good words penned by Judge Richards.

The one strong characteristic of Harry Edwards was his unfaltering loyalty to those for whom he labored. His friendships were as strong as his own mentality, and he never forgot a friend or forgave an enemy. He represented a type of the Californian that buffeted the storms of an awakening civilization, and went to his final rest with the same resoluteness of purpose that marked his whole active life.

It will be many days before California will duplicate such a man as he was.

J. A. B.

# Municipal Matters

*By* GEO. C. HOLBERTON.

The city has provided a fund of $1000 to enable the Chief Engineer of the Fire Department to inspect and investigate the workings of high pressure water systems for fire protection in eastern cities.

It is interesting to note that in the vicinity of the company's North Beach works, the Board of Public Works have removed the old buildings on the west of the North Beach playground site and will immediately construct tanks which are to be used for swimming purposes. In case of emergency these tanks are arranged so that they can be drawn upon by the Fire Department. Plans have also been perfected for the erection of a gymnasium on these grounds, and bids on same will be called for in the near future.

As we are all aware from the daily press, San Francisco is installing a very elaborate distributing system to take care of any bad fire which might occur in connection with an earthquake. The general plan has been quite thoroughly outlined, but it might be interesting to note some of the details, for instance, a contract has been awarded to the United States Cast Iron Pipe Foundry Co. for $920,988.50; seventy carloads of this pipe have been shipped and fifty-eight have arrived and have been unloaded. The bids for the gate valves have been awarded to the Pelton Water Wheel Company. As this amounts to an expenditure of approximately $400,000, it is interesting to note that the award has been made to a local concern.

There are also plans and specifications out for cast steel special castings aggregating 155 tons; also certain cast steel specials will be awarded on the 16th of August, involving 2378 tons.

The city is also installing a special pipe testing plant so that all this pipe can be thoroughly tested and investigated before being placed. The pipe proving press has been tested up to 1200 pounds pressure the square inch. This testing plant has been erected at Sixth and Hubbell streets and power for same has been supplied by the San Francisco Gas and Electric Company.

MURPHY AND MENSING

# Baseball News

FEENEY AND CONWAY

## Saturday, July 10

San Francisco captured the second game of the series by the score of 8 to 5.

The Pacific's team appeared on the field with several new men. Scanlon pitched good ball. Feeney and Murphy, the battery of San Francisco, played ball from start to finish, and certainly proved a big help toward gaining the second victory.

SCORE

| P. G. & E. Co.— | AB. | R. | BH. | PO. | A. | E. |
|---|---|---|---|---|---|---|
| Hall, 1b. | 5 | 1 | 1 | 10 | 0 | 0 |
| Sullivan, 2b. | 5 | 0 | 1 | 1 | 2 | 2 |
| Barieau, s. | 4 | 0 | 2 | 2 | 4 | 0 |
| Mensing, 3b. | 3 | 0 | 1 | 0 | 3 | 1 |
| Murphy, lf. | 3 | 1 | 0 | 1 | 0 | 3 |
| Barthol, rf. | 5 | 1 | 1 | 0 | 0 | 0 |
| Scanlon, p. | 4 | 1 | 1 | 1 | 3 | 1 |
| Bear, cf. | 2 | 0 | 0 | 1 | 0 | 1 |
| Ortega, c. | 2 | 1 | 0 | 11 | 0 | 0 |
| Total | 32 | 5 | 7 | 27 | 12 | 8 |

| S.F.G.& E.Co.— | AB. | R. | BH. | PO. | A. | E. |
|---|---|---|---|---|---|---|
| Mogan, 3b. | 4 | 1 | 0 | 1 | 2 | 1 |
| Melbourne, 2b. | 4 | 1 | 0 | 4 | 3 | 1 |
| Egan, s. | 4 | 2 | 1 | 2 | 3 | 1 |
| Murphy, c. | 3 | 2 | 1 | 9 | 0 | 0 |
| Cavanaugh, 1b. | 5 | 0 | 2 | 8 | 0 | 0 |
| Brearty, cf. | 4 | 0 | 0 | 0 | 0 | 0 |
| Lally, rf. | 3 | 0 | 0 | 0 | 0 | 0 |
| Hanifan, lf. | 3 | 0 | 1 | 1 | 0 | 0 |
| Feeney, p. | 2 | 2 | 0 | 2 | 1 | 1 |
| Total | 32 | 8 | 5 | 27 | 9 | 4 |

| Score by Innings... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| P. G. & E. Co. | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| S. F. G. & E. Co. | 0 | 0 | 0 | 2 | 0 | 0 | 3 | 0 | 3 |

Two-base hits—Cavanaugh, Sullivan. First on balls—Off Scanlon, 2; off Feeney, 4. Struck out—By Scanlon, 8; by Feeney, 6. Umpire, Conway.

## Saturday, July 17

The Hibernia Bank team gave battle to a picked nine chosen from Pacific and San Francisco. In the first inning, after Melbourne and Murphy went out, Trowbridge singled to center, Egan advancing him to third on a long hit to right field, scoring a moment later when Cavanaugh hit past short. Trowbridge, Hall, and Mensing all drove the horse-hide to different parts of the lot, putting three men on bases; when Melbourne, by a long hit to the right field fence, sent the three runs across the pan, scoring himself a moment later when Murphy with his big stick sent a safe drive to center field. After the second, it was simply walking, until, at the close, San Francisco and Pacific team had 13 to Hibernia's 3. Hibernia's three runs came in the ninth, made after Barieau missed an easy grounder to short.


"MEGOWAN"

SCORE

| Pacific & S. F. G. & E. Co.— | AB. | R. | BH. | PO. | A. | E. |
|---|---|---|---|---|---|---|
| Melbourne, cf. | 5 | 2 | 2 | 1 | 0 | 0 |
| Murphy, c. | 5 | 2 | 1 | 3 | 2 | 0 |
| Barieau, ss. | 3 | 1 | 1 | 2 | 3 | 1 |
| Egan, 2b. | 3 | 0 | 2 | 4 | 0 | 0 |
| Cavanaugh, rf. | 4 | 0 | 0 | 0 | 0 | 0 |
| Trowbridge, 3b. | 5 | 1 | 0 | 2 | 2 | 1 |
| Hall, 1b. | 4 | 2 | 1 | 9 | 1 | 0 |
| Mensing, lf. | 3 | 3 | 1 | 4 | 1 | 0 |
| Feeney, p. | 3 | 2 | 1 | 2 | 2 | 0 |
| Totals | 36 | 13 | 9 | 27 | 11 | 2 |

A. L. Trowbridge J. Barieau L. A. Melbourn Gus White, Manager W. Egan A. E. Hall W. A. Cavanaugh
M. Mensing E. Murphy J. Feeney

| Hibernia Bank— | AB. | R. | BH. | PO. | A. | E. |
|---|---|---|---|---|---|---|
| Muhl, ss. | 4 | 1 | 1 | 2 | 2 | 6 |
| Mahoney, 2b. | 3 | 1 | 2 | 2 | 0 | 2 |
| Delisle, cf. | 3 | 1 | 0 | 1 | 0 | 0 |
| Byrne, 3b. | 2 | 0 | 0 | 2 | 1 | 3 |
| Dougherty, p. | 3 | 1 | 1 | 2 | 3 | 1 |
| Molly, c. | 3 | 0 | 0 | 6 | 1 | 0 |
| T. Dougherty, 1b.. | 1 | 0 | 0 | 6 | 0 | 2 |
| Beardsley, lf. | 2 | 0 | 0 | 1 | 0 | 0 |
| Ellrod, rf. | 3 | 0 | 0 | 2 | 1 | 0 |
| Totals | 25 | 4 | 4 | 24 | 8 | 14 |

| Score by Innings... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Pac. & S. F....... | 1 | 4 | 0 | 3 | 2 | 0 | 0 | 3 | |
| Hibernia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |

Two-base hits—Melbourne. First on balls—Off Feeney, 4; off Dougherty, 1. Struck out—By Feeney, 3; by Dougherty, 5. Umpire, Conway.

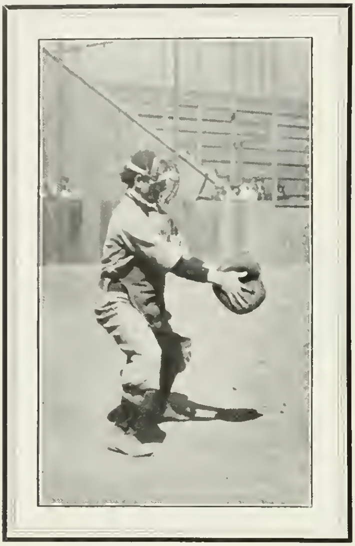
## Saturday, July 24

A good crowd showed up at St. Ignatius Stadium to see San Francisco put the finishing touches on Pacific to the tune of 4 to 3. This was the best game of the series, plenty of hitting and just enough misplays to make the game even.

As the score shows, up to the ninth inning the game stood 3 to 3. In the ninth, Brearty, the first man up, hit for a single; Egan drove a long hit to the outfield, sending Brearty to third, where he stood while the "boy wonder" Bigley, a new find, did his usual stunt, striking out. Murphy saved the day by sending a long hit to right garden, scoring Brearty —ending the game with the score in favor of San Francisco.

Here is the story told in figures:

| P. G. & E. Co.— | AB. | R. | BH. | PO. | A. | E. |
|---|---|---|---|---|---|---|
| Hall, c. | 4 | 1 | 1 | 12 | 0 | 0 |
| Mensing, lf. | 4 | 1 | 1 | 1 | 0 | 0 |
| Barieau, ss. | 3 | 1 | 1 | 0 | 2 | 2 |
| Trowbridge, 3b. | 4 | 0 | 0 | 2 | 1 | 3 |
| Swan, 1b. | 3 | 0 | 0 | 4 | 1 | 0 |
| Barthol, cf. | 4 | 0 | 1 | 1 | 0 | 0 |
| Sullivan, 2b. | 4 | 0 | 1 | 3 | 1 | 1 |
| Bear, rf. | 3 | 0 | 1 | 1 | 0 | 0 |
| Scanlon, p. | 4 | 0 | 1 | 1 | 2 | 0 |
| Total | 35 | 3 | 7 | 25 | 7 | 6 |



THE ONLY MURPHY—IN CHARACTERISTIC POSE

| S.F.G.& E.Co.— | AB. | R. | BH. | PO. | A. | E. |
|---|---|---|---|---|---|---|
| Oldis, cf. | 4 | 1 | 0 | 0 | 0 | 0 |
| Brearty, lf. | 4 | 2 | 2 | 2 | 0 | 0 |
| Eagan, 2b. | 4 | 1 | 0 | 7 | 5 | 0 |
| Bigley, rf. & ss. | 5 | 0 | 0 | 0 | 2 | 4 |
| Murphy, c. | 4 | 0 | 0 | 9 | 3 | 0 |
| Bennett, ss. & rf. | 4 | 0 | 0 | 0 | 1 | 0 |
| Lally, 3b. | 4 | 0 | 2 | 1 | 0 | 1 |
| Feeney, p. | 4 | 0 | 2 | 1 | 1 | 0 |
| White, 1b. | 3 | 0 | 0 | 7 | 0 | 1 |
| Total | 36 | 4 | 8 | 27 | 12 | 6 |

| Score by Innings | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| P. G. & E. Co. | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| S. F. G. & E. Co. | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 1 |

Two-base hits—Brearty, Murphy, Hall, Feeney. First on balls—Off Scanlon, 2; off Feeney, 1. Struck out—By Scanlon, 12; by Feeney, 8. Umpire—Van E. Britton.

## A Challenge From the Colgate Team

On July 25th the team from the Colgate Power House played its initial game with Oregon House, winning easily by a score of 14 to 6.

One of the features of the game was the work of Superintendent Adams, who more than surprised the boys by his batting and the manner in which he covered first base.

The second game, with the Rackerby team, showed a great improvement over the former game. From the first inning Colgate was in the lead, the final score being 11 to 1.

They are well organized and desire to play any team in the company.

## WALLACE FOSTER NEEDED THE MILK

It was three years ago. The statute of limitations has run even if the tale is a true one. Up to one morning three years ago Wallace Foster, the local manager of the Pacific Gas and Electric Co., had never seen a deer. He had a vague notion that they might have four legs and that they lived out in the balmy woods. It was in this blissful state of mental darkness that the man of live wires, meters, and water gas found himself at the head of a ravine in the Lucas Valley, waiting, rifle in hand, for his friend Tom O'Connor to drive a buck up to him. In due time the brush cracked and a deer jumped out about ten feet from the quaking hunter. There was a deafening volley from the rifle and lead was sprinkled over the yellow hillsides from Black Gulch to Big Rock. As the smoke cleared away a deer lay dead twenty feet from Foster. O'Connor and his friends rushed up and at first sight of the carcass were horrified. "Where are the horns?" yelled O'Connor. "Horns," queried the electric baron. "Horns?" Just as one of his great arc lights is wont to throw a penetrating brightness into the gloom and mist of a moonless winter night, so his mental light began to penetrate the darkness that befogged the situation in his "mind's eye." "Horns?" he queried again. "I don't need horns, but what's the matter with milk?" This tale is vouched for by O'Connor, who, when he is not busy doing an architect stunt on buildings is energetic in annoying his friends.—*Marin County Tocsin.*

# Commercial Notes

*By* S. V. WALTON, Commercial Agent.

A contract has been closed with the Patterson Ranch Company, for delivering about 1000 horse-power to be used for pumping water from the San Joaquin River, for the purpose of irrigating a tract of 18,000 acres of land.

Arrangements have been made with the North American Dredging Company for delivering about 800 horse-power to them at the Stockton Channel, near the city of Stockton, for dredging out the Stockton Channel from a point just inside the city limits to the San Joaquin River, a distance of about 8,000 feet. They have found that electricity is a much cheaper power than steam or gasoline, both as to economy of equipment and operating cost.

A contract has been closed with the United States Government for supplying light and power to the Navy Yard at Mare Island. The island is supplied by means of a 10,000-volt submarine cable about 2,000 feet long, extending from Vallejo across the Mare Island Strait.

A contract has just been entered into with the Los Gatos Ice Gas and Electric Company for delivery of current to it at our Mountain View substation. The Los Gatos company will distribute this current in Saratoga, Los Gatos, Los Altos, and intervening territory. The company already has a small water power plant in Los Gatos, but is unable to develop enough power to supply the demand.

Several new contracts have been secured in the San Joaquin Reclamation District. It has been four years since we first ran a line into this district and supplied power on the Orwood, Rindge, Victoria, and Woodward Tracts, the installations for the first year amounting to only 500 horse-power. The land owners were soon convinced that pumping by electric power was cheaper and very much more convenient than by steam or gaso-on other tracts. Our main 60,000-volt Herdlyn-South Tower transmission line reaches the west side of the district, where a sub-station is established on the Orwood Tract, the various tracts being supplied by 10,000-volt lines extending from the sub-station.

J. D. Farwell, of the Los Gatos Electric Gas and Ice Company, has very recently closed a contract with this company for power to supply Los Gatos, Saratoga, Los Altos, and all the intervening territory between Old Mountain View and the above mentioned places. They will take current at 11,00 volts from Mountain View substation and build sixteen miles of line to Los Altos and Los Gatos, to tie into their present and existing systems. This will open up a fine field for the sale of power for irrigation purposes in the many fine ranches in this territory. It is expected that they will commence to take power by October 1st.

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## A Hard-headed Tenderfoot

Dinah, crying bitterly, was coming down the street with her feet bandaged.

"Why, what on earth's the matter?" she was asked. "How did you hurt your feet, Dinah?"

"Dat good fo' nothin' nigger (sniffle) done hit me on de haid wif a club while I was standin' on the hard stone pavement."—*Ideal Power*.

# Local Notes

In the gas department in San Francisco a large amount of street main work is being done, 16-inch mains, for the purpose of stiffening pressures, being laid on Third, Fourth, and Fifth streets, from Folsom to Market; a 10-inch pipe on Hyde street from Sutter to Ellis and Hyde street from Ellis to Golden Gate avenue.

In Oakland a low pressure loop to connect the various feeders of low pressure in the middle section of the city is being hastened to completion, while many miles of pipe in the northern extensions of the city, around Lake Merritt, are being laid to accommodate the many new buildings at present under construction.

The work in the meter repair shop at Oakland is in such state that an enlargement of their present quarters at Station "B" is essential.

A 30-inch governor has been ordered for installation on the Oakland low pressure system.

At Sacramento a new oil tank with a capacity of 10,000 barrels is being installed, and a pier is being built out from the station into the river for a supply of water and unloading oil.

At San Jose, four purifiers, formerly at Oakland, are being erected, and the storage holder of 500,000 cubic feet capacity, is well under way.

At Vallejo the foundations are being prepared for the installation of the 200,000 cubic foot holder recently ordered, and a very considerable amount of street main work is being done.

At Colusa, the holder formerly in use at Point Orient, in Contra Costa County, is being erected.

A rotary meter, with a capacity of 50,000 cubic feet an hour, is being installed as a station meter at Fresno.

The San Jose and Santa Clara County Railroad Co., operating an electric railroad system in San Jose and Palo Alto, has decided to extend its railroad lines from the city limits of Palo Alto to the campus of Stanford University. Power will be supplied from the Palo Alto substation of the Pacific Gas and Electric Company.

The city of San Jose advertised a "Big Noise Carnival" on July 3d, 4th, and 5th. The streets were well decorated, and the night electric illuminations were very good. Over 3,500 incandescent lights were used in the main streets, stringers of lights enclosed in red lanterns being suspended across the streets, which gave a very pleasing effect.

## Too Much Limburger on Sacramento Cars

Sacramento, July 30.—The Sacramento Electric Gas and Railway Company issued orders to-day to the effect that no freight would be carried on their passenger cars on and after August 1st. The cause of the announcement is said to be due to the excessive loads of ice cream freezers and limburger cheese that were carried, to the annoyance of the traveling public and officials of the company.—*San Francisco Post*, July 30.

# PERSONALS

Following the policy of the company ever since its organization, district managers displaying merit in the conduct of the several duties allotted to them are advanced to positions of responsibility as opportunities afford.

The following changes in District managers occurred during the month of July:

The vacancy occasioned by the death of H. J. Edwards of San Jose has been filled by the promotion of J. D. Kuster, formerly of the Fresno District.

E. W. Florence, manager at Chico, promoted to the more extensive field of Fresno.

H. B. Heryford, manager at Colusa, advanced one step along the line to the district managership at Chico.

Will M. Henderson, formerly in the Gas Department under E. C. Jones, and lately occupying the position of superintendent of the Sacramento Gas Works, was selected to fill the vacancy at Colusa.

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E. C. Wescott has been appointed assistant manager of the Sacramento Supply District. He was formerly connected with the Canadian General Electric Company, the Allis-Chalmers Company, the Stanley Electrical Manufacturing Company, and the General Electric Company of Schenectady. For the past two years he had charge of the reconstruction of the York-Haven power plant.

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## FAREWELL DINNER TO E. W. FLORENCE

(From the *Chico Record*, July 23.)

E. W. Florence, manager of the Chico district of the Pacific Gas and Electric Company, was recently promoted to the management of the Fresno district and will leave soon with Mrs. Florence and their son to assume his new duties. As a farewell greeting over thirty-five of his friends, business and professional men of the city, tendered him a banquet at the Diamond Cafe last evening.

J. R. Wood presided as toastmaster, and orchestral music was furnished by J. Paul Miller and sister, Miss Regina Miller. It was an "electrical" evening, and the menu was in accordance. The toasts were prompt and witty, and it was an evening long to be remembered by those participating, and was a fitting farewell to the guest of honor who has won his way to success in this city.

The menu was as follows:

AN ILLUMINATION

*By a Bunch of Live Wires on the Occasion of the Departure of the*

HIGH POTENTIAL

*To a Drier Clime*

MENU

Dry Martini Cocktail
*(1550 Volts)*

Chicken Consumne en Cup
*(Gas House By-Product)*

Green Onions — Ehmann Olives

Cross & Blackwell Chow Chow
*(Tenth of the Month Sourball)*

Filet of Sole en Mattelet
*(Meter Rate Sucker)*

White Chianti Wine *(Direct)* — Pemese Chateau *(Alternating)*

Grenadines of Veal aux Champignons
*(Asphyxiated)*

Queen Fritters
*(Meter at the Gas House)*

Sliced Tomato-Cucumber Salad
*(With Transformer Oil)*

Roast Spring Chicken, with Dressing
*(Was a Chronic Kicker)*

French Peas *(Shocking!)* — Duchess Potatoes *(Oh, Ed!)*

Ice Cream a la Mode
*(Fresno Daily Diet)*

Red Chianti Wine
*(Real Juice)*

Roquefort, Swiss, or American Cheese
*(Twenty Candle-Power)*

Bent's Toasted Crackers
*(Insulated)*

Liquer, King Alfonse *(Short Circuit)* — Cafe Noir *(Lights Out)*

Dearest Eddie, we will miss you
When we come to pay our bill;
But we know good old John Martin
Will maintain your prices still.

## GAS MANAGER AS GUEST OF HONOR

(From the *Fresno Republican*, Aug. 2.)

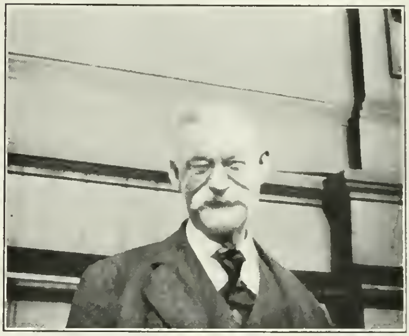
A dinner was given at the Hughes Hotel last Saturday evening at which John D. Kuster, retiring manager of the gas company, was host, and E. W. Florence, the future manager, was the guest of honor. Covers were laid for twenty employees of the company, and as the crowning feature of the evening, Mr. Kuster was presented with a gold ring, set with a diamond in a lion's head. He has been manager of the company in Fresno for three and a half years, and will go to San Jose to accept a similar position. He is expected to leave some time during the week. A. J. Devlin, foreman of the gas works, H. J. Carling, Jr., accountant, and C. C. Humphrey, superintendent of street work, made neat speeches of felicitation to Mr. Kuster and welcome to Mr. Florence.

## LINEMAN INJURED

Gus Stalter, a lineman for the United Gas and Electric Company, met with a serious accident Thursday at Belmont. He was cutting branches in a tree between that place and Gardner's Sanitarium when he fell a distance of twenty-five feet, striking on his back. He was at once removed to the sanitarium, where his injuries were treated. Mr. Stalter had three ribs broken, besides suffering internal injuries. It is thought no serious results will occur.

John A. Britton, President of the San Francisco Company and Vice-President and General Manager of the Pacific Gas and Electric Company, will leave August 24th for the Orient on the S.S. "Siberia," returning to San Francisco about the end of October. Captain Zeeder will retain command of the ship.

## JOHN YABLONSKY



John Yablonsky is the second oldest employee of the San Francisco Gas and Electric Company, being superseded only by Zachary Floyd, the present superintendent of the Meter Department, by a few months. He was born in Birmingham, England, in 1834, and came to San Francisco by way of Cape Horn in 1851. As a young man he went to work in a printer's office, as a printer's devil, but left the printing business and entered the employ of the gas company in July, 1862, in the capacity of general helper at the shop, cleaning meters, threading pipe, and setting and reading meters. In 1865 he was given the position of sub-collector, and in 1866 promoted to the position of collector, which he has held ever since without intermission. He married in 1871, building a home in Alameda, where he still resides with his wife. He is a Thirty-second Degree Mason, a Knight Templar, and Past Master of Oak Grove Lodge, F. & A. M., of Alameda.

"Johnnie," as he is familiarly called, owing to his cheerful, optimistic disposition, may truly be said not to have an enemy in the world, and in spite of his seventy-five years he is full of ambition and industry. He is, as a rule, the first man at the office in the morning, does a full day's work, and his ambition is to round out a term of half a century's active service with the company.

# A Meeting of the Gassy Meeters

A WELL attended meeting of the Gas Kiln Literary Association was held in Room 7, Franklin and Eddy streets.

The gathering, comprising as it did an aggregation of embryonic artists, poets, and philanthropists, was a decided success.

Brother Angelo was unanimously elected High Exalted Kiddo. His speech of acceptance was very touching, so much so that many of the members will subsist on a snail diet for several noons.

The benevolent and beneficient Brother Donovan was chosen Master of Delicatessen on account of his well-known free-lunch proclivities.

The position of Financial Secretary was the plum for which many contended. Brother Quigley, by the use of drastic measures, succeeded in having himself appointed to the enviable position. He immediately levied an assessment of five cents per capita payable on demand. The "*modus operandi*" for obtaining the same was not divulged.

Brother Cunningham, by reason of his versality in such matters, was selected to represent the club in the flowery realms of eloquence and poetry. The rendition of his initial contribution fitting so well with his environments, tended to produce a comatose condition deleterious to clerical manipulations. The disease appears to have been contagious, as it has since become necessary to post notices warning the bookkeepers that tardiness resulting from over-sleeping will not be tolerated.

A few of Brother Cunningham's deepest thoughts are here appended:

Here we are, and if forever,
Then forever, here we are;
For we would not, if we could be
On the Observation car.

We are not what others call us.
If we were we would not tell.
We feel that we, like other mortals,
In the end will go to—well!

To the haven of the happy,
To that dear eternal rest;
For no Books are kept in Heaven,
And Gas and Juice are never messed.

A general rumpus caused by rival claims of fourteen members for first baseman honors on the Ball Team was narrowly averted. Brother Murphy brought his legal acumen to bear on the case and finally pacified the contestants by deciding that the entire subject was "incompetent, irrelevant, and immaterial."

Brother Hyland's telephonic engagements interfered with his assimilation of the argument of the learned and erudite Brother Murphy, but he and Brother Conens later engaged in a heated argument over the relative importance of Emeryville and Larkspur.

Brother Brearty's exploitation of certain hallucinations regarding his past prowness as a ball-tosser was taken *cum grano salis*.

The meeting finally adjourned to enable Brother Kuechen to locate his stool.

---

A man in workingman's garb one day called at a local dentist's, and the door was opened by a maid.

Workman—"Is the gent in that draws the teeth?"

Servant—"No, sir; but I expect he will be in shortly."

Workman (pausing on doorstep)—"Does he give gas?"

"Yes."

"What does he charge?"

"One dollar."

"What! One dollar? Do you mean to say, miss, a fellow's got to swallow over 1000 feet of gas to have one tooth pulled out? No fear; I reckon I knows a bit about it, for I work down at the gas works myself. I'll go to another dentist and have it pulled out without gas."

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# Pacific Gas and Electric Magazine

Vol. I | Contents for September | No. 4



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THE PACIFIC GAS AND ELECTRIC COMPANY'S NEW HEADQUARTERS BUILDING IN SAN FRANCISCO

*—See article page 137*

PACIFIC GAS AND ELECTRIC MAGAZINE

VOL. I SEPTEMBER, 1909 No. 4

# A Trip to a Bonanza Mining Camp

By GEORGE SCARFE, Superintendent Nevada Power Division.

WHEN it was reported in Nevada City last April that E. H. Wilson, who had a bond on the 16-to-1 mine in the Alleghany district, had at one blast exposed gold

Nevada City in the Winter Time

ore to the value of $100,000, was taking ore out of the mine at the rate of $40,000 every day, and had already cached about $4,000,000 in ore in bank vaults in town, even the people of Nevada City were thrilled and their interest jumped to a regular gold fever.

For more than half a century Nevada City has been the chief town of the banner gold-producing county of the Golden State. The sight of golden riches in the clean-ups at the mines and virgin rock and nuggets all the while brought into town from the placer diggings had been such a common occurrence that nobody took much notice unless the product happened to come from some property in which he was personally interested.

Following this news about the 16-to-1 mine came recurring reports of other rich strikes in that same Alleghany camp, which is over in Sierra county about thirty-five miles from Nevada City, and reached only by a difficult mountain road.

Such were the conditions when, one morning, the writer suddenly met E. H. Wilson himself coming into town with a four-horse team loaded with ore sacks to the value of $125,000 from the 16-to-1 mine.

That won me. I had made up my mind that I would visit that camp at the earliest

Where Water Does the Digging

Still Prospecting !

opportunity. Later I met E. H. Wilson on the street and suggested going to his mine with him in an automobile. He agreed. Many protested that it would be dangerous to make such a trip in a twenty-horsepower machine.

But in the morning of the 3d of June we started from Nevada City—E. H. Wilson of the 16-to-1 and M. B. Kerr, manager of the Pittsburg Gold Flat mines—with the writer at the wheel.

Through Newton, down the Bridgeport grade, over the old covered bridge across the South Yuba river, up the hill past the gate leading to the Colgate powerhouse—that was the route we took.

Eight miles out a punctured tire stopped us thirty minutes and gave us a chance to get acquainted while doing a little team work on the job.

But we were soon churning ahead on the San Juan road. In plain sight as we passed along were the old hydraulic diggings of French Corral, Sweetland, and San Juan, mines that produced great quantities of gold up to the time they were closed down by law because the torrents of mud from the washings were filling up the river channels of the valleys below. Here and there like ancient cannons abandoned at the foot of unconquerable fortified cliffs were seen the rusty relics of the powerful hydraulic giants that had been used to tear hillsides asunder. Scarred precipices, tree-rimmed at the top, suggested what had been the sylvian appearance of the scene before man came and harnessed a river's power and tore away everything down to the bedrock of prehistoric river beds that ran almost at right-angles to the streams that flow today.

Passing San Juan, we soon crossed the Middle Yuba and started up the grade on a low gear. In many places the steady slope is 10 to 12 per cent., and this angle is em-

The Main and Only Street, Alleghany

bellished with a rough and sandy surface that makes a machine snort at its work.

About eight miles from the river-crossing the road took us over into Yuba county, so that we really traversed parts of three counties on the trip. We came to the Alaska mine pole line. We were in the pipe clay and lava formation. If lava come from volcanoes and volcanoes spout from the lower regions, these roads then were all that the lava would suggest. We worked on the roads and we worked on the machine till finally we got to the top of the ridge. There, at an elevation of 5,500 feet, we were 3,000 feet above Nevada City. But we were on a tableland, and the little car was sent at speed to celebrate the event.

Then we commenced the descent to Alleghany. We were on a toboggan. It was all we could do to hold back the car with all brakes set and the spark off. We were in such an uncontrollable hurry that we could not stop to kill a rattlesnake, but ran over it with both wheels and left it in the road without having a chance to get the rattles to prove the story.

We reached Alleghany in four hours from Nevada City, and on just three and a half hours of actual running time. The town looked tame. Its one street was deserted. There was nothing to indicate that under that street and the hotel were the tunnels of the Tightner and the 16-to-1 mines. The town is on the side of a steep cañon, and the mining is done in tunnels running back into the side of the mountain. But after a good dinner we called on Superintendent Johnson of the Tightner, and while we were there enjoying cigars he told us of his strikes and brought out some candle boxes containing some of the real yellow pebbles. Two of the party happened to be

Rockribbed Entrance to Oriental Mine, Alleghany using these boxes as footstools, and the query was raised as to how much the stools were worth. Then it was that we learned that

Tunnel Entrance, Morning Glory Mine, Alleghany

each box contained about $9,000. But none of it stuck to my feet.

Toward evening we saw the reason for its being such a lonesome town. Prospectors from the surrounding hills, men loaded with picks, pans, rock, here and there an engineer with his transit—such was the stream that came home to the town, until by supper-time the one street was like the approach to an ant's nest, and when the bell went clatter-de-gland, clatter-de-glang the press for places at table was so great that half the crowd had to wait outside for its turn.

The big event of the day was the arrival of the stage from Nevada City with more prospectors. It was dark when the stage rumbled in, although it had started from Nevada City three hours ahead of us that morning.

After breakfast next morning we went down into the famous El Dorado mine, lower in the cañon. Long before we reached the face of the drift, where the miners were at work far in the tunnel, we were shown a large vein of white quartz from which the day before some fine gold-bearing rock had been taken, and we saw a great quantity of this rock in pans and boxes down in the mine.

When we got ready to leave Alleghany in the afternoon it looked as though the depths of the earth had suddenly yielded up a future generation of miners that had never seen an automobile. The youngsters came at us from all sides and climbed all over the machine and stuck to it like a small swarm of bees as we cautiously moved down the main street.

At the end of a twelve-mile climb and descent we reached the Alaska mine and, as the guests of Mr. and Mrs. St. John, we there spent the night. Down in the mine they were regularly pumping out about 900 gallons of water with power from Pacific Gas and Electric Company lines, which were also called upon to operate the air-compressors and run all the other machinery about the place.

Next morning we were off for Nevada City, where we arrived about noon. It was

Entrance to 16-to-1 Mine, Alleghany

all a pleasurable experience, but of course the main purpose of the writer was business, and he returned with a contract to furnish 1,000 horsepower to a company that will operate in the Alleghany district, where they so much need power, and will use current from the Pacific Gas and Electric Company.

# The History of Gas Lighting in Oakland

*By* E. C. JONES, Engineer Gas Department.

ALTHOUGH San Francisco as early as 1854 was furnished with illuminating gas through the energies of Peter Donahue and others, it was not until 1867 that Oakland, then the second largest city in California, was supplied with this useful commodity.

The overflow population of San Francisco had not up to that time discovered the attractions of suburban life, and transportation across San Francisco bay was, at best, hazardous. Oakland's wonderful climate, its miles of oak-covered lands, and its contiguity to San Francisco, began to prove inviting to the tired business men of the metropolis. By 1864 Oakland commenced to take on the aspect of metropolitanism. Attention was called to its great harbor possibilities existing in the estuary of San Antonio, which divides Oakland from Alameda. As a land-locked harbor it attracted, even at that time, the attention of the government, which commenced taking measures to improve it by erecting a training wall and deepening it by dredging. This work made available on each side of the estuary large tracts of hitherto submerged lands, and they became convenient sites for manufacturies. The originators and promoters of the Central Pacific Railroad, recognizing the value of this land as a terminus for the proposed transcontinental railroad, soon became a large owner of the property bordering on the bay on the west and the estuary on the south.

December 9th, 1865, a franchise was granted by the Oakland city council to Joseph G. Eastland, at that time secretary of the San Francisco Gas Light Company, and William W. Beggs, the San Francisco company's engineer. This franchise gave the privilege of laying gas mains in the city of Oakland, and fixed the gas rate at $7.50 a thousand cubic feet.

Following the granting of this franchise, the Oakland Gas Light Company was incorporated June 12th, 1866, and the franchise was transferred to it by Joseph G. Eastland and William W. Beggs.

The first directors of this Oakland company were William W. Beggs, Joseph G. Eastland, and Anthony Chabot, a well-known citizen of Oakland, interested in the city's water supply. Anthony Chabot was elected the first president, and Joseph G. Eastland, the first secretary, of the company.

It was impossible at that time to locate a gas works upon the estuary lands. There obviously would have been the proper place for them, but the purchases made by the Central Pacific Railroad Company and the peculiar water-front grants given to others by the city of Oakland rendered the estuary lands unavailable then. So a lot on the northeast corner of First and Washington streets, within a half block of the waterfront, was purchased as a site for the gas works, and Tyler Sabbaton, at that time one of the engineers of the San Francisco Gas Light Company, was employed to prepare plans and specifications for the building of the gas works. Henry Adams was elected superintendent of these works. He was a resident of Sacramento. Later he was superintendent of the Napa Gas Works, and thereafter, until his death, was superintendent and manager of the Stockton Gas Company. When the Oakland company was reorganized in April of 1867, H. H. Haight, who had been governor of the state of California, was elected president.

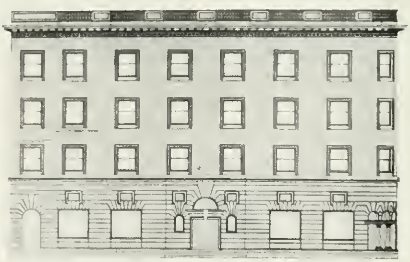
The first installation of the works consisted of a holder having a capacity of 5,000

Office Building of Oakland Gas Light and Heat Company, Thirteenth and Clay Streets

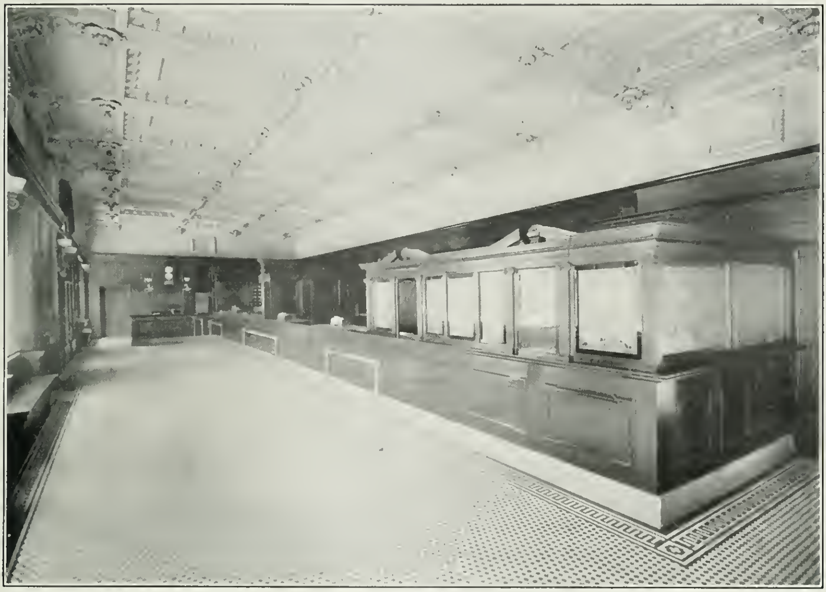
cubic feet, and one bench of three iron retorts housed in a brick building approximately 20x30 feet. The purifying house contained four purifiers, each 8x10x3 feet. It is recorded that in 1866, the first night that gas was turned on in the city of Oakland, the consumption for the night was 3,000 cubic feet. In 1866 Van Leer Eastland succeeded Henry Adams as superintendent, and he continued in that office until his death, September 8th, 1894. In 1870 a second holder, having a capacity of 25,000 cubic feet, was erected. The maximum consumption had reached 20,000 cubic feet a day. From 1870 until 1874 very rapid progress was made in the laying of mains and the obtaining of customers. In 1873 it became necessary to enlarge not only the retort house capacity but also the capacity of the purifiers and the storage tanks. Iron retorts had long since been discarded for those of clay. These clay retorts were imported from the east in benches of fives and were substituted for benches of threes.

Holder number 3 was built in the fall of 1873, and it had a capacity of 150,000 cubic feet. It remained in use until 1904, when it was discarded only by reason of the removal of the gas works from its original location.

The first dividend of the company was declared in January of 1874. From that day,



Front Effect with Two Additional Stories now being Constructed



Interior of the Oakland Office

until the consolidation with the California Gas and Electric Corporation in January of 1903, the Oakland company continuously paid dividends of twenty-five cents a share on the capital stock, with the exception of a period of eighteen months in 1884-5, when expenses of new construction caused the suspension of dividends.

Having faith in the future growth of Oakland and foreseeing the needs of the enlargement of its plant, the company bought, in 1875, what is known as city block number 3, which is bounded by Jefferson, Grove, and Second streets. This was the site of the palatial home of Domingo Ghirardelli, the well-known chocolate manufacturer. His was a place noted for a wonderful display of magnificent statuary, which he had collected during his frequent visits to Europe.

In 1875, also, J. West Martin, a prominent Oaklander, was elected president to succeed Ex-Governor Haight, who had died in the early part of that year.

In 1877 it became necessary largely to imcrease the capacity of the plant, and to use the old Ghirardelli home block. A bonded indebtedness was therefore incurred in the sum of $250,000 to provide money for the improvements. Holder number 4, having a capacity of 450,000 cubic feet, was erected, together with a purifying house having four purifiers 20x24 feet each. The capacity limit of the plant as enlarged became fixed at 500,000 cubic feet. The output at that time was approximately 150,000 cubic feet a day. It was supposed then that the ultimate requirements of the plant had been reached, but the future determined otherwise.

During all of the ten years following the establishment of the Oakland company, both the city of Alameda and the town of Berkeley, which had become the state university centre, had been growing. Therefore in 1877 the directors of the Oakland company determined to extend the service of gas to both these neighboring communities. In that same year, anticipating future necessities, a part of the waterfront lying between Jefferson and Castro streets, was purchased.

During the first month of the operation of the Oakland company the records show that there were only twenty-three consumers connected with the mains. But in 1878, after eleven years' development, the total number had grown to 1,801.

In 1879 a gas holder was erected in Alameda. A pipe connection from the Oakland works at First and Washington streets was made across the estuary and into Alameda over the company's own drawbridge, which had been built on Webster street. The year 1879 marks the first installation in the United States of high-pressure gas service, as a pressure approximating eight pounds was carried upon the mains that ran from the works in Oakland over to the holder in Alameda. This high-pressure system was subsequently extended to include the distribution to customers, and was produced by means of a Connelly governor, which, until recently, continued in daily use.

The year 1879 also marks the introduction into California of gas stoves. Joseph G. Eastland, then the secretary of the Oakland company, had purchased, during a visit to Europe, a large invoice of Fletcher stoves. These stoves, after some difficulty and persuasive arguments, were put in various Oakland homes.

In 1880 the Lowe process was installed, Oakland being the second city in California to make use of this method of manufacturing gas. The oil for the manufacture of the gas was purchased from the Pacific Coast Oil Company at the rate of $2 a barrel.

In 1881 the town of Berkeley was first lighted by gas. But about that time the attention of the entire world had been called to the introduction of electric lighting. Foreseeing possible annihilation in competition with this new form of lighting, the Oakland company, with its usual progressive spirit, determined to secure such rights as it could to the ownership of electric service. In 1883 it secured from the Thompson-Houston Company exclusive rights to use in the cities of Oakland and Alameda and the town of Berkeley that company's apparatus, and in 1885 completed a building and installed two 25-arc machines.

In 1886 Oakland got her first cable-car line. Prior to that time transportation about the town had been by means of the now obsolete horse-car, which still survives as a California relic only in San Francisco and San Buenaventura.

In 1887, the Edison light having been perfected for general purposes, the Oakland company purchased the right to use the Westinghouse alternating system, and in January of the following year installed a 50-ampere machine having initial voltage of 1,000.

In May of 1888 the company decided to erect an electric lighting station on waterfront property at First and Grove streets. And in September of that year it purchased from the Westinghouse company two 1,000-volt alternating current generators of 50-ampere capacity. This was the first installation of incandescent electric lighting in Oakland.

During 1889 Welsh anthracite coal was first used in the making of Oakland's water gas. Then holder number 2 was erected in Alameda. In 1892 holder number 7, having a capacity of 700,000 cubic feet, was built on block number 3 by the Stacey Manufacturing Company.

The Oakland company, in July of 1892, moved into its new office building, then just completed, at Thirteenth and Clay streets.

In 1893 the Station B electric light works was erected. It contained two Fitchburg engines, each of 400 horsepower with boiler equipment, all installed by the Risdon Iron Works.

In December of 1894 the company imported bituminous coal from Japan for the manufacture of coal gas. Earlier in the year a branch office had been established in Alameda.

During all the years following May of 1874, when he first entered the employ of the Oakland Gas Light Company, John A. Britton was intimately associated with the success of the concern, occupying successively various positions of trust prior to his election to the secretaryship in August of 1883.

In September of 1894, following the death of Van Leer Eastland, who had for many years been superintendent of the company, John A. Britton was elected superintendent and engineer in addition to his old position as secretary.

In 1895 the Berkeley Electric Lighting Company was purchased and absorbed. November 23d, 1895, Joseph G. Eastland, the secretary of the Oakland company, died, and January 2d, 1896, John W. Coleman, the president, also passed away.

In August of 1898 John A. Britton was elected president and engineer of the Oakland Gas Light and Heat Company.

During the spring and summer of 1902 the California Gas and Electric Corporation entered into a contract with the Oakland Gas Light and Heat Company to supply the Oakland company with oil gas. Station B at First and Market streets was therefore selected for the manufacture of the oil gas. This station had originally been erected as a gas works by the Equitable Gas Company in opposition to the Oakland Gas Light and Heat Company.

The first oil gas ever manufactured in Oakland was made at Station B, September 1st, 1902. Oil gas proved so successful that several additions had to be made to the plant. By September 11th, 1904, all of the gas supplied to the city of Oakland was what is known as crude oil water gas, and it was manufactured at Station B.

The gas business in Oakland increased normally until the earthquake of 1906. Then the enormous influx to Oakland of population from San Francisco created such a demand for gas that the gas delivery was increased from 563,000,000 cubic feet in 1905 to 970,000,000 cubic feet in 1906. This was at first considered a gain in business due to feverish conditions that would later shrink, but the increased sent-out of gas was sustained and even augumented during the two subsequent years. Oakland reached its maximum output of gas December 21st, 1908, when that one day 6,835,000 cubic feet was furnished.

In 1907 the company constructed, at First and Grove streets, a 2,000,000-cubic-foot gas holder resting in a steel tank. During that same year additions were also made to the generating capacity of Station B to provide for the increased demand for gas.

Oakland is now provided with modern gas-generating machinery and ample storage capacity to meet the demands of a city of its continued rapid growth.

## Liquid Gas

Liquid gas is made by compressing and freezing the gas obtained from the dry distillation of crude oil. The first plant for its commercial manufacture was established at Augsburg, Bavaria, in 1904, under the Blau process. In 1907 a plant was established at Bassensdolf, near Zurich, to use the Wolf process. After manufacture the gas is placed in steel tubes holding 20, 40, 60, and 80 pounds, which are accepted by the railways with no restrictions, as the gas is claimed to be non-poisonous and much less explosive than ordinary gas. It is used for heating, lighting, cooking, and soldering and welding. More than 100 installations have been made in Switzerland, and one is being built in Paris and one in Boston.—"Journal of Electricity, Power, and Gas."

Buying the bartender a drink is about as sensible as paying the conductor's fare.

# The Oakland Underground System

*By* GEORGE C. HOLBERTON, Engineer Electric Distribution Department.

IN electrical magazines and before various technical associations many articles have been presented upon the general subject of underground conduits for electric service wires, but this article deals specifically with a recent California experience in putting wires underground in the city of Oakland.

About seven years ago a strong agitation was started in Oakland for the removal of poles and overhead wires from the business streets. San Francisco had had underground conduits in its business section for a long time, but, so far as the writer knows, that was the only place in California that had such conduits. Later San Francisco materially extended its underground districts, and, in addition to the work in that city, the Pacific Gas and Electric Company constructed underground districts in both Oakland and San Jose. An ordinance has also been passed declaring underground districts for Sacramento.

Formerly ordinances outlined a district, set a time limit for the final removal of overhead wires, and fixed a penalty for failure to comply. But the Sacramento ordinance goes further than this. It specifies in detail the method of constructing the underground system. This tends to limit a company in the selection of the most desirable materials or methods, and it handicaps the city by depriving it of the benefits of later and more improved practice. Where there is an agitation for underground conduits the city's officials should be shown the practical general advantage of leaving the details of construction to the companies themselves, as it is the company's property that must be protected in the ground and preserved in the most effective manner.

In Oakland the conditions were in many ways ideal for the construction of an underground system. There was very little existing underground service, and there were very few pipes, because the Oakland Gas Light and Heat Company had practically had a monopoly of the field. Oakland's streets were not filled with a miscellaneous assortment of many sorts and conditions of pipes, as was the case in San Francisco. And that part of Oakland effected by the underground ordinance was built on high ground, so that in most places the system could be connected with the sewers.

Conduits in Course of Construction

The field being clear, the next consideration was the choice of that type of underground system best adapted to the requirements of the locality. There are two distinct types of underground electrical construction. In one the conductor and its container is one and the same structure. In the other the con-

A Mass of Poles and Wires on Broadway at Eleventh Street

ductor with its insulator and the protector for its insulator are held separate from the underground system. The first mentioned type is known as the "solid" system and the second as the "draw-in" system. The commonest example of the "solid" class is the Edison tube system, which is so largely used in England.

In the "solid" system the conductor is laid in a metal or wooden container and then surrounded by insulating material. The objection to this method lies in the fact that in the case of a burn-out the street must be opened at the point of the burn-out so that the repairs may be made. With the "draw-in" system, should a cable burn out, it is only necessary to withdraw the faulty length from the ducts and replace it with a length of new cable. In the United States the "draw-in" system has become standard, and all underground systems in this country are built on that principle. The "draw-in" type was therefore selected for Oakland.

The only remaining feature to be decided was the selection of the types of conduit and manholes to be used. There are many types of conduits, varying slightly in detail, but essentially they may be divided into four classes—those of vitrified clay, fibre, wooden ducts, and iron pipe.

The wooden duct as installed by the Mutual Electric Light Company of San Francisco was extremely satisfactory in the item of first cost, but since its installation it has been found almost impossible to withdraw a cable from the duct because of a burn-out or for any other reason. So the wooden duct may be eliminated.

The Same Scene, after the Underground Conduit Took the Wires

The iron pipe has certain advantages in that it is flexible, can be bent round obstructions, and is not very expensive. But it has certain disadvantages: it is subject to electrolysis, it rusts out, and it is sometimes difficult to keep the interior surface smooth enough to avoid breaking or injuring the sheath of the cable which has to be drawn through it. Therefore the use of iron pipe has been confined to special cases. It is used almost entirely for service pipes leading into buildings, for pole risers, and occasionally for connections between manholes on opposite sides of streets where there is a railroad track or other obstruction to the laying of a vitrified duct.

A choice is consequently limited to the so-called paper conduits and the vitrified ducts. The paper conduit as made today is very much better than the conduit available at the time that the Oakland underground was constructed. Paper conduits are now being used very extensively in eastern cities for underground systems. They are light, easily handled, and can be laid cheaply. But they are not so permanent as vitrified clay ducts, and at the present time on the Pacific coast they are not even as cheap, because the difference in price by the foot between the paper duct and the clay duct is more than offset by the cost of transcontinental transportation. Clay ducts are easily available because they are manufactured in California. All vitrified clay duct used for the Oakland work was made in this state.

For manholes and service holes the choice lay between brick and concrete. Some of the Oakland manholes are built of brick, and some of concrete. In general the concrete manholes will be found the better, but under certain conditions it is sometimes easier to construct a manhole with brick walls.

A vitrified clay duct line, with reinforced concrete manholes, was considered best for Oakland purposes. The next problem was whether to lay multiple duct, or a number of single ducts, or a combination of both. Multiple duct, up to a four-way duct, is cheaper to lay, but in laying multiple duct it is impossible to stagger all of the joints. For instance, take a case of laying two two-way multiple ducts. Although two-way ducts can be staggered there will always be a point exposed between the two holes in each piece of two-way duct. If four-way ducts were used there would be four holes where the joints were not staggered.

The principle necessity of not having joints opposite each other is to prevent a cable burn-out from affecting adjacent cables. At the same time it would be very expensive to have all single ducts. For these reasons single duct, with staggered joints embedded in concrete, was laid in Oakland for all primary cables, and for the secondary cables two two-way multiple ducts. Laying two two-way multiple ducts in place of one four-way multiple duct permitted a division of the ducts as they approached the manhole, allowing the cables to be laid neatly as they enter the manhole.

The underground district in Oakland as described by the ordinance takes in Washington street and Broadway, and all of the east-west streets lying between Washington street and also San Pablo avenue, Broadway, and Franklin street from Seventh to Fourteenth, and also San Pablo avenue, Broadway, and Telegraph avenue as far north as Seventeenth street. This ordinance became effective in 1906, and allowed three years for removing the poles and wires from the several districts. This period expired in July of the present year. But all of the company's work was completed within the time limit, as was the case in other work in former years. In fact, the company has installed more underground system than the ordinance required. It has built its duct lines as far north as Twentieth street and has recently installed duct lines on Franklin street from Seventh to Fourteenth streets, and on Sixteenth and Eighteenth streets from San Pablo avenue to Telegraph avenue. And it is completing the installation of duct lines on Tenth street from Washington street to Clay street.

Unquestionably the placing of wires underground is to be desired, both for the city and the company, the only handicap being the enormous expense.

The underground ordinances are generally made under the police power of the governing body. They usually start with the declaration that the overhead wires are dangerous and a menace to life and property. As a matter of fact this is not a fair statement of conditions. Statistics show that there is very little loss of life or property caused by overhead wires. But there is an objection to overhead wires on account of their interference with firemen when fighting fires. The main consideration is generally only that of appearance. Unquestionably a city and its buildings look better without the presence of poles and overhead wires.

Fortunately some of the photographs taken in the business district of Oakland prior to the removal of the poles and wires were saved from the San Francisco fire. These and some photographs taken since the poles and wires were removed are reproduced in illustrating this article, and show the improved appearance of the streets.

An illustration is also included showing the method of constructing a duct line. In this picture it will be noted that great care is taken to open the trench from manhole to manhole so that the proper grade may be established.

This subject of underground work draws very forcibly to the attention the fact that the placing of poles in business districts should originally be avoided as much as possible. Where it is absolutely necessary to place them great care should be taken to have them neat in appearance, well painted, and with as few service drops therefrom as possible.

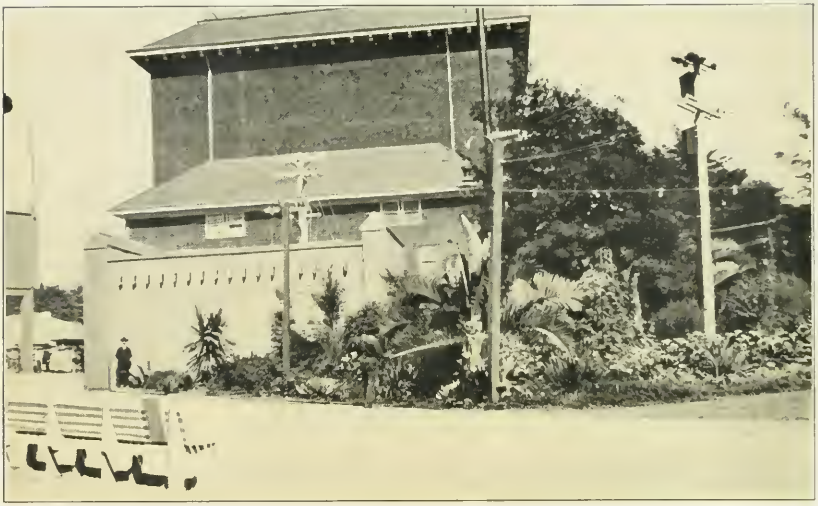
Those who care to go into the details of underground construction may profitably read Louis A. Ferguson's article on the subject (May 22, 1899), and also Mr. Hancock's article (May 24, 1904), which were presented before the National Electric Light Association.

## The First Electric Locomotive

The first electric locomotive, according to a description published in the London Times of December 10th, 1842, was sixteen feet long, seven feet wide, and propelled by eight powerful electro-magnets. The battery used for supplying the power was composed of iron and zinc plates immersed in dilute sulphuric acid. These plates were fluted to expose greater surface in a small receptacle. The weight of the entire locomotive was about six tons, including the four wheels on which it moved. On each of the two axles was a wooden cylinder to which were fastened three bars of iron at equal distances from one another and extending from end to end of the cylinder. On each side of the cylinder and resting on the carriage were two powerful electro-magnets. When the first bar on the cylinder had passed the faces of two of the magnets the current of galvanism was then let on to the other two magnets. By alternately cutting off and turning on the current one bar after another would be attracted, and this making and breaking of the circuit was simply accomplished by a part wood and part copper cylinder device at each end of the axles. This first electric locomotive attained a trial speed of a little more than four miles an hour and ran a whole mile and a half.

# Lighting and Power Installation at Idora Park, Oakland

*By* C. J. WILSON, Superintendent Electrical Distribution, Oakland District.

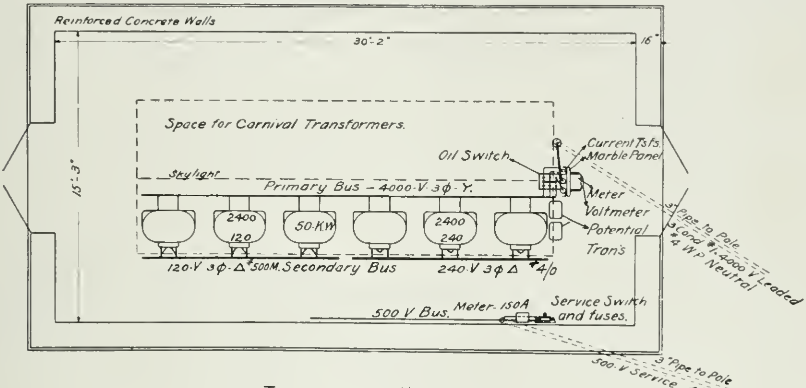


View of Idora Park Transformer House and Terminal Pole

AT the opening of Idora Park, May 3, 1903, the Oakland Gas Light and Heat Company installed a primary 2,300-volt single-phase circuit from the Temescal substation, to supply approximately a 100-kilowatt lighting load. The power load was taken care of by tapping a 500-volt trolley feeder, which supplied about 75 to 100 horse-power direct current. Owing to increase of the Idora load due to added concessions, the single-phase primary and trolley tap became inadequate, and it was necessary to string a three-phase 4,000-volt primary from the Temescal substation to Idora; also a separate 500-volt metallic circuit feeder. This was done in July, 1907. The diversity of load required 110 and 220 volts alternating current single-phase for incandescent and multiple arc lamps, and 220 volts for three-phase and 500 volts direct current for motors. Emergency lighting was provided for by using series of incandescent lamps and arc lights on the 500-volt direct current service.

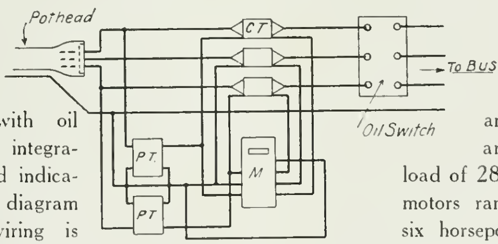
The primary circuit consits of four No. 4 weatherproof wires connected for 4,000-volt, three-phase, four-wire star from the Temescal substation to the terminal pole near the transformer house. The transformer house is located at the rear of the theatre building, near the centre of electric distribution in the park. A plan of the transformer house is shown in detail. The inside dimensions are 30 feet 2 inches x 15 feet 3 inches, with a 16-inch reinforced concrete wall 10 feet 6 inches in the clear. A large skylight gives excellent illumination. Floor space is provided for twelve 50-kilowatt pole-type transformers without crowding. Six transformers are now in use.

From the terminal pole to the transformer house, a three-conductor, No. 1, 4,000-volt, leaded cable was installed in a three-inch pipe, together with a No. 4 weatherproof neutral. This cable was potheaded at the pole and in the transformer house. G. E. expulsion type primary cutouts were placed on the pole and an oil switch on the panel inside.




TRANSFORMER HOUSE.

Panel equipment consists of an 18-inch x 54-inch x 2-inch marble panel, with oil switch, polyphase integrating wattmeter and indicating voltmeter. A diagram of the meter wiring is shown herewith.




METER WIRING DIAGRAM

The direct current feeder consists of two No. 4/0 weatherproof wires from the Temescal substation to the terminal pole, thence under-ground to the transformer house, with a No. 4/0 R. C. flexible cable in a three-inch pipe. Disconnecting copper-fuse-links are on the pole, and standard 600-volt cartridge fuses and 200-ampere switch are inside. The meter is 150 ampere TRW Type C6.

Referring to the drawing, it will be noted one bank of transformers supplies a 240-volt, three-phase delta bus for induction motors and 220-volt lamps. The other bank supplies a 120-volt, three-phase delta bus used for 120-volt lighting. The secondary distribution is over three-phase circuits and accurately balanced. The installed capacity at Idora is sufficient to supply 10,000 incandescent lamps, seventy arc lamps and sixteen flaming arc lamps on a motor load of 280 horsepower, with motors ranging from one to six horsepower. Additional transformers are installed for special occasions. The supplementary State Fair at Idora Park in September and October of this year will require about 300 kilowatt additional capacity.

Recording voltmeter charts taken at transformers show a maximum of 235 and minimum of 230 volts, or about 2.2% voltage regulation. Distributing circuits were designed for about 2% drop from the transformer to the most distant lamp.

## San Francisco News as Published in 1866

### Citizen's Gas Company

The legislature of 1862, on the second of May, granted to Eugene L. Sullivan, Nathaniel Holland, and John Benson, a franchise to lay pipes through the streets of the city of San Francisco, for the purpose of supplying the citizens with gas; the franchise extending over a period of fifty years. Shortly after the granting of this franchise, the company was organized by the filing of articles of incorporation with the county clerk and the secretary of state. The articles of incorporation were signed by Eugene L. Sullivan, Nathaniel Holland, John Benson, R. E. Brewster, John Bensley, E. R. Sprague, John A. McGlynn, James Brennan, T. Maguire, Wm. Sherman, A. C. Whitcomb, D. Northrope, W. F. Williamson, and Alfred Barstow. They placed the capital stock at $2,000,000, divided into shares of one hundred dollars each. As soon as the company was completely organized an agent was dispatched east for the purpose of purchasing pipe and material for the erection of the works. An arrangement was soon effected with John P. Kennedy, a well-known erector of gas works in New York, to furnish the plans and take the superintendency of the erection of the works. The company having purchased between two and three 100-varas of land fronting on the bay at the junction of Townsend and Second streets, work was begun early in the fall of 1863, and has been vigorously pushed to completion. B. P. Brunner has been elected the permanent superintendent of the works.

It is thought that the company will begin to furnish gas about the first of January next. One of the provisions of the company's charter makes it imperative that gas be furnished at a cost of not more than six dollars the 1,000 feet. The outcry made against the San Francisco Gas Company in 1862 by San Franciscans was, probably, the origin of the company; but be it what it may, the fact that it will be of vast benefit to the citizens of this city can not be doubted, for the healthy competition which will result from the struggle of the two companies to furnish light must have the effect of materially reducing the price.

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The play was bum without a doubt,
  And for applause got jeers.
Then gas and 'lectric lights went out,—
  Left empty seats in tiers.

---

"What does this mean? Why all these blankets up at the windows and the gas burning in the daytime?"

"Sh! it's a scheme of mine."

"What's the scheme?"

"Why, my wife 's in the country. I wrote her I stayed home every night and read. I 've got to use up enough gas to make a showing on the bill."

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A water tower consisting of scaffolding 100 feet high surmounted by a tank twenty feet in diameter and sixteen feet deep recently buckled up and thrillingly collapsed at Vermilion, South Dakota. The weakness lay in the fact that the foot-square timbers used for the uprights were all spliced about fifty feet from the ground, a decided joint being thus formed in the construction.

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Under the law in New York when a consumer complains of his gas meter and wants it tested, the commission has the test made. The gas company must pay the expense and install a new one if the meter be found running fast; while the consumer must pay the cost if the meter be found correct or running slow. Of 3,460 meters thus tested in two years the company had to pay $752 and the consumers $1,129.

# The Company's New Home

*By* ARCHIE RICE

AFTER a family gets established in a fine new house there is nothing then to indicate how humble may have been the abode to which it was accustomed. And the children, if they have snobbish social aspirations, make no mention of the old shack and its missing bathroom.

Although the Pacific Gas and Electric Company is a sort of big family of several thousand employees there is none of that sensitiveness about the humble appearance of some of the places it has called home. When it moved up from "south-of-Market" and entered its stylish new building on Post street, just above Powell, it went through the old form of getting into a more fashionable neighborhood and away from the smell of the gas works. Then pride and the building had a terrible fall, because the earthquake and fire left not even the conventional cross to mark the spot where that palatial Post-street home had stood.

First Week After the Fire—Residence of C. W. Conlish, Oak and Broderick Streets

When the fire was finally stopped at Van Ness avenue, after it had seared off the face of the earth nearly three thousand acres of buildings and more than $400,000,000's worth of property, social and financial planes in San Francisco had suddenly ceased to exist, and refugees from the blackened desert were glad enough to get any kind of shelter in the zone of standing buildings that the flames had not reached.

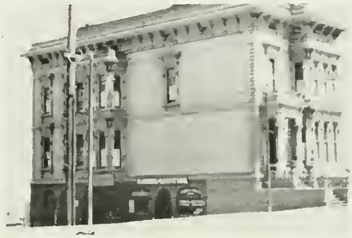
The Pacific Gas and Electric Company was a refugee, and it took whatever it could get as a temporary home, and moved from place to place till it finally secured a convent as a highly appropriate and commodious abode for a large family that was ever but silently expounding the scriptural dictum "Let there be light." The houses that were homes to the company during those first few months of confusion and crowding are shown in small photographic views illustrating this article. And the convent where the company spent three years of its life is displayed in larger style. In the spacious inner garden of that rented place were unconsciously formed noon-hour habits of recreation in the fresh outdoor air. That accidental experience prompted some of

Second Week After the Fire—Old Haight-street Branch Office of San Francisco Gas and Electric Company the pleasant features incorporated in the plans and equipment of the new home, which this luminous family, after being accustomed to a religious environment in the convent, erected downtown on Sutter street, directly opposite the largest synagogue on the western side of tthe continent.

The new office building, as the illustration indicates, is six stories high, and it has a big basement and an equally large flat roof, neither of which the picture shows. Down in that basement is a bathroom with a porcelain tub, hot and cold water, and other conveniences for the special use of engineers as they come in dusty or travel-stained from their trips to outside stations. And up on that great flat roof, which is protected all around by a breast-high wall, there is to be a sun garden and open-air observatory where the women employees may spend part of their noon hour in the fresh air but sheltered from the brisk sea breezes by walls of glass. There will be no obstruction of the panoramic view of nearby Union Square, the St. Francis Hotel, and the traffic of Powell and Sutter streets, and the sweeping outlook to such conspicuous points of interest as Twin Peaks, the Sutro forest, Nob Hill, Yerba Buena island, and the Oakland mole. Between the broadside effects of downtown skyscrapers glimpses will be caught of the bay and its shipping.

Third Week After the Fire —Residence of William Ham Hall, Haight St., Near Webster

The whole ground floor of this new building is one huge room, so well lighted by many windows that it is lighter than day itself, and so studded with hundreds of powerful incandescent globes along its lofty beamed ceiling that night can not detract from the whiteness of its walls. On first appearance this room suggests a big bank. It is the main business



Fourth Week After the Fire—Southeast Corner O'Farrell and Franklin Streets

office of the local gas and electric company, where the public goes to pay its bill.

On up through the building, floor by floor, are located the various departments and the private offices of their chiefs, until on the sixth floor at the back are the real "higher-ups" of the corporation, the little group of men who direct the forces and consider the plans that must keep in prosperous operation this combination of many gas and electric companies and water companies scattered over the whole middle third of California, from the snow-crested evergreen Sierras down to the sunset sea, and from centre to centre of the two great inland valleys of the golden state.

In this building are the personal forces that control the water power of the distant moun-

Second Month After the Fire—Loughborough Residence, Northwest Corner O'Farrell and Franklin Streets

The Convent at Franklin and Eddy Streets, the Company's Home for Three Years, from the Second Month After the Fire until the Removal to its Own New Building

tains and augment or lessen the flow that shall be turned to produce electric energy to be conveyed on down the slopes and across the valleys by great power lines extending more than 200 miles and serving current to upward of three score of industries in big and little communities from the coast back into the mining camps of the far-distant mountains. The gushing waters from melting snows on the mountain summits is made finally to contribute its force to operate man-made machinery and help dig the hidden yellow riches from the base of the mountain itself.

Every new device planned to save time and confusion in the operation of a great business enterprise has been installed in this new building. It has its own telephone system, with scores of special lines to outside stations. It has machines for rapidly printing the name and address on bill envelopes to go to 90,000 local addresses every month. It has its own postoffice, where all letters intended for any of the subordinate companies first come unstamped and then are made up into bunches and sent out for much less postage than a stamp on each envelope would have cost. This one feature saves at least $100 a month in postage. There are many machines like phonographs, and into the mouthpiece a man may talk his dictation for letters. Later a stenographer will receive the wax-like cylinder, put it on another machine in a room apart, and, listening to the repeated talk, rapidly reproduce the words in typewritten letters or memoranda. There are several sets of a wonderful new device called the dictograph, really a further development of the telephone to permit all sounds in one room to be heard distinctly in another at a distance, thus making possible easy, natural conversation between persons in different private offices of the big building.

Every floor has its roomy fire-proof vault for the protection of valuable papers: the fire taught its lesson. And every floor is fairly flooded with daylight that streams in through so many outside windows that it is the company's boast that it has the best naturally lighted office building in San Francisco.

At the back of the third floor is a large assembly room for meetings, for stereopticon lectures, and for the periodical sessions of the gas and electric associations of the west. In this room will be located a collection of books on gas and electricity, said to comprise the finest technical library of the kind in the world. Next to the library is the editorial room of the magazine that the company publishes for all its employees.

A rest-room and a lunch-room have also been provided on this third floor, for the use of the women employees and the telephone girls. These leisure rooms have some of the comforts of a home, with the conveniences of little gas ranges and handy sinks. On the different floors are coat and hat rooms, with individual metal lockers.

Such is the new home of the Pacific Gas and Electric Company, the executive headquarters of a corporation made up of many companies and employing several thousand men and women in the operation of water and gas and electrical properties representing a total investment of the enormous sum of $90,000,000.

## What the Employees Gave Mr. Britton

THE afternoon before John A. Britton started for the orient he summoned the heads of departments to his office for a conference, and then simply bade them good-by, wished them good luck, assured them of his confidence in their work, and suggested that every one in the company learn to act more on his own initiative. In return he was probably as agreeably surprised. Some one handed him a little pamphlet bound in limp brown leather and containing the autograph endorsement that day of between 200 and 300 persons to the following expression:

San Francisco, August 23, 1909

**To JOHN A. BRITTON**

*President of the San Francisco Gas and Electric Company*
*Vice-president and General Manager of the Pacific Gas and Electric Company*

On the eve of your departure for a recreation trip to Japan, we, at the San Francisco headquarters, of the widely scattered army of several thousand people in the great corporation that you direct, wish you a most healthful, enjoyable, and thoroughly care-free vacation. And to help make it so and that you may leave all business anxieties behind, we want you to know that each of us will do his duty just as conscientiously as though you were still here, and in addition will put forth a little extra effort toward co-operation to compensate somewhat for the temporary loss of your effective executive supervision and leadership.

# Whispering at Long Range

## The Dictograph and Its Uses

*By* SIDNEY P. SKOOG, Electric Service Department.

THE word "dictograph" gives a wrong impression of the purpose of the wonderful new device that bears that name. The title suggests some sort of a dictating machine or phonograph, possibily to facilitate letter-writing. But the dictograph is really a marvelous improvement upon the telephone. It is a little contrivance having telephonic wires running to different rooms in the same or in neighboring buildings, so that any person in one of the rooms may carry on almost a whispered conversation with one or many of the other rooms without having to talk into or listen at the machine. When the circuits are opened voices and other sounds are so intensified and magnified that a person in using the dictograph may go on about his work in his room or pace the floor and still carry on a conversation, even with his back to the inconspicuous little machine. As he talks he can hear his own voice just as it is sounding in the distant room. The whole system is intended for instant and confidential dialogue, especially between the heads of departments in great corporations, where privacy and time-saving are so desirable.

The whole contrivance is simply the development and adaptation of the principle of a familiar little device worn by deaf people. Some theatres have these sound-magnifying instruments near the stage, with wires to certain seats where there are tiny ear-pieces for the use of deaf patrons.

Several sets of dictograph instruments are installed and regularly in daily use in the new office building of the Pacific Gas and Electric Company on Sutter street in San Francisco. Some of them were latterly used in the old convent building temporarily occupied as the company's executive headquarters down to the time of the completion recently of the new building in the burnt district of the city. Their service was so valuable in providing instant conversational intercourse between the heads of departments that the system was greatly expanded in the equipment of the new building. In an instant, by a slight touch on different little levers, a department chief having in his room a master station may open up private conversational channels with as many as twenty of his subordinates and talk to all of them and have all of them hear one another's remarks at the same time, thus gaining all the advantages of a conference without the delays of personal visiting.

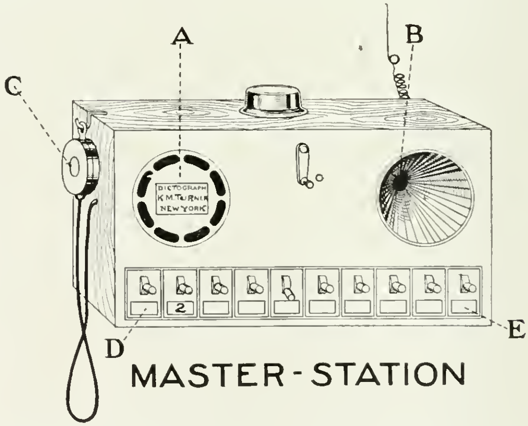
A dictograph system consists of one master station and any number of substations. Ordinarily a master station is provided with connections for ten substations. The master station is a small box-like object only about a foot long and half a foot square, and may be left lying on a table or kept inside a roll-top desk. The master station is provided with tiny press-levers that open the line to and instantly ring a summons at any particular one of the substations. A substation instrument is a much smaller and simplier device, somewhat resembling the little telephone boxes used in hotel rooms. From a substation instrument communication can be had only to the master station and no further, unless the person using the master station instrument choose to open some other substation channel and permit the conversation to reach there also. If a room have two or more substation instruments each naturally wired to its own master station then it becomes possible to open up communication to as many branches as may be desired. This is done simply by the person at a master station instrument pressing down such keys as may be necessary to let any or all of the other substations get in on the conversation. In this way each group of substations can be instantly connected up as a whole or in part with another master station or any of that other master station's branches. The number of persons that can thus be brought into the conversation or made listeners to the dialogue of any two or more talkers could be almost indefinitely expanded. By placing an ordinary telephone near one of the dictograph instruments and leaving it off the hook, a listener miles away might be added to the list.

The Pacific Gas and Electric building has seven master-station and more than sixty substation instruments. Four master stations with ten keys each are located on the ground floor, or business office. These are for the bill clerks and those at the complaint counter to talk with any bookkeeper on the second floor of the building and instantly verify some item. One master station with twenty keys is installed in the office of the vice-president and general manager on the sixth floor, his substation instruments being in the offices of the heads of the various departments. And another twenty-key instrument is installed in the adjoining office of the assistant general manager, with direct lines to substation instruments in the offices of all the department managers and in the engineering department. A master station with ten keys is in the private office of the treasurer and comptroller. The two twenty-key master stations in the offices of the general manager and the assistant general manager and the ten-key master station in the treasurer's office are all so arranged as to permit intercommunication whenever desired.

To be exact the size of a master-station instrument is 12x9¼x6¼ inches, and one of the ordinary little substation instruments is only 4¾x3¼x2¾ inches. The instruments are mounted after the manner of desk telephones. The battery strength required for each master station and its set of substations is produced for the talking circuit by two dry-cell batteries connected in series measuring three volts, and for the ringing or calling-up circuit by four dry-cell batteries measuring six volts.

As a delicate instrument of extreme sensitiveness the dictograph is free from all the objections generally associated with any device for electrical intercommunication. The one master-station and its substation instruments installed at the convent building before the removal to the company's new home were operated successfully without interruption or repairs during the entire period of nine months.

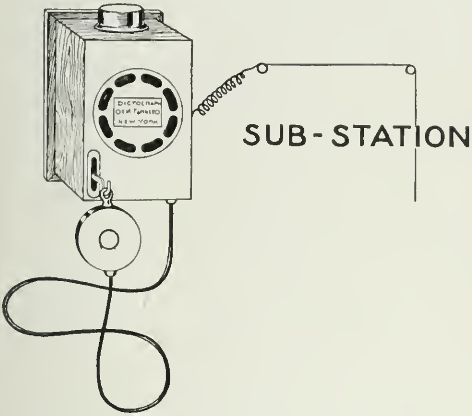
The accompanying drawings illustrate the appearance of the outside of a master- and of a substation instrument. The tiny projections shown along the front of the master station, the ten little levers between D and E, are the keys that must be pressed down to open communication with any desired substation. It will be noted that the fifth key is down, showing that the circuit is open to that room. The room number or the name of the department




MASTER-STATION

or person may be put in the little space under each key.

The sound enters an orifice, A, in the master station instrument and is reproduced




absolutely and in exactly the same tone and intensity at the other end of the line. The transmitter diaphram inside that orifice is as sensitive as the human ear in its detection and recording of sounds. The instrument has the power of magnifying sound to four times its original volume. As soon as the circuit has been opened to a substation by the depression of one of those little keys, the circuit is opened up, and any sounds that are being made in the room where that substation instrument is located are then distinctly heard by any person within a few yards of the master-station instrument. These sounds issue from another orifice, marked B in the diagram. This part of the instrument is called the loud speaker, and in some cases it is contained in a small separate box. A person anywhere within twelve feet of the master-station instrument may hear the voice or any other sound in that room coming right back from the distant room. He may also hear a clock ticking in the distant room or some one moving about just as clearly as though he were there too. A buzzer announces that the master station is calling for a conversation, and the sound of the buzzer buzzing in the distant room comes back clearly. If it be desired to keep the conversation so private that only two persons may hear the whispered discourse, the person near the master station has only to remove a small side disc, indicated as C in the diagram, and also shown on the smaller instrument, and then he and the person at the substation may stay close to their instruments and whisper to each other in so low a tone that listeners a yard from them could not even hear the whispers. There is no possibility of any one's coming in on the line and listening, as the person at the master station absolutely controls the channels of communication.

This verbal explanation does not adequately present the wonderful usefulness and mystifying mechanism of the dictograph. To be appreciated the instrument must be seen and tried.

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The separate wires carried in conduits under the streets of New York city would reach twenty times around the earth. There is more than $12,000,000's worth of copper wire in New York's underground systems, and some of the big single cables carry 1,000 wires. That is not all: through similar underground passages rush daily about 480,000,000 gallons of sparkling water for domestic uses, one part of this enormous supply consisting of 325,000,000 gallons a day brought from a clear mountain lake in two aqueducts, one of them bored through rock and earth for twenty-eight miles. New Yorkers pay $11,000,000 a year for their drinking water. But then New York is some city. It has 3,200 miles of streets, $1,500,000,000's worth of public parks, nearly 10,000 policemen, and more than 16,000 school teachers.

# Keeping High-Tension Apparatus Outdoors

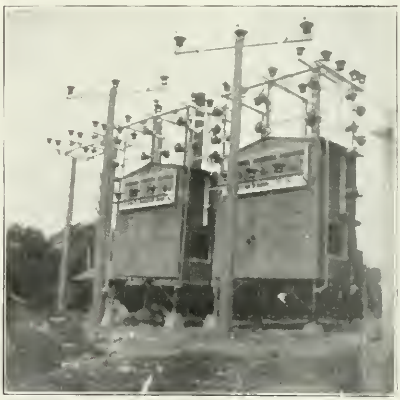
*By* C. H. BRAGG, Operating and Maintenance Department.

EVERY experienced high-tension engineer has, no doubt, had experiences which have caused him to decide that the best place for high tension switches and wires is out of doors, where walls, ceilings, and barriers offer no obstruction to the arcing current.

A brief review of the development of construction methods for the past ten years calls to mind wooden buildings, housing high-tension apparatus and wires, supported on wooden crossarms and brackets. This did very well until something "went wrong" and burned up apparatus and building, and incidentally caused a serious interruption to the service. An object lesson or two in this kind of workmanship called for attempts at fireproofing by making the buildings of non-combustible material, such as brick or corrugated iron, but still there was considerable woodwork adjacent to the high-tension wires. This was not satisfactory. Then it was demonstrated that nothing but non-combustible material should be used throughout, and so a radical change was made. Terra cotta hollow tile, and, later, reinforced concrete were introduced to make bus-bar compartments and barriers to group in sections the high-tension apparatus. This proved to be an effective means of preventing the spreading of arcs, but presented a sorry sight after the arc had been suppressed. In spite of this excellent fire-proof construction and in spite of the rugged design of the switches and apparatus, the handling of large quantities of energy exceeds the "elastic limit" of something or other at times, and the aftermath is a heap of molten copper, glass, and broken porcelain. The station which was yesterday trim and neat, even spotless in its white paint, is today black, shattered, and scarred from burning oil and intense heat. This has been the fate of many a station—so many, in fact, that an axiom of the profession might be written, "Put as little high-tension wire in the building as possible."

That the out-door practice is being gradually approached is indicated by the switch-house recently erected at Santa Rosa. It consists of an angle iron frame supporting air switches and an oil switch, housed in, the entire structure and apparatus being self-contained and capable of being erected anywhere.

An inspection of the accompanying illustration shows that the tendency is not only to separate the apparatus but to place it out of doors, as much as its design will permit, in order that trouble on one section may not be communicated to another. The damage resulting from an arc can be easily repaired and painted.



The Outdoor Switchhouse at Santa Rosa

Another indication that the present trend is toward out-door construction is evidenced by the fact that already some companies have undertaken this step and are actually operating the high-tension oil switches out of doors. From all reports it is quite as satisfactory as the present indoor and semi-outdoor construction, both from operating efficiency and original cost. So far, as near as can be ascertained, the cost of the out-door construction is somewhat less than the latest indoor construction—although in this connection it should be emphasized that the question of first cost should not enter into this portion of the equipment with too much influence. The final step in placing the high-tension part of the electrical equipment out of doors hinges on the development primarily of the high-tension oil switch and of the current transformer. These must be so constructed that they will operate out of doors in rain, sleet, and snow in winter and in dust and fog in summer, without a single failure from any cause.

When this is accomplished the troubles of the engineer will be somewhat lessened with the resultant improvement to the service.

# Electric Distribution

*By* S. J. LISBERGER, Engineer of Electrical Distribution.

The distribution departments have been very busy in revising the standard specifications for overhead light and power work that were first adopted and put into effect May 1, 1908. These specifications have been thoroughly revised, and many suggestions made by the various operating forces have been embodied in the new specifications. These new specifications will be ready for distribution before October.

The distribution system in San Jose is undergoing radical changes. More than 30,000 duct feet of clay tile has been recently installed for the new underground system. This will allow the removal of all overhead wires in the most important business sections of the city, and will greatly improve the appearance of the streets. The overhead system is also being given a general overhauling, which is resulting in a great improvement in the service.

Many managers, in looking for new business, will be glad to note the following clipping from a German newspaper:

"The Saxon authorities have discovered what would seem to be an excellent way to put an end to the caterpiller plague. They have discovered a method to catch the brown moths that lay the eggs from which the caterpillers come in enormous quantities.

"They make use of what they call the 'Electric Light Trap.' This consists of two large and powerful reflectors placed over a deep receptacle and powerful exhaust fans. This 'trap' has been erected on top of the electric lighting plant. At night two great streams of light are thrown from the reflectors on the wooded mountain sides, half a mile distant. The results have been astonishing. The moths, drawn by the brilliancy, come fluttering in thousands along the broad rays of light. When they get near to the reflectors the exhaust fans take up their work, and, with powerful currents of air, swirl them down into the receptacle. During the first night not less than three tons of moths were caught."

To those who have no caterpillars in their district it would seem that the same method might be applied to some other insect pests.

# Irrigating Fourteen Thousand Acres of Hillside Orchards

*By* W. E. LININGER, Auburn Water District.

THE irrigation system of the South Yuba Water Company is largely the result of the passing of the mining industry.

In the early 50's the Bear River Ditch Company constructed a canal about 50 miles in length from a point on Bear River about three miles above Colfax to a point near Newcastle, and from that point constructed several smaller distributing ditches for the purpose of supplying water for mining purposes. The control of this company passed through several different stages before, in 1876, it was purchased by E. Birdsall.

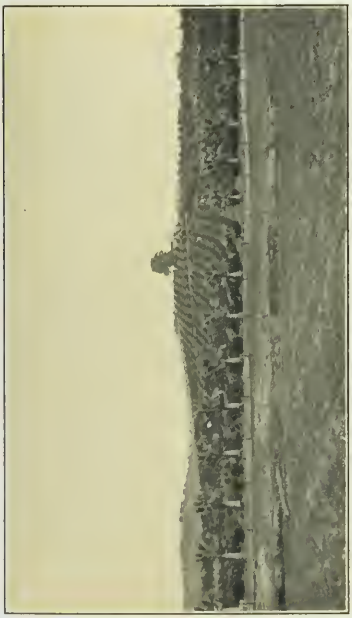
Up to that time irrigating had not been considered a factor in the water business. A few of the people, however, irrigated small garden patches and a few trees and vines, the product of which was marketed principally among the miners in adjacent towns.

Those pioneers in the fruit business demonstrated two facts: first, that the climate was ideal, and second, that with water for irrigation deciduous fruits could be grown to perfection and at a profit.

The gradual working out of the placer mines about that time rendered it necessary for many people to seek other means of livelihood and, the cities on the Comstock lode and other mining towns in the State of Nevada affording good markets, a large number turned their attention to horticulture. The demand thus created for water soon became greater than the Birdsall company was able to supply during July, August, and September, as it had no storage and was entirely dependent upon the natural flow in Bear River, which was very low during these dry months.

The South Yuba Water Company, which

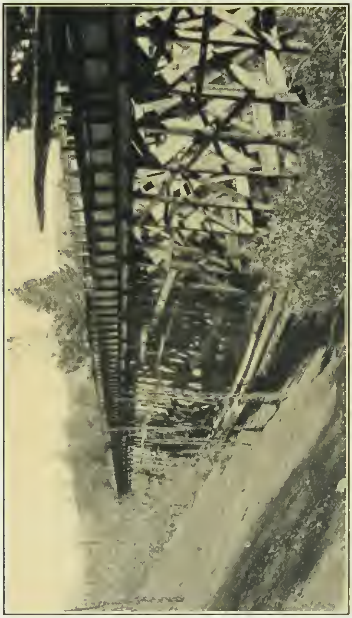
Lake Arthur Dam During Construction



An Irrigated Orange Orchard upon Undulating Hills near Loomis

Three Square Miles of Orchard Irrigated near Loomis

Section of South Yuba Canal



Flume and Pipes near Gold Run

up to that time had been operating only in Nevada county, and, prior to Judge Sawyer's decision in the debris cases, had derived a large part of its income from the sale of water to the hydraulic mines, had built or acquired a number of storage reservoirs. Among them were Lakes Fordyce, Meadow, Sterling, Cascade, and others, to provide an ample water supply during the whole of the year. The effect of the Sawyer decision, closing nearly all the hydraulic mines, left the South Yuba company with a bountiful supply of water for which there was no sale, and also cut off the greater part of the company's revenue. During the last few years of the Birdsall ownership of the Bear River Ditch considerable quantities of water were therefore easily purchased by the Birdsall company from the South Yuba company during the later months of the dry season.

This state of affairs did not prove satisfactory, and in the year 1890 the South Yuba Water Company bought the Bear River Ditch properties and began a systematic development of the irrigating system.

The constantly increasing demand for water, necessitating an increase in ditch capacity and storage, resulted in the reconstruction of the Boardman Ditch from Bear Valley to Gold Run; thence in the building of a new system into the fruit district, a distance, by way of the ditch, or 60 miles; also in the building of Lake Spaulding and Lake Van Norden and the acquiring of the Towle water system, including Valley Lake. Now the company has in operation for use in the fruit district of Placer County about 265 miles of ditches, pipes, and flumes and a storage capacity of 1,036,000,000 cubic feet, by means of which it distributes to the growers about 1,800 miner's inches of water each day of twenty-four hours from May 1st to September 1st. This water irrigates approximately 13,500 acres, the consumption being one inch for 5 to 10 acres and averaging about one inch to 7½ acres. The annual product of this irrigated land amounts to about 2,500 carloads of 24,000 lbs. each, 80 per cent. of which is shipped east and north and sold in the fresh state, the balance being either sold for canning

Lake Theodore in the Summertime

or dried. About one acre in three in the district covered by this system is now under cultivation.

The conditions are materially different from nearly, if not all, the other irrigation systems of California, in that the hilly nature of the ground to be irrigated and the distance the water has to be conveyed from the source of supply to the point of distribution renders flooding or the use of large heads impracticable and makes it necessary for each consumer to run a smaller head and use it continuously, shifting it from one part of the orchard to the other as occasion requires.

Taking into consideration the fact that any variation, at the source or along the line of ditch, by reason of leakage in pipes, flumes, or ditch, produces a proportionate variation at the ends of the distributing ditches, it is obvious that it requires the greatest watchfulness and care upon the part of the employees, from the greatest to the least, to the end that each consumer may receive his regular supply from May 1st to September 30th without wasting a considerable quantity of water in the process.

To overcome this, and also variation caused from evaporation arising from differences in temperature, the company has from time to time constructed reservoirs at or near the lower ends of the distributing ditches to act as regulators. These, together with Lake Theodore on the Boardman Ditch and Lake Arthur (just completed) on the Fiddler-Green Ditch enable them to give a very efficient service.

Only once since the writer entered the employ of the company, in 1894, has there been any serious interruption of service. That once was in August, 1905, when a break and slide in the bank of the Bear River Ditch rendered it necessary to transport the material 13 miles and build 450 feet of flume, 5 feet wide and 5 feet deep. This was done and the water turned in again in ten days' time.

## Natural History Pole-Line Troubles

A big gray tree-squirrel ran up an electric-power pole at Spencerville, several miles below Grass Valley, Nevada county, August 22d, and stepped on two wires at once. The little animal's body short-circuited the line. There was a flare that burned the wire in two. One end fell sputtering to the ground and started a forest fire, but fortunately the blaze was early discovered and subdued. That squirrel will never climb another pole: he is dead.

Not to be out-done, a big owl, carrying a rabbit in its talons, flew against an electric-power wire near Kennet, Shasta county, the night of August 25th, short-circuited the line, and put about 200 miles of electric lighting service out of commission for a quarter of an hour. The rabbit got roasted to a turn. The owl may be a wise old bird, but this one has been a dead one ever since that shocking experience with the bunny.

In parts of Texas, Arizona, California, Tennessee, old Mexico, and other sections of the southwest woodpeckers have done great damage to telephone and telegraph poles by boring innumerable small holes and a good many nest-size large ones in the wood, in some localities as high as forty per cent. of the timbers being weakened by this honeycomb work. Various preventatives have been tried, but thus far the most effective is creosote, in which the pole is immersed and soaked. This stops the attacks of the woodpeckers and also preserves the wood from moisture and decay.

# BIOGRAPHICAL SKETCH

## JOHN ALEXANDER BRITTON

Vice-President and General Manager Pacific Gas and Electric Company

### AN APPRECIATION

*By* E. C. JONES.

IT IS a pleasure to write of a successful man who has advanced from early boyhood to splendid manhood, and has reached by his own unaided efforts the highest position in the gift of his chosen profession.

His busy life of 54 years has been an open book, on every page of which is written a worthy ambition and its realization.

Born in Boston, Massachusetts, October 9th, 1855, of good stock, his father having served his country with honor in the Army of the Potomac in those dark days from 1861 to 1865, John A. Britton attended the public schools in the town of Roxbury, Massachusetts, until he was 13 years of age. In those days he was always bright and energetic, and he evinced a remarkable musical talent, both vocal and instrumental. And in everything the foundation of the present man was early established in strength and substance.

With the family he left Boston for San Francisco by way of the Isthmus of Panama, March 7th, 1868, and arrived April 2d of the same year. He attended the old Lincoln school in San Francisco, and in May of 1871 entered the law office of O. P. Evans and John Curry, who was later Justice of the Supreme Court. He remained with them three years.

His career as a gas man was begun in May of 1874 when, at the age of 19, he entered the employ of the Oakland Gas Light Company. He began at the bottom rung of the ladder, and mastered every detail of the business in his ascent to the very top. His thirty-five years of activity in the gas business cover a period of great strides in the advancement of the science of gas making. In every one of these advances he took a prominent and helpful part.

John A. Britton has become an honor to his profession by his untiring devotion to its betterment. We in the gas business can all remember when the name of the Oakland Gas Light and Heat Company and prosperity were coupled together by reason of John A. Britton's management and experience. He was elected secretary of the Oakland Gas Light Company in August of 1883, and in August of 1889 he was made president and engineer of the Oakland Gas Light and Heat Company. In November of 1902 he became general manager of the California Gas and Electric Corporation; in October of 1905, vice-president and general manager of the Pacific Gas and Electric Company; and in January of 1906, president of the San Francisco Gas and Electric Company. In the position of vice-president and general manager of the Pacific Gas and Electric Company, he has entire charge of all the industries that go to make up that great corporation from the time the rivers are harnessed in the mountains until the electric current is unbridled into light and power in all the cities and towns of central California. His hand controls the operation of the gas, steam, electric, water, and railroad interests of the company.

John A. Britton is gifted with a remarkably retentive memory. This gift was first displayed

Very Sincerely Your friend
John A. Britton.
August 10-1909.

when as a young boy he essayed the part of Cassius and other Shakesperian characters, and later it was further evidenced in his experience as a public speaker and a toastmaster.

His connection with fraternal organizations is both broad and creditable. He has been elected to the following offices:

July 5th, 1881—Noble Grand of Oakland Lodge of Odd Fellows; August 10th, 1896—T. I. M. of Oakland Council No. 12, R. & S. M.; December 1st, 1900—Master of Oakland Lodge No. 188, F. & A. M.; July 1st, 1901—Commander of Oakland Commandery No. 11, K. T.; April 18th, 1902—Grand Warden of the Grand Commandery of California, K. T.

He is also a member of Oakland Consistory No. 2, A. A. S. R., 32d degree, and of Islam Temple of the Mystic Shrine.

Some of his best work has been in unselfishly adding to the pleasure and happiness of others. The development of his musical talent fitted him to serve as organist and tenor to St. John's Episcopal Church in Oakland from 1877 to 1887.

The course of the Pacific Coast Gas Association, of which he was a charter member, has been guided by him from 1893 until the present time. He has served it almost unremittingly as its secretary, and during the year 1898 he was its president. From 1896 until 1902 he was president of the Athenian Club of Oakland. He is a member of nearly all the prominent clubs in San Francisco, Oakland, and Sacramento, and is also a member of the Elks and of the Sons of Veterans.

His affiliation with technical societies includes a charter membership in the American Gas Institute and membership in the American Society of Mechanical Engineers and in the American Institute of Electrical Engineers.

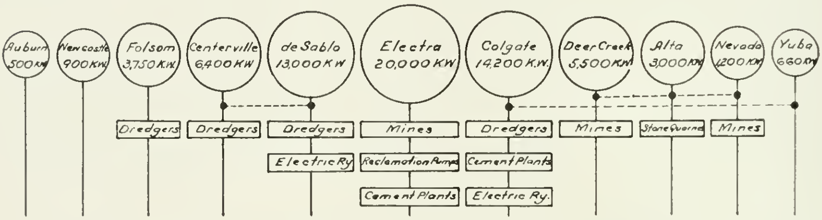
He was appointed a regent of the University of California by Governor George C. Pardee, March 16th, 1903.

In his family life John A. Britton has been particularly happy. He married, July 23d, 1879, Florence Mitchell, and their children are Van Leer Eastland Britton, Mrs. Florence Britton Kellogg, Mrs. Alice Britton Keefe, John A. Britton, Jr., and Emmet Nicholson Britton.

Happy is the man who can call him friend, and fortunate is the boy who reads the lesson of his career and emulates his splendid example, and, best of all, is the love and respect in which he is held by hundreds of employees. He is always fair and considerate, and in his prosperity he never forgets his less fortunate comrades who toiled with him through the early struggles in the gas business.

# Industries Supplied from Hydro-Electric Plants

FROM eleven great sources of power back toward the Sierras comes the electric energy that forms a saleable commodity in which the Pacific Gas and Electric Company deals. This power is supplied to more than sixty different kinds of commercial enterprises. Where it is generated, in what quantities, and its most immediate application are shown in the accompanying diagram, which also indicates how some of the sources are combined from the start but only suggests how the entire scheme is united to distribute power on along the line to scores of industries in and about the big cities.




Amusement parks
Breweries
Brick plants
Boiler shops
Can factories
Chemical plants
City sewerage plants
City water works
Coffee mills
Cooking devices
Cold storage plants
Creameries
Cracker factories
Dental motors
Elevators
Elevator factories
Fans
Feed mills
Flat irons
Flour mills
Foundries
Fruit canneries
Fruit packing plants
Fruit pre-cooling plants
Gas engine factories
Gas works
Glove factories
Grain elevators
Heating devices
Iced cream plants
Ice-making plants
Incubator factories
Iron works
Jute mills
Knitting factories
Machine shops
Mattress factories
Meat cutters
Navy Yard
Oil-pumping plants
Oil-refining plants
Paint factories
Paper mills
Planing mills
Printing presses
Publishing houses
Pump factories
Rock crushers
Rubber factories
Safe factories
Salt-refining plants
Saw mills
Sewing machines
Shoe factories
Slaughter houses
Smelters
Steam engine factories
Sugar refineries
Tanneries
Terra cotta works
Washing machines
Wineries
Woolen mills
Wood-working plants
X-ray machines
Yeast and vinegar works

"Ah, brother, these be barren days for those of us who court the muse."

"Even so: I've just been forced to accept a position scanning meters for the gas company."—Life.

A torch has recently been perfected to burn oxygen and acetylene gases together and produce a flame of such intense heat that it can be conveniently used in cutting off or welding iron.

# A City Water-Supply From Deep Wells

*By* J. W. HALL, Manager Stockton Water District.

THE growth of the Stockton waterworks, now owned by the Pacific Gas and Electric Company, forms an interesting record of an increasing water supply gained from the sinking and operation of a large number of deep wells to keep pace with the development of a city now having a population of 25,000.

When primitive man abandoned the nomadic habit, which is still manifest in some Asiatic tribes and in the life of gypsies, he naturally settled down close to a water supply; and near to streams grew the earliest communities. As towns arose and covered a wider area immediate access to the stream became more difficult for the distant householders, and out of this condition grew the necessity for and the development of systems for delivering water through ditches. The drying up of the closest streams after long seasons of drought, the increase of population, and the constantly growing demands for more water for other than ordinary domestic uses produced conditions that, in time, brought about the splendid stone reservoirs, aqueducts, and surface-delivery systems that reached a wonderful condition even 2,000 years ago for the city of Rome, where many of the original constructions are still extant. With the development of civilization and the growth of modern cities more and more water has been required for the industries, for fire protection, for irrigation, and for domestic purposes. And wherever there is a natural demand for anything, that thing becomes worth something and salable, and inventive and ingenious man arises with projects for furnishing a supply and reaping the financial reward. Thus it is that man and corporations and cities themselves have gone far afield in search of a water source for growing communities that promised to require much more than was immediately available.

In California, owing to its peculiar climatic conditions and the cessation of rain during practically the whole summer period from the first of April to the first of October, the conservation of water has become a paramount principle governing the growth of the state. At times it has been impossible to supply enough water to the inhabitants of some congested centres of population. During a protracted dry season following a period of comparatively light snows on the mountains many of the streams have almost entirely disappeared, but generally below the beds of some of them have percolated water at a great depth. In some places wells sunk deep enough to tap these subterranean supplies have found water with sufficient pressure to bring it bubbling up and overflowing above the surface of the earth. These are artesian wells.

Stockton, although situated on the San Joaquin, one of the two great rivers of the state, can not use river water for household purposes because it is brackish from the backing up of the high tides of San Francisco bay. When Stockton became the centre of distribution for supplies to the great mines along the mother lode then the necessity arose for obtaining a large supply of water for domestic purposes and for fire protection, because the future of the town was assured. Deep wells were sunk and an artesian flow was secured, and the expansion of this principle is the basis of Stockton's supply.

The history of the Stockton Water Company covers a period of just half a century. In 1859, ten years after the first wild rush of goldseekers into California, P. E. Connor made a contract with the town of Stockton and the county of San Joaquin whereby for a period of twenty years he was to have the use of wells owned by the town on a certain lot, was to pay $10 a month rental on the lot with the privilege of purchase, and was to supply the town and county's needs of water for a consideration of $700 a year. This arrangement was the beginning of the water company that gave Stockton a supply that its citizens could obtain as regular customers of the company. But it was not until August of 1867 that the company was incorporated, and then its capital stock appeared as $100,000, and it had a franchise that would run fifty years. Evidently O'Connor bought the lot from the city, because the records show that a few days after the incorporation papers were filed he deeded the lot to the Stockton Water Works Company, which was practically owned by L. L. Bradbury and wife of Los Angeles. The Bradburys retained possession until 1891, when they sold everything but the lot to the present Stockton Water Company. This Stockton Water Company was organized in October of 1890, with W. S. McMurtry of Los Gatos, W. S. McMurtry, Jr., of San Francisco, John Flournoy of San Francisco, C. T. Ryland of San Jose and R. D. Murphy of San Jose as its incorporators. A twenty-five-year franchise was obtained, and it will expire November 25, 1915. In 1895 the Blue Lakes Water Company secured a controlling interest in the stock, and in 1908 legal title to the system. In 1904 the property was absorbed by the California Gas and Electric Corporation, and in 1908 it was transferred to the title of the Pacific Gas and Electric Company.

In 1884, during the Bradbury ownership, pumping from the city lot was abandoned, because in 1882 and 1884 some lots had been bought east of Stockton, and deeper and better wells were sunk on them. The first of these deep wells flowed originally 10,000 gallons an hour and the second 5,000 gallons an hour, and they continued thus to flow into a surface reservoir in lessening volume until 1889, when they ceased altogether. Since 1889 there has been no flowing water from any of the wells. Pumps have been necessary.

In 1891 the Stockton Water Company issued $350,000 in bonds, running twenty years and bearing 6 per cent. interest, and with this capital started a system of cast-iron mains. Shortly before this the city of Stockton had bonded itself and laid four miles of mains for fire-protection purposes and with the intention of getting its own water supply. But the water company leased the city's new mains, and in consideration of the use of them agreed to supply free water for fire-protection.

The company paid dividends from 1891 to 1898, and then, because the city council, voicing the hostility of the people, had cut down the rate schedule about 35 per cent., there was so little revenue that no dividends were possible, and for a time there was not sufficient for the payment of the interest on the bonds. But since that period of depression the rates, after strenuous efforts annually applied, have been raised slightly four different times until now in 1909 by close economy and the help of the natural increase in business a fair earning capacity is attained. But ever since 1898 all surplus earnings have been put back into improvements of the system.

When, in 1891, the Stockton Water Company took control there were approximately 800 consumers' accounts. In July of 1909 there were 4,181 individual accounts of consumers, 229 fire hydrants, 309 sewer flushers, and forty-five miles of street mains from twenty-inch down to four-inch diameter.

The daily output of water in July and August is now about 4,500,000 gallons, and in December and January, about 1,800,000 gallons. The average per capita consumption for the 25,000 population the year round is 109 gallons a day.

Because domestic water is easily obtainable in Stockton at a depth of seventy feet the company has had an uphill fight against the competition of private wells and windmills over a scattered community. An inadequate company service in earlier years created public resentment. But under the present corporate control and its adequate financial backing it has been possible to produce a first class service and a capacity that has anticipated the future needs of the city. This good service, coupled with reasonable rates, has abated and removed the old antagonisms and made the company's service so popular that no new windmills have been constructed within the area of the company's system and the old ones are rapidly becoming disused.

The wells furnishing Stockton's supply of water, their depth, when they were bored, and the size of the casing are all shown in the accompanying table:

| *Deep Well.* | *Bored.* | *Depth in feet.* | *Size of Piping in inches.* |
|---|---|---|---|
| At Pumping Station No. 1. | | | |
| 1st | 1882 | 1,100 | 8 (below 800 ft., 7-in.) |
| 2d | 1884 | 960 | 6 (below 650 ft., 5-in.) |
| 3d | 1885 | 1,040 | 8 |
| 4th | 1891 | 560 | 10 |
| 5th | 1895 | 218 | 8 |
| 6th | 1895 | 218 | 8 |
| 7th | 1895 | 300 | 8 |
| 8th | 1895 | 577 | 8 |
| 9th | 1900 | 770 | 12 |
| 10th | 1902 | 223 | 20 |
| 11th | 1906 | 950 | 12 |
| 12th | 1907 | 1,002 | 14 (below 268 ft., 12-in.) |
| 13th | 1908–9 | 1,050 | 14 (below 250 ft., 12-in.) |
| At Pumping Station No. 2. | | | |
| 1st | 1903 | 667 | 12 (below 632 ft., 10-in.) |
| 2d | 1904 | 807 | 12 (below 594 ft., 10-in.) |
| 3d | 1909 | 960 | 14 (below 260 ft., 12-in.) |
| 4th | 1909 | (boring) | 14 |

# John, O John—An Acrostic

*(By a Gas Man Who Can't Scan Meters)*

J ust afore time fer closin wouldent yer bunch yer fist,
O n Saturday noon or later, wid baseball on the list,—
H undreds uv reckissishons, an all ter get filled ter once,
N one but marked "rush" or somethin, an every guy gone ter lunch?

H aint yer never tumbled ter the surenuf mix uv things
U nder that bluff uv innercence a wad uv them blue blanks brings?
N ipples an T's an pencils, pens, an, whatter yer think? yep hay!
T ons uv straw fer the gas works ter make night the color uv day.

P ush through them H transformers on a "req" that's been a week
U nder some feller's paper pile on a desk right clos ter his beak.
R ush, rush em out this minnit, with a barrel uv globes fer light:
C onsider the fight at Colma; it's gotter be bright ternight.
H urry along with them stove legs what was put on a 21-R,
A n how about them shovels an the order fer Mike's crowbar?
S ome tacks an a carpet-sweeper, some "Sweetheart" soap ("Is it fun?"),
I nclosin a list uv prices—"Must be bought uv Michaelson."
N ow wouldent that sort uv ruffle an make yer kinder sore?
G et back ter yer work! Yer got ter: here comes a whole lot more.

A n now fer the bunch uv "locals" what's gotter go on the file.
G ee whiz! One's marked "emergency." How did it pass? I smile
E asieren a pug what's losin an aint got no wollop or style.
N ow here's how genel orders gets stretchin out moren a mile
T er "give the service wanted an regerly wear a smile."

# A Turbine Load-Limiting Device

By J. P. JOLLYMAN, Construction Department.

THE most important unit in the Centerville plant of the Pacific Gas and Electric Company consists of a 5,000-kilowatt, 2,400-volt, three-phase, 400-revolution Stanley alternator, coupled direct to a Francis-type hydraulic turbine of 10,000 horse power.

Regulation of this unit is effected by rotating the guide vanes in the stationary casing of the turbine. This opens or closes the ports between the guide vanes and thereby varies the amount of water used. The guide vanes are controlled by a Lombard Type-N governor through a system of bell cranks and gears.

For two reasons it was necessary to provide a means by which the maximum amount of water taken by the turbine could be given a variable limit. First, the supply varied; second, it was found that the turbine had been liberally designed with respect to overload capacity and could take more than the available amount of water. The water is taken direct from the ditch, there being only a small concrete reservoir at the head of the penstock. To accomplish the desired result the stroke of the governor and, consequently, the port opening of the turbine had to be limited and the limit made easily adjustable.

It was seen that any device to limit the governor's stroke must be applied to the governor itself. So it was decided to apply the stop to the origin of the governor's motion; that is, to the small regulating valve which is controlled by the fly balls.

The stroke-limiting device, as indicated in the accompanying drawing, consists of a small bell crank, 14, pivoted at 15, which is connected to crank 16 by connecting rod 17. Crank 16 is attached to shaft 18, which is rotated by the motion of the main piston to which it is connected by lever 19 and connecting link 20. The bell crank comes down on the collar 21 on the regulating valve stem when the main piston reaches the desired limit of its upward stroke. By depressing the regulating valve to its centre position the motion of the main piston is stopped. Connecting rod 17 is made adjustable in length by means of nut 22, which may be turned by hand. By

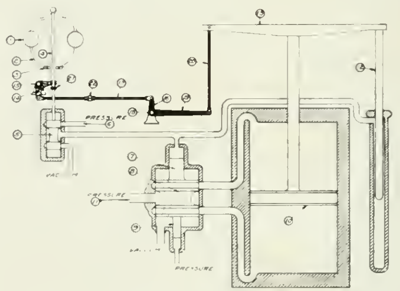


Diagram of Lombard Type "N" Governor with Stroke-Limiting Device

1. Flyballs
2. Flyball springs
3. Flyball spring pivot
4. Regulating valve stem
5. Regulating valve
6. Pressure oil inlet
7. Larger differential piston
8. Relay valve
9. Smaller differential piston
10. Main piston
11. Pressure oil inlet
12. Displacement piston
13. Yoke
14. Bell crank
15. Pivot for bell crank
16. Crank
17. Connecting rod
18. Shaft
19. Lever
20. Connecting link
21. Collar on regulating valve stem
22. Regulating turn buckle

this means the main piston may be allowed to make any desired portion of its upward stroke. The governor is so connected to the turbine that the ports between the guide vanes are closed when the main piston is down. Hence the device limits the travel of the main piston, and thus becomes a load-limiting device on the unit.

The device has proved reliable and easily adjustable. Its operation does not throw any strains on any part of the mechanism or governor. Neither does it interfere with the regular operation of the governor within the desired limit. The attendant who regulates this device can increase or decrease the load by the turning of a nut, to meet any condition of water flow reported by the ditch overseer.

The governor is also provided with an automatic electric trip to protect the generator from overload in case of continued short circuit. This mechanism is operated by means of an iron-clad solenoid directly connected to a mechanical trip, which, in operating, permits the governor to close the turbine vanes. The solenoid is actuated by direct current supplied by means of standard time-element relays. These relays are operated by current transformers included in the armature circuit of the generator. The generator is thus protected from destructive overloads whether the short circuit occur on the high-tension line or within the station.

These two attachments to the governor of this machine have proved of great value, and the service from this unit has been free from accident or trouble either hydraulic or electrical.

## Because She Was Well Thought Of


Miss Genevieve Wells

Because San Francisco bay was first discovered November 4th, 1769, by Gasper Portola, a Spaniard who was journeying up overland in command of a party that missed its bearings on its way to Monterey bay, San Francisco decided to celebrate that historical discovery and at the same time show the world how much the dauntless city has accomplished since the fire. So a Portola Carnival was decided upon for the five-day period from October 19th to 23d of this year.

Incidentally a contest was inaugurated to determine the twelve best-thought-of salaried young women in the corporations, business concerns, hotels, and larger stores of the city. Thirty-one acceptable candidates were permitted to enter the contest. The votes cost one cent each. In the aggregate a total of about $17,500 was in this manner raised for the carnival fund. The prizes for the twelve successful girls were free trips to the Seattle fair, to Victoria, and the scenic cities of the northwest, with certain cash funds added for spending money on an eleven-day steamer and and private-car tour.

Miss Genevieve Wells, head of the addressograph department of the San Francisco Gas and Electric Company, was one of the successful twelve and ranked seventh with a total of 73,075 votes. This result was remarkable because of the handicap that attached to her candidacy. She was not nominated by the company until late. Then nearly a week's good time was practically lost in the confusion and extra work for everybody incident to moving into the new building, and her ballot-box was installed for use only five days before the contest closed. The highest vote polled was by the St. Francis Hotel's candidate, a young woman who has long had charge of the Postal Telegraph Company's branch office in the hotel..

# Putting All Accounting on a Standard Basis

*By* M. H. BRIDGES, Traveling Auditor.

THE desirability of having uniform accounts as a basis for uniform reports upon the same classes of operations or industries has been recognized by an ever-increasing number of accountants, economists, government officials, and public writers. But experience has demonstrated that if this uniformity is ever to be attained there must first be an adoption of a common language of accounts, or the use by all of terms having the same significance to all. This adoption of common terms with the same significance is becoming imperative owing to federal and state legislation that is being enacted to regulate rates charged and service rendered and to tax revenues derived.

In the last few years considerable has been done toward making standard the accounts of public service corporations. Massachusetts pioneered this movement about fifteen years ago by organizing a commission to deal with gas, electric, and street railway companies. The New York Public Service Commission was organized, and its scheme of accounts for gas, electric, and street railway companies has gone into effect. The enlargement of the power of the Interstate Commerce Commission caused the reorganization of the accounting of railways, steamship lines, and other industries doing an interstate business. The various schemes and schedules of accounts that were thus made necessary have shown a carefully developed nomenclature, and these schemes are being freely copied throughout the country, wherever changes in accounting methods are being made.

The benefits to be derived from using standard methods of accounting are of almost inestimable value to the economical administration of corporations covering a large territory. A comparison of unit costs will bring out the most economical methods and processes. The results of individual effort and experience will be shown, and will enable the application of the most economical methods to the "high spots" that exist in all corporations of any magnitude.

In making this comparison between divisions and districts cognizance must be taken of the physical conditions even though the operations are the same. It will cost more by consumer to take statements and make collections in a sparsely settled district than in one thickly populated. In such cases a comparison of prior months and years will show if the expense have increased through decreased efficiency of the present operations. One familiar with that class of operations will be able to judge if the increased cost over the thickly populated district be equitable. Excepting increased cost of labor and material and the physical condition of the territory covered, there should be an equitable comparison of all unit costs for the same classes of operations.

The information given by an analytical report taken from a correctly organized system of accounting is far-reaching in the information it furnishes. If the account "Sets, Outs, and Complaints" were divided and shown as "Sets and Outs" and "Complaints" a comparison of the cost by "Set" and "Out" in several districts would, when based on same wages and similar territory, show the lowest efficiency of work performed. Complaints segregated as "Complaints—Service," when compared with other districts would show if it were economical to look into the processes of the manufacture or distribution of gas. In the electric department the question raised would be as to the cause of interruptions or as to the transformer efficiency in the distribution systems. "Complaints—High

Bills" would show by giving the dates of a few of the sets if the meters were breaking down because of inefficient work by the meter repair shop and testing department. "Complaints—Sundries" would show the number of unnecessary complaints (some consumers can not be satisfied any other way) sent out because of the inexperience or negligence of the counterman. The expense of boosting gas pressure will indicate if it would be more economical to increase the size of the mains, run trunk lines to the congested districts, or furnish additional holder capacity.

If the total amount of gas manufactured and the cost were accurately known a comparison of the cost by thousand cubic feet would bring out the most economical process, and the accurate loss by mile of main would indicate that the distribution system needed attention. In the electric department if the various lines had meters the line loss could be shown, so that by line work possibly a station could be closed down, thereby reducing the operating costs.

To render accounts standard usually spells increased reports and detail for the operating man. But if he be conscientious he then knows whether or not the best and most economical work is being returned. The increased detail can be greatly reduced if the accounts follow the course of operation which has developed the line of least resistance. Persons organizing a system of accounts should make themselves familiar with the production and distribution of the commodities involved. This will insure a system that will fit in with the operations and be a complete index of the condition of the business, and it will be applicable to the largest or the smallest territory for which reports are made.

# Electrical Co-Operator's Creed

I believe in Electric-city, the greatest "city" on Earth.

Daughter of Science and Mother of Progress.

Sister of Civilization, Handmaid of Industry, and First Cousin to the Spirit of Peace on Earth and Good Will to Man.

Lightener of Burdens, Tamer of Wilderness, Annihilator of Distance, and Goddess of Light..

The most necessary of luxuries.

Who would n't believe in Electricity?

---

I believe in Co-operation.

Pennant-winning "team work," rather than individual grandstand play.

Constructive and profitable combination as opposed to destructive unprofitable competition.

Greater general progress through reduction of individual friction.

Working together for the Grand Prize instead of quarreling together over scanty profits.

Co-operation!—who would n't be a co-operator?

---

I believe in Electrical Co-operation.

"All together all the time for everything electrical"—The application of the highest law of Modern Business to the greatest business of Modern Times.

The massing of forces to boost the sale of current and everything under Heaven that uses current—the generator of an enlightened "current opinion."

The step-up transformer of low-efficiency selfishness to high-voltage helpfulness—the incandescence of enthusiasm against the resistance of conservatism—and the short circuit to the final and complete electrification of the Universe and to that Millenium Age when what is n't done by electricity will not be done at all.

—Charles A. Barker in "The Electrical Times."

# The Draughting Room's Filing System

*By* MISS ROSA E. LAMONT, Draughting Department.

ONE of the problems confronting every large concern is the care and handling of its records. This company, up to the present time, has on file four thousand tracings and more than a thousand foreign prints. After much study and thought the arrangement herewith explained was considered a very feasible one for the care of its blue prints, tracings, etc.

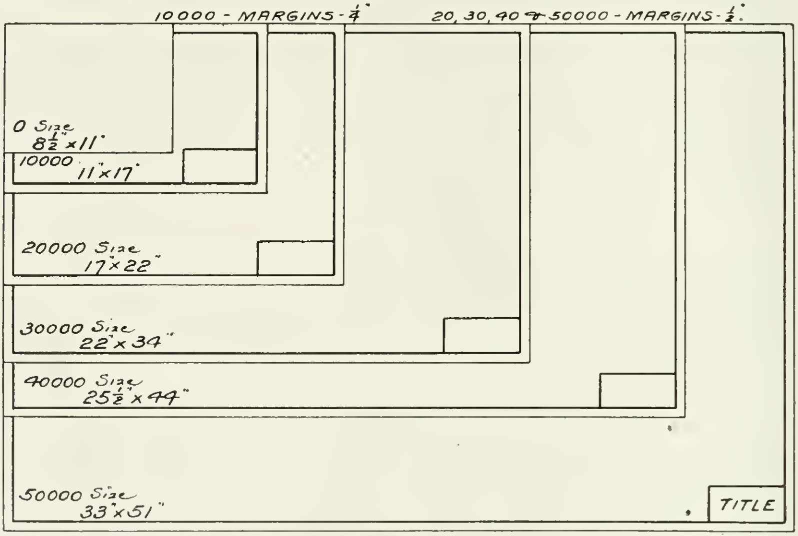



Plate No. 1

The original plan for designating tracings was by letters preceding the numbers: L, representing the letter size; A, the sheet 12x18, used for diagrams, outline drawings, panels, and switches; B, 18x24, for similar drawings and pole-line maps; C, 24x36, D, 30x48, and E, 36x60, for general powerhouse drawings; and F, for prints received from other companies.

There was so much delay caused by outsiders omitting the letter when writing for prints that about a year ago it was decided to substitute numbers, using 0 and ten to sixty thousand; the 0 sheet being the standard 8½"x11", letter size, and the ten to fifty thousand all multiples of this unit. The sixty thousand designation is used for all prints, regardless of dimensions, coming from any outside source. For convenience in mailing, the dimensions of the tracings were altered as indicated in Plate No. 1.

In order that the subject of the drawing may be readily noted, the title, name of station, designer, tracer, date, scale and number of the drawing are printed on the lower right hand corner of the tracing, as shown in Plate No. 2.

Prints from the tracings are filed in numerical order in cabinets in the draughting room, but the tracings are kept in a vault. For general reference the prints only are used.

The card file is arranged in six divisions: Hydraulic, Powerhouses, Substations, Pole Lines, General Drawings, and Maps.

The Hydraulic file is divided according to the different water systems, giving the reservoirs, dams, ditches, flumes, pipe lines, and the necessary mechanism used in their construction and operation.

In the second division, the Powerhouses, representing the steam, gas, and water power installations, are given, with the building plans, boilers, engines, water-wheels, generators, transformers, auxiliaries, and wiring layout for each plant.

In the Substation file are the building plans, transformers, regulators, switches, and all electrical apparatus used in these stations.

The Pole Line file contains the pole construction, maps of lines, and crossings used by the company.

The General Drawing file consists of accumulators, alternators, generators, motors, rheostats, transformers, insulators, and switches used as standards, and for general use in any or all of the stations. The cross index of machinery to be used at other stations besides the one they are originally built for is kept in this division. The underground system plans also are filed in this section.

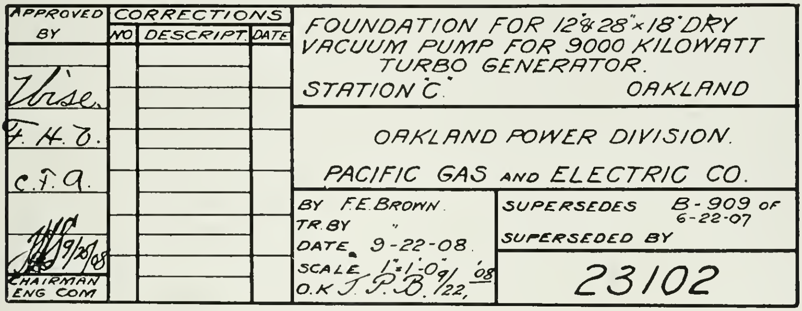



Plate No. 2

The maps of the cities and localities connected with the system are kept under a separate head for convenience and rapidity of location.

The standard 4″x6″ card is used for filing. The number of the drawing, name of detail, and particular location designed for, name of draughtsman, date, and scale are indicated, as in Plate No. 3.

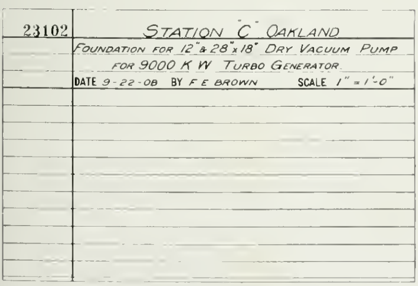



Plate No. 3

It is an old adage that "A shovel is not a spade," and on this suggestion has been based the filing for this indexed recording system. Thus, methods and terms which may be applicable to one may not be advantageous to another, although apparently similar.

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With the aid of five stationary engines and in the space of only eleven minutes, a huge steel bridge weighing 285 tons was recently substituted at Jersey City for the Pennsylvania Railroad's old iron bridge over Newark avenue.

# Where Electricity Played Leapfrog

*By* WILL T. JONES, Accountant Electra Power Division.

RUNNING from the Electra powerhouse to the Lightner mine at Angels Camp is a 17,000-volt transmission line which is probably one of the oldest that the company owns. It was built in 1897 and was originally a two-phase line, extending from the old plant that was located three miles below Electra.

In the construction of this line were used square redwood poles, thirty-five feet high, Oregon pine cross-arms, 4x4x26 inches, locust pins 1½ inch long, and five-inch, triple petticoat, porcelain insulators. A few years ago one of the wires was removed and the line changed from two-phase to three-phase. The wire used is No. 3 bare copper to the substation at San Andreas and No. 4 copper from there on. These wires have a spread of sixteen inches.

Tapping this line at pole 11/10, which is located at the San Andreas substation, is a line about one mile and a half long. It runs out to the Chapman gravel mine. This line is constructed the same as the main Calaveras line except that No. 9 galvanized iron wire is used instead of copper wire. Just before the line reaches the mine there is a span probably 600 feet long, the wires having a spread there of about six feet.

A few months ago the superintendent of the mine, Mr. Chapman (now deceased), had a man cut down a large pine tree which stood alongside this span. In falling, one of the limbs of the tree struck the line and short-circuited two of the wires.

At that time the writer of this article was at the substation at San Andreas, and the first notice he had of any trouble was when he saw an arc on this line about half a mile from and traveling toward the station. This arc followed the line for about three poles and then disappeared. It jumped about three poles and then broke out again. It continued these jumps four or five times before it reached the take-off pole, whence it traveled to pole 11/11. There the wires have a spread of five feet, as that is a dead-end pole from which the wires enter one of the regular three-pole, double-break, line switches.

Mr. Chapman at once sent word that the line was shorted out at the mine. After having the circuit killed an inspection was made and in the span at the mine two of the wires were found wrapped together, but the remainder of the line where so much arcing had occurred was all right.

According to Superintendent Chapman there were no fireworks any place along the line from the mine back toward the station for a distance of 1,000 yards, not even a sign of an arc where the wires crossed. It was at least three-fourths of a mile from where the tree hit the line before the wires started to arc.

No damage was done except here and there to an insulator that was scorched where the arc had followed.

"Go to my father," she said, when I asked her to wed,
And she knew that I knew that her father was dead,
And she knew that I knew what a life he had led,
And she knew that I knew what she meant when she said,
"Go to my father."

# When the Chiefs Played Ball

LONG time go big chief two tribe play ball.

Much cold. Much wind. Much dust.

Heap young buck, heap squaw, heap pap-poose watchum.

Much drum, much holler, much noise, all time—all same big medicin dance. Ugh!

Some ole chief, very ole chief, come play ball.

Two medicin man he come. Say no fightum, be frien.

One medicin man name Chief Four-eye Lee. Other medicin man him name Chief Smokum - Big - Torch Hockenbeamer. Not know how play ball medicin man, but think know how; tellum all time this way play.

Some chief too fat. Fallum down. All same ole squaw. Ugh!

One side gettum Chief Not-Much Wise, Chief Grabbum-and-Losum Henley, Chief Heap-Sweat Downing, Chief Small-Fox Walton, Chief Lizzy Lisberger, Chief No-Talk Adams, Chief Stand-Still Manchester, Chief Can-Yell Cantrell, Chief Never-Did Bragg, Chief Scalp-Lock-Gone Kline, Chief White-Moccasin Foote, Chief Horse-Kick-in-the-Arm Lusk, Chief Run-Fast-for-Fat-Man McDavid. Ugh!

Other side gettum Chief Hittum-Far Varney, Chief Turn-Wrong-Way Cunningham, Chief Man-Feel-Old Oldis, Chief Throw-Too-High Bostwick, Chief Catchum-One-Fly Barrett, Chief Rip-In-Blanket-Behind Guswhite, Chief Not-See-Ball Stroh, Chief Smile-Dont-Care Holberton, Chief Sore-At-Support Joebutler. Ugh!

Five time big chief Pacific tribe usum club, hittum ball, runnum. Gettum nine point. Ugh! Chief Rip - In - Blanket - Behind Guswhite feelum sick! Go gettum new blanket. Him tribe no ketchum nothin. Chief-Sore-At-Support Joebutler gettum big bunch flowers, but no good luck. Chief Guswhite too much tired.

Then come bad sign. Chief Can-Yell Cantrell ketchum flea in blanket. That all he ketchum. Pacific tribe chief actum all same too much fire water. Ugh!

Night time come. Ugh! Heap big eat. Heap smoke peace pipe. Much talk. Chief say, "What for no killum medicin man? Killum umpire?" Chief Four-Eye say, "What for?" I go now gettum boat go Deadtown. Makum big sleep. What for no findum pale face killum him? Young buck findum this on hill. You look see. White man sure." Ugh!

Showum all chief this:

ST. IGNATUS GROUNDS, SAN FRANCISCO, SATURDAY, SEPTEMBER 4TH, 1909.

| P. G. & E. Co— | AB. | R. | BH. | PO. | A. | E. |
|---|---|---|---|---|---|---|
| Wise, 1b. & p. . . . . | 5 | 4 | 3 | 5 | 1 | 2 |
| Henley, 3b. . . . . . . | 5 | 2 | 1 | 1 | 0 | 3 |
| Downing, c. . . . . . . | 5 | 1 | 1 | 10 | 1 | 0 |
| Walton, s.s. . . . . . . | 4 | 1 | 1 | 0 | 0 | 0 |
| Lisberger, 2b. . . . . . | 4 | 2 | 2 | 2 | 1 | 1 |
| Adams / Manchester } r.f. . . . | 5 | 1 | 0 | 0 | 0 | 0 |
| Cantrell / Bragg } c.f. . . . . | 4 | 1 | 3 | 0 | 0 | 0 |
| Kline / Foote } l.f. . . . . . . | 4 | 1 | 1 | 1 | 0 | 0 |
| Lusk, p. / McDavid 1b. } . . . | 4 | 1 | 1 | 0 | 0 | 0 |
| Totals . . . . . . . . . | 40 | 14 | 13 | 19 | 3 | 6 |

| S. F. G. & E. Co.— | AB. | R. | BH. | PO. | A. | E. |
|---|---|---|---|---|---|---|
| Varney, l.f . . . . . . . | 4 | 2 | 2 | 0 | 0 | 0 |
| Cunningham, s.s. . . | 5 | 2 | 3 | 0 | 0 | 2 |
| Oldis, 1b. . . . . . . . . | 3 | 2 | 3 | 8 | 0 | 2 |
| Bostwick, 2b. . . . . . | 4 | 0 | 0 | 2 | 2 | 5 |
| Barrett, c.f. . . . . . . | 4 | 0 | 0 | 1 | 0 | 1 |
| White, c. . . . . . . . . | 4 | 2 | 2 | 6 | 2 | 0 |
| Stroh, 3b. . . . . . . . . | 4 | 1 | 1 | 1 | 0 | 2 |
| Holberton, r.f. . . . . | 3 | 2 | 1 | 1 | 0 | 0 |
| Butler, p. . . . . . . . . | 3 | 0 | 0 | 0 | 4 | 0 |
| Totals . . . . . . . . . | 34 | 11 | 12 | 19 | 8 | 12 |

Two-base hits—Lisberger, Varney. First on balls—Off Lusk, 2. Struck out—By Lusk, 11; by Butler, 5. Wild Pitches—Butler, 3. Hit by pitcher—Holberton, White. Passed balls—White, 5.

Umpires—F. V. T. Lee and A. F. Hockenbeamer.

# PERSONALS

Announcement cards were issued late in August telling of the marriage way back in February,—and St. Valentine's Day too,—of C. H. Warren of the electrical engineering department and Miss Ida Isabel Graves of Berkeley. While marriage is no light matter, keeping it dark more than half a year may be considered hardly fair to the groom's professional associates, who, like himself, are really engaged in the great business of furnishing light to dispel darkness everywhere.

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E. C. Jones, engineer of the gas department, was in Woodland about the 18th of August to solve a peculiar problem. The Pacific Gas and Electric Company's property there is so situated that petroleum from that plant seeped down into and contaminated two large wells used for Woodland's municipal water supply. The company agreed to bore a new well, but when water-depth was reached such continued incaves of sand occurred that even sand-pumping could not clear the hole. Then the company undertook to rebore and clean out the city's oil-contaminated wells, and that failed. So the boring of a new well was decided upon, and Engineer Jones suggested that the city bore it and send in its bill. But the city council declared it had enough troubles without going underground to hunt for more.

---

When Sam Sorenson, aged 43, died about the end of July, after a brief illness, the Oakland Gas Light and Heat Company lost a faithful employe who had been continuously with the company from the very day he arrived in California, nearly twelve years ago. He was latterly a gang foreman, but in all his active service there was never a night too stormy or "juice" too hot for him to do his duty and maintain the reputation for hardihood and fearlessness that characterize the rugged race of Danes from whom he was descended.

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## The Right Address

A young New York broker of convivial habits fell in with an old school friend who had gone on the road.

"Whenever you 're in town come up and bunk with me," urged his friend as they separated. "No matter what old time it is. If I 'm not there just go ahead and make yourself at home. I 'll be sure to turn up before daybreak."

Soon after this the salesman arrived in town about midnight, and, remembering his friend's invitation, sought out his boarding house. There was only a dim light flickering in the hall, but he gave the bell a manful pull. Presently he found himself face to face with a landlady of grim and terrible aspect.

"Does Mr. Smith live here?" he faltered.

"He does," snapped the landlady. "You can bring him right in!"

---

The man who lives upright is apt to die in a horizontal position.

---

And occasionally we hear of a man getting on his feet again—just as though he had been walking on his hands.

---

The Pacific Gas and Electric Company is contemplating the construction of sixteen miles of 60-kilovolt line for distributing power in Sutter county. The proposed new line would extend from Terra Buena to Meridian by way of Sutter City and would have a substation at Meridian.

# SHORT CUTS

*Under this title each month will be published handy formulae, simple practical methods, and time-saving ways for doing things that have to be done in the day's work. Thus may all in the employ of the company come to benefit somewhat from the combined knowledge and experience of the individuals.*

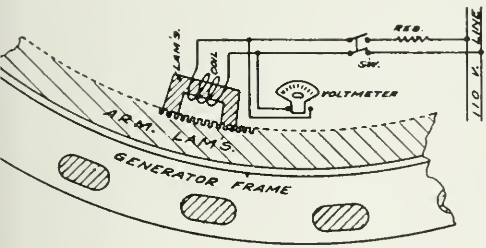
*No one knows all the shortest and easiest methods, but each one probably knows some little scheme to save time and trouble. That little idea is wanted for this department. Jot down on a bit of paper its salient features, just as you would talk of it to some friend, and send it to the magazine. The editor will put it in proper form for printing and give you the deserved credit.*

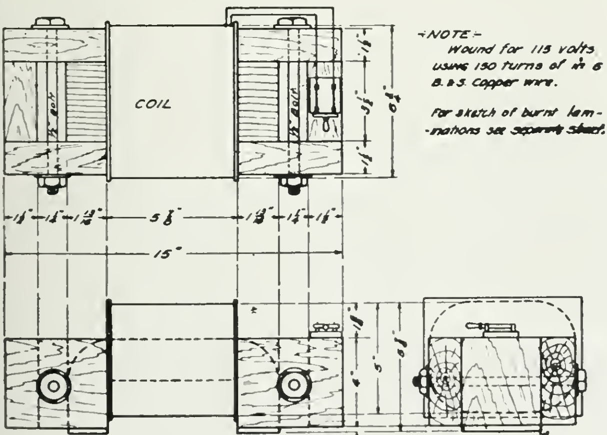
*Now which individual, which station, which division can show the most of these practical little ideas? Get into the game: co-operate. We can all teach one another something.*

## Locating Eddy Currents in a Damaged Section of Armature

*By* I. B. ADAMS, Acting Division Superintendent Colgate Power Division.

After a recent burn-out of a 2,300-volt, 5,500-kilowatt generator of the closed slot type at the Colgate station there was considerable trouble with eddy currents, due to the coils in the damaged section of the armature melting and filling the air ducts, and becoming fused with the laminations. Owing to the closed slot, it was impossible to remove the melted copper with tools. Nearly all of it has to be removed with acid. After all the visible copper had been removed the armature bars were replaced and the generator started up. Before the machine had built up to half voltage the insulation on the bars in the damaged section began to smoke. The armature bars were removed and the slots filled with wooden dummy armature bars. This was done to get an exact record of the hot spots, which charred the wood bars, thereby locating and recording themselves. The wooden dummy armature bars gave a sure and accurate test, but, owing to the amount of labor involved in moving the armature after each test, it was not considered a practical course to pursue. In order to ascertain the pro-




Design of Detector Device

gress being made in removing the fused copper a device was designed and built to detect and locate the eddy currents. The print shows the design of the detector and the method of using. The detector is very simple and was used at Colgate with marked success. E. O. Klipphahn suggested making the device, and it was made at the station's shop at a cost of $5.

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## Oil Output Exceeds Gold in California

According to State Mineralogist Aubry, eight counties of California produced 48,306,910 barrels of petroleum in 1908. Kern county led with 18,777,871 barrels, valued at $9,388,935. He also shows that the total value of the oil output in 1908 was $26,566,181.

"The striking feature of this is that the petroleum output is not only great in itself, but it actually outstrips the year's production of gold by $6,000,000," says Aubry.

He also asserts that the annual output of petroleum has increased practically twenty-fold in the last ten years.

---

## Freaks of Electricity Alarm People of Los Angeles

Two freaky electrical disturbances, one of which engineers have been unable to account for, occurred at Los Angeles recently. The first was the stopping of all the cars on the streets and all machinery drawing electricity from the Kern River power plant. The trouble was located on the Newhall division, and men sent out found that a forest fire had swept under the transmission line, but had not destroyed their poles or wires. The explanation is that fire is a conductor of electricity and the high flames led the current to the ground, "shorting" the line until the blaze subsided. Then everything moved as usual.

But the unexplained happening was the sudden burning in two of a large Sunset telephone cable. Both ends continued to spurt sheets of green and orange flame that made the sunlight seem dim. When one end fell to the street there was a roar like the discharge of a cannon, dirt flew in all directions and the heavy wire leaped in the air, dancing several minutes. Each time it touched the ground there was another roar. Seven linemen two miles away had a narrow escape from death at the same time, when a guy wire came in contact with the mysteriously charged telephone cable and performed similarly. Two were severely shocked. Hundreds of telephones were disabled.

---

## Electrocuted by Flying Kite

Stanley Klovberg, of Tacoma, Wash., the sixteen-year-old son of Nicholas Klovberg, former member of the city council, was electrocuted recently by a wire, attached to a kite he was flying, coming in contact with a high-tension electric power wire.

---

Consistency is a jewel, but many people do not wear jewelry.

---

The following telephonic message was recently received at the Berkeley office:

"Mr. ——— is dying at Ben Lomond. Expects to be back before long and will settle all bills."

---

So live that, when thy summons comes to join that innumerable caravan which moves to that mysterious realm where each shall take his chamber in the silent halls of Death, thou goest not like the quarry slave, scourged to his dungeon at nightfall; but, soothed and sustained by an unfailing hope, approach thy grave like one who wraps the draperies of his couch about him and lies down to pleasant dreams.—Bryant's "Thanantopsis."

# QUESTION BOX

*Ask questions. Any one of the several thousand men and women in the Pacific Gas and Electric Company who wishes information pertaining to any phase of the company's work or concerning matters of common interest to residents of any section reached by the company's lines, is urged to use this department freely. Send your questions to the magazine. There will be no charge.*

Query:—How should a billiard table best be lighted—say, where there is one table and where there are several? SACRAMENTO.

Answer:—The usual method of lighting a billiard table is by means of incandescent lamps hung directly over the table and equipped with Dolier reflectors. Where there are several tables, if the ceiling be not of too high pitch, a white metal ceiling is used, with lamps set in the ceiling. This gives a very good light. S. J. LISBERGER.

Query:—Will an incandescent lamp, mechanically perfect, and not connected in circuit, deteriorate with age? If it deteriorate, what is the nature of the deterioration, and what is the cause? FRESNO.

Answer:—There is no deterioration in the life of the carbon filament. The only deterioration is from handling. S. J. LISBERGER.

Query:—Are any consumers operating moving picture machines reporting any difficulty in operating machines supplied by alternating current. SAN FRANCISCO.

Answer:—The picture machine usually causes a fluctuation of the lighting circuit when the machine is supplied directly therefrom. The best results are obtained by use of a special transformer, or even better results are obtained by the use of the recent Mercury Arc Rectifier, as developed specially for picture-machine work. S. J. LISBERGER.

Query:—What form of an induction motor is best adapted for operating a pump that must start under full load? STOCKTON.

Answer:—Any style of induction motor that has an internal starting resistance, or any style motor that has a resistance cut into the rotor by means of an external drum or other type of controller.

S. J. LISBERGER.

Query:—Are the so-called "flaming arc" lamps successful? B. K.

Answer:—Flaming arcs are rapidly gaining prominence, particularly in the east, where many have been installed. But, as with all new apparatus, time is required to develop various conditions that may show its defects. The foreign-made flaming arcs were in favor for a time, but now those of American make are gaining in popularity. The greatest trouble with a flaming arc lamp is the difficulty of obtaining a proper carbon and to have it trimmed properly. The average flaming arc lamp burns only about seventeen hours on one trim XYZ.

Query:—Why is No. 6 B. & S. copper wire the smallest size used for primary work on this company's system when there are other smaller sizes that have ample carrying capacity? CHARLES BARRETT.

Answer:—The practice specifies the minimum size to be No. 6 B. & S. copper, because a smaller size would have a breaking strength of less than 1,200 lbs., and therefore be apt to break by the combined action of wind, cold, and ice, when supported on poles out of doors on the ordinary spans of the pole line. P. M. DOWNING.

## Simply Exchange Souvenir Postals

In Bankok, the great capital city of Siam, they have electric-lighting developed to such a high state of efficiency that all a customer now has to do is to follow the company's printed order, which reads:

Sir: For the case that your electric light should fail we beg to send you inclosed a post card, which please send us at once when you find your light out. The company will then send you another post card. Yours truly, Manager, Siam Electricity Company, Ltd.

**Pacific Gas and Electric Magazine**

PUBLISHED IN THE INTEREST OF ALL THE EMPLOYEES OF THE PACIFIC GAS AND ELECTRIC COMPANY

ARCHIE RICE, - - - - - - - EDITOR
A. F. HOCKENBEAMER - - - BUSINESS MANAGER

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PACIFIC GAS AND ELECTRIC MAGAZINE
445 Sutter Street, San Francisco

VOL. I SEPTEMBER, 1909 NO. 4

## EDITORIAL

WHEN a man knows an attractive woman but slightly he is courteous. He strives to please and is agreeable. He gets better acquainted, married. In the consciousness of permanent possession he comes more and more to omit those little courtesies that helped to make life so pleasant. Domestic existence for them sinks to a humdrum level of indifference to each other or is periodically interrupted by arcs of anger and resentment, flashing invidious comparisons or references to what used to be. There is repeated short-circuiting of the line that carried love vibrations. With variations, of course, this is the experience in tens of thousands of homes. Courtesy continued as a domestic habit would prevent a lot of domestic woe.

From the home the man goes forth daily to his vocation, pre-impressed with a grouch or a feeling of kindliness and courtesy. What he does not practice at home he usually employs only on special occasions where he seeks to please. When not on his guard that man's indifference, his curtness, his brusqueness, his irritability, are impressed upon others.

A man growls back through the telephone, "Watter-yer-want, Who-is-it?" and, discovering it is "the boss," instantly changes to dulcet tones and obsequeous phrases. He exposes two traits—one that he can grovel to those that control his job, and the other that he can be gruff to subordinates or the poor public, and probably is. That kind of a man is a handicap to a business.

Here is a large store. A clerk, perhaps by a word, possibly only by attitude, incurs the ill-will of a chance customer. That customer may say nothing then, but he goes away and never returns. Enough such experiences in a month will cost that store in missed financial opportunities more than the price of that clerk's salary. Courtesy is a business asset.

Here is a public-service corporation. Perhaps it has a monopoly of the local field. Some employee needlessly offends a customer by his attitude. That customer goes away cherishing a grievance and developing what may grow to be enmity for the whole concern. He tells his associates. Perhaps they have had similar experiences. The corporation is referred to as a big, soulless, grasping, grafting impersonal machine intent only on making money and going on about it on the principle of the dictum attributed to one of the older Vanderbilts when he exclaimed "The public be damned!" This feeling gets a good start. May be it is augumented by enmity aroused in others by that same employee. A suit for damages, due to some accident in the company's service, comes to trial. One of these personally offended citizens or one of his informed acquaintances is on the jury. The award costs the company more than it otherwise would by an amount possibly as large as the whole year's salary of the employee that helped produce that enmity. It is too expensive to keep such a man.

The personal causes may be numerous but small and thus unknown to the corporation's officials. But public displeasure finally assumes the form of an insistent desire either to put upon that corporation a punishing reduction in its rates or to have competition enter the field and reduce that corporation's revenues and its arrogance. What brought about this feeling? An employee was dis-courteous. A man like that costs more than his salary, because his attitude is contagious and its effects are far-reaching and not immediately discernable. The corporation becomes unpopular: the public refers to it as a robber. It is an object of suspicion, a proper mark for retaliation or revenge. All along the line the work of the other employees is rendered a little more trying, a little less pleasant.

Take two persons of equal capabilities and efficiency—the one that is always courteous and pleasant, without, of course, being servile, is worth half again as much to the business of a public-service corporation, twice again as much to the happiness of a home.

Courtesy counts, but the only safe way is to get the habit and use it at home and in business all the time.

---

No other quality is so diffusive of joy, both to him who possesses it and to those with whom he comes in contact, as cheerfulness. It is the phase of a soul sitting in its own sunlight. There are celestial bodies that are seen through the aid of their own light; others that show only with the light from those before them. So it is with individuals. There are some who possess an inexhaustible amount of cheerfulness that renders them not only self-illuminating but capable of brightening the spirits of those about them. Some are cheerful when prosperity surrounds them or appears gorgeously in prospect. But few are cheerful when adversity casts her gloomy shadow over them, when sorrow and disappointment dry up the fountains of pleasure and wither the hopes. In such trying crises cheerfulness is an independent virtue, at other times it is an accidental mood.

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In this number of the magazine appears an article entitled "Putting All Accounting on a Standard Basis." It is the first of a series of three related subjects presented by M. H. Bridges of the auditing department having to do with the auditing and economics of business enterprises and the presentation of the necessary records by methods that shall be part of a system rendered generally intelligible and uniform throughout the various branches of the company.

## Out With His Wife

She—"Bloom does not pay his wife much attention."

He—"No; the only time I ever knew of his going out with her was once when the gas exploded."

---

"Look at the funny long ulster on that gentleman over on the corner."

"That's no gentleman."

"Why, yes."

"No. That's my husband."

## Bless Her!

ALL LIFE as a rule  
Is a great old school  
Of WO, O MAH, and a MAN,—  
Expressed in brief as WO-MAN  
And commonly written WOMAN.

Yet lawyers, you'll see,  
Divide LIFE in three:  
A LI and an IF and a FE.  
But the total is still,  
As you'll learn by the bill,  
Another sad case of WO-MAN,  
Generally traced back to WOMAN.

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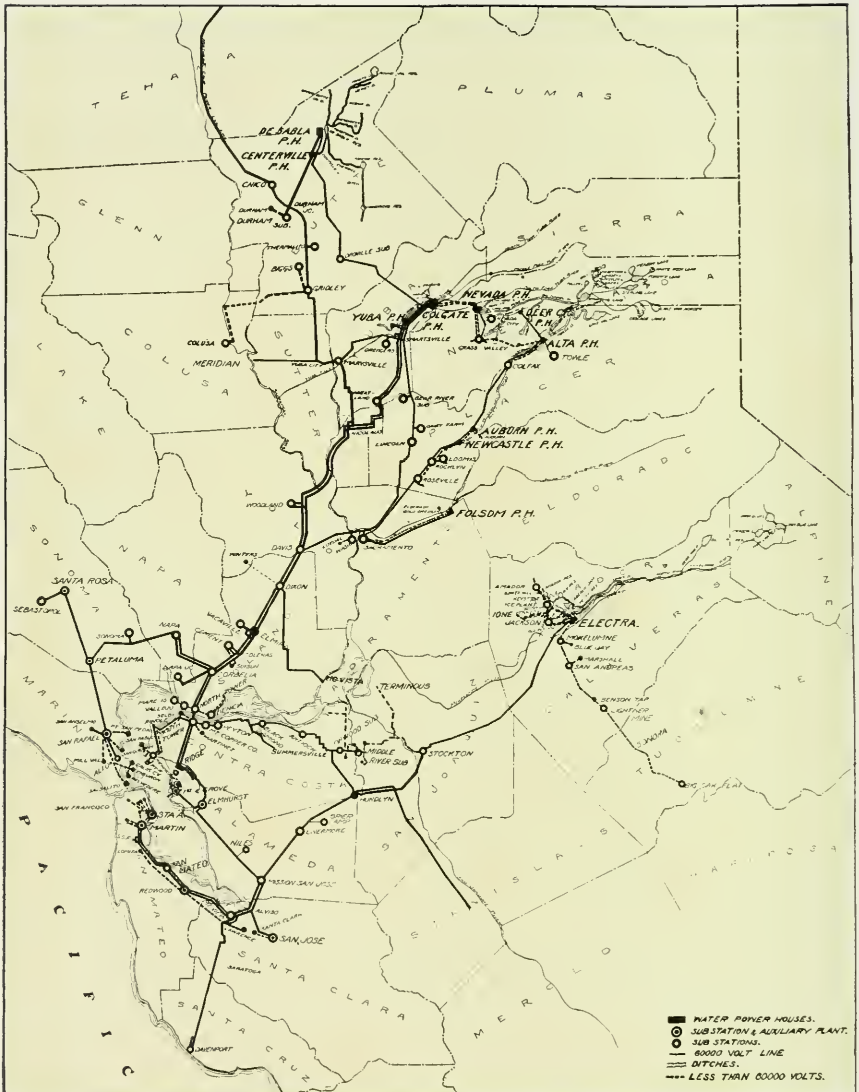



MAP OF POWER PLANTS AND POWER LINES OWNED BY THE PACIFIC GAS AND ELECTRIC COMPANY

# Pacific Gas and Electric Magazine

VOL. I    OCTOBER, 1909    No. 5


# Water-Power Developments in California*

## The Public Benefits Derived and the Government's Attitude


*By* JOHN MARTIN, of the Board of Directors.



John Martin

**In the early days** of California mining the streams were utilized very generally to aid in the extraction of gold by ground sluicing, hydraulicking, and for power purposes in the development of quartz mines.

Owing to California's well-known wet and dry seasons, it became necessary for the mine owners to insure a continuous supply of water during the dry season. This resulted in the construction of a large number of reservoirs.

###### EFFECT OF HYDRAULIC MINING

The result of hydraulic mining, particularly in the northern part of California, was the filling of the river beds with debris to such an extent as to threaten agricultural interests throughout the great Sacramento and San Joaquin valleys. As the beds of these streams rose the construction of levees became necessary. This involved the expenditure of many millions of dollars to protect the agricultural lands from inundation, and it finally resulted in national legislation that practically prohibited hydraulic mining, except under the most severe restrictions, involving the impounding of the debris. As a result, hydraulic mining ceased to be a factor in California's production of wealth, and many hydraulic properties with their expensive investment were left almost valueless.

###### IRRIGATION FOLLOWED

After the cessation of hydraulic mining the companies owning the reservoirs, flumes, and ditches were able to obtain a small revenue from a limited use of some of the water for irrigation purposes. In time this use became more general, particularly in the irrigation of deciduous and citrus fruit trees.

Soon after hydraulic mining ceased the development of electric energy to be transmitted long distances was taken up very earnestly. In some instances water systems of old hydraulic mines became available for this new enterprise. An impetus was also given to the hydro-electric industry in sections where large volumes of water were available under low heads or where small amounts of water were available continuously under high heads.

*This article, before condensation to its present size for publication here, was read at the seventeenth annual meeting of the Pacific Coast Gas Association, held in San Francisco from September 21st to 23d, 1909, and was awarded the association's gold medal for the most interesting paper presented.

EARLY HYDRO-ELECTRIC DEVELOPMENT

August 18th, 1892, the very first alternating current power-transmission plant began operation. It was for the Standard Consolidated Mine of Bodie, California, and operated one 120-kilowatt single-phase generator, transmitting the current thirteen miles to the mine, where a motor of similar voltage received the electricity to propel the mining machinery. That plant near Bodie was the pioneer electric power transmission installation in California, and, I believe, in the United States.

PRESENT DEVELOPMENT

The hydro-electric industry has grown until now in September of 1909 more than 380,000 horsepower has been developed and is in regular operation in California.

Numerous difficulties had to be overcome and problems solved in the development and perfection of long-distance transmission. The particular handicaps were lack of proper insulators, transformers, and motors.

NECESSITY FOR HIGH VOLTAGES

High voltage in long-distance transmission is necessary to keep down the total plant cost to such a basis as will make the enterprise financially possible.

In the development and construction of hydro-electric plants there has been a large variance in the cost of the hydraulic development. Sometimes the installation has been unprofitable. The great initial incentive to the rapid development of hydro-electric power plants in California was the high fuel cost existing at that time. Practically all coal for power purposes was imported from Australia and British Columbia. This meant not only marine transportation, but an import duty.

The production of oil in California was then very limited, and its true value and usefulness were not yet known. The selling price of fuel oil in Los Angeles was as low as 25 cents a barrel, which is equivalent to $1 a ton for the very best grade of bituminous coal. As long as fuel prices remained so low there was little incentive to hydro-electric development. This price meant loss to oil producers, so the rate was increased, until now the approximate selling price in Los Angeles is 75 cents a barrel, and in San Francisco $1 a barrel.

NATIONAL CONSERVATION

During the last few years the government has reserved immense tracts of timber land for the purpose of conserving the timber for future generations and protecting the waters in the streams, upon the theory that the forests and streams belong to the people, and that national restriction alone can secure beneficial results.

So much publicity has been given to this matter during the past few months that the average citizen would infer that some terrible injury has been inflicted upon the American people by developments in hydro-electric transmission.

These natural gifts of forest and stream can never be of service to the people until developed, and the development is practically dependent upon private enterprise. If this development depended upon governmental action it would take twenty or more years to obtain the first results.

Such was the experience with the irrigation projects. Not until the last term of President Roosevelt had they begun to show development.

The national government has apparently reached the limit beyond which our statesmen will not go in making appropriations for the irrigation of arid lands, forest reserve, and reforestation. Unless private capital and enterprise take hold the extension of this grand work will necessarily be limited.

RAINFALL NO GUARANTY OF SUMMER FLOW

After years of investigation of the climatological, geological, and forestry conditions effecting the conservation of water in the mountainous sections of California, I submit that the season's quantity of rainfall is no guide to what will be the minimum flow of the streams during the summer months.

The geological formations in the various watersheds are solely responsible for the minimum flow, except where augmented by artificial conservation.

In watersheds where numerous old river channels or lava cappings exist, the minimum flow will be very uniform each summer, irrespective of the amount of rainfall during the preceding season.

### EFFECT OF HIGH TEMPERATURES

The water stored in the ancient river channels of the North Yuba river watershed is of approximately the same volume annually, and when the surplus run-off ceases, this underground storage gives forth its normal quantity, except when restricted by the heating of the earth's surface during the summer, which results in evaporation to a greater or less degree. Summer temperature is what affects the minimum flow in these underground storage watersheds, but only to a minor degree. Where there are few or no ancient river channels because of the massive rock formations, the opportunities for underground storage are very restricted and the run-off is almost immediate, save for the saturation of the thin soils which cover these rock formations.

Generally the streams reach maximum flow shortly after the commencement of rainfall, except where there is frozen storage due to low temperatures following the rains. The low periods come shortly after the melting of the frozen storage.

This frozen storage is sometimes eliminated in April, May, and June by high temperatures and warm rains. Such watersheds are of little value for minimum flow during the summer months.

### RELATION OF TIMBERED LAND TO MINIMUM FLOW

No timbered lands in any of these watersheds afford water storage available during the very dry summer months, particularly July and August, and timbered lands furnish less opportunity for the accumulation of frozen storage in the winter.

The experience of mountaineers demonstrates that snowfall does not accumulate as rapidly in growing timber as upon open bare ground. The only advantage of timber and vegetation is to delay the gravitation of water by preventing a quick run-off. Snow formed into ice on barren soil will melt much more slowly and furnish a run-off for a much longer period. On many California streams it is necessary to provide from 180 to 210 days of conservation to insure a uniform daily supply to the hydro-electric plant and provide for evaporation and leakage in transit.

As a result of the hydro-electric plant's necessity for continuous flow throughout the year the water it conserves becomes available for and is used by the agriculturists for irrigation during the dry season, when most needed.

The many early financial failures of California irrigation districts and companies, due to the fact that the price which the agriculturist could afford, did not produce revenue enough to pay the costs of operation, maintenance, interest on the cost of installation, and depreciation, have demonstrated that conservation of the waters for irrigation purposes, except in a few isolated cases, would not be a profitable venture. But where the conservation is made for hydro-electric power and the uniform flow is afterward made available for agricultural purposes, then an irrigation system can pay.

### MOTIVES PROMPTING DEVELOPMENT

The motives which prompt these hydro-electric developments are not always simply for financial gain. Many of the pioneers in these enterprises have felt greater reward in the fact that they were doing something toward the upbuilding of California, in making two blades of grass grow where none or one grew before, than in the sense of financial gain and the comforts and pleasures that would result. Numerous are the financial sacrifices that have been made for the benefit of the communities in which these developments were started in order to assist various new enterprises to become factors in the production of wealth. Had these developers of hydro-electric power left the work to some one else and, since 1892, invested the same amount of energy, brains, and capital in real estate in the larger cities of the Pacific coast and taken their profits in increased values, due to industrial growth and population, they would have made ten times as much money.

#### COMPETING FUELS

Power can be and is produced alike from wood, peat, coal, and oil. The owners of hydro-electric transmission plants have no monopoly. They meet competition with these fuels in their respective sections. The selling price of the fuel commodities, particularly wood and coal, is regulated by the value of labor necessary to produce them. But many fluctuations are caused by the law of supply and demand. The great redeeming feature in hydro-electric development is that when the plants are wisely and judiciously constructed with relation to the maximum output in connection with the minimum supply of water, the installation can be considered reliable enough to warrant the making of very long term contracts at uniform prices. This enables industries using electricity to bring about a permanent cost for fuel or power. This assurance does not apply to any of the fuels which heretofore have been used.

#### RESTRICTIONS BY FORESTRY DEPARTMENT

The only control which the national government can exercise upon the waters within California is due to the government's right of ownership of land upon which and over which the water travels in its downward course to the ocean. By putting restrictions and financial burdens upon the proposed use of such water the government is thereby increasing the cost of the power that would be produced and is placing the development of that water at a serious financial disadvantage in competition with plants already in operation.

The most economical sites available in California have already been developed or are in possession of the existing companies. This condition will tend to retard the development of other available sources that would compete with the established plants. The profits from these new installations must necessarily be less when entering into competition with those that chose the best places and were not restricted.

#### WOULD ENCOURAGE MONOPOLY

All water rights in California, except on public lands, are state property, and laws over which the national government has no control govern their appropriation and use.

If the conservation of the waters on government lands shall prevent future development by private enterprise, the result may be the possible encouragement toward a monopoly of the existing interests.

The forestry department has apparently lost sight of the value resulting from private development. Water that is being used by the various power plants today is not absorbed or consumed, but continues, uncontaminated and undiminished, to flow on for man's uses as if developed specifically for those purposes.

#### PUBLIC BENEFITS

There are many industries in California now producing and materially assisting in the state's wealth production which would not be a factor but for the developments which have been made in hydro-electric transmission.

A notable example is the cement industry, entirely new in California within the past ten years. Owing to the conditions existing with hydro-electric plants, these companies are able to make and have made very long term contracts at uniformly low prices for all their electric power. In most cases these contracts were made when oil was selling from 25 cents to 40 cents a barrel in the districts concerned, and it was in competition with oil at those prices that the rate for electric current was figured.

The price of oil today is more than double what it was when those contracts were initially made. But if they could not have made long-term contracts for current at a uniformly low cost the industry would not have been financed, through fear of possible increased costs that would force it into idleness in competition with foreign production, which previously supplied the entire market.

Another very large industry promoted by hydro-electric power is the recovery of gold by the use of dredgers in lands adjacent to the streams of northern California. Material is elevated from a depth in some cases of sixty to seventy feet below the surface of the ground and is then washed and passed over riffles to obtain the gold before returning the material upon the ground excavated. More than one-third of the total yield of gold in California in the year 1908 was produced by these dredgers.

The use of hydro-electric transmission is particularly valuable in agricultural sections, where thousands of motors are now in use pumping water to the surface for irrigation that otherwise would not have been possible.

The sources of water supply available for hydro-electric development in California are in the mountains. Where possible this water is obtained under as high a head or pressure as physical conditions will permit. This usually lessens the cost of development. These supplies of water are available from the ordinary flow in the streams for many months of the year, but, owing to California's wet and dry seasons, many of the hydro-electric plants must depend also upon the conservation of water in supplementary reservoirs that can be drawn from during the summer months. These waters are impounded during the rainy season at a time when the conservation of this surplus water is of no disadvantage to any users below. By the additional flow from these reservoirs streams, particularly the Sacramento and San Joaquin rivers, have had their summer flow so augmented as to make river transportation possible to many points that would otherwise not be reached by steamer during the dry months.

Without this added flow at low water the area of agricultural production in many of the rich bottom-lands of California would be curtailed by the restriction of transportation and irrigation facilities.

#### ARE PROTECTING THE FORESTS

The hydro-electric companies operating in the forests and mountains of California have a large number of employees whose duties are to patrol, repair, and protect its properties. Those men put out many incipient fires that might otherwise result in the devastation of large areas of timber lands. And this is done without cost to the state or its people.

In many sections of California prior to the development of hydro-electric plants the entire country had been denuded, particularly in mining sections. As soon as a second growth of timber would be large enough it would also be destroyed for fuel purposes. During the last fifteen years some of these districts are becoming covered again with a new growth, and in time will produce suitable timber for lumber purposes because of the protection given by the hydro-electric companies.

All through the mountains the patrol is continued day by day, and the surrounding country is being protected by this patrol to a much greater extent and more reliably than is being done by any other interests.

The hydro-electric companies now supplying the markets have their greatest demand during what are known as the "peak" hours, beginning approximately at sunset and continuing through the succeeding four or five hours. The minimum consumption is between the hours of midnight and 6 a. m. The consumption during the daylight hours is materially less than during the peak hours. The average output, or load factor, of the majority of the plants will not exceed 60 per cent. of the maximum, or peak, load. Therefore, these plants have idle capacity ranging from nothing for a few minutes a day to 60 or 70 per cent. of the total installation, with an average of 40 per cent. of the installation available and for sale, but untaken, unless patrons be obtained to use it during the hours when there is no heavy general demand for current.

### NEW USES FOR POWER

There are some purposes for which this idle power can be utilized. It is now being used in the furtherance of developments similar in purpose and value to that to which the government had given its aid through its reclamation service. In the San Joaquin and Sacramento valleys there are numerous pumping plants where electric power is used for three or four months of each year to pump water from the rivers to reservoirs on the uplands, whence irrigation ditches distribute the flow to lands that formerly produced nothing. This class of customer could use electric power during the daily low periods of consumption, and, by means of the governing reservoirs, be able to pump from fifteen to eighteen hours a day and at the same time keep off the peak demands of the power plant. Such customers are able to contract for power at much lower prices than can be obtained by those who use current on the peak hours.

As this pumping service requires power only for three or four months in the year the installation of steam plants and their operation becomes prohibitive, because the interest and depreciation charges are so great for the limited period of use.

In some of the sections adjacent to the rivers where levees have been built to protect the surrounding country from inundation, large acreages have become flooded each spring with the run-off from the watershed above them, because there was no outflow.

### PUMPING OUT LEVEED LANDS

In order to utilize these lands for agricultural purposes it becomes necessary to remove this water by pumping into the river during a period of time ranging from two to four months prior to the planting season. This work has been accomplished very successfully and profitably to the landowner by the use of hydro-electric power available during the eighteen hours of low load and at prices with which no other form of power could compete, and also at prices below the average obtained by the power companies. In fact, all power companies make inducements to patrons where possible to keep off the period of maximum demand each day. By so doing the power company gets from the same investment increased revenue which otherwise would be lost.

### THE FUNCTION OF NATIONAL CONTROL

The function of control of any project or measure by the national government has been and should be limited in its exercise to the projects that are not permissible of development by private enterprise. If it is to be the policy of the United States government to control all public service there are so many more vital and important problems to be considered before this question of benefit or injury to a small section of the United States and a smaller percentage of its people.

WATER POWER COMPARED WITH OIL PRODUCTION

If all the water power available on government land in California be developed it would not produce an amount of power equal in value to one-fourth of the annual production of the oil wells of California.

The injuries or benefits that might affect the people of California because of any action of the government in the conservation of water upon forest reserves must of necessity be very small and less worthy of time, attention, and expenditure of money than many of the larger and more important problems that affect the public throughout the whole country.

It is incontrovertible that the existing developments of hydro-electric power in California are responsible for a very large increase in assessable property and for the employment of many thousand people in mines, mills, quarries, farms, railroads, and other industries, and that without these developments California's progress would have been very materially restricted.

The baby arrived; they had no scales. The iceman came. Happy thought. The father borrowed the iceman's scales. Ah! the baby weighed 26 pounds! Just think of it!

---

In 1900 the government reported 10,460,000 foreign-born people in the United States, or 13.7 per cent. of the country's population; ten years earlier the percentage of foreign-born was 14.8 per cent.

---

Curious effects of lightning strokes have been authentically recorded. Persons have been found regaining consciousness but with every vestige of clothing torn from their bodies by the force of the electric bolt. In other cases victims have been found rigid in death and remaining in the very poses they happened to have assumed the instant they were struck. In one instance a group of farm laborers having luncheon under an oak was found seated and in all the varied postures of eating, but stiff in sudden death; at another time a woman was found struck and left standing just as she had plucked a poppy. The greater the current the more apt it is to induce instantaneous rigor of death.

The accidental crossing of a current wire with a dead circuit upon which he was working at the top of a pole near Oroville September 15th sent 4,000 volts through the body of and instantly killed Lee Stark, aged 27 and popular as the superintendent of the Oro Water Light and Power Company.

---

Thomas A. Edison has suggested that East river, separating Manhattan Island from Long Island, be stopped up and a canal be cut through Long Island, the object being to make New York and Brooklyn one city area and avoid ferrying, bridges, and the dangerous Hell Gate. And the idea is declared to be within the bounds of possibility.

---

A dirigible airship was starting to make an exhibition at Ottawa, Canada, September 16th, when the anchor caught in electric light wires, scraped off some of the insulating, and threatened to spill the aeronaut. Spectators rushed forward and, in grabbing the metal rail of the balloon cage, were promptly knocked down one after another, till twenty-four were dropped by the unexpected shock from the anchor's connection with the electric line.

# The History of the Folsom Power Plant

*By* ARCHIE RICE.

Archie Rice

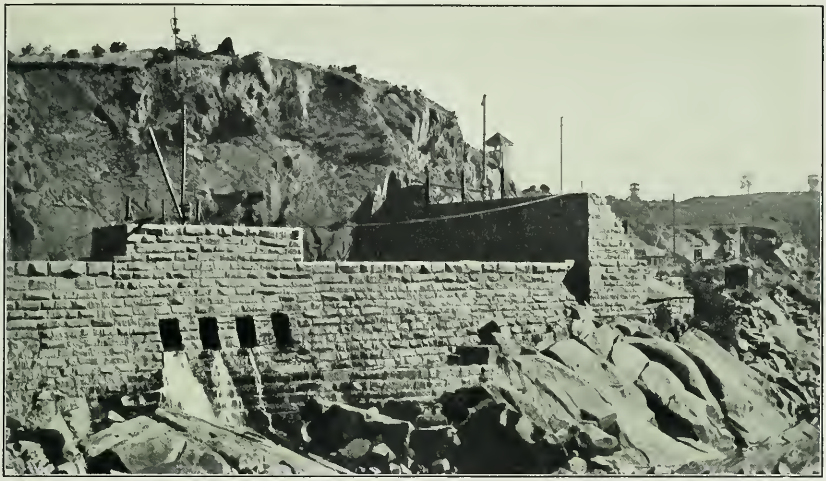
**At the little town** of Folsom, on the American river to the eastward of Sacramento, is the oldest of the eleven hydro-electric power plants now owned by the Pacific Gas and Electric Company. While not the first installation in America for long-distance transmission of electric energy, Folsom was among the pioneers. It was preceded only by the sixteen-mile power system installed in the latter part of 1892 for a mine at Bodie, California, and by a very few similar plants established after Bodie and before Folsom began, in July of 1895, sending electric energy through a twenty-two-mile power line to the city of Sacramento. There the current was to furnish light, operate machinery, and propel street cars.

Circumstances often change the purpose of a man's life. An isolated farmer may be disturbed by the advent of a railroad and the creation of a townsite on his property. A few years later these circumstances may have changed the quiet rustic into a bank president, a hotel proprietor with a diamond stud, a man of affairs in his own community.

Unexpected developments in local and business conditions helped to bring about the establishment of that power plant at Folsom. It was a creature of circumstances, plus. And the plus was the personal energy of a few men—Horatio Livermore, Charles Livermore, and Albert Gallatin, Sr.

Back to the beginning of Folsom's advent as a producer of electricity there is a series of developing events covering a period of forty years and involving an old Spanish ranch,

Upstream Face of Folsom Dam, Showing Prison Watch Towers on Hill



View of Wing Dam and Its Four Sandgates, with Headgates to the Right

placer mining, a logging industry, state politics over the selection of a prison site, transfers of property ownership, six years of convict labor on the Folsom dam and power canal, disputes with state officials as to water privileges, and years of litigation, which was perpetuated in a case taken before the supreme court of California to determine the relative rights of the power company and the state prison in the use of the water flow, and that case was not satisfactorily settled until the 29th of September, 1909.

In pioneer mining days the American river was a mint, where a great army of argonauts worked with shovel and rocker. Up the granite-ribbed bed of that stream, miles above Folsom, the middle and south forks of the river come together from two sides of the famous Georgetown Divide in El Dorado County. There James Marshall, in February of 1848, made the first discovery of gold in California. He happened upon it while repairing a water ditch at Sutter's mill. That Georgetown Divide district is mountainous. Half a century ago it was heavily timbered with sugar pine and yellow pine of exceptionally good quality.

Things were booming in the mines, and Sacramento was the commercial centre of the mining industry. Lumber became a necessity, and its production a profitable enterprise. By 1855 the Sacramento Valley Railroad, from Sacramento to Folsom, was completed. It was the earliest steam road on the western slope of the continent. "Uncle George" Bromley, the well-known, jovial, nonagenarian member of the Bohemian Club, was its first passenger conductor. The day the first train ran was the most notable in Folsom's history. Men whose names loom big in the annals of California were there to celebrate the event. Five or six years later Stanford and Huntington and Crocker and Hopkins started the idea of a transcontinental railroad, and Stanford, as war-time governor, lawyer, and personal friend of Lincoln, got the government land concessions that made possible the financing of the amazing undertaking.

Albert Gallatin, Sr.

That little railroad to Folsom became in 1863 the initial part of the Central Pacific's transcontinental line.

These facts are not necessary to the story of the Folsom power plant, but they have a historical connection with it, because the very bricks of which the power house is made were part of the first railroad shops built at Folsom in 1855, upon the spot where the Folsom passenger station now stands. And just upstream from the power house is one of the original granite masonry abutments upon which rested the first bridge built for America's first transcontinental railroad.

In 1851 the Natoma Water and Mining Company had acquired some rights along the American river, and in 1857 it purchased from Charles W. Nystrom lands on the east bank, and also bought river-channel lands.

Horatio P. Livermore and his brother, Charles E. Livermore, were interested in the lumber business. They wanted to market a lot of that timber from the Georgetown Divide, and they had to have river rights that would permit them to float the logs down stream. So they had bought river land and acquired the "Rancho Rio de los Americanos," which suggests that the original Spanish name of that stream was "River of the Americans," probably called from the Americans like Sutter and others who settled along its course before gold was discovered.

In 1858 the California legislature decided to establish a branch prison to supplement the original penitentiary at San Quentin, and a choice of location was restricted to the granite-quarrying district at Rocklin or the granite district near Folsom. Year after year no selection of a site was made by the prison directors, and the matter was allowed to drag.

The Livermores needed a still-water basin somewhere near Folsom to catch the logs as they came down stream. So, in 1866, Horatio Livermore, as president of the Natoma Water and Mining Company, laid the foundations of the present Folsom dam, about two miles up the stream from the

Charles E. Livermore, who was President of the Company when the Folsom Plant was Started

Folsom Power House and Granite Forebay

narrow little town that now claims 1,500 people but does not look the part.

In 1868 the legislature awakened from its Rip Van Winkle sleep of ten years and pushed through a resolution requiring that a choice between Rocklin and Folsom be made by the prison directors before July of that year. The Livermores' dam was only partly built, and there was an immense amount of work ahead to complete it and the outflow canal that was to float the logs down to a proposed sawmill near the present site of the power plant. The Livermores met the prison directors and offered big inducements to get the prison at Folsom. Their proposition was accepted.

The Livermores were to give the state 350 acres of quarrying and agricultural land on the east side of the river adjacent to the dam. They were to include with the land a perpetual and exclusive right on the part of the prison to waterpower produced by a fall of five feet. This was to be provided at the end of the first 1,000 feet of canal just before it left state property and resumed its course down to Folsom. In exchange for the land and the waterpower the Livermores, as soon as the prison should be finished, were to get $15,000's worth of convict labor to complete their dam and part of their canal.

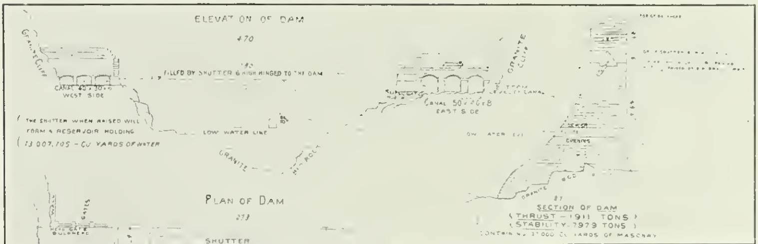
In May of 1872 the Livermores filed a claim to a flow of 100,000 miner's inches of water.

The state decided, in 1874, that it would be desirable for the new prison to have some other lands adjoining the original tract, and an additional 134 acres was secured from the Livermores, making a total area of approximately 484 acres.

The prison was not completed till July of 1880. No convict labor could be available until the prison was built.

The water company had gone on working and had expended an aggregate of $119,-000 in constructing its two-mile railroad from Folsom up to the dam and in laying the foundation of the dam itself. But it had not yet received one dollar in money or an hour in labor from the state in payment for that tract of 484 acres upon which the new prison was standing. For twelve years the company had been waiting for that promised pay in convict labor.

In September of 1881 the Natoma Water and Mining Company became the Folsom Water Power Company, a change of name but not of men chiefly interested. The company then demanded the prison labor due. But in August of 1892 a controversy arose. The company insisted that it was not giving all that land and those waterpower rights for the originally designated $15,000's worth of prison labor. No; there was $30,000's worth of convict labor coming to it. The warden of the prison continued to offer eighty convicts who would be put to work on the job, and the company just as regularly declined to accept the labor with its implied payment of only $15,000.





Detail Plan of Folsom Dam

The company had stopped work on the dam. The state brought suit to compel the company to accept the convict labor and go on with the construction of the dam and the canal. But the superior court decided that the company did not have to accept the labor unless it so desired. Thus matters dragged along until 1888, when Governor Stoneman came into office. Then the Folsom Water Power Company made a new proposition to the state the 5th of May, 1888. The proposition was this: the state should furnish the convict labor necessary to complete the dam and build the canal as far as the mud sink at Robber's Ravine, a distance of about 2,000 feet below the dam, and in consideration of that labor the company would then give the state additional water power produced by a fall in the prison yard of 7.33 feet, instead of the originally designated 5-foot fall; would give the state the right to use the company's railroad line from Folsom up to the prison, provided the state kept the road in repair; would permit the taking or pumping from the canal of all water desired on the prison property for irrigation and domestic

County Bridge Across American River; Also Old Stone Abutment That Supported First Transcontinental Railroad Bridge

purposes; would permit the taking of gravel from the adjacent river bed, which was all owned by the company; would permit ingress and egress over the company's lands on the river side of the prison, and the passage over the company's land of a prison sewer to flow into the river. These rights, aside from the water power, were considered by the prison warden to be worth more than the value of the convict labor desired. He reported to the governor that the water power alone would produce 800 horsepower, which, at the existing price of fuel, would otherwise cost $64,000 a year to produce and would mean to the state the equivalent of a million-dollar power investment.

The company's new proposition was readily accepted by the state, and the first day of July, 1882, convicts were put to work on the dam and the canal.

H. T. Knight was the company's engineer of construction. Later he started the power plant as its superintendent, a position in which he was succeeded by his son. He had all along been supervising the work on the dam. He continued doing so. The understanding was that the company should supply the granite, the materials, and the engineering plans, and that the state should simply furnish the manual labor. For exactly six years the convicts worked on the dam and the canal. During that time they did an aggregate of 520,349 days' labor, which, valued at 50 cents a day, was equivalent to the payment of $260,174 to the company. In addition to this convict labor, the state provided free labor for which it paid $24,508. This made the total price paid by the state equivalent to $284,682, but the labor was worth to the company many times 50 cents a day.

The water was first turned into the Folsom canal and allowed to flow through the prison yard in January of 1893. The prison had built a power house of its own to use the seven-foot fall. The water company had meanwhile completed at its own expense the remainder of the canal.

The original intention had been to have the canal bring logs down to a sawmill at Folsom, and thence to convey the water on for irrigating purposes. This idea had evolved into a plan for having an electric power plant at Folsom that would supply energy to manufacturing enterprises which it was hoped would be established there. But before the dam and the canal were completed long-distance transmission of electric energy became a practical fact. So all those dreams about factories at Folsom went glimmering, and

Folsom Dam Across American River, With Outflow to Canal in Foreground

Downstream Face of Canal Headgates, Showing Massive Granite Bluff at Right

plans were changed to give Folsom a hydro-electric plant, its prime object then being the transmission of energy down to Sacramento. Late in 1892 Horatio Livermore and Albert Gallatin secured a street-car franchise in Sacramento, and November 1st of that year they conveyed the franchise to the Sacramento Electric Power and Light Company, which later took current from Folsom.

The Livermore brothers were natives of Boston and came to California in the later 50's. Horatio Livermore was the financial manager of their enterprises, and was married. Charles never married, but always made his home with his brother. He embarked in the wholesale drug business in Nevada in the palmy days of the Comstock, and later engaged in quicksilver mining with Horatio. But their chief concern was the development of water power at Folsom. Charles Livermore was at the head of the company when the Folsom plant began operations. He was an ardent lover of athletic sports, established the first rowing club on California waters, and was one of the fourteen original incorporators of the Olympic Club of San Francisco. While not educated for engineering or art, he developed natural talents for these subjects, and was an original member of the San Francisco Art Association. The names of Horatio Livermore and Albert Gallatin are intimately associated with the Folsom enterprise and with the business life of Sacramento more than a generation ago.

When the Folsom dam was constructed, water power under high head was not yet a practical engineering development. By using a very gradual fall of about one foot in every 1,000 feet of canal the promoters found they could deliver an enormous flow of water to Folsom at a point about eighty feet above the river bed. From the forebay at the lower end of the canal they could easily secure a sudden fall of fifty-five feet, and that would give them what was then considered considerable power.

They figured that the American river could always be relied upon for an unusually large flow during the dry season. Its numerous branches all have their rise in the Sierra Nevada mountains within a few miles of Lake Tahoe. The heavy snowfall on the ridges there and the late melting of this snow would furnish abundant water late in the season when the effect of the rains had long since waned in other districts. The theory was all right, but the practice did not work out just that way.

The Folsom plant started July 13th, 1895. But its real public inaugural was the

Looking Up Canal Toward Headgates—Folsom Prison Quarry on Right

Further Down the Canal, Looking Back Toward Prison Rock Crusher and Watch Towers

day it sent power through to Sacramento for the Native Son's electrical carnival, the 8th of September, celebrating the forty-fifth anniversary of the admission of California into the sisterhood of states.

During the summer of the following year the waterflow in the American river became surprisingly low. Larger demands had come upon the Folsom plant for electricity in Sacramento. What is now the Sacramento Electric Gas and Railway Company had in December of 1895 secured the street lighting contract by underbidding the old Capital Gas Company for a general reduction of twenty-five per cent., and much other electric business was obtained. Accordingly it became necessary to install a supplementary plant at Folsom, and it was established early in 1897, to develop an additional 750 kilowatts by using the twenty-six-foot fall after the water left the power house on its way back to the river.

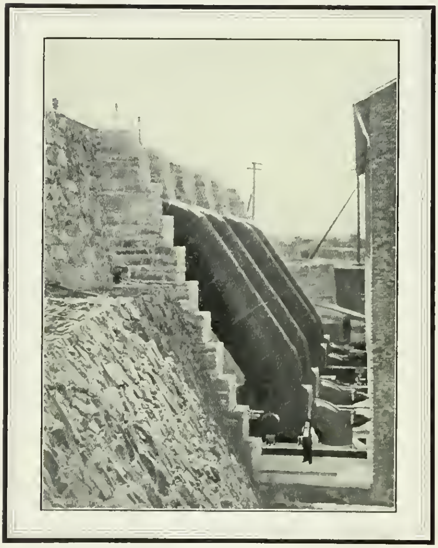
In 1896, also, a sawmill was established adjacent to the canal and about a quarter of a mile above the Folsom power house. Logs were floated down the river and then through the canal. Here again trouble arose with the prison authorities. Up to that time the headgates of the canal had been operated from the prison power house. Now the prison refused to raise the gates a little higher to permit the passage of logs. Then arose the questions, Whose dam is that, any way? and who has the right to open the headgates?

In the summer of 1897 the American river got still lower. There was not sufficient waterflow to produce the desired power. It became necessary at Sacramento, from September 22d to October 3d, to shut off current from such large consumers as the Phoenix Mill, the Buffalo Brewery, and the Southern Pacific Railroad shops.

In 1898 the American river dropped still further, and so suddenly that an auxiliary steam plant that was being built at the substation in Sacramento for just such an emergency had to be rushed to completion. Even then it was not quite quick enough, because July 17th, the night before it started, the water fell below the top of the penstocks, and the Folsom plant had to be shut down for that evening.

In 1899 a contract was made with the Bay Counties Power Company to secure auxiliary energy the next year from that company's plant, then being built at Colgate on the Yuba river. Meanwhile the series arc lighting system of Sacramento was switched on to the Capital Gas Company's plant, and the steam engine at the substation was left to provide the energy for the street railway and

The Folsom Power House, With Outflow Canal Through Solid Granite



The Four Penstocks, Through Which the Water Plunges From the Forebay to the Power Wheels of the Folsom Plant

such alternating current as its capacity could furnish. With the perfection of the transmission system from the Colgate plant the problem of water storage for Folsom became less alarming, and in June of 1902 John Martin and Eugene de Sabla, Jr., the men behind the Colgate enterprise, secured a controlling interest in the Sacramento company and the Folsom plant, though the active management did not change till May of 1904. The control of both the Folsom plant and the Sacramento company became, late in 1902, a part of the system of the California Gas and Electric Corporation, and in January of 1906 it was conveyed to the Pacific Gas and Electric Company.

While Folsom receives an enormous flow of water through its canal, the impounding area provided by the dam is not sufficient to maintain that great flow all through the dry season. The fall at the power house is comparatively low, and a tremendous volume of water is required to produce the power.

Carefully made surveys of the catchment area of the American river have indicated that it would be possible to construct in the mountains impounding reservoirs that would permanently increase the flow at Folsom until that flow during the season of least water would be as great as the maximum canal flow now known at the Folsom plant. And the construction of such a system of storage reservoirs would perhaps make constantly available at Folsom 5,000 horsepower, where now it is producing from 800 to 1,000 horsepower during the lowest flow of the American river.

Where the Folsom dam is located the American river narrows naturally between blackened granite bluffs that taper off downstream into a river bed that for nearly two miles suggests a confusion of solidly made stone walls between which flows the surplus water from the dam.

The dam itself is 81 feet high, 854 feet long, and 16 feet thick at the base.

The elevation of the dam is 210 feet above sea level and 175 feet above the level of the city of Sacramento. It is of solid granite masonry, as may be seen by the accompanying photographs and the detail drawing. The first intention was to have a canal on each side of the river, but only the east-side canal was built. This canal consists of three sections.

Secondary Plant at Folsom Power Station, Run by Outflow From First

The first is 2,000 feet long, and is cut into solid granite cliffs and walled up on its river side with the granite cut from the cliffs. At the end of this section is the prison power house, a granite structure through which all the water of the canal flows, when it is not purposely diverted to avoid the power house and continue right along down to Folsom. The second section is 4,000 feet long, and has its inner side faced with a masonry wall and the outer side protected against the river by heavy riprap work. The first two sections were built by convicts. The third section is 3,500 feet long, and was built by the company. It cuts through earth and rock formation, and has an earth and rock fill on the outer edge, which is also protected in places by riprapping. The total length of the canal is 9,500 feet, or almost exactly 1.8 mile. A standard gauge railroad track runs along the canal bank next to the river.

R. A. Rose, Foreman Frank O. Hutton, and George Ferguson, Who Has Been at the Plant From the Start.

The canal is generally forty feet wide on the bottom, its banks sloping up to give it a width of fifty feet at the top, and the depth is eight feet. At full flow the canal is capable of carrying a constant run of 70,000 miner's inches, or 1,750 second-feet, and the plant takes 40,000 miner's inches, or 1,000 second-feet at full load.

Four enormous headgates, each sixteen by fourteen feet in the clear, are situated at the entrance to the canal at the end of the wing dam, and these huge headgates are operated by hydraulic rams, a system which is possible here where there is never snow or ice to interfere. The wing dam is provided, as seen in the illustration, with four sandgates or sluices to carry off sand and prevent its being taken down canal to interfere with the waterwheels in the prison plant. And supplementing these sandgates there is a ledge across the canal itself to catch the sand that may come through the headgates. Below the prison power house are four other sandgates.

Twice convicts have unsuccessfully tried to escape by dropping into the canal, on the theory that a man could just keep his nose above water and float down to safety without being discovered.

The canal ends in a large granite forebay that is made double by having a granite partition wall dividing it into two sections. This permits one to be cleaned of accumulated silt while the plant is still taking water from the other.

The forebay is 150 feet long, 100 feet wide, and 12 feet deep, and the fall to the turbines is fifty-five feet through four penstocks eight feet in diameter and made of five-eighths-inch steel. Each pair of turbine wheels is ten feet in diameter. At the time of its installation the hydraulic equipment at the Folsom plant, weighing upward of 400,000 pounds, was considered the most massive and powerful in the world, excepting only the plant at Niagara Falls.

The equipment of the original plant consisted of four S. Morgan Smith turbines, four Lombard governors, and four 3-phase, revolving-armature type, 800-volt, 750-kilowatt generators of General Electric make. There are four transformers, one held in reserve, and their combined capacity is 5,000 kilowatts, or 6,600 horsepower. The only change from the initial installation is in the transformers, which have been altered to deliver 60,000 volts in addition to the original voltage of 10,000.

The supplementary, or lower, station at Folsom takes advantage of a twenty-six-foot fall of the water after it leaves the old power house, and there an additional 750-kilowatt unit is installed. It is of the 3-phase, revolving-field type, 11,-500-volt, General Electric pattern.

Jacob C. Kearns

Who has been at the Folsom Plant ever since the machinery was installed

The turbines at the upper power house, under a fifty-five-foot head, run at the rate of 300 revolutions a minute, and are directly connected to the armature shafts of the generators by insulated flexible couplings. Each pair of wheels is supplied with a steel flywheel ten feet in diameter, weighing 10,000 pounds, and having a speed at the outer edge of 9,425 feet a minute. Heavy steel rims are shrunk on the wheels to provide for the great strain such speed produces.

The transformers are on the second story of the building. The high-tension leads are led from the transformers to the double pole lines out through a hood-protected opening in the end of the station. The pole line consists of forty-foot, round, cedar poles extending to Sacramento in two parrallel lines, one on each side of the county road. From the power house to the railroad station at Folsom the distance is 1,056 feet, from the Folsom railroad station to the city limits of Sacramento is 19.4 miles, and from the edge of the city in to the Sacramento substation is 1.9 mile, making a total transmission distance of practically twenty-one and a half miles.

A change was made in the transmission line early in 1905, when the pole line on the south side of the county road was supplied with larger insulators, its wires were given a greater spread, and the potential carried was raised from 10,000 to 60,000 volts.

In the preparation of this sketch the writer acknowledges information obtained from an article published in 1895 by the late George P. Low in the "Journal of Electricity"; from C. W. Hutton, an old employee of the company but now with the Great Western Power Company; from the report made to the state board of prison directors in 1900 by Warden Aull at the Folsom penitentiary; from some data kindly supplied by United States District Attorney Devlin, who was formerly a prison director and a Sacramento lawyer; and from various employees of the company who have personal knowledge of some of the events as they occurred.

Enthusiasm is a lubricant to business; a grouch is sand in the bearings. Smile!

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She had light hair. In fact, it might be termed electric-light hair; among the coils there was a switch.

"Married or single?" was asked of one of the talesmen.

"Married 4th of July, 1906."

"Have you formed or expressed any opinion?"

"Not for three years."

# Regulation of Cycles

*By* OTTO A. KNOPP, Oakland District.

opp

**Many opportunities** have come to the writer, by reason of some experience in aeronautics and meteorology in Europe and America, that have suggested methods of applying directly to the electrical field several principles involving the use of precision instruments and recording devices.

The importance and the difficulties of maintaining the proper frequency in an electrical transmission system have therefore suggested the prospect of creating some device that will preserve uniform frequency.

The measurement of the frequency of an alternating current induced by an alternator is purely and simply a time measurement. This can be easily demonstrated by connecting the hands of a clock with the alternator shaft and using a gear that will give the clock hands the same speed they would have if moved by the clock's works. Then, if the speed of the alternator could be maintained constant, we would have a clock keeping perfect time, run, not by clockwork, but by the alternator.

The problem is how to maintain the speed constant so that the attached clock hands will not run too fast or too slow. This could be done by using a regular clock in conjunction with the clock hands run by the alternator. The hand of the alternator clock could be set exactly in time with the hand of the standard clock, so they could run in synchronism, moving at exactly the same speed. To insure an absolute equality of speed the standard clock and the alternator clock hand could be connected concentric, so that every time the alternator tended to go faster than the hand of the standard clock an electric contact would be closed and operate a relay upon the governor of the prime mover, reducing the speed of the alternator and keeping it down to the speed of the standard clock. In case the alternator should tend to run below standard speed then another contact would be closed, keeping it revolving at the same rate as the hand of the clock. Therefore, by means of the electric contacts the frequency would be kept in exact synchronism with the standard clock and would be constant to the highest possible degree.

As all the alternators of an electric power system run in parallel the entire system could be kept in synchronism with this alternator clock. Then every alternator in the whole system would be a perfect time element, and there would be standard time throughout the system. It would also be interesting to assume the possibility of furnishing correct time to every lighting customer by having his clock operated by a small synchronous motor.

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The man with more knowledge than judgment will always be working for someone else and not for himself.

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"He Did His Best" was the inscription on the gravestone, till a man who knew came along and printed after it the word "Friend."

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In the industrial application of water power New York state ranks first with a regular production of 885,862 horsepower, California second with the production of 406,774 horsepower, Maine third with 343,-096, and then follow Oregon, Idaho, Nevada, and Washington with a combined product of 472,165 horsepower, where there are possibilities of the enormous amount of 12,979,700 horsepower.

# They Say

From the "Pacific Telephone Magazine," August number:

The Pacific Gas and Electric Company has begun the publication of a monthly magazine for the benefit of its employees. We welcome the advent of the "Pacific Gas and Electric Magazine" in the field of public service publications and extend our best wishes for its success and prosperity.

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From the magazine "Light," August number:

A copy of the new "Pacific Gas and Electric Magazine" has found its way to our editorial desk, and, after a careful perusal, we wish to compliment the Pacific Gas and Electric Company on the completeness of the company's house "organ." Its excuse for being is well stated in an editorial.

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From a citizen of Milwaukee, Wisconsin, to E. C. Jones:

It is a pleasure to see that you have first achieved the "nineteenth meridian" in gas company literature as well as in engineering. Your periodicals are more than creditable; they are remarkable. I know of no other company in the United States that has gotten out so finished a product.

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From the manager of the Stockton Water Company:

The September edition of the Pacific Gas and Electric Magazine has just been received by us. The employees of this company hail the magazine as "the greatest ever."

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From F. V. T. Lee, as chairman addressing the Association of District Managers, at San Rafael, August 28th:

The third number of the magazine was gotten out yesterday, and we are justly proud of it. It is a great improvement over the first two issues. It is a very good publication, and is being very favorably received by the employees. It is your magazine, gentlemen, and it is "up to you" to help put it ahead.

---

From the "Grass Valley Union," issue of September 24th:

The Pacific Gas and Electric Company has commenced the publication of a monthly magazine which is to be circulated among the employees of the company. The September number is the fourth issued. It is handsomely printed and illustrated, and will be the means of conveying many valuable ideas and much information to the employees of the big company. The articles are contributed by the heads of the various departments and those connected with the company whose experience enables them to present thoughtful and interesting articles both of a technical and a general nature. The leading article in the September number is a description of the Alleghany district from the pen of George Scarfe, manager of the Nevada division, and is well written and profusely illustrated. In the August number Herbert Cooper had an article concerning the water conservation in the Auburn district. The October [November] number is to contain a description of the Rome power house, and will be illustrated with views of the works and vicinity. The magazine fills a unique place in the organization of the big corporation, and each succeeding number will be eagerly looked for by those interested.

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From editorial in Alameda Argus, October 4th:

We are in receipt of the September number of the Pacific Gas and Electric Magazine. It is a very neat and clean-cut publication, having attained its fourth number. It contains much of interest to the general reader. The article that will most directly interest people on this side of the bay is a history of gas lighting in Oakland. As Alameda's gas supply comes from the same source* as Oakland's, this article will constitute good reading for the people of this town. With that idea uppermost, we reprint it. Older Alamedans will have their memories refreshed thereby, and later comers will gain knowledge of the earlier and more primitive times.

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From W. T. Keskeys, Chalk Bluff reservoir, Nevada water district.

As for the magazine, I find it interesting, and many articles are very instructive. I shall willingly lend a hand in filling out with anything that I think of interest.

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The "Clow Bulletin," a monthly trade magazine published by Clow & Sons of Chicago, used as an outside cover feature for its September number a photogravure picture of the new San Francisco headquarters building of the Pacific Gas and Electric Company.

# Some Things About Steam

*By* W. F. DURAND, Professor of Mechanical Engineering, Stanford University.*

W F Durand

**Steam is known** to the engineer through its properties or characteristics. Of these there are five of chief importance, and to these the discussion of the present brief article will be restricted. These characteristics are pressure, temperament, volume, quality, and energy.

#### PRESSURE

Steam in common with all vapors and gases exerts a pressure on the walls of any containing chamber, such as a boiler drum or steam cylinder. According to the molecular theory of matter, this pressure is the result of a bombardment to which the walls of the chamber are subjected by the flying molecules of the vapor or gas. If we could imagine, say, one hundred men throwing a stream of baseballs at an average rate of one a second for each man, and suppose these baseballs to land on a target, say, three feet square, then such a series of impacts would develop a very considerable force acting on the target in the way of a pressure. In a somewhat similar manner the walls of a chamber containing a gas or vapor are supposed to be bombarded in all directions and in every direction equally, and thus is developed the characteristic we call pressure. The pressure is reduced to numerical measure by taking the total force thus acting on a unit area and calling this the intensity of the pressure, or, more briefly, the pressure. The actual units employed are the inch and pound or the foot and pound, the former giving us the latter the pressure in pounds the square the pressure in pounds the square inch and foot. In all ordinary specifications and for all purposes of every-day use the square-inch unit is employed.

On the surface of the earth we live, move, and have our being in an atmosphere which is itself a gas having an average pressure measured at sea level of about 14.7 pounds the square inch. All operations of the engineer are carried on surrounded by this atmosphere. It is present everywhere, except when specially and carefully excluded. In particular, all ordinary pressure gauges and instruments for measuring pressure are surrounded by the atmosphere and exposed to its pressure. This means that the ordinary pressure gauge which is used for measuring steam pressure is in reality exposed to the pressure of the steam on one side of the elastic tube or diaphram, and to the atmosphere on the other. It follows that the steam on its side must produce a pressure of 14.7 pounds the square inch in order to balance the pressure of the atmosphere, and in order to put the gauge in the condition in which it was made in the shop, with, of course, the atmospheric pressure on both sides. Hence the movement of the gauge pointer upward will not begin until this pressure of 14.7 pounds has been reached by the steam, and what the gauge pointer measures is really the excess of the actual pressure over the atmospheric pressure or starting value of 14.7 pounds.

The pressure as read from a gauge is called gauge pressure. The total or real pressure of the steam is then greater than this by the pressure of the atmosphere or by 14.7 pounds. This total or actual pressure is called absolute pressure. Absolute pressure is therefore found by adding 14.7 pounds (in round numbers 15 pounds is often employed) to the value of the gauge reading.

*Professor Durand has been retained by the Pacific Gas and Electric Company in consultation incident to the installation at Station C, Oakland.

### TEMPERATURE

When water is heated under any constant condition as regards pressure it is found that vapor is not formed until the temperature of the water rises to a certain value depending on the pressure, and that when such value is reached, then the further addition of heat results simply in the formation of water vapor or steam, without further rise of temperature so long as any water remains in the liquid state. Conversely, in any such condition the abstraction of heat will result in a partial condensation of vapor back into liquid, the temperature meanwhile remaining unchanged. The temperature at which water may thus pass back and forth between the condition of vapor and liquid by the addition or removal of heat, the temperature and pressure remaining constant meanwhile, is called the temperature of the steam. It results that for each value of the pressure there is a particular corresponding value of the temperature or for each value of the temperature there is a particular corresponding value of the pressure.

This relation between pressure and temperature is not one which can be satisfactorily expressed in algebraic form, though various attempts at such expression have been made. Every engineer should, however, have in mind the general character of the relation. Thus at very low pressures the rise in temperature by pound increase in pressure is very rapid. Between one pound and fifteen pounds absolute the temperature rises from 102 to 213°, or through a range of 111°, an average of about 8° a pound. At the upper end of this range, or about atmospheric pressure, the rise in temperature is about 3.5° a pound. At 28 pounds absolute it has dropped to 2° a pound, at 66 pounds absolute to 1° a pound, at 160 pounds absolute to .5° a pound, and at 212 pounds absolute pressure to .4° a pound. It results that a few pounds change at such pressures as are met with in modern steam plants results in a much slower rate of change in temperature. On the other hand, a change of very many degrees temperature at the lower end is required in order to produce a change of a single pound in pressure. Thus from 2 pounds absolute to 1 pound the drop is about 25°. These facts have an important bearing on the difficulty of increasing the vacuum from the values of 25 or 26 inches which prevailed some years ago up to the 28 and 29 inches demanded by the best practice with steam turbines at the present day. From 26 inches vacuum to 28 inches means about the same in cooling effect as from no vacuum to 18 inches.

### VOLUME

By the volume of steam we mean the volume occupied by one pound. This is always measured in cubic feet, and is found to decrease continuously with the increase of pressure and temperature. The relation between pressure and volume is likewise too complex for expression in algebraic form, at least with any high degree of accuracy. A very crude thumb rule relation is the following: The product of the pressure in pounds the square inch absolute by the volume in cubic feet equals 440. Between pressure of 50 pounds and 200 pounds the error in this will not exceed 5 per cent. It is sometimes convenient to have in mind a roughly approximate rule of this character.

At low pressures the volume of a pound of steam enormously increases. Thus at 100 pounds absolute it is 4.4 cubic feet, at 15 pounds absolute it is about 26 cubic feet, at 10 pounds it is about 38 cubic feet, and at 1 pound 335 cubic feet. This fact has an important bearing on the difficulty of realizing expansion to low values of the terminal pressures in the cylinders of a reciprocating engine, and furnishes the basis of one of the relative advantages of the turbine, by reason of the comparative ease with which such large volumes are handled and the corresponding low terminal pressures realized with the turbine form of prime mover.

QUALITY

Steam as actually generated in all boilers is liable to carry with it in the form of a fine mist or spray a certain amount of water in the liquid condition. When steam escapes into the air it is the mist or finely divided spray thus formed by partial liquefaction that renders the steam visible. Water vapor without liquid admixture is as colorless and invisible as air, and the visible part of steam, so-called, is not vapor but water in the form of a finely divided mist. The proportion of water which the steam may thus carry determines the so-called quality of the steam. It is usually measured as a percentage, the figure denoting the fraction of the total which is in the form of actual pure vapor. Thus 94 per cent. quality means moist steam in which 94 per cent. by weight consists of actual vapor and 6 per cent. by weight is water in a more or less finely divided state. Pure water vapor without admixture of mist or liquid water and at the same temperature as moist steam of equal pressure, is known as dry saturated steam. This condition evidently corresponds to 100 per cent. quality. Good steam boilers should furnish steam with not more than 1 to 3 per cent. moisture; that is, with a quality of .97 to .99, and under the best conditions these values may be improved somewhat. But it is practically impossible to obtain steam without some moisture when drawn directly from a boiler drum containing in its lower part a body of water in more or less active agitation and liberating steam at its surface.

If steam of ordinary quality be taken away from contact with the water from which it was formed and at the same constant pressure be subjected to still further contact with a heating surface, then it will absorb additional heat, the last remnants of moisture will be vaporized, and from the instant this condition is realized the temperature will begin to rise and the steam will pass into what is known as the superheated condition. Superheated steam is therefore steam with a temperature higher than that corresponding to the formation of saturated steam of the same pressure. The amount of superheat is measured by the number of degrees excess of temperature thus contained. In modern steam turbine practice the amount of superheat may vary from 100 to 150° or higher.

ENERGY

The energy possessed by steam is usually measured from the temperature of melting ice as a convenient datum. Steam possesses energy as a result of the input of heat in the process of its formation. The input of heat required to transform one pound of water at 32° F. into dry saturated steam at any temperature is not, however, quite the same as the change of energy between the same two conditions. This is because the heat which is required to produce such a change of condition really does three sorts of things or is divided into three kinds of energy before it is finally stored away. One part makes the body hotter. This represents an increase in molecular kinetic energy and remains within the body as a part of the increased store of energy. A second part overcomes external pressure during the process of vaporization and while the temperature remains constant. This external pressure is represented by the pressure required to control and contain the steam as formed. This work or its equivalent energy is not stored up within the steam at all. It is work performed against a resistance external to the steam itself, and as such produces an external result, and its equivalent energy or result, whatever it may be, is not manifest within the steam. This portion of the heat is not therefore stored within the steam and does not represent any part of its increase of energy.

A third part of the heat during the process of vaporization is used in performing work against an internal resistance. The water molecules are pulled or forced apart against a force many times greater than that represented by the external pressure, and the heat energy required to perform this internal work is stored up within the steam as its potential energy. The total energy of steam is therefore in part kinetic, corresponding to the increase in temperature, and in part potential, corresponding to the work performed against internal molecular forces.

Thus at 200 pounds pressure absolute these three amounts of heat are

Required for raising temperature
from 32° to 382° ............... 354.1 B.T.U.
Required for doing external work.... 84.4 B.T.U.
Required for doing internal work.... 759.2 B.T.U.

The first and third items constitute the energy content of the body and aggregate 1,113.3 thermal units.

The second and third items constitute the so-called latent heat of the substance and aggregate 843.6 thermal units.

As the pressure of steam is carried higher and higher the kinetic energy continuously increases, the potential energy slowly decreases, and the total energy undergoes a slow increase.

The so-called total heat of steam is not properly speaking a characteristic. It is the heat flow into the body which is necessary in order to transform one pound of water at 32° into steam at the stated pressure and temperature, and supposing that the water is carried along a definite path of change consisting first of a rise of temperature and pressure without vaporization until the temperature and pressure corresponding to the stated condition is reached, and then a change of state from liquid into vapor at constant temperature and pressure until the liquid is completely transformed into dry saturated vapor. This is a particular path of change and the heat input along this path is called the total heat of the steam. Such a program corresponds closely to that actually followed in a steam boiler, and hence such values of the total heat are of use in dealing with the usual run of power-plant problems. It may be of interest to note, however, that by varying the path of change the heat input required to form one pound of steam from water at 32° may be made to vary between wide limits, so that the expression "heat of steam" has no meaning aside from the particular path along which the substance is supposed to be carried in passing from the initial to the final condition.

He came home with a black eye, a broken nose, and a contused face.

"Ooo!" observed his wife sympathetically. "Who was it, Mike?"

"That Dutchman, Schneider."

"Shame on you, then! To let a little, bloated, toad of a Dutchman like that——"

"Stop; do n't speak disrespectful of the dead."

A wireless telegraph operator at Marysville had an interesting experience September 28th, when he got electric notice early enough in advance to give him time to step to the window and then see toward the mountains a lightning bolt that told of a storm. He found the wireless instrument would indicate a coming storm in time for him to disconnect the instruments and avoid danger to himself.

# Meeting of the Pacific Coast Gas Association

*By* HENRY BOSTWICK, Secretary to President.

Henry Bostwick

**One hundred** and twenty-five of the 300 members of the Pacific Coast Gas Association attended the two-day business sessions held September 21st and 22d in the assembly room of the Pacific Gas and Electric Company's San Francisco office building, 100 attended the banquet at the St. Francis Hotel the night of September 22d, and a party of 150 went on the social outing September 23d to Muir Woods, a beautiful public park of giant redwoods at the western base of Mt. Tamalpais in Marin county, and there had luncheon, followed by open-air dancing to the music of the city orchestra that was a feature of the excursion.

Such, in brief, was the seventeenth annual convention of the association. Nine of the eighteen addresses made before the convention were by officers of the Pacific Gas and Electric Company, the association's gold medal was awarded to John Martin, a director of the company, for the most interesting paper of all those presented, and four of the eight officers elected by the association were chosen from among the men identified with this company: Frank A. Leach, Jr., of Oakland being newly elected vice-president, John A. Britton of San Francisco being re-elected secretary-treasurer, Henry Bostwick of San Francisco being re-elected assistant secretary-treasurer, and F. V. T. Lee of San Francisco being newly elected a director. The other officers elected were: W. B. Cline of Los Angeles, president; Christian Froelich of San Francisco and C. S. Vance and C. A. Luckenbach of Los Angeles, directors.

For the first time in all the seventeen years John A. Britton was not present when the roll was called, but a letter was read from him with greetings from the orient and his wish expressed that "May all the days of all the members be days of gladness and good cheer." Back to the other side of the world went this cablegram: "Britton, steamship Siberia, Hongkong: In convention assembled, Gas Association sends greetings beloved secretary."

From London came a cabled greeting from C. O. G. Miller, president in 1908. And from his sickbed in St. Francis Hospital in San Francisco came a cheery note from George C. Colquhoun, ill during almost the entire period of his year's presidency just closed. To him was sent a tender expression of sympathy and the declaration that "We look back upon your efforts with a feeling of satisfaction and pride, and realize that the work you have done is a record of which any one of us should be justly proud."

Four members came several thousand miles to attend the meeting. They were H. L. Strange of Honolulu, Herman J. Trenkamp of Cleveland, O.; J. F. Parker of Rockford, Ill., and W. P. Hutchinson of Marion, Ia. Twenty-three new active and five new associate members were unanimously elected to the association.

The president's address, by Vice-president W. B. Cline, dealt with gas manufacture, distribution, rates, legislation, and litigation, and received the highest possible formal endorsement from a committee consisting of John Martin, John Clements, and E. C. Jones. The other addresses were: "Public Benefits Derived From Water-power Development in California" by John Martin, "The Emergency Service of the Los Angeles Gas and Electric Corporation" by C. S. Vance, "The Gas Exposition as a Means of

Advertising" by John D. Kuster, "Some Results of Personal Interviews With the Dissatisfied Consumer" by John Clements, "The Public and Its Complaints" by C. L. Barrett, "Underground Electric Construction" by S. J. Lisberger, "Damage Claims—a Modern View" by John P. Coghlan, "A Word About Gas Collections" by Homer F. Keyes, "Gas Distribution in San Francisco" by W. R. Morgan, "Some Notes on Naphthalene Conditions in California" by Sherwood Grover, "Effective Gas Lighting" by R. J. Thompson, "New Business Methods" by T. D. Petch, "Oil Gas Residual and How to Handle It" by R. P. Valentine, "Wrinkles" by R. L. Clarke, and "Experiences" by R. P. Valentine.

The speakers at the banquet were F. V. T. Lee, John Martin, E. C. Jones, F. A. Leach, Jr., and John Werry of the Pacific Gas and Electric Company, and J. F. Parker of Rockford, Illinois, H. L. Strange of Honolulu, and L. P. Lowe, president in 1905. President-elect W. B. Cline was toastmaster.

By unanimous vote the eighteenth annual meeting of the association will be held in Los Angeles next year.

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## On the Old Scrap-Heap

"I AM taking the liberty of sending you an anonymous communication received from an unknown source. I have some misgivings as to whose scrap-pile is meant, and I am therefore sending it to you to get it as far away from Philadelphia as possible." Such is the explanation sent by W. H. Gartley of Philadelphia when submitting the following suggestive verses to this magazine:

THE SONG OF THE SCRAP-PILE

In the yard of a gas house that 's not far away
You can see in a big pile, if you go that way,
A lot of old rubbish, a sight worth your while.
There are wonderful things in this old scrap-pile.

Inventions of genius, lights that have failed,
Machines that went wrong (their coming we hailed),
Old gas apparatus now gone out of date,
Huge bars of cast iron for some new patent grate.

Mechanical stokers that cost a large sum,
(Used but a short time and now on the bum)
Are resting and rusting; for sale they are cheap.
An interesting sight is this old scrap-heap.

Steam engines, exhausters that were wonders when bought;
Great things now have come of the lessons they taught.
On the scrap-heap they 're cheaper than the day when they ran.
You 'll see humor and pathos if this jungle you scan.

John Smith made a boiler, the greatest thing out;
It would steam without fuel, of this he 'd no doubt.
Like others before him, poor John got it wrong;
It 's now on the scrap-pile and part of the song.

Tom Brown was the next man to get something up,
Some overflow system on a gas-holder cup.
Way back in a corner, behind a big pipe,
Rests the scheme that Tom Brown pulled before it was ripe.

Bill Jones made a thing, which I wish to report;
It leveled the charge in a coal gas retort.
It did its last duty a short time ago;
Now it 's out with the others, and part of the show.

You could stand by the hour
And gaze on the waste
Of contraptions most costly
Purchased in haste.

Sleepless nights represented;
Calculations most deep
Tell their sorrowful tale
On the old scrap-heap.

There 's an acre of ground left;
Can 't you think something out,
Some brand new idea,
You know nothing about?

'T would add to the splendor.
Get up something, do.
The scrap-pile is waiting
To have one on you.

# The Public's Complaints*

## A Recital of Some of the Troubles of Being a Gas Man

*By* CHARLES L. BARRETT, Secretary San Francisco Gas and Electric Company.

Charles L. Barrett

**Whatever may be** the public's attitude toward the lighting company concerning the fairness of its methods, the personnel of the company, from its president to its most humble employee, rests secure in the knowledge that the correct measurement of the product sold to the consumer is as absolute as can be determined by human means. In this fact lies the keynote of the uniformly successful argument of the company's adjuster of supposed overcharges. There is no business so paternally cared for at the present moment by state and municipal authorities as the sale of gas. There is no business so censored in the sale of its goods as the gas industry. This is eminently proper and is nowhere welcomed more warmly than by the gas company's officers who have to discuss with the public the vagaries of bill fluctuation. Dishonest dealers in almost any of the daily necessities and commodities of life can, with little fear of detection, adjust their measures and adulterate their products or change the price by unit of quantity sold. Not so with the lighting company.

Of all the recurring monthly household expenses that for gas seems to the careless, the improvident, and the unreasonable, to be a perennial enigma, and their class represents about 40 per cent. of the people. The momentary daily use of trifling quantities of a commodity, so intimately connected with domestic life that it becomes absolutely unnoticed or forgotten, produces a bill that causes such people much genuine surprise. The other 60 per cent. of the community, the careful, the watchful, the provident, the reasoning, the reasonable, and the meter-reading classes, never visit the gas company's office except at the commencement and termination of their supply. High-bill complaints are almost invariably traceable to carelessness in use of gas.

The meter test made with the standard prover and preferably in the presence of the customer is the ultimate remedy. The visit should be made by a trained inspector, who should be a good mechanic and a man of pleasing personality, who understands himself and the situation thoroughly. As the whole matter is really one of fancied error rather than real the action of this man more often determines the mind of the consumer for satisfaction than even the meter-test method.

Should the investigation findings warrant, a new meter is set and a shop test made of the old one. A report of its condition is always sent to the consumer. Meters proving by test to be fast are so rare, the percentage so small, and the satisfaction to the consumer at learning of a fast meter so great that the company in making rebates for over-registration does not stand upon its legal rights for a computation upon the bills of the three months immediately prior to the test, but includes bills for any reasonable period, occasionally covering eight or nine months.

There was an unusual public clamor of gas and electric consumers in San Francisco during the winter of 1908 against what was thought to be poor quality of gas, low pressure, and exorbitant charges. The discussion culminated, after great hostility upon the part of the daily press, in a muchly advertised public hearing before the artificial lights com-

*Digest of paper presented before the seventeenth annual convention of the Pacific Coast Gas Association at its meeting held in San Francisco during the latter part of September.

mittee of the San Francisco board of supervisors. This hearing was in itself an absurdity, for of the company's 80,000 consumers, just sixteen appeared before the committee to complain, their statements being mere generalizations based solely upon their personal ideas.

The published report of this investigating committee, which was the opinion of two of the state's foremost engineers versed in gas and electric matters, was so thorough and fair and educational in its nature that the company ordered some 30,000 reprints from the original type and mailed them to that number of its consumers, with most gratifying results. The investigation was of the most beneficial nature to the company. The more rigid and searching an investigation may be as to false or exorbitant charges, if made by honest, intelligent investigators, the more the gas companies will court it.

One of the most interesting things developed in this investigation was the contradiction of the popular fallacy that in using gas for heating at low pressure several times the quantity would have to be used to produce the same result as gas supplied at higher pressures. Even one of the engineers who was afterward engaged in the examination, in discussing the matter at the original hearing, so gave it as his opinion. By experiment it was found to take $18\frac{1}{2}$ per cent. less gas to develop a given amount of heat at $\frac{5}{10}$ of an inch water pressure than to attain the same result at 6.1 inches of water pressure. In other words, the consumers in the outlying districts of the city who had been complaining of little or no pressure had really been saving money in their gas usage.

Adjustments for leakage where the company is really at fault are rare, but when the fact that the company is responsible is determined, generous allowances are always made, this being one of the few instances where a basis for allowance is patent, and it enables the adjuster to carry out the company's policy of solving all doubts in favor of the consumer.

Probably the most difficult complaint to adjust is that arising from the transposition of consumers' meters, this being occasionally done inadvertently by the company's own men or by outside gasfitters, in locations where a number of meters set together. If there is a wide discrepancy in the amounts used, the transposition is quickly detected, but where the usage of the consumers interested is fairly equal it may be a long time before the matter is discovered. When the consumers do ascertain the true state of affairs those who have paid more than the correct charge insist rightly upon reimbursement, but the ones undercharged never can be made to see the justice of a bill for the difference, and almost invariably decline payment upon the ground of supposed legal rights in having receipts covering the period involved.

There are two classes of dissatisfied consumers that are oddities, but they become nuisances. One of these is the fire-eating, anarchistic, letter-writing, anti-corporation crank whose screed regarding his bill, be it large or small, shows up at regular periods, indicating that he can not stand the mental pressure a moment longer and not explode. The other is the violent monthly kicker against his bills, which are as a rule of ridiculously small amount. These types when possible air their grievances in the daily papers and are absolutely impossible to satisfy by any treatment whatever.

Another type of complainant, who is to be pitied, is the poor, struggling landlady who ekes out a living by renting rooms with gas for stove and lighting use furnished either gratis or at a flat rate of small amount so as to attract or hold the sub-tenant. This bad business judgment is always taken advantage of by careless or unprincipled renters, and its effect is visited upon the gas company's adjusting office at more or less regular intervals.

San Francisco's foggy weather in summer is the bane of the gas engineer. In its immense temperature difference between midnight and mid-day seems to lie the cause of the formation of the feathery naphthalene crystal which builds upon the slight protuberances in service mains and meters and which in a short time causes the flow of gas to fail and finally cease altogether. This one cause, together with cases of condensation and leakage, approximates from fifty complaints a day in the four or five rainy months to from 200 to 600 a day during the other months of the year. While the largest number is less than one per cent. of the San Francisco company's consumers, it makes up a troublesome complaint condition, interferes with shop management because of its variability, and gives an impression of poor service because it is so generally distributed throughout the mains system. Although the San Francisco company is blessed with the most capable gas engineer in the country, and of whom it is said that he can even "make light of the truth," this pressure question gets upon his nerves at times.

After all, the poor pressure complaint is a blessing in disguise, for it is the best known local indicator of an outgrown distributing system. Upon this indication the engineering department can by enlargement of mains and services in the locality of the trouble remedy the defect of chronic low pressure, and naphthaline stoppage at that, for a long period. In making complaints, both oral and written, there is often displayed by the consumer much unconscious good nature, curious expression, ridiculous assertion, and errors in spelling and diction. Herewith are a few verbatim quotations from letters which are at hand or have been received by the San Francisco Gas and Electric Company:

I wish that you would send a gas leak at your meter.

Respectfully,

MRS. P. C.

(From a Chinaman)—

Your man must please come fix, have bad gas breath.

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(Another from a Chinaman)—

Please you call fix metter, heap stink.

---

My gas meter is out of order also my neighbor Mr. Schmidt— Will you please sent somebody to fix them?

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(Another from a Chinaman)—

Please you call make more gas in meetle, all run out.

---

(From some old gentleman with time to burn)—

Gentlemen:—Did you ever read Kipling's "The Light that Failed?" Well, it's not in it with the story of the lights that fail at Whitten's every night. We have eastern company and they make odious comparisons between what they have and what we get. For the honor of our noble city and state please make a showing and send a man down to pump up our gas.

I will remember you in my prayers when I say them.

It is too bad, alack, alas,
The trouble we're having with the gas.
You can not see to read or eat.
In fact, I never saw the beat.

I scarcely know just what to do,
But took a chance at writing you,
In hopes that you would surely try
To make our gas blaze way up high.

Now, Mr. Gasman, bring your pump
And cause our light to blaze up high.
And perhaps our bill may take a jump,
But that will never make us cry.

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(Another from a Chinaman)—

Gentlemen:—We have been burning your gas for so many years and that usually to pay the bill from three dollars to five dollars a month with no excessive. How ever the bill claims so much in the future two months. It is hardly to satisfactory. We will mail those receipt to you kindly compare it at once whether its righteous. Answer.

From these few quoted extracts it will be seen that the usual tragedy of the gas trouble man's life is sometimes relieved by a little comedy, bringing out a normal, natural cheerfulness which is, after all, the greatest alleviator of the complaint condition.

# History of Gas Lighting in Marysville

By E. C. JONES, Engineer Gas Department.

E. C. Jones

**Marysville,** named in honor of Mary Murphy, one of the few survivors of the ill-fated Donner Party, was the third place in California to introduce illuminating gas. During the pioneer mining days Marysville was one of the most important towns in California. It is situated almost at the geographical centre of the Sacramento valley, on the east bank of the Sacramento river, near the confluence of the Yuba and Feather rivers. Because of its location it was the natural source of supply for the miners early operating along the Yuba and Feather rivers. The large population and the richness of its tributary mining district established Marysville as a town of importance.

When red-shirted miners by the thousands were working in the placer diggings in the foothills to the eastward, Marysville was a big place with a population as great half a century ago as its 5,000 of today.

It is a flat town, protected along its river side by a 20-foot embankment to ward off the menace of high water during the rainy season.

Original Gas Works Building, Second and B Streets, Showing One of Old Cast-Iron Retorts at Corner, Between Men

First Marysville was all for the miners, but when mining began settling to a system of fewer individuals and more machinery, and agriculture grew to be a greater and greater prospect in California, then Marysville became the storm centre of that historic legal struggle between the hydraulic miners in the foothills and the farmers in the valleys, where the navigable streams were being slowly but surely made shallower and shallower by torrents of mud from the hydraulic mines. Marysville found herself in the middle of a rich, level, agricultural area of vast proportions.

The farmers were becoming more numerous than the miners, and they were doubly interested in preserving the depth of the river channels, because of the commercial advantage of having water transportation to compete with railroad rates and because of the necessity of maintaining a channel of sufficient depth to avoid the certainty of ruinous inundation by high waters and the covering of the adjacent farming lands with a deposit of "slickens" from the mining regions.

Today Marysville is an old town still

young. The buildings in its business section and some of its sidewalk signs proclaim an origin dating back half a century, and the styles, created when miners' money was dominant, have not been changed much, though Marysville has become a commercial centre of farms and orchards, and has within its own limits machine shops, founderies, sash and door factories, flour mills, woolen mills, and canneries.

Gas Works and Electric Substation, View Taken from Levee

In 1857, the success of gas making in San Francisco and Sacramento having been assured, proposals were made to the common council of Marysville relative to lighting the city with gas. Charles H. Simpkins, a prominent citizen of the place, and A. F. Williams, who had been well and favorably known in connection with water ditches in northern California, made a proposal to furnish Marysville with gas and water. Proposals were also made by Tiffany and Wethered of San Francisco, and by Dr. Teegarden of Marysville and David E. Knight, who was then connected with the gas works in Sacramento.

May 22d, 1858, the Marysville Coal Gas Company was incorporated by David Edgar Knight, Charles H. Simpkins, and Adoniram Pierce, with a capital stock of $50,000. This was subsequently increased to $100,000. May 10th, 1858, the right to lay pipes through the streets of Marysville for the purpose of distributing gas was granted to D. E. Knight & Co. In exchange for the privilege the company agreed to furnish free gas for lighting public buildings so long as no franchise was granted to any other gas company. Thus was the original company safe-guarded against competition. The work of constructing the gas plants was personally supervised by Knight, Simpkins, and Pierce.

Gas was first manufactured in Marysville August 18th, 1858, and sold for $12.50 a thousand cubic feet. The works consisted of two benches of 3's, iron retorts in what was known as the H setting. The retort house was a small, brick, flat-roofed warehouse, and the capacity of the works was 18,000 cubic feet in twenty-four hours. The flat roof of the retort house was found convenient as a scaffold while cleaning out stopped stand pipes through holes in the roof. The condenser consisted of a 3-inch, cast-iron, return pipe located in the coal shed. Two wooden casks, one above the other, served the purpose of the washer and scrubber. The purifiers were made of wood, and hydrate of lime was used on perforated, sheet-iron trays. A 3-foot station motor completed the sequence of apparatus up to a 20,000-cubic-foot gas holder.

In 1860 the distributing system consisted of 14,550 feet of mains, from which were served 200 consumers. The average output of gas was 200,000 cubic feet a month. The first reduction in price was made December 16th, 1860, in response to a public petition. A system of discounts was established, 10 per cent. being allowed on consumption of more than 200 and less than 1,000 cubic feet a week, and 15 per cent. discount on all gas consumed amounting to more than 1,000 cubic feet a week.

In 1862 a uniform price was established of $10.50 a thousand. In the spring of 1867 the works was reconstructed on the original location.

The iron work, including the gas holder for reconstructing the gas works, was shipped from Philadelphia on the clipper ship "Old Hickory" some time during 1866. The ship was 356 days on the voyage, and was given up by the underwriters as lost. The owners did not lose their ship, but the captain lost his commission as her master.

During 1867 a voluntary reduction to $9 a thousand was made in the price of gas. From the beginning of this industry in Marysville gas was made entirely from Cannel coal from Scotland, Ireland, New Brunswick, and Australia, sacked in gunny bags in San Francisco and reshipped by river steamer to Marysville. Old timers in the gas business will remember the names of Boghead, Ince Hall, Lesmahoga, and Albertite, as well as Australian shale. The price of this coal ranged from $25 to $50 a ton. Excessive freights did not warrant the use of low-grade coal in the interior towns of California, as the rate from San Francisco to Marysville, together with drayage, was in excess of the rate by ship round Cape Horn. Castor beans, rosin, wool waste, and pitch pine were also used from time to time to assist in making gas. Lime was hauled in half-barrel rawhide baskets from Cave City, and delivered in Marysville at $2 a basket.

The fire brick used in the construction of the benches were shipped from the east, packed in straw in crates, and cost $125 a thousand. But there were some consoling features in the business, as coke sold for one cent a pound (unscreened) and tar brought $7.50 a barrel, the purchaser furnishing the barrel.

Original 20,000-Foot Gas Holder, with Glimpse of Knight Residence

There was no competition until 1886, when an electric light plant was established. But it was not until late in 1898 that a rival gas company came into the field, with a water gas plant having a capacity of 3,000 cubic feet an hour. March 1st, 1899, after competition lasting just four months, the two gas companies became merged under the new title of the Marysville Gas and Electric Company. The consolidation of the companies marked the beginning of a new era in selling gas in Marysville.

A further reduction in rates and persistent missionary work resulted in placing Marysville in the front rank as a gas-consuming town. In 1896 there were only six places in Marysville using gas for fuel. In less than six years more than 300 gas stoves were installed in Marysville homes. To-day gas is generally used there as a kitchen fuel and for heating.

David E. Knight

The water gas sets installed in 1898 were displaced September 1st, 1901, by a Lowe, crude-oil, water-gas set, having a capacity of 90,000 cubic feet every twenty-four hours.

Since the consolidation of the rival gas companies, ten years ago, all the gas used in Marysville has been made at the works near the levee, adjoining the electric substation of the Pacific Gas and Electric Company. At this works there is a 20,000-cubic-foot storage holder, installed in 1898, and a 20,000-cubic-foot relief holder. There has also been recently installed a 175,000 - cubic - foot, crude-oil gas set. Pipes to the original gas works connect with and make use of the old 20,000-cubic-foot holder that came "round the horn."

Nearly every new enterprise is stamped at the beginning with the personality of some one man. Marysville's gas business was the creation of David E. Knight. He was a remarkable man in his town. He had been a plumber, a copper worker, a cobbler. Then began his time of bigger undertakings. He established the first horse-car line between Marysville and Yuba City, and was president of the company; he owned the race track; he started the first steam laundry, situated where the old Columbia Hotel now stands; he was one of the three owners of the Marysville Foundry; he was president and manager of the Marysville Woolen Mills; and was president and manager of the Marysville Gas and Electric Company. The Sacramento river boats "Knight No. 1" and "Knight No. 2" were named after him. When he died, January 5th, 1900, the board of supervisors, of which he was a member, published in memoriam an expression declaring: "He was a pioneer citizen of our state, and one of that sturdy type of men who have builded so truly, so permanently, and so splendidly the social and industrial structure of California statehood. As a citizen he was enterprising, progressive, and judicious. His life was full of substantial accomplishments marked by uniform justice during its course and by a beautiful charity at its close. As a member of this board he was constant in his attention to duty, liberal in his policy, and wise and just in his counsel. His loss to us can not well be replaced, and we deem it a privilege to make here this acknowledgment of his worth and to pay this tribute to his memory."

Such was the man who established the Marysville gas business now owned by the Pacific Gas and Electric Company.

There is a little, old, one-story, brick building at the corner of Second and B streets in Marysville. That was the original gas works. The front end of it is now used as the Marysville office of the Pacific Gas and Electric Company. At the corner of the curb on two sides of the street, half buried in the earth, are two of the original cast-iron retorts used in the first manufacture of gas in Marysville. They serve now to protect the sidewalk from the encroachment of wheels of passing vehicles. Just back of this old building, looming big and red amid shade trees and huge old fig trees, is the former home of David E. Knight.

The writer in preparing this article has drawn freely from an excellent historical sketch entitled "Auld Lang Syne" by T. R. Parker of Napa, who was an associate and warm friend of David E. Knight, and was superintendent of the Marysville Gas Works from 1862 to 1867.

# Troublesome Small Animals on the Pole Line

*By* C. E. YOUNG, Acting Superintendent Marysville Power Division.

IN the Marysville power division of the Pacific Gas and Electric Company, a tree squirrel climbed a pole of the 60-kilovolt line near the Dairy Farm Mine, August 18th, shorted the line, and caused the current to be shut down for about twelve hours. A fire was started when the live wire struck the ground, but was soon extinguished by ranchers in the neighborhood.

September 7th, about ten miles south of Lincoln on the same line, a coyote frightened a flock of turkeys, and one of them flew into the line, causing it to short and burn down. The turkey was found by its owner a few minutes after the accident. It had one leg and one wing broken, and was badly burned, but was still alive and kicking.

September 18th a large Tom cat climbed a pole of the same line, about thirteen miles south of Lincoln, and shorted the line, causing it to burn down. That cat has but eight lives left. It forfeited one by trying to be a pole cat. A grass fire was started when the line went down, and completely destroyed a five-foot culvert on the county road. The culvert was promptly replaced by the company.

Again, September 26th, a tree squirrel shorted the line near Smartsville, causing it to burn down. At the same time an insulator broke and was shattered to pieces about ten miles south of Lincoln, causing the line to burn in two. This insulator trouble was the cause of twenty-four sheep, of a flock of seven hundred, being killed by electrocution.

A picked team, forming a combination of the Pacific Gas and Electric Company and the San Francisco Gas and Electric Company nines, played the formidable Presidio post team of United States soldiers on the Presidio reservation grounds Saturday, October 9th, and the civilians won—12 to 6.

The towns of Alta and Towle in Placer county were busy during the forepart of October harvesting and shipping an unusually fine season's yield of approximately 30,000 boxes of apples. Many of the trees, according to H. M. Cooper, yielded from thirty to thirty-five boxes, and some as many as forty boxes.

# Right of Electric Companies to Condemn Lands

*By* LEO H. SUSMAN, Law Department.

Leo H. Susman

**To what extent** private property may be taken by electric light and power companies when it is required to enable them to generate or transmit electricity is an interesting problem. It is a question of great practical importance to a concern like the Pacific Gas and Electric Company, with its miles of transmission lines, flumes, and ditches extending over more than a score of counties.

The power of eminent domain, or as it is more popularly called, of condemnation, has been defined as the right of a sovereign state to appropriate private property to particular uses for the promotion of the general welfare. This power is inherent in and an attribute of every independent state or government by virtue of its sovereignty.

The constitutions of the various states of the union contain provisions relating to the power of eminent domain. They differ somewhat in the language employed, but practically all of them limit the right to such cases only as involve a public use. The constitution of California provides that "private property shall not be taken or damaged for public use without just compensation having been first made to, or paid into court for, the owner." (Article I, Section 14.) No definition of public use is given in the California constitution, and it therefore becomes of prime importance to determine what is a public use in each particular instance. If the use in question be public, there can be no constitutional objection to a statute permitting the taking. But if the use be private, the taking is impliedly forbidden by the constitution of California.

The California law provides that the right of eminent domain may be exercised in behalf of the following public uses: "12. Canals, reservoirs, dams, ditches, flumes, aqueducts, and pipes and outlets, natural or otherwise, for supplying, storing, and discharging water for the operation of machinery for the purpose of generating and transmitting electricity for the supply of mines, quarries, railroads, tramways, mills, and factories with electric power; also for the applying of electricity to light or heat mines, quarries, mills, factories, incorporated cities and counties, villages, and towns; and also for furnishing electricity for lighting, heating, or power purposes to individuals or corporations, together with lands, buildings, and all other improvements in or upon which to erect, install, place, use, or operate machinery for the purpose of generating and transmitting electricity for any of the purposes above set forth. 13. Electric power lines, electric heat lines, and electric light, heat, and power lines." (Code of Civil Procedure, section 1238.)

The California legislature has declared by statute that private property may be condemned for certain designated uses. At first glance this may appear to be conclusive that property may be taken for any of such uses. But the fact that private property may be taken does not imply that it may be taken for private use. To illustrate: If one man own a city lot and another desire that lot for the purpose of erecting thereon and conducting an office building, the prospective builder can not force the owner of the lot to sell the land to him, as the erecting and conducting of an office building are essentially a private use, one in which the public has no concern. Suppose that the California legislature should enact a law providing that the erecting and conducting of an office building constitute a public use and that private property may be condemned therefor. Can the mere declaration by the legislature that a private use is a public use make it so? The California supreme court, in consonance with the views of many other authorities, has denied the California legislature this power, holding that the legislature can not, in the exercise of the power of eminent domain, permit the taking of private property for a purely private industry and that when it appears plain that property is sought to be taken for a purely private use, courts are not bound by the legislative declaration that a certain business is a public use. In a recent case Judge Gilbert, speaking for the United States circuit court of appeals, said: "The legislature can not by its enactments make that a public use which is essentially a private use, and the question whether the use is public in its nature is a judicial question to be determined by the courts. But it is the general rule that where it is uncertain and doubtful whether the use to which the property is proposed to be devoted is of a public or a private character, the legislative determination of the question is of persuasive force, and the courts will not undertake to disturb the same." (Walker vs. Shasta Power Company, 160 Fed. Rep. 856.)

The mere fact that the public is interested incidentally in the operation of a business and that the use may benefit the public in some collateral way does not make it a public use. In a recent case, decided by the supreme court of Minnesota, it was held that a use is not public unless the person or corporation seeking to condemn property can be compelled, under proper police regulations, to supply the public with the service or use for which the property is sought to be acquired. In this case the plaintiff company sought to condemn lands for the construction of canals and for the creation of a water-power plant that would generate and distribute electricity for light, heat, and power purposes and supply water power. The court held that while the generation of electric power for sale to the general public on equal terms is a public enterprise and the property so used is devoted to a public use, the creation of a water-power plant to supply water power from its wheels is not for a public use for the reason that only a few persons can purchase water power from the wheels. The court declared: "Water power from the wheels must be used at the wheels, and the actual result necessarily is that a very few individuals will use that power for manufacturing purposes to the exclusion of all other persons. The effect is the creation of a power plant to create water power to sell to a few manufacturers for use in their private business. Under such conditions, the willingness of the power company to sell power from the wheels to the general public has only a theoretical value."

The difficulty in determining whether or not a given electric power or lighting business is for a public use is not so much over the legal principles involved as over the proper application of those principles to the facts of each particular case.

In some states the generation and sale of electricity under certain circumstances have been held not to be a public use. But in the majority of jurisdictions where the question has arisen the generation and sale of electricity have been held to be a public use wherever the company proposing to exercise the power of eminent domain must serve the public fairly and without discrimination.

In the case of Rockingham County Light and Power Company versus Hobbs (72 N. H. 531) the supreme court of New Hampshire said: "The knowledge recently acquired concerning electricity has made it possible to divide power into any desired portions and freely to transmit the same to almost any point for use. This has created a demand for power, which, though not so general as the demand for water, is nevertheless of a public character. Like water, electricity exists in nature in some form or state, and becomes useful as an agency of man's industry only when collected and controlled. It requires a large capital to collect, store, and distribute it for general use. The cost depends largely upon the location of the power plant. A water power or a location upon tide water reduces the cost materially. It may happen that the business can not be inaugurated without the aid of the power of eminent domain for the acquisition of necessary land or rights in land. All these considerations tend to show that the use of land for collecting, storing, and distributing electricity for the purpose of supplying power and heat to all who may desire it is a public use, similar in character to the use of land for collecting, storing, and distributing water for public needs, a use that is so manifestly public that it has been seldom questioned and never denied."

In some instances the electric company, seeking to condemn, has been incorporated for the purpose of generating and selling electricity to the public generally, and also for private purposes. The right to exercise the power of eminent domain has been denied to such companies where they sought to condemn indiscriminately for both public and private uses. But the fact that such a company was, by its articles of incorporation, authorized to engage in a private enterprise as well as to serve the public, will not prevent it from exercising the power of eminent domain for the public use. In determining whether an electric company is exercising a public use the court is not limited solely by the description of the objects and purposes set forth in the articles of incorporation, but may consider evidence outside of such articles, showing the actual purpose in view.

In the case already mentioned of Walker against the Shasta Power Company the United States circuit court of appeals upheld the validity of the subdivision of section 1238 of the California code of civil procedure relating to the condemnation of ditches for supplying water to hydro-electric machinery. Although the question has not been directly passed upon by the supreme court of California, this decision of the United States circuit court of appeals would be of persuasive force. Both reason and authority being in favor of the validity of this statute it may be taken to be the law in California that a corporation, such as the Pacific Gas and Electric Company, generating and selling electricity to municipalities and their inhabitants for light, for the operation of railways, and for general commercial enterprises, uniformly and without discrimination, is engaged in a public use for which it may exercise the power of eminent domain.

"Stand with anybody that stands right. Stand with him while he is right, and part with him when he goes wrong."—Abraham Lincoln.

Whispered the tactful toastmaster to the great orator: "Shall we let them enjoy themselves a bit longer, or shall I introduce you now?"

# BIOGRAPHICAL SKETCH

## ZACHEAUS FLOYD

### Who Has Served the Company More Than Two Score Years in the Gas Meter Department

FORTY-ONE years and two months continuously in the service of the gas company in San Francisco is the remarkable and unequaled record of Zacheaus Floyd, an excellent likeness of whom illustrates this page. Such length of service is rarely equaled in any industry in any country. It tends to show not only unusual perseverance and loyalty on the part of the man, but also continued satisfaction on the part of the company.

At the time of the birth of Zacheaus Floyd, July 19th, 1838, his father, Captain John Floyd, a mining engineer by profession, was chief engineer and superintendent of the Westminster lead and silver mines at Llanarmon in Yale, Derbyshire, North Wales. In 1854, when 16, Zacheaus Floyd, immediately after graduation from Floater's grammar school at Wrexham, took a position under his father as an assistant timekeeper at the Westminster mines, where about 600 men were employed. Three years later, seeking to better his position, he entered the employ of the Herrington Gas Company at Liverpool, and two years afterward, becoming affected by the emigration wave that passed over Europe in 1859, he sailed for New York and was there immediately given employment by the Manhattan Gas Light Company as inspector and tester of meters. This New York position he retained about three years, until in 1862, because of unsettled business conditions following the outbreak of the civil war. He started for California, going in the steamer Champion to the isthmus of Panama and from the Pacific side

Zacheaus Floyd

in the steamer Orizaba. That trip up the coast was made historically memorable by the succor lent by the Orizaba to the shipwrecked passengers from the celebrated old steamer Golden Gate, which had been wrecked near Manzanillo, Mexico.

Zacheaus Floyd arrived in San Francisco in August of 1862. He was then 24. He recalls interviewing at that time J. Mora Moss, the president, and Joseph G. Eastland, the secretary, of the San Francisco Gas Company at the old office, which was then at the corner of First and Natoma streets. Floyd was given a position in the meter department by the company's engineer, William Beggs, whose brother, James Beggs, was then meter department foreman but later the company's engineer. Floyd's first gas work in San Francisco was in statement reading. Two old employees had done all the statement reading, and as they had been with the company from the first they knew the whereabouts of all the consumers without bothering with addresses. One of them, John Carroll, taught young Floyd the routes, but even then Floyd was greatly puzzled at times to locate some of the consumers, as he was a stranger to the city.

It occurred to him as a rational idea to supply his statement book with the house numbers grouped by streets. When Secretary Eastland came to review Floyd's statement book he noticed the innovation, and promptly ordered the use of house numbers throughout the book system. That was after the company had been doing business for more than seven years without the necessity of recording meter locations by house number.

It was not long before Floyd was given charge of the work and the employees connected with the installing and removal of meters, together with the handling of all the minor physical complaints of the distribution system. And he has held that same position or similar positions down to the present time, serving in sequence under the following company engineers: William Beggs, J. Sabatton, James R. Smedberg, James Beggs, J. B. Crockett, and E. C. Jones.

In February of 1865, when he was 26, Zacheaus Floyd married Mary Kelleher, a native of Australia. From their union have come nine children, eight of them boys. Two sons, Edward T., and Charles L. Floyd, are in the employ of the gas company and partake in a marked degree of the zeal and conscientious efficiency of their good father.

Zacheaus Floyd is a member of Yerba Buena Lodge of the American Order of United Workmen, the only fraternal affiliation he has.

He has no known hobbies, unless it be the giving of considerable goodly advice in a medical way to those who request it and know the experience he has had in the raising of a large family.

He is highly respected by the men under his charge and they, through his just but firm treatment, render excellent service to the company.

No better tribute to business loyalty can be given than to record that a man's life and interests have become absolutely merged and identified with those of the company employing him, and this tribute can certainly be paid to Zacheaus Floyd. C. L. B.

Many are called, but few deliver the goods.

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A man of honest dignity is never ashamed to lay aside his dignity to perform his honest duty.

Do n't kick a man when he 's down; same advice applies to a live wire.

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If you have palpitation of the heart bend down low and let more blood flow into the heart; exit palpitation.

# Care of High-Voltage Insulators

*By* J. O. HANSEN, Superintendent San Jose Power Division.

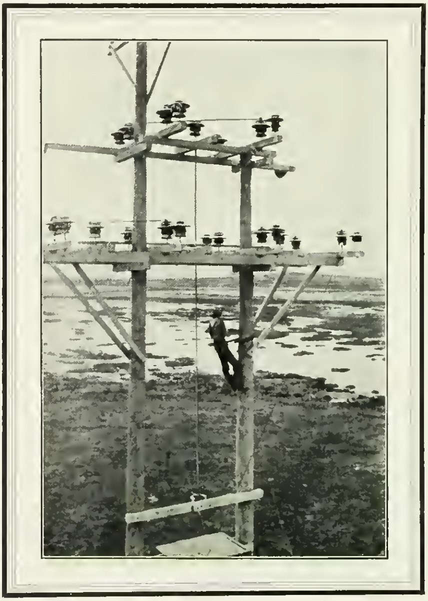
J. O Hansen

**The large insulators,** supporting the wires and insulating the high-voltage currents on the transmission lines, while ordinarily performing their peaceful alloted duty, are at the same time doing strenuous work, and, if not properly cared for become overburdened. Then there is at the best a momentary disturbance. It is noticed on the lights as a blink or on the motors as a groan.

On the system of the Pacific Gas and Electric Company there are more than 100,000 high-voltage insulators. Their efficiency must be great to avoid an average of one breakdown a week, and even that is too frequent. But at this rate the average life of an insulator would be nearly 1,000 years. This, of course, is not reckoning on breaks due to mechanical causes. The small boy with a stone is often the most frequent cause for a mechanic on the job, and the small boy is closely seconded by the unsuccessful hunter who must use his ammunition on something.

A few hundred insulators put under test will undoubtedly make a satisfactory showing. But there must be very general great reliability for all climatic conditions. In the intensely foggy and windy climate about San Francisco bay insulators are things that require careful watching and attention. Insulators made to stand a rain or wet test will render good service in fog and wind when they are clean, but, when dirty, their insulating quality becomes much impaired.

The heavy winter rains keep the insulators clean a part of the year. During a dry spell of from one to two months so much dirt will have collected on the insulators that when they become wet there will be enough current leak over to fire the pole. The soft redwood or cedar pole itself catches fire much more easily than the pine cross-arms. When iron pins are used, and are shortened by wire, the leakage current may be entirely between the wires over the insulators, or the leak may be between a wire and the ground, and then fire the pole. But by running the shorting wire to the ground, the pole is thoroughly protected from such burning. Still the leakage current is present, and, if allowed to become large enough, through the wetting of the accumulated dirt by fogs or light rains, an arc forms which either shatters the insulator or burns the transmission wire in two. In the majority of cases either of these



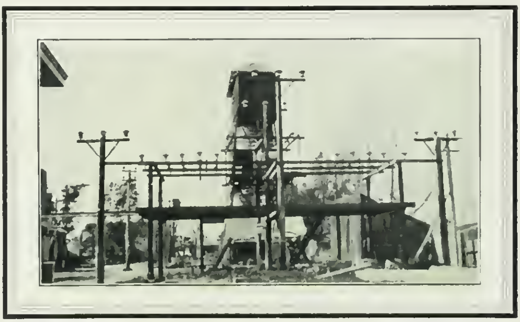
Insulators on the Double-Throw Switches Near South San Francisco accidents is easier to repair than a burned pole. With the iron insulator pins shorted and grounded more current and consequently a greater accumulation of dirt and dampness are required to start trouble, so that more time can be allowed between cleanings of the insulators. The dirt accumulates over all parts of the insulator in an even layer. But an insulator that has been on the line through the winter has more dirt left on the protected parts than on the exposed parts where the rain has washed some of it off.

On the Pole Line Between Berkeley and Elmhurst

For this reason the suspension type of insulator is better than the pin insulators, because in the suspension type a larger percentage of the entire surface may be washed off by the rains. The method of supporting by a large clamp is also probably better than by a small tie wire on the pin insulators, because of the difference in corona discharges from small and large diameter surfaces.

First dry cloths were used in cleaning the insulators. Later it was found more effective to apply gasoline on the cloths to cut the dirt and grease. But because gasoline evaporates so quickly kerosene is now being used with good results. The best cleaning is with clear water applied with a hose. All parts are then washed off without any residue being left on the surface.

An insulator made to hold up under all of the dirt that will accumulate on it during a season and have its surface so exposed that the winter rains will thoroughly clean it, should give satisfactory results. The problem then presented is whether it will be cheaper to use small insulators and pay to keep them clean or use large insulators which will withstand the dirt and fogs through the summer and be automatically cleaned by the winter rains washing them.



Insulators on Switches at Petaluma

# Why Does a Dog Bite a Gas Man?

*By* FRED B. LANGTRY, Meter Reader, Oakland District.

Fred B. Langtry

**The Oakland Fraternity** of Honest Meter Readers was in Saturday-night session. Every member was bristling with importance and a week-end beard. But no one was thinking of his own scrape; it was the piteous plight of Brother McCrudden, who had suffered a rear attack from an East Oakland bull-pup while faced to his duty scanning meters under a bay window.

Because of the nature of the injury the lodge went into a committee of the whole and extracted resolutions of condolence for the stricken brother and cash subscriptions for a pair of new trousers, as the punctured pants could not be replaced with the dog's pants.

Jimmy O'Brien, "Kittie" Maddocks, and J. Cycle Gallagher were plucked as the most select trio to compose the Oakland Chapter Committee for the Investigation of Wanton Cruelty to Sincere Meter Readers. This committee was instructed to enlist the co-operation of the Society for the Prevention of Cruelty to Children and also to appeal to Poundmaster Zabel through the Board of Public Works.

Brother Jerry O'Brien protested, until subdued with a chair, that the pound did not come under the Board of Public Works, as dogs were not public works but public nuisances. J. Motoritis Gallagher took the floor, there being nothing else handy for him to take, and declared that much depends upon the dog; he himself had a dog he would n't sell for ten dollars.

"I do n't care," interrupted O'Brien, "whether the gentleman would sell his pup for a corned beef sandwich; what I contend is that if we do n't stop these assaults and protect meter readers from rear attacks the house lighting of Oakland will be seriously handicapped. Excuse the Irish bull if I say we meter readers are facing a stern necessity these dog days."

Brother "Lily" Langtry suggested the use of a hand mirror, so that meter readers might sit down, face to the dog, back to the meter, and read the figures while simply appearing to be enjoying a beauty show.

"I dinna care whut ye doo," exclaimed Brother Jack McNeil, "s'lang's the dog's lut me alane, but I ken 't would be a gud thing to use amooney goons."

Brother Archie Donaldson arose like a Salvation lassie to give his testimony. He had found music very successful as a coaxer with savage dogs. By playing the piano at houses where they had a comely lassie and a cranky canine, he had been able to produce a pleasing influence upon both the beauty and the beast, and where there was no piano he always used a harmonica, which he carried in his back pocket. A dog had once bitten him on the harmonica before he could pull the music on it.

Brother Hennings arose to ask Brother Donaldson if his music frightened the dogs.

"I scorn the insinuation," replied Donaldson. "While I do n't claim to be a Pawderski, I may say that every dog that has heard me play has invariably wagged his tail, a sure sign, as even Dr. Cook and Commander Peary would agree, that a dog is pleased."

Brother Jack Colgate cited a sad instance of the dense ignorance of the gas-consuming masses. When he called he found an old lady, and where should he meet her but sitting in front of her meter! She declared he need n't read it. He asked her why. She said she had been sitting there for the past three days watching the 10,000-foot dial, and the hand had n't moved; that the same thing happened last month; and still the company had the nerve to send her a bill for $1.35 for gas. Brother Colgate then suggested that possibly some unfriendly neighbor had been using her gas while she was out in front watching the meter. This seemed to relieve her, and instantly she declared that Mrs. Hooligan, who lived down in the next block, was mean enough to do anything, and it would n't be beyond her to use the gas. She would pay the bill this time and have Mrs. Hooligan arrested.

This experience recital was followed by loud and appreciative laughter — from Brother Colgate.

Brother Billy Chocik, the "Poet Meter Reader," then recited the following "pome":

Dogs delight to bark and bite,
For 't is their nature to.
We do n't object to hear them bark,
But we can 't endure their chew.
Now it 's up to them to "cut it out,"
Or we 'll notify Mulgrew!
So, all you back-yard dogs, beware
Of Colgate, Hennings, too,
Of Langtry, Donaldson, and Mc,
And when you see us, "screw!"
Or it 's Zabel with his trusty scouts
And the whizzing, sure lassoo;
And following that 't will sadly be
"Amonia guns for you!"

The Mother Goose Division reported progress along many lines, principally streetcar lines, and submitted a quatrain for the free kindergarten, running behind time like this:

Hogarty, Hogarty sat on a rafter.
The plaster fell through and both feet came after!
"My!" quoth the owner when the legs did appear,
"I wonder who ordered that bum chandelier!"

The fraternity then sang its business-college hymn, while the janitor stood impatiently waiting to turn out the lights:

A bunch of gassy sports are we.
We 're wise ones on the lights.
In social circles we are known
As the Meter-reader-ites.
We roam the town both up and down,
Through valley and on hill.
With dainty little pencils we
Lightly compose your bill.
So treat us nice, and chain your dogs
When we are on your street,
And then we 'll not re-tal-i-ate
With thirty-thousand feet!

What 'll I do? I can 't get that station by wireless.

Easy; tell him, "Air 's busy."

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The employee who is willing to steal for his employer would steal from his employer. The man who would be tricky for you would be tricky with you when he got a good chance.

The power of amber to attract hair, straw, and dry leaves was first noted by the Greeks 2,230 years ago, and from the Greek word for amber came the word electricity. But it remained for Dr. Gilbert of Colchester, England, physician to Queen Elizabeth, practically to found the science of electricity about 320 years ago. Old Dr. Gilbert would n't recognize it now.

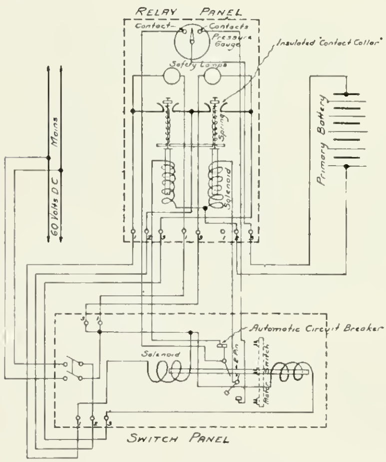
# An Automatic Governor Pump Control

By I. B. ADAMS, Acting Superintendent Colgate Power Division.

I B Adams

**The device illustrated** herewith and described is an automatic governor pump control that has been working successfully for the past three months on a 4-inch by 6-inch Lombard triplex pump at the Colgate power house.

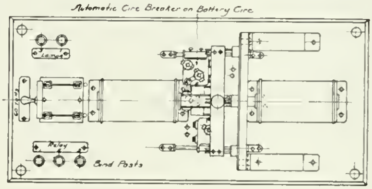
The mechanism is operated from the pressure tank of the governor system. It consists of a pressure gauge and a primary battery. The battery operates a relay trip coil, which actuates the main switch on the governor pump motor circuit, either starting up or shutting down the motor.



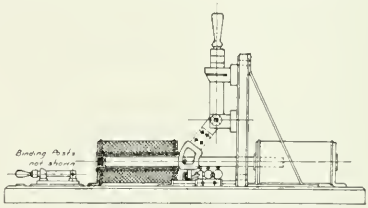

One lead of this primary battery is grounded to the frame of the pressure gauge. The other lead is connected to two insulated contacts on the dial of the pressure gauge. The insulated contacts are placed at 145° and 185°, thus giving the needle a range of 40°.

[Editorial Note:—This device was designed by I. B. Adams.]

To prevent the primary battery from running down, an automatic circuit breaker is provided on the main switch, and it opens the circuit closed by the pointer of the pressure gauge.



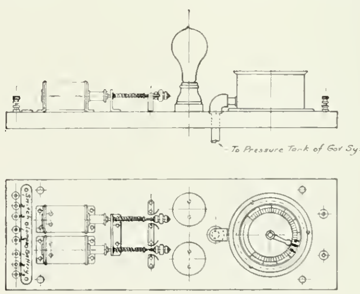

Plan.




Elevation

If the relay trip coils become stuck and do not operate the signal lamps light up, calling the operator's attention to the trouble.

The object in creating this device was to reduce the wear on the pump. Whenever the plant is not governing the governor stays



in one position for hours at a time, and the pump goes on running continuously. But since this device has been installed on the governing system the pump remains shut down fully 65 per cent. of the time. It would therefore appear that the lifetime of a pump might be more than doubled by the continuous use of such a device.

# Meetings of Managers and Superintendents

THE fifth regular meeting of the association of district managers of the Pacific Gas and Electric Company was held at the Hotel Rafael in San Rafael the 28th of August, and included a forenoon and an afternoon session, separated by a luncheon at a long table in the hotel and followed late in the afternoon by an impromptu baseball game on a vacant lot near the railway station while waiting for a train. The business discussions were interesting, instructive, and diversified. Thirty managers and company officers were present and seven absent.

The sixth regular meeting was held in the assembly room of the San Francisco headquarters building September 24th, a day in advance of the original plan, in order to take advantage of the fact that many of the district managers had come to town earlier for the sessions of the Pacific Coast Gas Association. The unfinished business of the San Rafael meeting was concluded, and the seventh regular meeting of the district managers was set for Chico, Saturday, the 13th of November.

The fourth regular meeting of the company's division superintendents was held at Marysville the night of the 11th of September, all being present. The session, in the office of the Marysville power division, was a coatless affair, but, despite the warm weather, was not concluded till near midnight, although Chairman P. M. Downing and Superintendent Finely of the Sacramento division and Wescott of the Sacramento supply station had hurried away about 10 o'clock by the first train going to Sacramento after they received warning of some trouble at the Sacramento substation.

The division superintendents left Marysville early Sunday morning, accompanied by Fred George, chief load dispatcher, G. H. Bragg of the operation and maintenance engineering department, and the editor of the magazine, and went by electric train to Oroville and thence by special train on the Western Pacific's new line as far as Big Bend, the site on the Feather river of the large hydro-electric plant of the Great Western Power Company, from which the Pacific Gas and Electric Company buys a large amount of supplementary power. The trip was instructive, the weather was hot, and there was nothing to eat from early breakfast at Marysville till late supper after the return to Marysville.

The superintendents declared themselves in favor of challenging the division managers to a baseball match at the earliest joint meeting of the two associations.

# "Practical Mathematics"

ALL who have studied mathematics in the conventional way will appreciate the truth of the following quotations, which are from the pen of that pioneer of engineering mathematics, Professor John Perry, whose little book, herewith discussed, covers the essential mathematics that the average engineer will use in his daily work.

"The average boy is taught many subjects in water-tight compartments, whereas he ought to learn all subjects as if they were one.

"When calculating from observed quantities, it is dishonest to use *more figures* than we are sure of.

"Mathematical symbols are merely a very easy form of shorthand; they usually instruct us to perform certain arithmetical operations.

"Elementary algebra is made difficult by the mere statement of rules. Why should any fuss be made over addition, subtraction, and multiplication? Why, anybody who has used a formula with brackets knows these things already.

"Tell a boy about ghosts, and the simplest things become complex and mysterious. Tell a boy that he is sure to find difficulty with simple algebra, and of course he finds great difficulty with a problem that would be quite easy if you told him it was easy.

[A student should] "practice using all sorts of formulae, so that he shall cease to be afraid when he sees one. Of course, there may be some bit of shorthand, some symbol, which has not yet been explained to him, but he ought to know that there is nothing magical or uncanny about it. I might call any one of them a rule and so create difficulty, but indeed there is only one way with them all.

"The average man who has worked through many rules in complex arithmetic, and algebra, and engineering, very quickly forgets them all, except the one or two that he constantly needs. It is only a teacher who remembers hundreds of rules. But if at the beginning a man knows that his rules are all one rule; that all his separate rules are mere examples of one general principle, he never can forget it, for every common-sense calculation that he makes only fixes the general principle firmly in his mind.

"Have you not noticed that a great man has only a few simple principles, on which to regulate all his actions? A great engineer keeps in his head just a few simple methods of calculation. But note that through constant practice these simple principles or methods are always ready for use in his mind. It may be that an expert may be quicker or neater in working some one kind of problem, but however clumsy or tedious may be the great man's method of working the problem, he gets the right answer, and he has no misgiving as he writes it out."

Perry, like most engineering teachers, found that the majority of his students had been taught their mathematics by mathematicians who looked upon their subject from the viewpoint of pure mathematics, rather than with a view to practical application in engineering. This condition is most noticeable in the case of the Calculus. The writer has a vivid recollection of a hard course in differential equations rendered necessary by a single equation in alternating current theory which was not covered in the regular courses as usually given in the Calculus. Perry, appreciating the importance of the proper teaching of the calculus, wrote his book "Calculus for Engineers." It is a book which has made the subject clear to many who, though they studied calculus in college, seldom derive from the collegiate course a working or practical knowledge. The usual result is that students early learn that the easiest way to get over an equation involving the Calculus is to take it for granted, or get someone else to solve it for them.

Perry's book on the Calculus approached the subject from a different viewpoint, and on the assumption that there was nothing difficult in the subject. He showed that when properly handled it was a most valuable tool for engineers. His book is practical in every sense, and every principle is illustrated with practical problems. It eliminates as much as possible those general theorems which appear to the student to be introduced simply for the amount of work they entail, and seem to have no practical purpose in after life.

Calculus today is taught in many of the engineering schools by engineers rather than by mathematicians. The result is that the students learn the application and necessity of this very powerful instrument that is placed at their service; and, having learned its use, they do not hesitate to use it.

Perry realized that his treatment of the Calculus could be applied to the more elementary mathematics. He developed a course in which the study of mathematics is treated in a similar way, and without the mystery and catch problems which seem to be so necessary to the authors of the text-books now in use.

Following up this work, some ten years ago Perry delivered a course of lectures to working men on the subject of "Practical Mathematics." These lectures were given under the auspices of the British Board of Education. They were so successful that they have been rewritten, and the British Board of Education has published them in book form, for sale at a nominal price. The quotations at the beginning of this article are from the first few pages of the book. The six lectures cover an introduction which explains the slide rule and its principle and other things, and deals with algebra, the use of squared [co-ordinate] paper, and vectors. Three of the lectures are devoted to squared paper, and include some of the important principles of the Calculus. With each lecture there is a number of suggestive examples, with their answers.

It is not to be imagined, of course, that a brief exposition of the subject, such as is given in Professor Perry's lectures, is contemplated to take the place of a mathematical education. This book will, however, give to those who have not had the opportunity to study mathematics a chance to get a working knowledge of the essentials that it is very difficult to obtain otherwise.

The writer feels that it is to the advantage of any body employed in engineering work, whether he be an operator or a superintendent, to obtain a copy of this book and go through it carefully. To those engineers who have studied mathematics it will form an interesting review of the work they have done. I believe it will show them some simple mathematical applications that they have not heretofore been familiar with or that they have forgotten. The writer has read the book with much interest and benefit to himself, and feels that he is justified in recommending it to all employees in the engineering departments of the Pacific Gas and Electric Company.

Since this view of mathematics was put forward by Professor Perry, it has received the attention of other writers, and several books have been published on the subject. It is now included in the regular curricula of a number of technical schools in England.

The published price of the book is nominal. It can be obtained for about 26 cents, including postage. F. V. T. L.

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"Practical Mathematics, Summary of Six Lectures Delivered by Professor John Perry, D. Sc."

Published by Wyman & Sons, Fetter Lane, London, E. C., 1907. Price, including postage, 26 cents.

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He wanted to know how long girls should be courted, and the reply from the query editor read thus: "Same as short girls."

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A good way to keep flies out of a room is to saturate small cloths with oil of sassafras and lay the cloths on the windowsills. The flies will give you absent treatment right away.

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In Korea and India it is not customary for a woman to see her husband until they are married; in a country more familiar to most of us it is not customary for a woman to see her husband after they are married.

# Oakland Gas Men on Parade

GIVEN a beautiful silver loving cup as third prize, the gas men employed by the Oakland Gas Light and Heat Company, a subsidiary branch of the Pacific Gas and Electric Company, led the second half of the first division in Oakland's Labor Day parade early in September, and received special commendation from the committee for their general appearance.

Some of the Gas Men and Their Float

Following a military band of sixteen pieces came this gas brigade, forty-one from the manufacturing department—gas makers, gas makers' helpers, repair men, repair men's helpers, and purifying men; then twenty-eight from the service department — pipe men, caulkers, yarners, ditch men, and others; then fifty-six from the meter department—meter repair men, meter repair men's helpers, meter setters and helpers, complaint men, and others; and finally eight statement men.

Those in the manufacturing department each carried a small gas balloon; they were: J. Aldride, H. D. Cahill, C. G. Christianson, T. Devine, A. F. Derrick, A. Franco, F. Gordo, J. Kearney, Chas. Hoffman, F. G. Gustafson, A. M. Gunnison, E. H. Halnan, T. Kelley, W. J. King, H. Keegan, J. M. Lowe, S. Lucie, E. Lockwood, N. Sendice, F. C. Lowe, D. McHugh, M. Marks, P. Marke, A. McGill, M. O'Hara, V. Polleta, D. Riordan, N. Rossi, V. Razovitch, J. Razovitch, D. Razono, H. Shermantine, C. Scriven, A. J. Sheerin, E. Thieman, J. W. Toole, F. Vogelsang, R. H. Wells, George West, George Warren, H. Aldridge.

The service department men each carried a three-quarter-inch pipe painted red and having two handholds an equal distance apart and painted white. They were: Jas. Halnan, Jas. Kirk, E. McKinney, M. Augusta, S. Belford, J. Casey, P. Curley, T. Devine, A. W. Davidson, T. Davey, R. Green, L. R. Gilbert, J. Haggerty, J. C. Hitchcock,

J. Innes, P. Hughes, J. P. Jones, A. J. Kallstron, P. Kenefick, P. Lucy, C. L. Lewis, D. F. McCarthy, Chas. McCarthy, M. McSweeny, M. McWilliams, Jas. Phair, Elmer McKinney.

Each of the men from the meter department carried a three-light meter on his back knapsack-fashion. They were: W. Blakely, Jas. Bryan, T. Curran, T. Conroy, H. Cumiskey, J. DeWitt, S. English, A. Glavin, J. Glavin, H. Hoffman, W. J. Knapp, T. LeFort, J. J. O'Byrne, R. Richter, Wm. Slattery, Geo. Smith, J. Thompson, Jas. Short, Jas. Varley, R. Windon, F. Weber, Wm. Ward, Chas. Schaeffer, W. Slauterback, P. Edwards, J. Shannon, Geo. Brown, P. Brady, Wm. Chambers, A. E. Coleman, L. Ellison, R. Fulton, Thos. Halnan, W. E. Hogarty, A. Hess, Geo. Hertle, F. Jacobs, J. Lind, J. J. Long, C. Lasswell, J. McCrudden, L. B. Marshall, J. Minikello, Jas. A. Martin, J. J. O'Brien, J. Orbell, Geo. Price, J. Roche, W. Ramsell, P. C. Smith, H. Sousa, Wm. Scales, W. Smith, A. Schraeder, H. Votaw, W. Weeks.

The statement takers each carried a statement book. They were: A. Ballard, A. donelson, J. Colgate, J. K. Maddocks, M. N. Hennings, J. McNeil, F. Langtry, D. P. McCarthy.

Some doctors say the skin of fruit is healthful and should always be eaten. Guess they were n't thinking of pineapples.

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Teacher—Construct a sentence using "indisposition."

Pupil—The body was found in dis position.

---

He looked sad, and the best man, meaning to be friendly and keep every one jolly at the joyful wedding, accosted him. "I say, have you kissed the bride?" he inquired. "Not lately," replied the sad one, with a far-away look.

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P. M. Downing was preoccupied with a terrapin stew when S. J. Lisberger interrupted him with the query: "About how many men work in his department?"

" 'Bout two-thirds of 'em," came the reply mumbled through a mouthful of small bones.

Late in September construction was begun on a six-mile power line of three wires from the Colgate power house to Indian Ranch to supply power there for the operation of the California Mother Lode Mining Company.

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The Fresno Republican contained a lengthy article the 21st of September announcing that T. W. Patterson, a local bank president, was back of a project for bringing electric power into Fresno by having an eighty-mile extension line built from the nearest power line of the Pacific Gas and Electric Company.

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The contract for lighting the city of Oakland was awarded September 16th to the Oakland Gas Light and Heat Company on its bid of $6.30 a month for each arc light. One of the city councilmen wanted a rebate to the city for moonlit nights, but Manager Leach showed that the company had already refunded the city $5,000 to prevent a city deficit, and that this amount was greater than the rebate asked.

# Reclaiming the San Joaquin Delta Lands

*By* S. V. WALTON, Manager Commercial Department.

S. V. Walton

**In the early spring** of the year 1905 a representative of the California Gas and Electric Corporation, who has since resigned, was traveling on the Santa Fe railroad from San Francisco to Stockton. Let him be known as R. U. Wise. The train stopped at Orwood, a small station where the track crosses the old channel of the San Joaquin river. Orwood is at the centre of a large area of overflowed land which was then just beginning to be reclaimed.

Four well-dressed and apparently well-to-do men got on the train. They happened to take seats across the aisle from R. U. Wise. All four were engaged in earnest conversation. The gist of their discourse was that the large pumping plants located on the reclaimed land were closed down owing to the non-arrival of a barge of fuel oil for the steam engines.

The Orwood 200-Horsepower Pumping Plant

After a few minutes R. U. Wise leaned across the aisle and, speaking to the man nearest him, asked if they had ever considered operating their pumping plants by electric power. No; they had not, because no electric distributing lines were built in that locality. R. U. Wise volunteered the information that some company—the name of which he could not recall—had a transmission line running from Stockton to San Francisco, and this line crossed the San Joaquin river, not far from Stockton, on large steel towers. Looking out of the window to the south at that moment they noticed the towers in the distance.

"Well, that line must run near our property," observed the reclamation man. "But we could n't be supplied from that, as the power all goes to San Francisco. Any way, the price would probably be so high that we could n't afford to use it."

Wise asked if the fuel oil for the pumping plant was not being purchased from the Standard Oil Company. Yes. He then remarked that he believed the oil company operated its plant at Point Richmond by electric power secured from that very line.

This brought forth a remark from another of the four reclamation men to the effect that R. U. Wise must be wrongly advised; the Standard Oil Company could not afford to purchase power when it could so cheaply generate it by the use of its own fuel, of which it had an unlimited quantity. Wise replied that the oil company must necessarily value its oil at the price for which the oil could be sold, and would probably adopt any method that would secure power at a less rate than the selling price of oil. The four reclamation men assented that this was logical, and asked where they could see a representative of the electric company and be properly advised as to the cost of obtaining electric power.

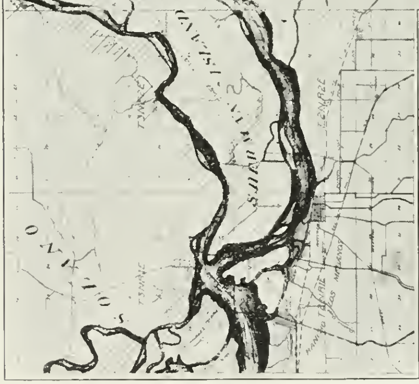
A few days later two of the four reclamation men, while leaving the old San Francisco office of the California Gas and Electric Corporation in the Rialto building, happened to meet R. U. Wise, and were somewhat surprised to learn that he was an employee of the power company. They said that they had just signed contracts for electric power for operating their pumping plants.

During the summer of 1905 that electric transmission line was extended to the west side of the Orwood tract. A substation was established, and in it were installed transformers for reducing the voltage from 60,000 to 10,000. At this decreased voltage it was decided to supply the various pumping plants. Each pumping plant had to have transformers for further reducing the current to 440 volts, and at that voltage each motor was supplied.

The 10,000-volt distributing lines were extended during the summer and fall of 1905 an aggregate distance of about ten miles, to supply the pumping plants on the Orwood, Palms, Woodward, Victoria, Upper Jones, and Lower Jones tracts. This meant an additional total of 600 horsepower. During the four years since electric power was first supplied to these islands the lines have been further extended, until now there is a total of approximately thirty miles of 10,000-volt distributing lines, supplying a total of sixteen pumping plants, in which there is installed 1,715 horsepower in motors. In addition to these there are under contract six more plants, with a total of 1,000 horsepower in motor capacity. To supply these the Pacific Gas and Electric Company began building this summer about twenty miles more of distributing line.

The use of electric power for the operation of pumping plants in reclamation districts has, for two reasons, been a very large factor in the industry of reclaiming overflowed lands. First, because of the reliability of electric power, the consumer never having to await the arrival of an oil barge and meantime sadly watch the water rise over his crops while he figured out what his losses would be; and second, the cheapness of electric power, both as to operation and maintenance of the pumping plants. The installation cost is also somewhat less than that of a gasoline plant and a great deal less than that of a steam plant. First cost is a thing to be considered, but the fact that electric power is always available when required is by far the most important consideration in its favor.

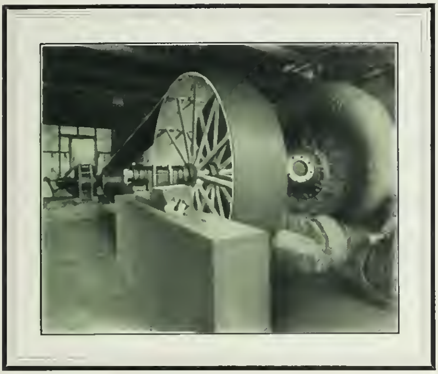

Cheap Transportation on the San Joaquin



In addition to the plant required for the regular pumping several of the larger tracts are equipped with emergency plants. These are to be used only in time of flood or in case of excessive seepage, due to long-continued high water in the river. The surface of the water in the river during the flood season is from six to ten feet higher than the level of these reclaimed lands. In the district there are two or three floating steam plants which

Map of San Joaquin Delta Lands

Inundated Section Indicated by Diagonal Lines



Inside View of 200-Horsepower Pumping Plant

36-inch centrifugal pump driven by a 200-horsepower induction motor, throwing 50,000 gallons of water a minute

can be moved to any tract where an unusual amount of pumping is required for a short time. These movable plants are complete, with engine and pumps and pipe of sufficient length for crossing the levees.

There are four stages in the reclamation of these overflowed lands. First, a dredger goes around the tract throwing up a levee to keep the water out. Second, a small dredger, called a ditcher, cuts the tracts up into sections, the ditches being so run that they will drain to one point, where a sump is dredged out from which the water of the tract is pumped into the river or into a slough. Third, the pumping plant is installed at the sump, and pumping is then started to drain the main ditches. Fourth, men are now put to work digging by hand small, straight drainage ditches emptying into the various main ditches. By the time this ditch work is done the land is pretty well drained. As soon as the top of the ground dries out then the tule, which grows thickly to a height of several feet all over the land, is burned off. It sometimes happens that the peat land itself gets on fire. It will burn for days unless put out by flooding. In order to flood the land it is necessary to cut open the levee. After the fire is extinguished the levee is repaired, and the tract is again pumped out.

When a tract has been drained and its tule burned off it is plowed up and left to lie fallow for that season. The next year the ground is worked over and the first crop, usually potatoes, is planted. In addition to potatoes the principal crops grown in this reclaimed district are asparagus, celery, and barley. Hemp has also been tried during the past year, and seems to be a paying crop.

Because the various tracts are bounded, at least on one side, by the San Joaquin river or one of its branches, the problem of transportation is a simple one. It is only necessary for the farmer to haul his crop to a landing on the river bank, where it is picked up by a steamer. There is a large number of these river boats going through the districts on their way between Stockton and San Francisco. The Santa Fe railroad also runs through the district. A large part of the products of these river islands is hauled to the nearest tule-land railway station and loaded into freight cars for transportation to distant markets.

This reclaimed San Joaquin river land is owned chiefly by large companies and leased

A Dredger Throwing Up a Levee

out in farms of from one hundred to several thousand acres to Japanese and Chinese tenants. George Shima, a Japanese known as the "Potato King," is the largest single tenant; he has leased several thousand acres from the Rindge and the Empire Navigation Company. In some cases he pays as high as $19.50 an acre yearly rental, and the crops must be profitable, as he is reputed to have made a fortune and owns a handsome home in the most fashionable part of Berkeley, near the state university campus.

A Main Drainage Ditch

The pumping plants on the several tracts are used for the purpose of irrigation as well as for reclamation. The irrigation process is a reverse of the usual method. For the most part the land is below the level of the water in the river. So water for irrigation purposes can be let in by gravity. This is done by using a large pipe reaching over the levee. The water is siphoned across the embankment into the ditches, and thence it percolates through the land, which is very porous, owing to the peat formation. If allowed to remain, this water would cause the land to sour and destroy the crops. So it is necessary to pump the water off the land almost as fast as it is siphoned on to it.

The two chief enemies of the farmer of these reclaimed swamp lands are floods and fires. The farmer has protected himself against floods by large levees thrown up at great expense by big dredgers and by installing powerful pumping plants. Even then the water sometimes gets the advantage and destroys the crops. The danger from fires is less, and the fires can always be put out by flooding the land. But, in flooding, the "cure is about as bad as the disease." When there is a peat fire the ditches surrounding that particular section are rapidly filled with water. This usually confines the fire to a small area where it burns itself out in a few days. The loss by flooding that section is less than would be the loss by flooding the whole tract. But there have been several instances where the fire could not be stopped simply by the water in the surrounding ditches, and it spread, and the crops were ruined on hundreds of acres. This happened in 1906 on the Upper Jones tract after the potatoes had been dug and sacked; the entire crop was destroyed.

The attention of the federal government has been attracted during the past few years to the reclamation of the San Joaquin and Sacramento delta lands. Lieutenant-Colonel Biddle and Captain Jackson are now preparing a comprehensive report that will imply government aid in the reclamation of the entire district. If this government plan be carried out there will be saved for the people thousands of acres of the most fertile and productive land within the boundaries of the United States.

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## A Holey Waist!

His nose was red a week or two,
Because it got a tweak or two,
After he tried a peek or two
At lovely spots of pinkish hue
Showing through a "peek-a-boo."

# SHORT CUTS

*Under this title each month will be published handy formulae, simple practical methods, and time-saving ways for doing things that have to be done in the day's work. Thus may all in the employ of the company come to benefit somewhat from the combined knowledge and experience of the individuals.*

## Linear Expansion of Steel

*By* F. V. T. LEE, Assistant General Manager.

A convenient and closely approximate rule, and one which may be readily remembered, for determining the linear expansion of steel due to change of temperature is that *for each 100 feet and 100° F. temperature the expansion will be .75 inch, approximately.*

Example: Steam pipe 125 feet long, range of temperature change 410° F. Required, the linear expansion.

Answer: $1.25 \times 4.10 \times .75 = 3.84$ inches.

The coefficient of expansion of steel is usually given as .0000065 expressed in feet for each foot of length and degree (F.) of temperature change. Applying this to the example given, we have

$125 \times 410 \times .0000065 = .333$ feet $= 3.99$ inches.

From the foregoing it will be noted that the error introduced by the approximate method is within 4 per cent. and probably accurate enough for all ordinary purposes.

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## Testing Transformers for Overload

*By* C. E. SEDGWICK, Commercial Department.

In operating transformers on poles of a distributing system it may become desirable to learn if a transformer is at any time subjected to dangerous overload. This information can be obtained in a variety of ways, more or less laborious and tedious, provided the necessary instruments are at hand.

The writer, when operating, did not have these instruments, so he hit upon the idea of using a maximum and minimum recording thermometer, such as can be obtained in almost any town. The metal back was removed, a string tied to the wooden scale on which the glass tube is mounted, and the thermometer then lowered by the string into the transformer oil until it was completely submerged. It was placed close to the coils of the transformer and left there over night, and in some cases a week. When the thermometer was removed the maximum temperature reached by the oil during the period could be readily ascertained. This temperature was a measure of the sustained overload carried by the transformer, and, in fact, a direct measure of the dangerous overload, for it is the excessive temperature caused by overload which does the damage in a transformer.

The oil is never quite so hot as the coils and core of a transformer, so allowance should be made for this in considering the temperature of the oil. The writer estimated that if the temperature of the oil was above 180° F. more transformer capacity was needed, and he was governed accordingly.

This system of testing worked out so well that at regular intervals readings were taken on all the transformers where there was any question as to their overload.

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Don't expect to be paid overtime for dreaming about your work at night.

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The headquarters of the San Jose district were moved October 1st to offices in the Alexandria building on South Second street, a more central location.

# American Institute of Electrical Engineers

*By* S. J. LISBERGER, Secretary San Francisco Section A. I. E. E.

S. J. Lisberger

**The American Institute** of Electrical Engineers is twenty-five years old, has more than 6,000 members, nearly 5,000 of them in the United States, about 300 in the rest of North America, and about 800 in other foreign countries.

Its San Francisco section is composed of 263 members in California, thirty-six of whom are in the employ of the Pacific Gas and Electric Company.

This San Francisco section has regular end-of-the-month meetings, generally the last Friday, but in September the assemblage was earlier because of the presence of notable visitors.


The Badge

The institute had commissioned its veteran secretary, Ralph W. Pope of New York, who has held the office for a quarter of a century, to journey to the Seattle fair and there attend the sessions of the water conservation congress and later visit the western sections of the electrical institute. Secretary Pope came to San Francisco accompanied by Charles F. Scott, a past president of the institute and chief engineer of the Westinghouse Company at Pittsburg, and Paul M. Lincoln, one of the institute's vice-presidents, and also an engineer of the Westinghouse Company at Pittsburg.

The night of September 15th these three

San Francisco Section of American Institute of Electrical Engineers

**Less Style but More Appetite**

A Colgate flume-repair crew at Rottey's Point, high above the Yuba river. Under the floor is the rushing water of the mammoth flume that clings along the mountain side for eight miles

official visitors were given a dinner by the past and present officers of the San Francisco section, and the next night they were the guests at a dinner given by the San Francisco section. The accompanying illustration is from a flashlight photograph taken at the second dinner, which was attended by a good many of the members that are in the Pacific Gas and Electric Company. Who the company's members are is shown in the following alphabetical list:

Henry Bosch, of the construction department; George Bragg, of the operation department; R. C. Bragg, of the Redwood district; John A. Britton, vice-president and general manager; A. H. Burnett, superintendent of the South Tower power division; J. R. Carl, of the Electra power division; C. D. Clark, superintendent of the North Tower power division; F. T. Clarke, of the operation department; Paul M. Downing, engineer of hydro-electric operation and maintenance; W. E. Eskew, superintendent of the Electra power division; W. E. Finely, superintendent of the Sacramento power division; Lester Flagg, of the Electra power division; C. R. Gill, superintendent of electric distribution at Sacramento; John O. Hansen, superintendent of the San Jose power division; A. L. Harris, of the electric distribution department; George C. Holberton, engineer of electric distribution; R. J. Hughes, of the construction department; A. V. Joslin, of the Oakland power division; Otto Knopp, of the electric meter department; F. V. T. Lee, assistant general manager; S. J. Lisberger, engineer of electric distribution; John Martin, a director in the company; J. H. McDougal, of the electric meter department; C. E. Sedgewick, of the commercial department; L. H. Newbert, manager of the Redwood district; H. C. Parker, of the President's office; R. C. Powell, of the electric distribution department at Oakland; A. J. Ramstad, of the electric distribution department; George Robb, superintendent of supplies; Paul Shipley, of the Sacramento district; A. J. Thies, of the electric distribution department; J. O. Toby, of the Sacramento district; F. H. Varney, engineer of gas engine operation and maintenance; Chester Warren, of the operation and maintenance department; Charles J. Wilson, superintendent of electric distribution at Oakland, and C. E. Young, superintendent of the Marysville power division.

J. Danner and Bob Treaor, Colgate Power Plant Operators, Panning Out $48 in Two Days on the Yuba River, 300 Feet Above the Power House

# New Contracts for Electric Current

*By* S. V. WALTON, Manager Commercial Department.

A CONTRACT was recently closed with the Bucket Gravel Mining Company for supplying electric service in the Oroville district to a new type of gold dredger invented by Gunn, the mining company's general manager. This new style dredger is a dry-land affair, moving on skids. Its cost was only $10,000, while gold dredgers operated as huge flatboats cost $100,000 each. This dredger on skids has been in operation for about two months, and it promises to be a great success. High auriferous gravel land that has heretofore been considered not dredgable, because water could not flow to it, will become of great value for dredging purposes through the use of this skid-type dredger.

The mining business of the new Alleghany district in Sierra county has received a great stimulus from the fact that the Middle Yuba Hydro-Electric Power Company has entered that field, and will sell power to the mines. This power is generated by the Pacific Gas and Electric Company and is furnished to the Middle Yuba company under contract, the initial demand calling for 1,000 horsepower.

The California Wine Association, which has been operating a steam plant in its Napa winery, recently contracted with the Pacific Gas and Electric Company for electric power to supplant steam. The winery found electric power would be superior to steam for its operations, even though steam was still necessary about the plant for washing and for antiseptic purposes. But it was found that the steam so used could be handled at a very low pressure and at a very small cost compared with the high-pressure steam required for running engines.

The Sacramento Riverside Park and Amusement Company bas constructed a large swimming tank and amusement park on the Riverside Road, just south of Sacramento, on an extension of the Sacramento railway system, which is owned by the Pacific Gas and Electric Company. Light and power for this swimming tank and amusement park are being furnished by the Pacific Gas and Electric Company. The water for the swimming tank is pumped from wells, and it is necessary to work the pumps fifteen hours a day.

A contract has been closed covering service to a 100-horsepower pumping plant on the Franks Reclamation Tract in Contra Costa County. This plant had been operated by a steam engine for several years past. But the trustees of the district became convinced that electric power was cheaper than steam and invested several thousand dollars to make the change.

The trustees of Reclamation District No. 548, known as the Terminus Tract, in San Joaquin County, have signed a contract for 300 horsepower. They have been operating with steam, but have decided that electric power is cheaper for their purposes.

The Kennedy Extension Mine, which is located in the Jackson mining district, adjacent to the well-known Argonaut mine, Amador County, has recently been reopened and has contracted for electric power for the operation of the plant. This property is considered very valuable, and the owners are introducing a very expensive and up-to-date installation.

The Gold Bar Dredging Company, which is operating a large gold dredger on Butte Creek, about three miles below the Centerville power house, is meeting with great success in the operation of its dredger. This Butte-Creek field was prospected several years ago by W. P. Hammond, but, while he found gold values far greater than those in the Oroville and Yuba-river districts, he decided not to install a dredger, owing to the presence of so many large boulders, which his type of dredger boat was unable to handle successfully. The dredger operated by the Gold Bar company is moving these boulders satisfactorily, and the amount of gold being saved is very much greater than that obtained in the Oroville and Yuba-river districts. The Gold Bar company has several hundred acres of ground and will probably soon install other dredgers.

The Standard American Dredging Company, which has been operating at Stockton, dredging the Stockton channel between the city of Stockton and the San Joaquin river, a distance of about two miles, has moved its large, electrically-operated suction dredge to Mare Island for the purpose of dredging the approach to the government's new million-and-a-half-dollar drydock, which has just been completed by the Scofield Construction Company. The dredger will also dredge out the channel between Mare Island and Vallejo, so that large battleships can approach the pier at the island navy yard.

The firm of Levi Strauss & Company, which for a great many years has been operating its overall and shirt manufacturing plant in San Francisco, recently equipped a manufacturing plant in San Jose, all the machinery being operated by electricity. The firm is experimenting with the labor problem, and if it find labor conditions agreeable in San Jose it will remove all of its manufacturing plants to that city.

A German scientist is privately experimenting with a process for electrifying land by means of underground wires from a 250,000 volt plant, the idea being, it is claimed, to induce soil conditions that will do away with the necessity of fertilizers and will produce big crop yields.

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Secretary Snow of the state board of health, in inquiring recently into the causes of typhoid at Lincoln, Placer county, condemned the well at the high school and other wells in that town, indicated what precautions should be taken, and incidentally declared the water brought in by ditch from the mountains much better than the water from town wells. The water ditch referred to is that of the South Yuba Water Company, owned by the Pacific Gas and Electric Company.

According to careful measurement records kept at the bridge across the Yuba river at Marysville since 1873 it now appears that the Yuba river at that point is really scouring a deeper channel. In 1873 the low-water reading was considered as zero. By 1880 the bed of the river had so filled up that the low-water reading was up to 6 feet; by 1890 the channel had slightly washed out, making the reading only 5 feet and 10 inches; by 1900 it had again filled in till the reading was 7 feet 4 inches; by 1905 it had filled in more, till the reading was 9 feet 1 inch; but in 1908 it had washed out again and left the reading only 8 feet 4 inches; and in 1909 the scouring process had deepened the channel further, till the reading was only 6 feet 4 inches, showing a deepening of two feet in one year.

# PERSONALS

H. C. Vensano, a civil engineer in the construction department, and Miss Teresa Cassinelli were married August 25th.

J. H. Wise, civil and hydraulic engineer for the Pacific Gas and Electric Company, is building a new home in the Elmwood Park tract of Berkeley.

Fred Mason, a lineman in the Yuba river district, and Miss Alicia Wark, a telephone operator of Marysville, were married at Smartsville September 11th.

Alfred N. Warburton of the draughting department of the Pacific Gas and Electric Company and Miss Emma D. Smith of the Pacific States Telephone Company were married August 12th.

S. V. Walton, manager of the commercial department, surrendered the supremacy of his home October 5th to a younger rival, who arrived there at 10 o'clock that morning and measured and weighed fully up to the standard for a healthy infant boy.

Thomas Stephens, first operator at Marysville substation, became the proud father of a bouncing boy August 14th. He declares he will make young bouncer president of the company or break him in as an operator; it all depends on whether the boy takes to ladders or poles.

A. H. Burnett, the giant acting superintendent at the south tower substation at Richmond, and P. M. Downing, engineer of hydro-electric operation and maintenance, were classmates at Stanford and played on the same varsity football team seventeen years ago. In their college days they were "Ox" Burnett and "Phat" Downing.

George Scarfe, division superintendent at Nevada City, and reputed to be the most daring automobile driver in all that mountain section, is interested with several other men at Nevada City in constructing an aeroplane. But if he runs the flying machine with the dare-devil speed that characterizes his auto driving, his friends predict that it will not be long before they are saying, "Poor George! He is flying with the angels now."

The Petaluma Argus of September 16th contained an article on the arrival there Sunday morning of Joe D. Butler, a veteran athlete of the San Francisco Gas and Electric Company, past 55 years of age.

He walked all the way from El Verano to Petaluma, eighteen miles, before breakfast, to visit his friend, Herman Weber, manager of the Petaluma district, and right after breakfast started back on foot by the road, sixteen miles, as his friends dissuaded him from trying to follow the company's pole line over the steep and waterless hills.

Frank H. Varney, engineer of steam and gas engine operation and maintenance, had a birthday the 15th of September and was on that day presented with a very unusual gift. The present weighed eight and one-tenth pounds. It is the very latest thing in Varney type, Class A1, autocratic, self-feeding, "governor" attachments, and in the Varney catalogue is styled Frank H. Varney, Jr. Since the arrival of the new boarder the Varneys have commenced the erection of a cozy home at Green and Leavenworth streets, where little Frank may have all the advantages of a splendid marine view and early develop a preference for water and an interest in water power.

E. C. Jones, engineer of the gas department, is to read a paper before the American Gas Institute at Detroit, Michigan, October 20th, on "The Development of Oil Gas in California," the first scientific presentation of oil-gas making ever written. This notable paper will be published in part in the November number of this magazine. The American Gas Institute—and E. C. Jones is one of its charter members—is the parent gas association of America, has about 1,300 members, and was formed in 1906 by absorbing the American Gas Light Association, the Western Gas Association, and the Ohio Gas Association.

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The counter men and some of the employees of the other departments of the San Francisco Gas and Electric Company had a banquet the night of the 18th of September, with Gus White as toastmaster and C. L. Barrett as the guest of honor. S. Wardlaw of the "firing line" in the main office kept the fun at peak load with stories and recitations, and nearly every one present was called upon for an extemporaneous speech, a song, or a story. At the last there was a standing toast drunk to the good health and safe return of the company's president, John A. Britton.

Those present were Charles L. Barrett, W. R. Morgan, George N. Stroh, Joseph J. Walsh, Frank E. Oldis, J. J. Cunningham, Willis J. Egan, W. E. Dawson, Frank J. Mogan, Walter Webber, R. J. Courtier, D. A. White, Cyril E. Holt, Charles L. Butler, S. Wardlaw, W. F. Loughlan, A. E. Flagg, W. J. Fitzgerald, T. F. Denny, Joseph Goger, R. B. Bowman, E. H. Miles, Jack Judge, together with Sam Hamilton, George H. Farrell, E. V. Daily, and W. Gilchrist of the Gas and Electric Appliance Company.

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Miss Suzanne Tracy and Miss Miriam Choynski, cooking teachers demonstrating the uses of gas stoves, were in Woodland last month showing about 150 interested housewives how to cook without getting hot about it. Their visit created quite an appetite for the delicious sponge cakes, devil's food with nut filling and sugary icing, and the two-inch-thick, juicy steaks they cooked. Incidentally W. E. Osborn, manager of the Woodland district, was so inspired by the angel cake that he hemstitched the following verses on a typewriter and dedicated them to Miss Tracy and Miss Choynski, whereat they soon departed for the next town:

COOK WITH GAS AND GAS WITH COOK

To show and teach our good housewives,
The cooking girls were here in class
To bake and fry, to roast and broil;
And they did it all with gas.
They had a sign above the door,
Where all who shop'd must pass,
Their slogan was, in fact, 't is ours—
Always "COOK WITH GAS."
Good Dr. Cook the north pole reached
Before another man
Could find the way, howe'er he tried
The icey space to span.
It matters not what Peary writes
In magazine or book,
The slogan still is "COOK WITH GAS"
And also, "GAS WITH COOK."

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If booze interfere with business, cut out the business.

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In Bavaria, during the past four years, a good deal of attention has been given to the government proposition of using its abundant waterpower as a substitute for coal, which is scarce and costs $5.70 a ton to the government railways. Waterpower can be developed to electric energy, it is thought, at a cost of one-fourth to one-half cent a kilowatt hour. Hydro-electric power is wanted for two principal purposes: One in the manufacture by a new process of a substitute for Chile saltpeter by securing calcium cyanide by combining the nitrogen of the atmosphere; two, in the operation of railways.

# Pacific Gas and Electric Magazine

PUBLISHED IN THE INTEREST OF ALL THE EMPLOYEES OF THE PACIFIC GAS AND ELECTRIC COMPANY

ARCHIE RICE, - - - - - - - EDITOR
A. F. HOCKENBEAMER - - - BUSINESS MANAGER

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## EDITORIAL

SAN FRANCISCO, Oakland, and San Jose have adopted ordinances requiring that in certain districts electric transmission lines be placed in underground conduits. No doubt there are advantages in substituting underground conduits for poles and wires as means for transmitting electricity in the most thickly populated parts of the larger cities. But the removal of the poles and wires from the streets and the substitution of underground conduits cost a great deal of money. Who is to pay for these advantages? In the first instance, the corporations or natural persons engaged in the business of furnishing electricity for light and power purposes advance the capital required. But who finally pays the bill? Unquestionably the consumer.

Each additional burden placed by national, state, or municipal authority upon corporations or natural persons engaged in public or quasi-public service eventually falls upon those who purchase the products or make use of the service. It would be unreasonable for the public to demand service without making just compensation, and the constitution of the United States and the constitutions of the several states afford ample protection against the enforcement of any such demand. Just compensation necessarily includes the entire cost of all service rendered to the public and a reasonable profit upon capital invested. Should not the public, therefore, consider well whenever it is proposed to impose additional burdens upon those who are engaged in the public service?

The end to be accomplished by the enactment and enforcement of laws defining the rights and liabilities, regulating the conduct, and prescribing the duties of public-service corporations should be to obtain the safest, best, and most efficient service for which the public can afford to pay. If private corporations or natural persons engaged in serving the public demand too much for their service, their charges may be limited or prescribed by law; if, in rendering service to the public, they are negligent or make use of unsafe or dangerous appliances, they may be made to respond in civil damages or be made liable to fine and imprisonment.

Public franchises may be granted upon such terms and conditions as to insure reasonably efficient service. But the public can get no more than it pays for. Street railroad and other franchises granted for short terms upon onerous conditions will inevitably result in cheap construction and poor service. The owner of such a franchise can not afford, during a considerable period of time immediately preceding the expiration of the franchise, to keep his plant and equipment in first-class condition.

The head of the Forest Service is reported in the daily papers as saying: "Corporations should no more be granted the right in perpetuity to water and power sites than street railroads should be granted a franchise in perpetuity." By parity of reasoning, railroad corporations owning and operating transcontinental railroads should not be granted title in fee to the lands occupied by their railroads. This doctrine, if followed to its logical conclusion, leads to state or national ownership of all land and all natural resources. Is the public ready for this? Do the farmers and miners think that the United States, instead of granting title in fee to agricultural and mineral lands, should grant leasehold estates only, and, in consideration thereof, exact a rental or share of the products?

The head of the Forest Service contends that those who, under the authority of the laws of the United States, appropriate and develop sources of water supply and sites for the construction of reservoirs to conserve flood waters within the forest reserves should be required to pay to the national government what he terms a "conservation charge," the amount of which should be determined from time to time by executive authority. How popular would the contention be if it should be extended so as to apply to miners whose claims are situate within the national forests? What prudent business man would seriously consider making a large investment in any enterprise if the owner of the land to be occupied by him reserved the right to change at his discretion the charge to be made for its use and occupation? Would not this policy of the Forester, if adopted by the government of the United States, result, throughout the western states and territories, in placing directly upon the power producers and indirectly, but no less certainly, upon all power consumers—including miners, farmers, and manufacturers—burdens from which persons in like position in the eastern and middle states would be free? Is it right or fair at this late day to put this policy into effect in respect to the remaining public lands of the United States?

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WHEN a technical subject is presented in the simple language and style that characterize the article in this number on "Some Things About Steam," by Professor Durand of Stanford University, then any reader may find the matter interesting.

YOUR attention is called to an article in this issue entitled "Practical Mathematics." Most of us have grappled with mathematical problems of one kind or another and found some of them almost baffling. The trouble seems to be that the subject of mathematics and its principles were never made easy of comprehension to the average student. The English government has published a little book, written by a great engineer and teacher, who has made the thing so simple that anybody can grasp all the mathematics needed by the average engineer. And you can get one of those little books for twenty-six cents.

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## Not Edited

"Tickets, 25 cents; children half-price to be had at the office."

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"A man was walking slowly along a road with a wooden leg."

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"I would like to get copies of your paper for a week back."

"You do n't want a newspaper; you want a porus plaster."

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"The kopardnershipp heretofor resisting between me and Mose Jenkins is hereby resolved. All perrsons owing the firm will settel with me. All perrsons that the firm owes to will settel with Mose."

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"Any person driving over this bridge at a pace faster than a walk, shall if a white man be fined $5, and if a negro receive twenty-five lashes, half the penalty to be bestowed on the informer."

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"Hereafter, when trains in an opposite direction are approaching each other, on separate lines, conductors and engineers will be requested to bring their respective trains to a dead halt, and be careful not to proceed till each train has passed the other."

# QUESTION BOX

*Ask questions. Any one of the several thousand men and women in the Pacific Gas and Electric Company who wishes information pertaining to any phase of the company's work or concerning matters of common interest to residents of any section reached by the company's lines, is urged to use this department freely. Send your questions to the magazine. There will be no charge.*

Query:—How high is North Tower, near Dillon Point in Solano county, where the power lines start on the long suspension across Carquinez straits? OAKLAND.

Answer:—That tower is 191 feet high.
P. M. DOWNING.

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Query:—What is the height from the water level to the lowest wire of the Carquinez span? Is there room for the tallest masted ship to pass under it?
C. L. BARRETT.

Answer:—The lowest part of the lowest wire is 206 feet above the surface of the water. Tallest-masted ships, even when empty, would have twenty or thirty feet clear space above the mast-tops.
P. M. DOWNING.

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Query:—How great is the strain on the cables suspended over Carquinez straits?
J. D.

Answer:—Approximately 12 tons. P. M. D.

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Query:—What is the altitude of Blue Lakes in Alpine county? J. W.

Answer:—Approximately 8,000 feet above the level of the sea. P. M. D.

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Query:—Which power house of the Pacific Gas and Electric Company is located at the greatest distance above sea level? J. W.

Answer:—Deer Creek power house; it is 3,500 feet above the level of the ocean. P. M. D.

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Query:—Have variable speed motors been used in California with any marked degree of success? If so, where, and what do they operate? CHICO.

Answer:—On most of the gold dredgers at Oroville and near Folsom. Also one of twenty-five horse-power at the Mathoid Roofing Mills in Alameda county. T. E. F.

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Query:—When do accounts become outlawed under the laws of California?
A. F. H.

Answer:—Amounts due under contracts executed and to be paid in California become outlawed four years after due date; notes become outlawed four years from date of maturity; and actions to recover a balance due upon a mutual, open, and current account or upon an open book account must be brought within four years. This last provision was extended to four years by the adoption in 1907 of section 337 of the California code of civil procedure. It is therefore a correction of the two-year limit published as an answer to this same query in the July number of the magazine.
LEO H. SUSMAN.

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Query:—By what calculation can the gas lost from the mains be computed if the pressure at the point of leakage be known?
S. F.

Answer:—If all the gas unaccounted for were leakage from the mains, its increased flow through the various leak apertures, if their elevation and sizes were known, would be increased above the minimum pressure flow in a given period of time acording to the well-known formula of Pole for the passage of gases through openings, under pressure. If the question implies the total loss of gas from the mains, that can not be determined by any calculation, a very large part of the unaccounted-for gas being due to non-registering or faulty-registering meters. It is difficult to determine the leakage loss from the mains by pressure variation calculation, because of the impracticability of getting the varying pressures at the different openings. This pressure changes momentarily in every case, and, in addition, the leakage at the minimum pressure is never known.
CHAS. L. BARRETT.

# Pacific Gas and Electric Magazine

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GENERAL VIEW OF MARTIN STATION AT VISITACION VALLEY, NEAR SAN FRANCISCO—THE FIRST LARGE PRODUCER OF OIL-GAS IN THE WORLD

# Pacific Gas and Electric Magazine

VOL. I NOVEMBER, 1909 No. 6


## The Development of Oil-Gas in California*

By E. C. JONES, Engineer Gas Department.

E. C. Jones

**The various methods** of distilling oil into gas in externally heated vessels date back to the discovery of petroleum. In nearly all of these processes the oil was subjected to a comparatively low temperature in either iron or clay retorts, with unsatisfactory results attended by much trouble. Not until the introduction of generators and superheaters for water-gas making was it attempted to decompose oil in contact with highly heated surfaces of refractory material in internally heated vessels. Then the oil was looked upon as an enricher of other gases, and subservient to these dilutent gases, which took the name of water-gas. The name of oil-gas with its unctuous suggestion is apt to awaken unpleasant memories in the minds of the older generation of gas men, who experimented with the many ways of stewing oil in iron retorts. For this reason oil-gas as well as water-gas is badly named. The oil-gas of California is so much like enriched coal-gas that no chemist could identify it as having been made from oil.

### HIGH PRICE OF OIL ELSEWHERE

The high price and scarcity of petroleum in the populous and large gas-producing districts of the United States have probably deferred the invention and use of oil-gas apparatus. But the discovery of vast quantities of oil in California made it an economic necessity. The full extent of this necessity and the reasons for completely changing the method of making gas in California and the abandoning of all other generating apparatus will be better understood by referring to the following table, showing the quantity and value of petroleum produced in the state during the past twenty-one years, and to a chart, showing the relation of quantity to value.

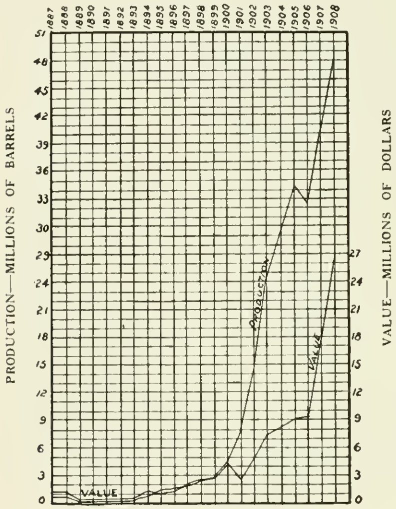
PRODUCTION OF PETROLEUM IN CALIFORNIA

| Year | Quantity, bbls. | Value | Value a bbl. |
|---|---|---|---|
| 1887 | 678,572 | $1,357,144 | $2.00 |
| 1888 | 690,333 | 1,380,666 | 2.00 |
| 1889 | 303,220 | 368,048 | 1.21 |
| 1890 | 307,360 | 384,200 | 1.25 |
| 1891 | 323,600 | 401,264 | 1.24 |
| 1892 | 385,049 | 561,333 | 1.45 |
| 1893 | 470,179 | 608,092 | 1.29 |
| 1894 | 783,078 | 1,064,521 | 1.35 |
| 1895 | 1,245,339 | 1,000,235 | .803 |
| 1896 | 1,257,780 | 1,180,793 | .90 |
| 1897 | 1,911,569 | 1,918,269 | 1.00 |
| 1898 | 2,249,088 | 2,376,420 | 1.05 |
| 1899 | 2,677,875 | 2,660,793 | .99 |
| 1900 | 4,329,950 | 4,152,928 | .95 |
| 1901 | 7,710,315 | 2,961,102 | .38 |
| 1902 | 14,356,910 | 4,692,189 | .32 |
| 1903 | 24,340,839 | 7,313,271 | .30 |
| 1904 | 29,736,003 | 8,317,809 | .27 |
| 1905 | 34,275,701 | 9,007,820 | .26 |
| 1906 | 32,624,000 | 9,238,020 | .28 |
| 1907 | 40,311,171 | 16,783,943 | .41 |
| 1908 | 48,306,910 | 26,566,181 | .54 |

*Read at the fourth annual meeting of the American Gas Institute, held at Detroit, Mich., October 20th, 21st, and 22d, 1909.

Until 1884 coal-gas was made in California exclusively from coals brought from Australia as ballast for English wheat-carrying ships, and coals from the state of Washington and from Vancouver Island. The finding of oil in considerable quantities encouraged the making of water-gas as an auxiliary to coal-gas, so that in 1899 there were in California:—

YEARLY PRODUCTION AND VALUE OF PETROLEUM IN CALIFORNIA




1 Crude Oil Water-Gas Works,
10 (Lowe) Carburetted Water-Gas Works,
18 Coal-Gas Works,
5 Oil- and Air-Gas Works.

This was the beginning of oil-gas making, and during the year of 1899 there were 2,677,875 barrels of petroleum produced in California. For some years after this the production of oil doubled each succeeding year, and the difficulty of finding a profitable market for this enormous increase caused a corresponding drop in the price of oil. This was the incentive for having oil displace all other crude materials for gas making.

Today there are in California fifty-six oil-gas works, and in connection with these are three plants for manufacturing water-gas from lampblack residual of oil-gas making, one small coal-gas works, and one oil and air gas plant.

L. P. LOWE DISCOVERED METHOD

The cedit for discovering this new method of making gas and the invention of suitable apparatus for use in making it belongs to L. P. Lowe of San Francisco, who anticipated the eventual use of oil-gas long before the plentiful supply of cheap oil warranted its commercial use on a large scale. He constructed several small plants in different parts of California, and September 1, 1902, completed the erection of and started an oil-gas plant in the works of the California Gas and Electric Corporation in Oakland. This was the first adaption of the new process to the suppiy of gas to a large city, and was the basis of experiments from which the present oil-gas apparatus has developed. Improvements made it possible by September 11, 1904, to supply the entire output of Oakland.

EARLY TYPE OF APPARATUS

The first type of oil-gas apparatus was constructed with the idea that extremely high heats for decomposing the oil produced the best results. It is, of course, understood that a generating apparatus consists of two or more shells filled with checker brick, and as there is no solid fuel used, there is an absence of boxes and grate bars found in the ordinary water-gas generators. The checker brick are heated by oil injected under pressure with steam in company with a blast of air for combustion. No secondary air was used in the first types of apparatus, and it was quite impossible to control the heat in different parts of the machine. The oil for heating was usually injected at the bottom of the generator under an arch or series of arches.

There is a temptation to use arches in oil-gas generators over the combustion chambers for supporting checker brick, but is was soon discovered that no arch can be constructed that will withstand the blow-pipe effect of the oil flames, and the most carefully constructed arches made of the best material obtainable lasted but a few days or weeks.

It was first supposed that burning oil in a primary shell and passing the products of combustion over checker brick in a second shell without the use of secondary air coated the checker brick in the second shell with particles of lampblack deposited from the decomposed oil, and that during the succeeding run the steam admitted with the oil for gas making was converted into carbonic oxide and hydrogen in contact with these lampblack-coated surfaces.

#### HIGH TEMPERATURES DESTROYED OIL

The high temperatures at first employed destroyed a large quantity of oil, resulting in a diminishing yield of gas at but low candlepower, and in the production of a large amount of lampblack. The yield of lampblack amounted to more than thirty pounds for each thousand cubic feet of gas made. As this lampblack was the result of decomposed hydrocarbons, the hydrogen which had been linked to this carbon remained in the gas as free hydrogen.

Following is an analysis of early oil-gas:—

| Composition | Percentages |
|---|---|
| Heavy hydrocarbons | 6.2 |
| Marsh gas | 25.6 |
| Hydrogen | 62.4 |
| Carbonic oxide | 3.0 |
| Carbonic acid gas | 0.2 |
| Oxygen | 0.4 |
| Residual nitrogen | 2.2 |
| Total | 100.00 |

Specific gravity, .303.
Net British Thermal Units, 624 the cubic foot.

The candlepower was 18.6. This gas was made in Oakland, California, in September, 1902, and is a fair sample of the oil-gas of those days, which was produced in very highly heated generators with no means of regulating the heat, without wasting it. This gas, burned through an open tip, had every appearance of coal-gas of the same candle-power, the flame being of the same size, but of apparently greater brilliancy than coal-gas. The small percentage of carbonic oxide is good evidence that little or none of the steam admitted with the oil was decomposed. This is borne out by the fact that carbonic acid gas was 0.2 per cent., and as the gas was purified by oxide of iron none of the carbonic acid was removed by purification.

The low specific gravity .303 is, of course, due to the large percentage of hydrogen, and it is undesirable for the reason that there is a greater waste in use by consumers, and the increase in street-main leakage is noticeable.

#### RELATIONSHIP OF SPECIFIC GRAVITY TO HYDROGEN

The specific gravity and hydrogen content bear so close relationship to each other that all oil-gas containing 50 per cent. or more of hydrogen is of specific gravity .4 or less, and oil-gas containing less than 50 per cent. of hydrogen has a specific gravity of .4 or more.

The high temperature in the generators created troubles of about the same character and disagreeable qualities as those encountered where extreme high temperatures are used in regenerative coal-gas benches.

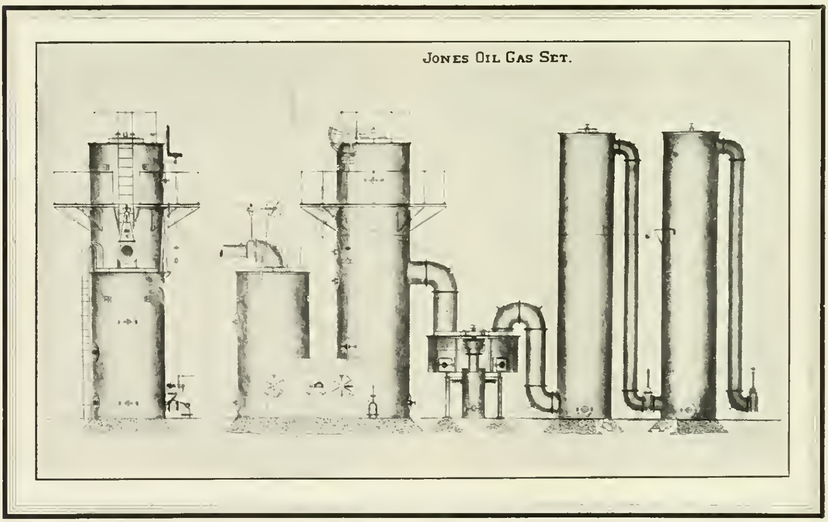
Tar, which under other conditions would have passed over to the scrubbers and been condensed in the ordinary way, was made into pitch. The pitch mingled with the particles of lampblack and formed solid stoppages in the wash-box, so that it was no uncommon experience to make gas twenty hours one day, devoting four hours to cleaning the wash-box and down-take pipe, while on the following day twenty hours would be devoted to cleaning the wash-box, with four hours' time remaining for gas making. The lampblack recovered as a by-product was made in such large quantities that after a generous amount of it had been used for firing boilers about the works there remained a sufficient quantity to become a nuisance.

The lampblack as it is removed from the separators contains from 50 to 60 per cent. of water, and it is necessary to drain off the water until the water content is reduced to about 30 per cent. before the material is fit to be used as boiler fuel. The large amount of water in the lampblack prohibits the use of any of the briquetting presses that are successfully used for briquetting other dry materials, or materials containing a small amount of binder.

### DIFFICULTIES ENCOUNTERED

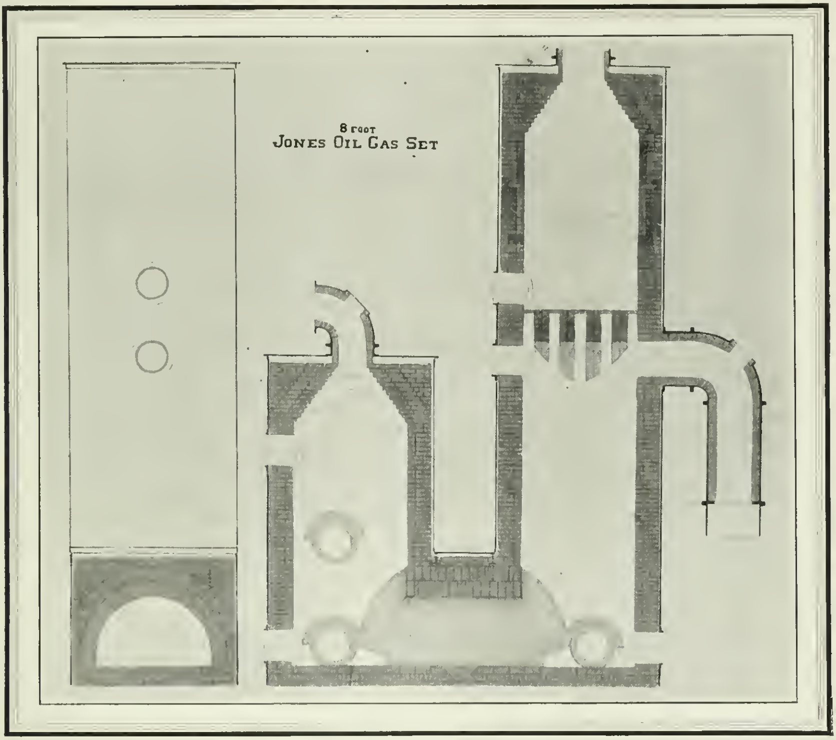
To add to the discomforts of making gas in this way, the wash-box was so constructed that it retained a large amount of lampblack within itself, while the lampblack separator permitted large quantities of lampblack to overflow and be wasted. This waste was not deplored so much on account of the loss in money as from the fact that the drainage from the gas works was usually emptied into a river or bay, and the State Fish Commission complained of the pollution of the water. With these discouragements and the meager amount of knowledge of the work actually being done, the construction of oil-gas apparatus in large units for the supply of gas to cities to the exclusion of all other kinds of gas seemed dangerous, and the task was unattractive.

Oil-gas machinery had been constructed of all kinds and sizes with hardly two alike, and it was first necessary to design an apparatus applicable to both large and small works, and make standard every detail of it, thus accomplishing in three years the same results that have required thirty years of hard work with water-gas apparatus.




**The Apparatus for Generating Oil-Gas**

The illustration shows the arrangement of the primary and secondary generators connecting at the bottom with a throat piece large enough not to constrict the passage for gas; shows the wash-box, which acts also as a hydraulic seal; and shows two ordinary steel scrubbers provided with wooden trays. Ample scrubbing of oil-gas is very important.




Showing a Vertical Section of the Generators with Their Linings

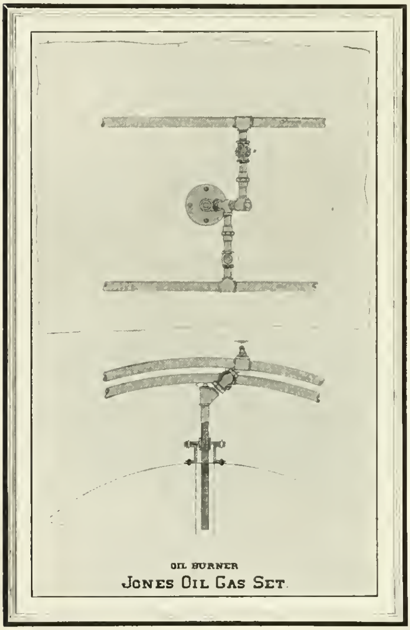
#### IMPORTANT IMPROVEMENTS MADE

The first important improvement was the eliminating of brick arches over the combustion chamber, and the substitution of corbel work at the top of both generators in place of arches. To provide a combustion chamber without arches it was necessary to construct a pair of generators in the shape of a letter U, one leg of the U being much longer than the other. The shorter of the two shells is used as a primary generator and the air blast is admitted downward through the centre of the top of this generator.

At first the oil was fed through burners pointing downward through the top of the primary in the same direction as the air. But it was found that better results were obtained by placing the oil burners in a circle around the side of the generator near the bottom of the corbel work, thus injecting the oil at several points around the circle at right angles to the direction of the air. The top of the primary thus becomes a combustion chamber, and there is no sharp impact of oil flame against any part of the brickwork. To assist a proper understanding of the apparatus, a few illustrations have been prepared; these were photographed from working drawings of a modern and satisfactory oil-gas set, as well as from apparatus now in operation.

#### SEQUENCE OF OPERATIONS

The sequence of operations in blasting and making gas, after the brickwork has been brought to a temperature that will ignite petroleum, begins with the opening of the stack valve at the top of the secondary generator and is followed by the opening of the air blast at the top of the primary generator and the admitting of oil and steam through the heating burners at the top of the primary generators.



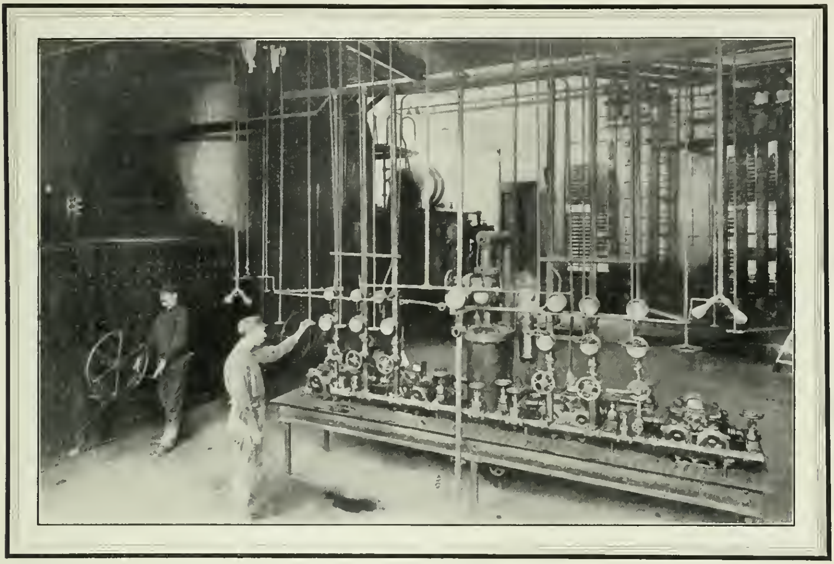

Oil Burner

The set is entirely operated from the floor, the gas-maker and helper working in unison handling the stack-valve, the primary and secondary blast valves, and turning on the oil and steam at the "oil table." The oil and steam for heating are admitted through a specially arranged burner shown in one of the illustrations. Separate coils of pipe encircle the generator, one being for oil, and the other for steam, that for the oil always being at a lower level than the steam coil. This is a precaution to avoid a possible leakage of oil downward into the burners when the apparatus is not in use. Experience has proven that the straight pipe burner with open end gives better results in large sets than any other kind of burner. Much care, however, has been devoted to the selection of an injector, which will force the oil through the burner into the generator, using steam in the most economical manner. This injector is made of brass, carefully finished, and the oil and steam openings are nicely centred. The straight pipe burner is connected to the shell of the generator through a flange, and on the outside end of the burner is placed a Y fitting. The injector is attached to this Y fitting, connecting it with the steam and oil pipes. This arrangement does not interfere with the workings of the injector, and has the advantage of leaving a straight way for cleaning the burner with a small rod through the plugged end, C, without disturbing the rest of the burner mechanism.

A regulating service cock is placed on the oil inlet and a standard globe valve, B, on the steam inlet to insure good regulation at the burner. These controlling valves require nice adjustment for the exact proportion of oil and steam, so that when once set the amount of oil and steam used for heating and making is controlled from the oil table.

A glance at the illustration of the oil table shows an oil meter for the heating oil and one for the oil used for making gas. Gauges are provided for showing the steam pressure at the boiler, and the oil pressure at the outlet of the oil heater. In addition to this there are six nozzle gauges used in connection with each set. Three are for steam, and three for oil. These gauges are connected to the oil and steam pipe between their respective throttle valves and the machine, so that these gauges practically become steam and oil meters for the guidance of the gas-maker.

The oil table is also provided with thermometers, a jet photometer, and a test light. The oil is heated to about 150 degrees F. in a tubular oil heater of well-known design.



The Operating Table Between Two 16-Foot Sets, Showing the Convenience and Simplicity of Operation

There are nine burners for heating at the top of the primary generator. Assume that the machine has been making gas and a blast is about to begin. The stack valve has been opened and the air is turned on at the blast valve. No oil is admitted to the machine during the first three minutes of the blast, and the steam on the burners is turned on to a sufficient pressure to keep them clean and protect them against overheating. The blast pressure inside of the primary generator is nine inches. At the end of the third minute oil is turned into the primary generator at a pressure of eight pounds inside of the machine, while the steam pressure is retained at thirty-five pounds, and the blast pressure is reduced to seven inches also within the machine.

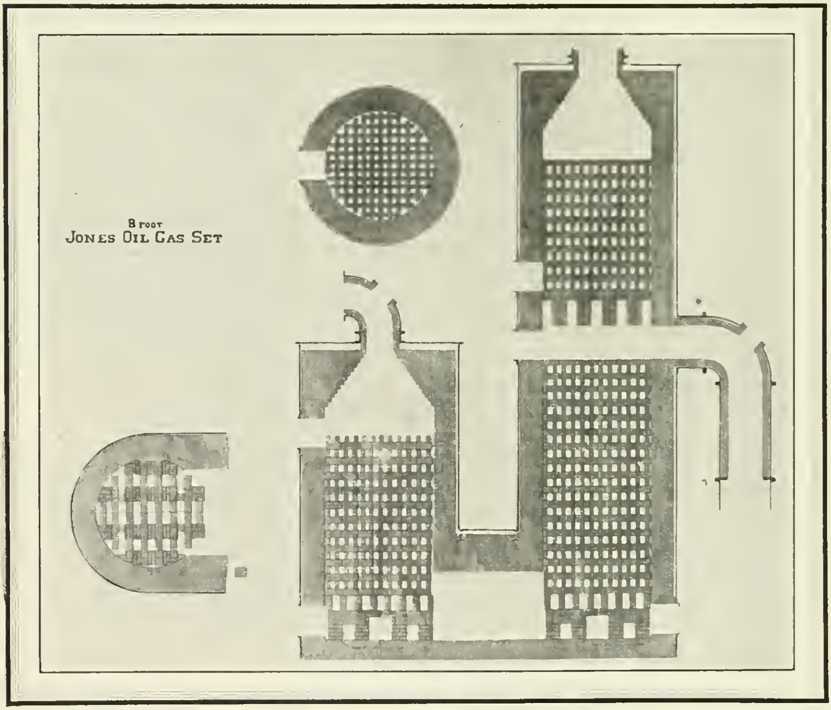
The accompanying table shows the progress of the blast on the sixteen-foot set at Generator No. 2 Jones, Monday, July 26, 1909:—

PROGRESS OF BLAST

| Minute | Oil temp., Fahr. | Oil pressure to heat, lbs. | Steam pressure to heat, lbs. | Oil to heat, gallons | Blast pressure, inches |
|---|---|---|---|---|---|
| 1st | | | 35 | blow | 9 |
| 2d | | | 35 | blow | 9 |
| 3d | | | 35 | blow | 9 |
| 4th | 150° | 8 | 35 | 3.25 / 3.25 | 7 |
| 5th | 150° | 8 | 35 | 3.50 / 3.50 | 7 |
| 6th | 150° | 8 | 35 | 3.25 / 3.25 | 7 |
| 7th | 150° | 8 | 35 | 3.50 / 3.50 | 7 |
| 8th | 150° | 8 | 35 | 3.25 / 3.25 | 7 |
| 9th | 150° | 8 | 35 | 3.50 / 3.50 | 7 |
| 10th | 150° | 8 | 35 | 3.25 / 3.25 | 7 |
| 11th | 150° | 8 | 35 | 3.25 / 3.25 | 7 |
| 12th | 150° | 8 | 35 | 3.25 / 3.25 | 7 |
| | | | | 60.00 | |

The duration of the blast in the large machines is twelve minutes; three minutes without and nine minutes with oil.

At the end of the heat the blast valve is closed, and a quick-opening valve at the outlet of the first scrubber is opened by means of a winch attached to the generator and by a wire rope running over pulleys to the valve stem. This valve is opened during runs and closed during heats, for the purpose of isolating the set from the rest of the works during the heating process and to permit the use of high blast pressure without breaking the seal in the wash-box, thus sending oil producer gas through the wash-box and scrubbers. As the man on the floor turns off the blast, opens the scrubber valve, and closes the stack valve, the gas-maker does not shut off the heating oil. He first turns on the oil and steam to the gas-making burners, which are separate and distinct from the heating burners. Then he shuts off the oil and steam from the heating burners, so that there is no interruption in the making of gas. The heating oil serves for this purpose during the moment necessary for changing the valves. The temperature of the primary and secondary generators is observed by means of sight cocks, the gas-maker becoming very skillful in detecting changes of color in the checker brick and turning on secondary air when the outgoing stack gas has the appearance of containing combustible gas.




**The Arrangement of Checker Brick in the Generators**

Note that the elbows for the admission of air and the outlet of gas are lined with fire brick to protect them from excessive heat.

###### SKILL OF GAS-MAKER IMPORTANT FACTOR

In this connection the personal factor represented by the skill of the gas-maker enters more largely into the equation of good results than in either coal- or water-gas making. For making gas the oil and steam are first turned into the top of the primary. The oil is decomposed by passing downward through the checker brick in the primary generator, thence through the connecting throat piece and up into the secondary generator. Should the gas thus made be permitted to traverse the entire length of the secondary generator to the top, the illuminants would be partly decomposed by breaking down into marsh gas, hydrogen, and lampblack. To prevent this overheating and to protect the gas the outlet of the machine is placed at or near the middle of the secondary generator. Above this point there is a large amount of heat stored in checker brick placed upon a number of arches, sprung across the generator. These arches are durable, because there is no direct combustion of oil in proximity to them. To make use of the heat in the top of the secondary generator coils of steam and oil pipes are connected with eighteen burners in the corble work at the top of the secondary. Fifteen of these burners are used for making gas, while three are steam pipes for purging. The gas thus made passes downward and through the side outlet into the wash-box. It will thus be seen that gas is made in two directions, leaving the machine through a common outlet. The reasons for this are obvious.

Sometimes during the process of heating, it is difficult so to regulate the temperature in the primary and secondary generators, even if the checker brick in both generators are in equally good condition for breaking up the oil. If the gas were taken off at the top of the secondary it would be impossible so to regulate the heat that no oil would be wasted, no gas overheated, or the yield of gas the minute not reduced. By adopting the side outlet all heat is conserved. If the top of the secondary be overheated more oil is used in that part of the machine, and if the primary be at too low a temperature less oil is used in the primary. In this way all heat is used for gas making and practically none is wasted. At the same time a uniform quality of gas is maintained.

###### INDICATORS OF GAS QUALITY

One of the best indicators of the quality of gas being made is the condition of the overflow water from the wash-box and from the first scrubber. The presence of tar in the wash-box seal shows that the heat is too low, and lampblack in the overflow from the first scrubber shows that the heat is too high.

The table following shows the amount of oil used in gallons, in different parts of the set, together with the steam and oil pressures, all pressures being on the inner side of the throttle valves and within the machine. These figures were taken from the run after the foregoing heat. The duration of the run was ten minutes. Oil is admitted to the top of the primary, beginning with twenty-six gallons a minute and reduced to nine gallons during the eighth minute. Oil is admitted to the top of the secondary, beginning with thirty-nine gallons during the first and ending with twelve gallons during the eighth minute. The steam pressure remains constant during eight minutes of the run. At the end of the eighth minute the oil is shut off from the primary and secondary; and the steam pressure on the primary and secondary is raised to 110 pounds, and is allowed to remain at this pressure for the last two minutes of the run for the purpose of purging the machine. For purging the machine during the last two minutes of the run three special open steam pipes are used at the top of the secondary. Steam is maintained on the burners at the top of the primary and secondary. A one-inch steam pipe admits steam to the bottom of the primary directly opposite the throat piece; this is also for the purpose of clearing the machine.

MAKE OF GAS, JULY 26, 1909

| Minute | Oil temperature, Fahr. | Oil primary, gals. to make | Oil secondary, gals. to make | Oil pressure primary, lbs. | Steam pressure primary, lbs. | Oil pressure sec., lbs. | Steam pressure sec., lbs. | Boiler steam pressure, lbs. |
|---|---|---|---|---|---|---|---|---|
| 1st | 150 | 26 | 39 | 21 | 25 | 27 | 25 | 110 |
| 2d | 150 | 26 | 39 | 21 | 25 | 27 | 35 | 110 |
| 3d | 150 | 18 | 26 | 19 | 25 | 24 | 35 | 110 |
| 4th | 150 | 18 | 26 | 19 | 25 | 24 | 35 | 110 |
| 5th | 145 | 18 | 26 | 19 | 25 | 24 | 35 | 110 |
| 6th | 145 | 17 | 26 | 19 | 25 | 24 | 35 | 110 |
| 7th | 145 | 17 | 26 | 19 | 25 | 24 | 35 | 110 |
| 8th | 145 | 9 | 12 | 19 | 25 | 24 | 35 | 110 |
| 9th | 140 | purge | purge | | 110 | | 110 | 110 |
| 10th | 140 | purge | purge | | 110 | | 110 | 110 |

Following are two analyses of gases taken at the stack valve at the middle of the heating period:—

JONES SET NO. 2

| Composition | Percentages |
|---|---|
| Carbonic acid | 13.1 |
| Oxygen | 1.9 |
| Nitrogen | 85.0 |

JONES SET NO. 1

| | |
|---|---|
| Carbonic acid | 15.3 |
| Oxygen | 0.2 |
| Nitrogen | 84.5 |

These analyses are frequently taken to determine the ratio of air to heating oil.

According to experiments at Munich in 1880 (Stillman's Engineering Chemistry) 6 per cent. of carbonic acid indicates three times the theoretical amount of air required; 9 per cent. of carbonic acid indicates two times the theoretical amount of air required; 17 per cent. of carbonic acid indicates one time the theoretical amount of air required.

The following table gives the make of gas a minute for a series of five runs. These tests were of necessity on different days so that the gas could be carefully measured in a relief holder isolated for the purpose and careful corrections for temperature be made to avoid error in measurement. The amount of oil used for heating and making and also the total oil used by the thousand feet of gas are given in this table. The make of gas a minute during a ten-minute run is a good indication of the application of the heat contained in the checker brick in the making of gas, and is an index to the proper length of run.

TEST RUNS ON NO. 2 JONES SET

| Min. | July 9th | July 10th | July 10th | July 12th | July 12th | Average |
|---|---|---|---|---|---|---|
| 1st | 7,080 | 6,664 | 5,206 | 8,538 | 7,497 | 6,997 |
| 2d | 6,247 | 7,705 | 6,872 | 6,664 | 9,371 | 7,372 |
| 3d | 6,039 | 7,080 | 7,082 | 8,333 | 7,497 | 7,206 |
| 4th | 5,831 | 6,664 | 6,247 | 8,225 | 7,393 | 6,872 |
| 5th | 5,623 | 6,248 | 6,248 | 6,248 | 6,664 | 6,206 |
| 6th | 5,623 | 6,248 | 6,247 | 6,351 | 5,831 | 6,060 |
| 7th | 5,415 | 6,664 | 6,248 | 6,559 | 6,768 | 6,331 |
| 8th | 4,790 | 2,915 | 4,165 | 3,748 | 3,540 | 3,832 |
| 9th | 2,707 | 2,290 | 2,082 | 1,978 | 2,291 | 2,270 |
| 10th | 2,082 | 1,042 | 2,082 | 1,874 | 833 | 1,583 |
| Totals ... | 51,437 | 53,520 | 52,479 | 58,515 | 57,685 | 54,729 |
| Oil for | Gals. | Gals. | Gals. | Gals. | Gals. | Gals. |
| Heat .... | 70 | 70 | 70 | 70 | 70 | 70 |
| Make ... | 370 | 373 | 370 | 370 | 400 | 377 |
| Total ... | 440 | 443 | 440 | 440 | 470 | 447 |
| 1,000 cu. ft. | 8.55 | 8.28 | 8.38 | 7.53 | 8.13 | 8.17 |

Following is a table giving the analyses of the gas made during a run July 19, 1909, on Jones Set No. 2. Samples of gas were taken from the wash-box at the end of the second, fifth, and seventh minutes, and analyzed:—

| Composition | End of 2d min. | End of 5th min. | End of 7th min. |
|---|---|---|---|
| Carbonic acid gas | 1.6 | 0.8 | 0.4 |
| Illuminants | 3.4 | 6.6 | 9.0 |
| Oxygen | 0.2 | 0.2 | 0.0 |
| Carbonic oxide | 9.4 | 8.0 | 6.6 |
| Hydrogen | 53.2 | 50.6 | 44.8 |
| Marsh gas | 28.5 | 30.9 | 35.0 |
| Nitrogen | 3.7 | 2.9 | 4.2 |
| B. T. U. the cu. ft. | 589.0 | 665.0 | 732.0 |
| Specific gravity | .382 | .391 | .423 |

The results of a typical run at the Potrero Station, San Francisco, June 4, 1909, giving the amount of gas made, oil used, and an analysis of the gas taken at the outlet of the wash-box during the first minute, when all the gas was made in the primary generator, and during the second, fifth, seventh, and tenth minutes, are shown in the following table, which gives the analyses of samples taken at the outlet of the wash-box of the No. 3 Jones Set.

RESULTS OF TYPICAL RUN

| Composition | 1st Min. | 2d Min. | 5th Min. | 7th Min. | 10th Min. |
|---|---|---|---|---|---|
| Car. acid | 1.8 | 1.3 | 0.0 | 0.0 | 0.0 |
| Illuminants | 8.6 | 2.1 | 5.0 | 5.8 | 7.8 |
| Oxygen | Tr. | Tr. | Tr. | Tr. | Tr. |
| Car. oxide | 5.6 | 20.2 | 9.4 | 8.2 | 14.6 |
| Hydrogen | 31.7 | 44.1 | 46.6 | 44.9 | 47.4 |
| Marsh gas | 43.4 | 26.7 | 35.7 | 37.3 | 25.9 |
| Nitrogen | 8.9 | 5.6 | 3.3 | 3.8 | 4.3 |
| B.T.U. | 765.0 | 549.0 | 675.0 | 698.0 | 747.0 |
| Spec. grav. | .514 | .469 | .402 | .411 | .435 |

| Minute | Cubic Feet |
|---|---|
| 1st | 5,625 |
| 2d | 5,833 |
| 3d | 6,041 |
| 4th | 5,625 |
| 5th | 5,416 |
| 6th | 5,000 |
| 7th | 4,373 |
| 8th | 4,166 |
| 9th | 3,125 |
| 10th | 833 |
| Total | 46,041 |

Oil 320 gallons to make, 60 gals. to heat; 380 gallons total.

8.25 gallons for each 1,000 cubic feet.

7½ minute primary oil off.

8th minute secondary oil off.

PERCENTAGES OF CARBONIC OXIDE

The percentage of carbonic oxide in these analyses would lead to the conclusion that the carbonic oxide is not formed by contact of steam and the carbon remaining in the generators after a heat.

It will be noticed that the gas made in the primary generator at the beginning of the run contains 5.6 per cent. of carbonic oxide, while during the second minute it increases to 20.2 per cent. and then drops to less than half that amount during the fifth and seventh minutes, rising again to 14.6 per cent. during the tenth minute. The carbonic oxide is undoubtedly produced by the dissociation of steam in contact with incandescent particles of lampblack, which have been thrown down by the breaking down of hydrocarbons.

A fact now well understood is that the oxygen of steam will not unite with carbon in combination with hydrogen, so that neither carbonic acid nor carbonic oxide is generated directly from the hydrocarbons of the oil in contact with steam. First it is necessary to convert the oil into gas or hydrocarbon vapor and then break down the hydrocarbons into lampblack and hydrogen. This lampblack, becoming incandescent, will unite with oxygen of steam. The high percentage of nitrogen in the primary gas is probably due to the presence of a small amount of products of combustion remaining in the primary generator after the heat. The nitrogen diminishes to the fifth minute and then increases to 4.3 per cent. during the tenth minute.

California petroleum contains more than 1 per cent. of nitrogen; usually 1.1 per cent. This is twice the amount of nitrogen contained in the petroleum of Pennsylvania and West Virginia. In distilling California petroleum the third fraction, taken off between 200° and 250° C., has a strong odor of ammonia. This ammonia is destroyed in the gas generators at higher temperatures, and appears in the gas as nitrogen and hydrogen.

PART PLAYED BY STEAM

Further to determine the part played by the steam admitted with the oil three runs were made on a sixteen-foot set, first in the ordinary way, second with oil injected under its own pressure without steam, and third by steam without the use of any oil. In each case the test was made after the generator had been heated ready to make gas. And these are the results:—

| Composition | Ordinary run | All oil | All steam |
|---|---|---|---|
| Carbonic acid | 0.4 | 0.4 | 43.8 |
| Illuminants | 5.2 | 6.2 | 0.0 |
| Oxygen | 0.1 | 0.1 | 0.2 |
| Carbonic oxide | 7.0 | 5.3 | 10.6 |
| Hydrogen | 46.6 | 47.9 | 5.0 |
| Marsh gas | 30.6 | 36.7 | 0.0 |
| Nitrogen | 5.1 | 3.4 | 40.4 |
| Specific gravity | .404 | .388 | 1.168 |
| B. T. U. a cu. ft. | 668.302 | 700.746 | 53.55 |

Ordinary run—Same gauge pressure as combined oil and steam runs; 17-inch pressure inside machine, 47 gallons a minute.

All oil run—18 lbs. to 19 lbs. oil pressure on primary, 25 lbs. to 27 lbs. oil pressure on secondary; 21-inch pressure inside machine; 51 gallons a minute.

All steam run—25 lbs. pressure on heat burners; 26 lbs. pressure on primary make burners; 32 lbs. pressure on secondary make burners; 10-inch to 11-inch pressure inside machine.

The run made with all steam can not be directly compared with the two other runs, as very little gas was produced; barely enough to enable the taking off of a sample at the wash-box. The generator at this period was at the same temperature as during ordinary runs. That is, it was at a temperature high enough to decompose steam in the presence of incandescent carbon, and only 10.6 per cent. of carbonic oxide was produced. Had there been much carbon deposited on the checker brick this generator would have been in ideal condition for the manufacture of "blue" water-gas.

QUALITY OF CALIFORNIA PETROLEUM USED

As to the California petroleum from which this gas is made, the crude petroleum from 12 degrees to 17 degrees B. is best adapted to the purpose of making gas. This oil has an asphaltum base, as has most of the petroleum produced in California. This makes it in a measure unattractive to oil refiners. The California crude petroleum used during the following experiments was 15.8 degrees B. at 60 degrees F. Distillation began at 85 degrees C.

| | Temperatures | Percentages | Color of fraction |
|---|---|---|---|
| No. 1 | Below 150°C. | 5.0* | yellowish |
| No. 2 | 150°—200°C. | 4.0 | yellow |
| No. 3 | 200°—250°C. | 27.5 | lemon / $H_2S$ and NH. |
| No. 4 | 250°—300°C. | 14.0 | lemon |
| No. 5 | Above 300°C. | 39.5 | red |
| No. 6 | Coke | 8.0 | black |
| | Loss | 2.0 | |
| | Total | 100.0 | *2¼% water |

Flash point, 257° F.
Fire test, 293° F.

After the 300° fraction comes off the temperature rises immediately to above 380° C.

The ultimate analysis of oil taken from this same field is:—

| | | |
|---|---|---|
| Carbon | 85. | per cent. |
| Nitrogen | 1. | per cent. |
| Sulphur | .8 | per cent. |
| Oxygen | 1.0 | per cent. |
| Hydrogen | 12.2 | per cent. |
| Total | 100.0 | by weight |

The exact amount of sulphur in the oil used for these experiments was 0.93 per cent.

PERCENTAGE OF SULPHUR IN OIL

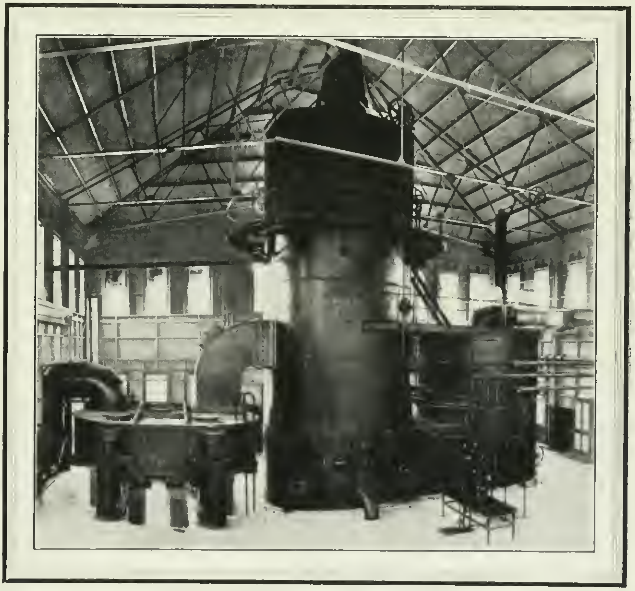
Oil containing sulphur in quantity less than 1 per cent. will produce gas which may be satisfactorily purified by ordinary oxide of iron. Should the percentage of sulphur exceed 1 per cent, purification becomes difficult, unless there is a large purifying capacity provided for it. Crude oils in California in some instances contain as much as 4 per cent. of sulphur. It is better not to purchase oils containing so much sulphur as it is necessary to provide elaborate and expensive means for purifying the gas. Fortunately the most available crude oils, produced in greatest abundance and best adapted to oil-gas making, have a small percentage of sulphur. After these crude oils are distilled and the distillates are sold for gas manufacture the distillate contains all of the sulphur of the crude oil condensed into the lesser quantity of distillate.

It is the opinion of the writer that a crude petroleum from 14 degrees to 16 degrees B. is the oil which gives the best results in oil-gas making. In other words, the more pounds in weight to the gallon of oil the greater will be the production of gas, and there will be less waste of oil. This is diametrically opposed to good water-gas practice, but the conclusion has been reached after the use in practice and experimentally of crude oils from 8 degrees B. to 37 degrees B. and distillates from 20 degrees B. to 42 degrees B.

### THE WASH-BOX

The wash-box serves a double purpose as a hydraulic seal and as a piece of apparatus in which nearly all of the lampblack is separated from the gas and held in suspension in the water. The early forms of wash-boxes were comparatively of small dimensions and were filled with baffle plates and partitions, forming excellent lodging places for lampblack, so that the cleaning of the wash-boxes was an important part of the gas-maker's daily work. In the development of a self-cleaning wash-box, to take care of the amount of lampblack made by a sixteen-foot set, it became necessary to depart from the square or circular form and adopt an oval shape, having a superficial area of 265 square feet, also to depart from the usual custom of connecting the generator to the wash-box and the wash-box to the scrubbers with pipe of the same or even smaller diameter than the trunk mains in the gas works. Allowance is made for the expanded condition of the hot gas leaving the generator. In what is known as a twenty-four-inch gas works the inlet and outlet pipes to the wash-box are forty-eight inches in diameter, while the diameter of the dip pipe in the wash-box flares to sixty-eight inches. This removes one of the chief causes of back pressure and enables the hot gas easily to get away from the machine.

In the new form of wash-box there are no partitions or diaphragms, and the space within the box is clear. The gas enters through a dip pipe at one end, and passes out through



**A 16-Foot Set with a Capacity of 150,000 Cubic Feet an Hour**

This is called a 3,000,000-foot set; it will produce that amount of gas every day in the year and can be forced to produce 4,000,000 feet. Eight such sets are in operation in San Francisco and Oakland.

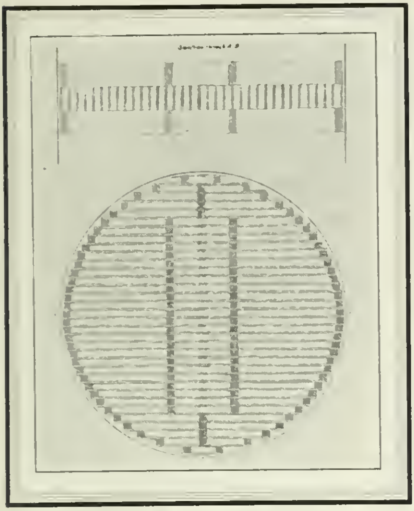
an outlet pipe from the top of the wash-box at the other end. Two large overflows on the side of the wash-box carry away the lampblack. The self-cleaning principle of this wash-box is in the constant agitation of the water in the box. This agitation is produced by dividing the main water supply into a number of one-inch pipes, twelve in all, extending to within three inches of the bottom of the wash-box. The water is thus forced downward to the bottom of the box, and it rises to the overflow. The lampblack is washed out of the gas by this turbulent water, and is carried out of the box before it has an opportunity to settle. The average temperature of the water entering the wash-box is 61 degrees F., and the average temperature of the water leaving the wash-box is 129 degrees F. The temperature of the gas leaving the wash-box is 142 degrees F., and the amount of water used in the wash-box is forty-six gallons for each thousand cubic feet of gas. The lampblack and water pass from the wash-box through open drains to the lampblack separator.

### IMPORTANCE OF SCRUBBING

Thorough scrubbing of oil-gas is all important. It has been proven conclusively that it is better to treat oil-gas directly with a large quantity of water than to use the methods of condensing and scrubbing as applied to coal-gas, where valuable by-products must be removed. Oil-gas requires more water for scrubbing than any other kind of gas, on account of the finely divided particles of lampblack held in suspension in the gas. These must be removed, as they would tend to destroy the purifying material. Should the lampblack pass through the purifiers it would cause endless trouble by stoppages. One uniform kind of scrubber and one method of filling it have been adopted. The old-style cylinder filled with trays through the top is the best to be had, but the filling should be carefully done. The trays are made of one-inch by six-inch pine lumber surfaced on four sides and nailed together in sections, with spacing pieces one inch thick also made of surfaced lumber. These trays are made in sections small enough to go through a door on the top of the scrubber. Each alternate layer of trays is placed at right angles to the one immediately under it, and the entire shell is filled without voids of any kind. As these trays are made somewhat smaller than the inside diameter of the steel shell, in order to provide for easily getting the trays in and out and for the swelling of the wood, it is essential that the space between the trays and the shell shall be caulked with excelsior, so that the gas can not pass round the trays instead of through them, or the water flow down the inside of the shell. In this way the gas is compelled to pass upward through the trays, meeting smooth wet surfaces; and the water passes evenly downward through the trays, thus the maximum efficiency is obtained by the use of the smallest amount of water.

### SCRUBBER TRAY

A plan of a scrubber tray and the arrangement of the trays in the scrubber are shown in the accompanying illustration. In the larger works there are three scrubbers twelve feet seven inches in diameter by forty feet high, and the water is supplied to them through ten sprays passing through the top head. With each sixteen-foot apparatus the amount of water used is approximately fifteen gallons for each thousand cubic feet of gas for each scrubber, or forty-five gallons the thousand cubic feet for the complete scrubbing of the gas. Salt water is used in the wash-box and in all the scrubbers. It gives satisfactory results, having no deteriorating effect upon the gas or upon the scrubbing apparatus. Salt water has the further advantage, where gas works are located on tide water, of being available in abundance at small cost for pumping, and it can be wasted after it has been used. In small plants, where water is scarce or ex-



Trays for 6-Foot Scrubbers

pensive, it becomes necessary to be more saving in the use of water and in some cases to cool the water and use it over again.

#### THE LAMPBLACK SEPARATOR

The overflow water containing lampblack flows from the wash-box through open, exposed drains into the lampblack separator. In nearly all oil-gas works the overflow water containing tar from the scrubbers flows into the same separator. The amount of tar is so inconsiderable that it is seldom recovered for sale, but when the tar is mixed with lampblack it adds somewhat to the fuel value of the lampblack and acts as a binder in briquetting.

Separators of small dimensions and containing many partitions have been superseded by those of much larger dimensions with fewer partitions. Experience with the separating of lampblack from water has developed the fact that the greater the area of the separator, and consequent slower speed of flow of water, the more thoroughly is the lampblack separated from the water.

The lampblack-and-water first empties into a separator provided with a constantly moving skimmer, consisting of pieces of 1 x 3 oak fastened to sprocket chains. The light, fluffy lampblack, rising to the surface of the water, is skimmed off by these scraping pieces and taken through a trough to a height of about twenty-five feet, and emptied into a settling tank, the walls of which are made of dry lampblack in the form of the crater of a volcano. After this skimming process the water flows into a separator, an illustration of which is here shown.

This picture is of a separator recently installed. This separator is capable of separating lampblack from water used in the manufacture of 12,000,000 feet of gas a day. In this separator there is a single partition running longitudinally. The partition is provided with a skimmer extending below the surface of the water. The separator is made in two sections to enable the alternate cleaning and use of the sections. The water containing lampblack flows into one of the large pits, and the separation is accomplished by the settling of the lampblack particles through the water. This process is of necessity slow, because the specific gravity of the lampblack is so nearly that of water. The water passes under the skimmer and over the partitions into the next pit, where further settling takes place. Out of this pit the clarified water passes through an open flume and is wasted. When the two pits are filled with

Where the Lampblack Is Separated From the Water lampblack the water gates are opened into the next pair of pits, and the water is shut off from the pits filled with lampblack. The removal of the lampblack is then performed by means of a locomotive crane with a clam-shell bucket. The water-soaked lampblack thus removed is deposited in a pile and allowed to drain. After it has drained until there is about 30 per cent. of water remaining in it, it may be used as boiler fuel. This was the only use to which lampblack was put in the early days of oil-gas making. Attempts were afterward made to make lampblack briquettes for domestic use. This proved difficult on account of the large amount of water contained in what seemed to be comparatively dry lampblack. It was found that the only simple and practical method of briquetting was by the use of a plunger operated by a crank shaft to force the lampblack into an open cylindrical mold, thus forming an endless briquette, after the manner of a sausage machine. These briquettes would break by their own weight in lengths that were multiples of the length of a stroke. That is, if the stroke of the machine were 1½ inch, the briquettes would break off in lengths of 3, 4½, or 6 inches. This method was found to be slow and expensive. So a vertical press was invented which had four plungers arranged on one shaft. The lampblack was fed through a trough into four molds and pressed by the plungers into and through these molds, breaking off into pieces in the same manner as described of the single horizontal press. This vertical press produced fifty tons of briquettes in twenty-four hours. The briquettes were three inches in diameter, weighed 5.4 ounces the linear inch, or 82½ pounds the cubic foot. They were smooth on the outside and possessed cohesion enough to permit of ordinary handling. The only binder used in the making of these briquettes was the normal amount of tar flowing from the scrubbers into the lampblack separator. Apparently the briquettes were dry when made, but they still contained a considerable quantity of water.

Here is an analysis of a briquette after it had been stored for one year in a dry place:

| | | |
|---|---|---|
| Moisture | 8.5 | per cent. |
| Volatile matter | 10.8 | per cent. |
| Fixed carbon | 79.9 | per cent. |
| Ash | 0.8 | per cent. |
| Total | 100.0 | per cent. |

LAMPBLACK BRIQUETTES FOR FUEL

These briquettes are an ideal fuel, particularly for use in open grates. Owing to the small percentage of ash, the briquettes when once ignited remain at a glowing heat until they are entirely consumed. The only objection to the use of them is the strong odor of naphthalene which they possess, and which does not entirely disappear after storage for a long time.

In order to avoid the inconvenience of dealing in by-products, it was decided to make the experiment of using lampblack briquettes as a substitute for anthracite coal in water-gas generators. In a station contiguous to the Potrero plant in San Francisco there were six sets of double, superheater, Lowe water-gas apparatus, with a rated capacity of 1,000,000 cubic feet each. Briquettes were used in these sets with some success, but the capacity of the sets was reduced 50 per cent. by using lampblack; that is to say, no more than 500,000 cubic feet of gas could be made in a day with a set rated at 1,000,000 cubic feet. But the making of gas in this way had decided advantages: there was an entire absence of clinker, and very little time was required to clean the fires. Contrary to expectations, the air pressure required to blast through lampblack was extremely low, never exceeding nine inches. The average amount of lampblack used the thousand cubic feet of gas covering a period of six months was 39.86 pounds, and the oil used for enriching was 6.8 gallons a thousand. This oil was the ordinary 14° to 16° crude oil with asphaltum base. The candlepower ranged from 28 to

33 candles. At that time the gas supplied to San Francisco was 23 candlepower. The oil-gas, which was made in the large generators, was 19 candlepower. The candlepower of the oil-gas was raised by mixing about 24 per cent. of the high candlepower lampblack water-gas with it.

### TYPICAL LAMPBLACK WATER-GAS

Here is a typical analysis of the lampblack water-gas:

| Composition | Percentage |
|---|---|
| Heavy hydrocarbons | 16.5 |
| Marsh gas | 32.8 |
| Hydrogen | 24.6 |
| Carbonic oxide | 13.7 |
| Carbonic acid gas | 6.2 |
| Oxygen | 0.2 |
| Residual nitrogen | 6.0 |
| Total | 100.0 |
| Specific gravity | .647 |
| Net B. T. U. the cu. ft. | 814. |
| Candlepower | 28.5 |

A lampblack fire is apt to flue during the blast, and it requires some care to keep the fuel bed in condition, as shown by the amount of carbonic acid in the gas produced.

In using the lampblack the ordinary round grate bars are placed half an inch apart. Great care is necessary not to overheat the superheater and thus make lampblack in the water-gas apparatus. During the heavy demand for gas during the winter of 1908-9 the use of lampblack exceeded the capacity of the single briquetting press. It became necessary to use lumps of lampblack dug from the side of a pile of dry material. These lumps were of about the same size as the coarse anthracite coal ordinarily used, and were broken away from the pile with pick-axes. It was found that the lumps held their shape fairly well in the generator, and gave fully as good results as briquettes. So lump lampblack was substituted for briquettes in all the generators, thus saving the cost of briquetting and considerably reducing the cost of lampblack water-gas.

Following is a recent analysis of the lampblack used in the generators:

| | |
|---|---|
| Volatile matter, including moisture | 34.15 per cent. |
| Fixed carbon | 65.80 per cent. |
| Ash | 0.05 per cent. |
| Total | 100.00 per cent. |

The first lampblack water-gas was made July 14, 1906. This gas has been made continuously, without the use of other fuel in the generators, since May 5, 1907.

### IMPROVEMENTS HAVE REGULATED LAMPBLACK

The improvements in oil-gas manufacture described in this paper have made it possible to regulate the amount of lampblack produced so that a combination of oil-gas and a lampblack water-gas plant will produce only enough lampblack for boiler fuel and generator fuel, with no product remaining for sale, excepting gas. The amount of lampblack now produced in the largest oil-gas sets is twenty pounds the thousand cubic feet of gas.

For the purpose of showing the average composition of oil-gas, lampblack water-gas, and the mixed gas now made and distributed in San Francisco, the accompanying series of ten analyses of each are given. These analyses were taken at random during each of the dates from June 11th to June 22d, inclusive, so the average of these is a good criterion of the composition of the gas.

### ANALYSES AND AVERAGES OF TEN SAMPLES OF CRUDE-OIL-GAS

| June | $CO_2$ | $C_nH_{2n}$ | $O_2$ | CO | $H_2$ | $CH_4$ | $N_2$ | C. P. | B.T.U. | Sp. gr. |
|---|---|---|---|---|---|---|---|---|---|---|
| 11th | 2.5 | 7.1 | 0.2 | 9.2 | 40.5 | 33.8 | 6.7 | 18.4 | 675. | .479 |
| 12th | 2.5 | 7.0 | 0.2 | 9.3 | 37.8 | 35.8 | 7.4 | 22.2 | 686. | .495 |
| 14th | 2.4 | 8.0 | 0.2 | 9.4 | 40.0 | 33.3 | 6.7 | 21.2 | 687. | .485 |
| 15th | 2.8 | 6.2 | Tr. | 9.4 | 39.0 | 35.4 | 7.2 | 18.5 | 670. | .487 |
| 16th | 2.2 | 6.8 | 0.2 | 8.8 | 40.1 | 35.5 | 6.4 | 20.8 | 685. | .474 |
| 17th | 2.4 | 7.0 | 0.2 | 8.4 | 42.8 | 34.2 | 5.0 | 18.8 | 683. | .456 |
| 18th | 2.4 | 7.0 | 0.2 | 9.4 | 38.7 | 35.1 | 7.2 | 18.7 | 681. | .489 |
| 19th | 3.0 | 7.2 | Tr. | 9.8 | 39.1 | 34.7 | 6.2 | 19.7 | 684. | .490 |
| 21st | 3.0 | 6.8 | 0.4 | 9.4 | 40.2 | 33.5 | 6.7 | 18.4 | 665. | .481 |
| 22d | 3.0 | 7.0 | Tr. | 9.0 | 39.6 | 35.1 | 6.3 | 20.2 | 683. | .484 |
| Av. | 2.62 | 7.01 | 0.16 | 9.21 | 39.78 | 34.64 | 6.58 | 19.69 | 679.9 | .482 |

ANALYSES AND AVERAGES OF TEN SAMPLES OF CARBURETTED WATER-GAS

| June | $CO_2$ | $C_nH_{2n}$ | $O_2$ | CO | $H_2$ | $CH_4$ | $N_2$ | C. P. | B.T.U. | Sp. gr. |
|---|---|---|---|---|---|---|---|---|---|---|
| 11th | 5.6 | 17.0 | 0.2 | 14.0 | 26.0 | 31.6 | 5.6 | 32.5 | 816. | .636 |
| 12th | 5.6 | 16.8 | 0.2 | 13.4 | 23.8 | 34.7 | 5.5 | 32.2 | 836. | .643 |
| 14th | 5.4 | 17.0 | Tr. | 13.6 | 27.0 | 32.0 | 5.0 | 33.1 | 822. | .624 |
| 15th | 6.0 | 17.0 | Tr. | 13.0 | 25.6 | 33.6 | 4.8 | 30.5 | 833. | .633 |
| 16th | 5.6 | 16.2 | Tr. | 13.6 | 24.4 | 33.4 | 6.8 | 29.1 | 812. | .643 |
| 17th | 5.7 | 16.3 | Tr. | 13.2 | 25.2 | 33.5 | 6.1 | 29.5 | 817. | .635 |
| 18th | 6.0 | 16.0 | Tr. | 13.0 | 25.3 | 33.6 | 6.1 | 28.3 | 812.. | .636 |
| 19th | 5.8 | 16.0 | Tr. | 14.2 | 24.9 | 32.0 | 7.1 | 28.8 | 797. | .645 |
| 21st | 5.5 | 15.5 | 0.2 | 13.8 | 25.3 | 32.5 | 7.2 | 30.3 | 793. | .638 |
| 22d | 6.0 | 16.0 | Tr. | 14.0 | 23.5 | 34.1 | 6.4 | 30.4 | 814. | .650 |
| Av. | 5.72 | 16.38 | 0.06 | 12.58 | 25.10 | 33.10 | 6.06 | 30.47 | 816.2 | .638 |

ANALYSES AND AVERAGES OF TEN SAMPLES OF MIXED CRUDE-OIL GAS AND CARBURETTED WATER-GAS

| June | $CO_2$ | $C_nH_{2n}$ | $O_2$ | CO | $H_2$ | $CH_4$ | $N_2$ | C. P. | B.T.U. | Sp. gr. |
|---|---|---|---|---|---|---|---|---|---|---|
| 11th | 3.4 | 9.2 | 0.4 | 11.0 | 37.2 | 32.9 | 5.9 | 21.8 | 703. | .518 |
| 12th | 3.5 | 9.7 | 0.4 | 9.8 | 36.6 | 33.2 | 6.8 | 22.9 | 710. | .522 |
| 14th | 3.4 | 10.2 | 0.4 | 10.0 | 36.3 | 33.6 | 6.1 | 22.9 | 724. | .523 |
| 15th | 4.0 | 10.0 | 0.4 | 10.6 | 35.8 | 32.5 | 6.7 | 21.4 | 708. | .535 |
| 16th | 3.5 | 9.3 | 0.4 | 10.2 | 38.3 | 31.9 | 6.4 | 21.6 | 696. | .512 |
| 17th | 3.4 | 9.6 | 0.2 | 10.0 | 36.7 | 34.6 | 5.5 | 20.9 | 724. | .515 |
| 18th | 3.6 | 10.0 | 0.4 | 10.0 | 37.2 | 32.3 | 6.5 | 21.5 | 709. | .521 |
| 19th | 4.0 | 9.6 | 0.2 | 10.6 | 34.5 | 34.0 | 7.1 | 22.1 | 712. | .540 |
| 21st | 3.8 | 9.7 | 0.2 | 10.0 | 35.6 | 33.7 | 7.0 | 21.7 | 712. | .531 |
| 22d | 3.7 | 9.7 | 0.4 | 10.2 | 37.2 | 32.9 | 5.9 | 22.0 | 710. | .519 |
| Av. | 3.63 | 9.70 | 0.34 | 10.24 | 36.54 | 33.16 | 6.39 | 21.88 | 710.7 | .5236 |

PERCENTAGE

The amount of gas made and the percentage of oil-gas and of water-gas involved in the immediately preceding analyses are given in the following table:

| June | Oil-gas made M | Water-gas made M | Per cent. oil-gas | Per cent. water-gas |
|---|---|---|---|---|
| 11th ..... | 6,921 | 2,095 | 77 | 23 |
| 12th ..... | 7,094 | 2,089 | 77 | 23 |
| 14th ..... | 6,664 | 2,090 | 77 | 23 |
| 15th ..... | 6,522 | 2,090 | 76 | 24 |
| 16th ..... | 7,054 | 1,975 | 78 | 22 |
| 17th ..... | 5,976 | 2,102 | 74 | 26 |
| 18th ..... | 6,072 | 2,102 | 74 | 26 |
| 19th ..... | 6,718 | 2,077 | 77 | 23 |
| 21st ..... | 6,742 | 2,097 | 76 | 24 |
| 22d ..... | 5,869 | 2,060 | 74 | 26 |
| Average... | 6,563 | 2,077 | 76 | 24 |

EARLY DOUBTS

The early days of oil-gas were filled with doubts as to whether it could ever take the place of coal-gas or water-gas. Doubters prophesied that the gas would not be fixed and that it would be impossible to maintain uniformity in candlepower. These doubts and fears have all been allayed. Oil-gas as now made in California has the same stability as well-made coal-gas, with the further advantages that any desired candlepower may be maintained and that naphthalene stoppages can be practically controlled from the station.

Oil-gas has another advantage which is most important from a humanitarian standpoint. In the days of coal-gas, deaths from asphyxiation, either accidental or suicidal, were infrequent. But after the introduction of water-gas the number of deaths from gas asphyxiation materially increased. This increase was attributed to the greater amount of carbonic oxide contained in water-gas. To be sure, illuminating gas is not sold to be inhaled. When properly consumed the products of combustion of carbonic oxide are no more harmful than those from other gases. But as the percentage of carbonic oxide was greatly increased by mixing water-gas with coal-gas, and finally by the use of water-gas alone, the mortality from gas asphyxiations correspondingly increased. These facts refer particularly to San Francisco, which has a cosmopolitan population, and more nearly resembles a foreign city than any other place in the United States.

### LESS SUICIDES FROM GAS

An examination of the coroner's records shows that nearly all of the deaths from gas asphyxiation were suicides. This leads to the thought that when it became known that illuminating gas containing much carbonic oxide was a simple and convenient means of suicide gas became popular with suicides. The introduction of oil-gas immediately dropped the percentage of carbonic oxide to less than 7 per cent., and deaths from gas asphyxiation became rare. There followed many unsuccessful attempts at suicide. Persons deliberately turned on the gas in closed rooms, but, after remaining under its influence for several hours, were easily resuscitated. A great many instances of this kind seemed to discourage the use of gas as a means of suicide. The subsequent improvements in oil-gas that increased the percentage of carbonic oxide to 9 per cent. and the addition of lampblack water-gas that further increased it to between 10 and 11 per cent. have not increased the mortality from gas asphyxiation. This would seem to prove that very few deaths from gas asphyxiation are purely accidental.

### WHERE OIL-GAS CAN PAY

The question now naturally arises, In what localities can oil-gas be made a commercial success? This depends primarily on the cost of oil. As oil-gas can be made in large or moderate size machines, with nine gallons of oil or less, the cost of oil the thousand cubic feet may be easily calculated from the cost of oil the barrel delivered in any given place. Next is the item of labor. In California, and particularly in San Francisco, labor is strongly unionized, and the wages of the men employed in gas works are much higher than in other parts of the country. The hours of labor are invariably eight a day, so that it requires three shifts of men to operate any gas-making apparatus. Gas-makers received $110 a month, their helpers $90 a month, and no ordinary laborer is paid less than $2.50 a day for eight hours' work. With these high prices for labor prevailing, it is imperative that the largest units for gas making shall be employed. The large generators herein described have accomplished great saving in the cost of labor in gas making.

During December, 1908, at the Potrero station in San Francisco, the amount of gas made was 267,792,000 cubic feet, and the cost of labor the thousand was as follows:

| | |
|---|---|
| Generator labor, including gas-makers, helpers, and all men on the floor....... | $0.00811 |
| Labor handling lampblack by hand....... | .00585 |
| (This was before the installation of the crane for handling lampblack) | |
| Estimated cost handling lampblack by crane. | .00333 |
| All purification labor .................. | .00491 |

During June, 1909, the total make of gas was 170,776,000 cubic feet.

| | |
|---|---|
| Labor in the generator room............. | .00994 |
| Handling lampblack ..................... | .00522 |
| Purification wages ..................... | .00624 |

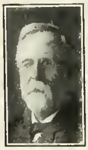
The miscellaneous labor about the works, including firemen, water tenders, engineers, helpers, other mechanics, and office help, is about the same as in any economically operated water-gas plant where no residuals are handled. The improvements in labor-saving apparatus in oil-gas making have thus kept pace with the increase in wages and the reduction of hours of labor, so that the present system of gas making is most economical, notwithstanding the obstacles presented by local conditions.

The future of oil-gas depends largely upon the price of oil and the practice of economy in the manufacture of gas. The price of oil may be regulated by a gas company owning its own source of supply of oil, and the practice of economy rests in the hands of every conscientious worker in the gas industry.

# Hydraulic Pressure Gauges

## A Few Notes on the Importance of Correct Readings

By W. R. ECKART, Consulting Engineer.



W R Eckart

**While considerable** attention has been given to the care, use, and handling of electrical instruments in power houses, and much advice has been offered in regard to them, hydraulic pressure or recording gauges installed in these buildings have been almost, if not entirely, neglected, although the importance of correct readings, records, and their interpretation may and often does have a vital bearing on the "up-keep," or life, of pipe lines and water wheels connected with them.

It may be well to suggest that, if possible, gauges should be located in a convenient place for observation at all times, with the centre of the gauges placed about five or five and one-half feet above the power-house floor, to avoid parallax in reading. This height should be of record, so that the floor may become the datum point for all other elevations.

The connection of pipes from the gauge to the conduit should be made outside of the main gate valve, if there be one, the hole being drilled and tapped at right angles to the axis in a straight portion of the main pipe, and the inside diameter at this point should be recorded.

All small pipes and fittings when exposed to frosty weather should be well protected, as freezing will readily occur in the pipe, and it often strains the gauge tube to such an extent that correct readings can not afterward be obtained. This may take place without being observed at the time or without otherwise injuring the piping or fittings.

Between the gauge and the first valve (a valve of the needle type being preferable at this point) there should be a union coupling for readily disconnecting the gauge for calibration. In this union coupling there should be inserted a thin diaphragm of sheet copper or brass, through which a small hole can be drilled. For high heads the hole should not be more than $\frac{1}{64}$ inch in diameter, a hole made with a No. 80 drill often being sufficient. For low heads two or three holes of the same size may be required. This diaphragm will be found very valuable in protecting gauges from being injured by employees opening the valve too rapidly when there is no pressure on the gauge. Further, it is a protection from heavy surges, or water rams, that often occur from different causes in a pipe-line system.

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## What They Say

From editor "Progressive Age.," New York:

We have just received the September issue of the Pacific Gas and Electric Magazine, in which, along with other interesting matter, is described your new offices in San Francisco and the office at Oakland. We would like, with your kind permission, to republish these descriptions.

We wish to compliment you on your magazine, and trust that you will place us upon your mailing list.

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From W. E. Eskew, superintendent Electra power division, October 15th:

We have endeavored to instill interest in the magazine in the employees here, and believe it will bear fruit. They all seem to appreciate the magazine, and as soon as they see more articles from the rank and file of the company we believe they will be more confident and will commence sending in articles.

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The October number of the "Architect and Engineer of California" used as one of its illustrations a photogravure of the new San Francisco headquarters building of the Pacific Gas and Electric Company.

# Important Features of Water-Wheel Bucket

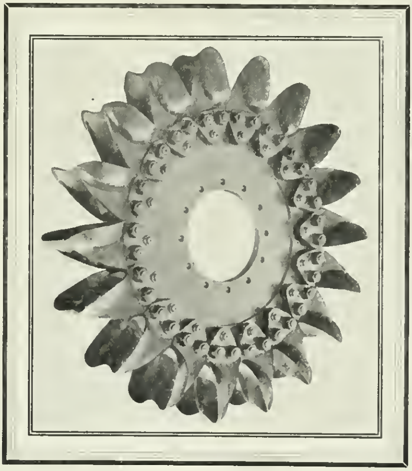
By A. N. WARBURTON, Draughting Department.

A. N. Warburton

**Various types** of water wheels have been installed at hydro-electric plants. These water wheels are used for driving generators, and they are of two general classes, the reaction type and the impulse type. The purpose of this article is to describe a few of the features of the impulse type of wheel, a photogravure illustration of which appears herewith.

This form of water wheel consists of a plain disc mounted upon a central shaft. To the outer edge of this disc are bolted curved buckets. They are so placed that the propelling jet of water will strike into them at a tangent to the circumference of the wheel.

This impulse type of wheel is suitable for very high heads, where the jet of water strikes at great speed produced by a high fall. It should be used only for a fall exceeding 150 feet. At just what head the reaction turbine would give place to the impulse wheel it is difficult to say. A high-head reaction turbine has been developed and extensively used, and it is said to give excellent satisfaction. And an impulse wheel has been operated under a head very much lower than 150 feet.

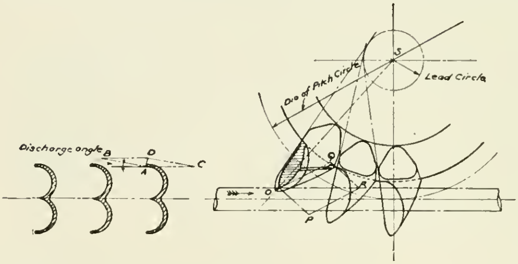


An Impulse-Type Water Wheel

The buckets of the impulse-type wheel are made with a central division lip, or "splitter." They are curved outward, forming a cup shape. The jet is thereby deflected in two ways and discharged parallel to its original path. With properly designed buckets, when the circumferential velocity of the wheel is about half that of the jet, the water upon leaving the buckets will be inert, indicating that every bit of the energy in the jet has been expended upon the wheel. The efficiency of such a wheel will be high.

The proper size of the buckets is determined from the diameter of the jets. The projected area of the buckets should be kept as small as possible to diminish surface friction and windage losses. But if an attempt be made to reduce these losses by reducing the surface of the buckets the stream will be crowded and will not properly discharge from the sides of the bucket. This condition is illustrated by an accompanying drawing.

In practice the discharge is generally made anywhere from 10 to 17 degrees, according to the size of the jet. The idea is to make the angle wide enough so that the water may clear the following bucket. The final velocity of the water as it leaves the edge of the buckets can be easily determined by the parallelogram of velocities, thus: Draw A B, the velocity of the water, and A C, that of the buckets; then A D is the final velocity of the water. Therefore the loss of kinetic energy is proportional to the square of A D. This shows the angle of discharge, and that angle should be kept small. But in the designing of a water wheel the exercise of the most careful judgment is necessary as to the shape of the buckets. The following data are particularly required: 1st—The bowl of buckets; 2d—The bottom of buckets; 3d—The angle of the cutting edge of buckets with reference to the edge of the "splitter;" 4th—The lead circle of splitter (see drawing); 5th—The location of bolts; 6th—The thickness of the bucket wall from tip to base.




All of these points should be carefully studied out, and the front of the bucket properly shaped, so that the bucket will not interfere with the stream. In other words, the entrance angle should be made to coincide with the resultant velocity line, as shown in the accompanying drawing.

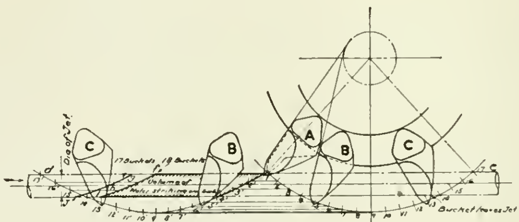
Draw a vector diagram; from O draw a straight line to the centre of the wheel; lay off O R to any scale, representing the spouting velocity; and O P at right angles to OS equal to the periphy velocity; and form a parallelogram: O Q is the resultant velocity. The entrance angle should be made about 3 degrees from this line O Q, since the wheel is rotating about an axis, and the relative velocity would vary at different points and naturally take a curved path. The bottom of the bucket should therefore be designed to clear this path. Otherwise the stream moving over the bottom surface and across the rough spots will imprison the air, and this imprisoned air, suddenly becoming released under high pressure, will produce chemical erosion of the surface of the bucket.

What the spacing of the buckets shall be is determined by drawing a diagram, after finding the size of the water-wheel to be used with the known effective head. The size of water-wheel is determined from the following equation:

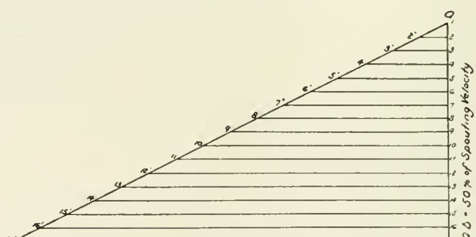
$$V = \sqrt{2gh}$$

$$\therefore \text{Diameter of Pitch Circle} = \sqrt{2gh} \times \frac{\text{Specific Speed}}{100}$$

Specific speed=percentage of periphery velocity to spouting velocity.




Showing Relative positions of Bucket




b c. = 100% Spouting Velocity
O b = 50% of Spouting Velocity or Periphery Velocity at tip of Bucket

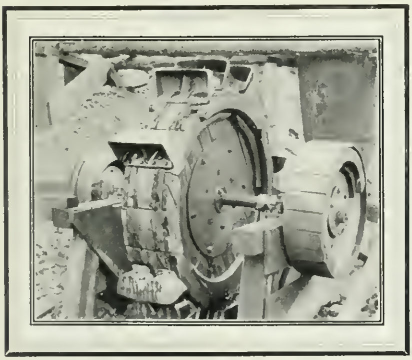
A diagram of an impulse wheel is shown above. In constructing the diagram, first draw a perpendicular line, a b, equal to arc 1–17, to represent the periphery velocity of the bucket tip; from the point b lay off the horizontal line b c, corresponding to 100 per cent. of the spouting velocity, which, in this case, will be twice the height of the perpendicular line, a b (theoretically 50 per cent. of the spouting velocity), and join a c; divide the line a b and the arc 1–17 into the same number of equal parts; take the point at 2 in the arc, a distance which is equal to 1–2 on the perpendicular line a b; lay off 2–2′ parallel to the jet line, d c; and the distance 3–3′, and 4–4′, etc., to 17–17′ in the same manner; thus outlining the velocity line.

Let A B be the actual spacing of the buckets on the disc. When bucket B travels from the point 1–5 the jet will travel twice the distance, which is equal to 5–5′. Lay off 5–5′ on the jet as 1–f, 2′–g, 3′–h, and 4′–I; thus developing the length of the jet cut off by each succeeding bucket.

This shows that eighteen buckets is the right number for this size of wheel. If seventeen buckets were used the amount of water indicated between cutoff line J and 14′ would be wasted.

## An Old-Time Water Wheel

The accompanying picture shows an old-time water-wheel at an abandoned gold



mine, four miles from Colfax, Placer County. It was photographed in June of 1907 by James H. Wise, hydraulic engineer.

## Water Wheel for a Grindstone

The ingenuity of some of the men working in the mountain sections is suggested in the accompanying illustration, furnished by I. B. Adams. This is a view taken on top of the great eight-mile flume that carries water along

the mountain side to furnish power by its final drop to the Colgate plant. A small impulse wheel has been made so that it is revolved by the rush of water down the flume, and the energy is used to turn a grindstone. There are several such grindstone wheels at the stations along this remarkable flume.

A young rancher living near Mesa City in Arizona was instantly killed, October 3d, by the current from a high-voltage line. He had climbed a pole to scan the surrounding country for some missing horses. Suddenly he fell in plain sight of his mother and sister, a lurid ball of fire that nearly burned off his head and all his clothes.

# The Alto Substation

By J. W. COONS, Construction Foreman.

J. W. Coons

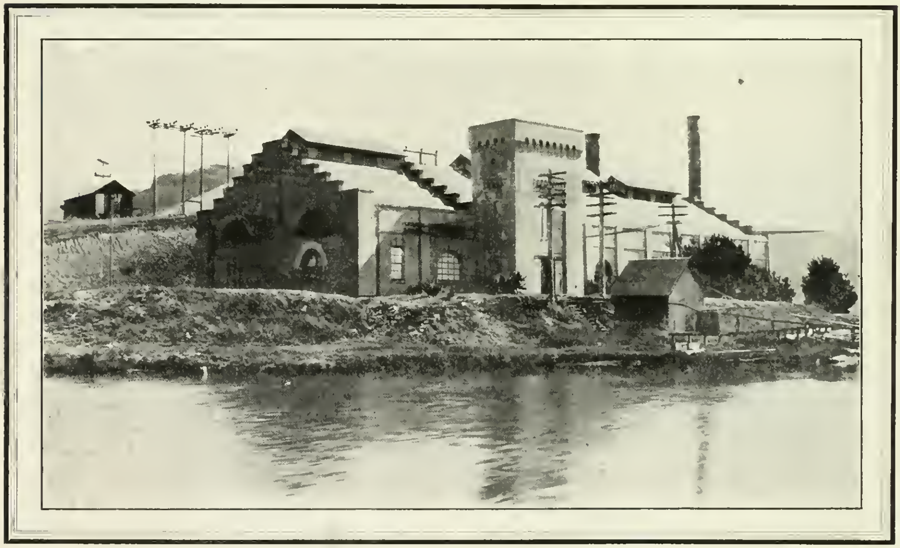
**The increased demand** for electric energy in Sausalito, Mill Valley, Belvedere, California City, and San Quentin made it necessary to erect a distributing station nearer the common centre of these communities. They had been supplied with current from the San Rafael substation, distant about five miles from the nearest of these towns.

Alto was chosen as the place for the new distributing station, for two reasons. One was that Alto was at the geographical centre of the load, and the other was that arrangements could be made with the Northwestern Pacific Railroad for the use there of a part of the railroad's power station and for the operation of the substation itself by the railroad's employees.

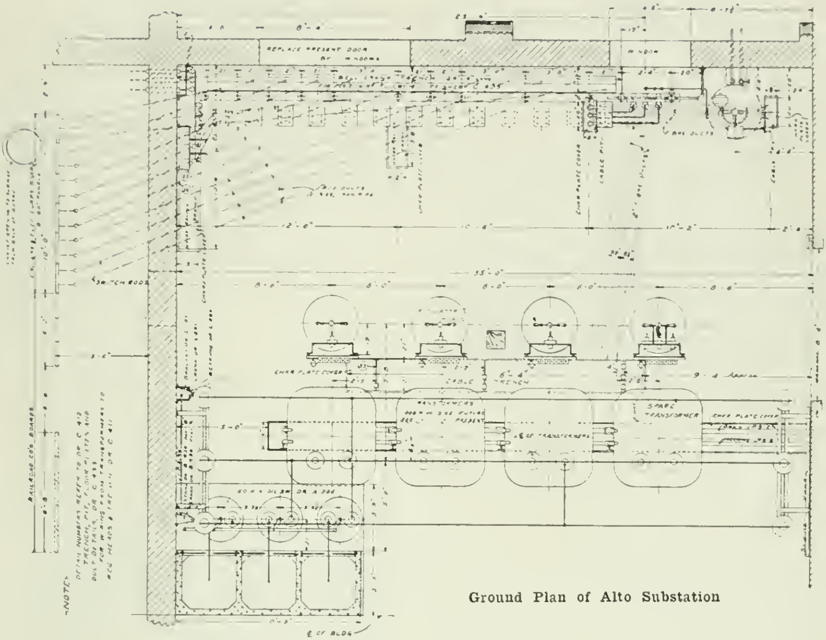
This Alto substation was planned to be operated conveniently by the operators at the Northwestern Pacific Railroad's power house.

All the switches, transformers, arc tubs, regulators, and other devices were located in what was formerly used as a battery room, and the switchboard was placed in the engine room, alongside the railroad company's board. The equipment consisted of four 500-kilowatt transformers, one of them being held in reserve and all of them equipped with regulator heads; and of one 100-light arc tub, one 25-kilowatt induction regulator, high- and low-tension oil switches, and a five-panel switchboard. The transformers operate at 55,000 to 4,000 volts.

All the low-tension oil switches, wiring current transformers, and a set of double buses were mounted on a large pipe frame, about



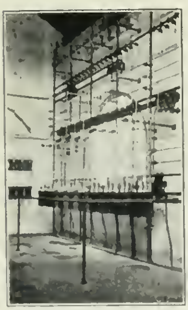
General View of Alto Substation, near Richardson's Bay, an Arm of San Francisco Bay.



Ground Plan of Alto Substation

thirty feet long by sixteen feet high. This frame was made of one-and-one-quarter-inch pipe and rail fittings.

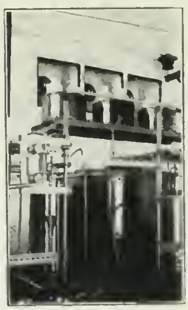
The two sets of buses were for feeding the various circuits, either from the transformers direct or from an induction regulator. Provision was made on this frame for ten, type K 3, General Electric line switches and one transformer switch, one paralleling switch, and one switch connecting with the railroad's steam-driven sets. There are also disconnecting switches to permit the separation of the oil switches from the line. The oil switches were mechanically operated by means of control rods



Pipe Frame and Wiring

—some of them thirty-five feet long—connecting the switch handles in the engine room to the oil switch by means of a series of levers and cranks. Special links were designed to open the switch at the switch frame, so that the friction in the long operating rods would not have to be overcome. These links are operated by solenoids placed on the switches controlled by automatic relays. Signal lamps were put on the switchboard to indicate when the switch had opened. All the wiring on this switch board is low-voltage.

The transformers were all equipped with a small pipe frame for supporting the leads that connect to the



60-kv. Transformers and Oil Switches

regulator heads. A concrete trench was built under the transformers for the water pipes, and a second trench was run in front of the transformers to carry the low-tension leads to the ducts in the floor connecting with the buses.

The problem of bringing the high-tension lines in from the pole switches and making a fireproof construction for these wires was perhaps the most difficult part of the work. On account of the local conditions the lines had to be brought into the building through a louvre in the top of the power house. A reinforced concrete tower, consisting of three ducts or tubes, each thirty-six inches square inside and about forty feet high, was built for bringing in the 60-kilovolt lines.

At a distance of about twelve feet from the floor the regular three-foot glass inlet windows were put in, and the lines were brought out to a 60,000-volt, triple-pole, iron-tank oil switch, mounted on an iron bracket on the side of the tower.

The cooling water for the transformers was taken from a large tank, which was a reservoir for boiler-feed water, and was circulated by means of a small motor-driven centrifugal pump. Because of the large quantity of water in this tank no cooling tower was needed.

The station is ordinarily operated from the transmission line, but arrangements exist whereby the load can be carried from the lines to the San Rafael substation or by the railroad's engine-driven alternators.

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A special blast machine to do the etching in the photo-engraving industry is one of the latest applications for electric motors.

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London now has more than 3,400 motor-driven vehicles regularly in use, and taxicabs have become so popular that it is freely predicted that the day is not far distant when horse-drawn hansoms will no longer be seen on the streets of the world's largest city.

## Shooting Off Insulators

The top wire of the 23,000-volt line between Alta and Grass Valley was cut in two September 30th by some one's firing a rifle bullet at it. Both ends fell to the ground, and, according to J. E. Calvert, foreman of the Grass Valley district, they were five hours in locating the trouble. The only thing noticeable in the substation was that one ammeter on all the outgoing circuits was reading ten amperes high. The accident occurred about eight and a half miles from Alta.

Another accident from a similar cause occurred October 1st on the 5,000-volt line between Rome power house and Nevada City, according to George Scarfe. It was found that one of the No. 3 wires had been shot in two, and that the ends in falling both struck a telephone wire suspended at a lower point along the same pole line. One end looped down so far that it grounded. Protecting fuses on private telephone lines were blown out.

Manager Osborn of the Woodland district was bothered several times during October by some one's maliciously shooting the big porcelain insulators off the 60,000-volt power lines. It was necessary to shut off the power an hour at a time in order to make repairs.

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Pray if you must, but do n't prey.

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Both New York and Boston had electric expositions in October. The object was educational and the purpose commercial.

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To avoid the former dangers of explosions from the igniting of dangerous gases in mines a device has been introduced whereby the ordinary incandescent electric lamp is placed in a glass globe containing pure air. Then when the electric globe explodes the carbon filament does not directly reach and ignite the gas of the mine.

# An Effective Street Sprinkler

By C. W. McKILLIP, Manager Sacramento District.

C. W. McKillip

**The illustrations** on this page are from photographs of a street-sprinkling car designed and built at the shops of the Sacramento Electric Gas and Railway Company, a subsidiary branch of the Pacific Gas and Electric Company, operating twenty-nine miles of street-car system in the city of Sacramento.

Each car is equipped with a gravity sprinkler for the track space and with a big lateral spray sprinkler for each side of the street.

On the car are two 80-horsepower motors of General Electric pattern and one centrifugal pump operated by a 10-horsepower Sprague motor.

The capacity of the water tank is 3,250 gallons. The tanks are filled at city hydrants, and require from eight to fifteen minutes for the filling.

These sprinkling cars are used daily about seven months in the year. The city trustees ask for bids for street sprinkling about April 1st, and the yearly contract is then awarded to the lowest bidder.

The sprinkling done by these trolley cars is in the residence district. In the business section the street sprinkling is done by wagons.

Any one who has seen these electric sprinkling cars in operation in Sacramento can testify as to how thoroughly they wet down the streets.

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According to data compiled by C. W. McKillip, manager of the Sacramento district, the capital city is busy with the construction of or has just completed important new buildings representing in the aggregate an expenditure of $2,887,000, as follows: By Dr. Cox $15,000, by Hale Brothers $25,000, by Elkus & Co. $45,000, by the Sacramento Hotel $500,000, on the Turclu building $65,000, by the People's Bank $250,000, by August Coolot $20,000, by the Federated Trades $50,000, by the Sunday News $40,000, by John Haub $35,000, by the county of Sacramento for a jail $225,000, for a courthouse $400,000, for good roads $600,000, for bridges $225,000, by the city of Sacramento for a building for municipal officials $200,000, by the American Cash Store $125,000, and on the Oschner building $67,000. This list has no reference to the numerous private residences that are being erected.

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To err is human, but to repeat the error is inexcusable.

# Sketching for Mechanical Drawings

By F. W. BROWN, Draughting Department.

F. W. Brown

**A draughtsman** is sometimes called upon to work up rough, freehand sketches of an existing or imaginary arrangement, so that, later on, complete drawings may be made from them by himself or some one else. For instance, a machine may be in use of which the firm owning it has no detail drawings. For the purpose of duplicating this machine, of getting complete detail drawings as a matter of record, or, as is more generally the case, that a certain alteration may be made upon it, or a new detail introduced, sketches will have to be made of the whole or necessary parts of the machine from which working drawings may be developed.

A good sketch should embody the principal features of a working drawing, except that it is not drawn to scale, but the relative proportions should, as far as possible and practical, be maintained. It must contain the same dimensions and notes that will appear on a finished drawing. In fact, in many cases, sketches are used in the shop to work from in place of detail drawings, the principal difference being that a working drawing is to scale and very much more elaborate, while on a sketch many "short cuts" and time saving methods of the draughtsman are employed that would not do on a working drawing.

Sketching should be undertaken systematically. Possibly the best way is to draw the object first before taking a single measurement, and then take all necessary dimensions. Much time is lost trying to make sketches and take measurements simultaneously. Drawing the object first also fixes it firmly in one's mind and assists in determining the essential and unessential dimensions. Although it is well to have a system whereby you can do the most accurate work in a short time, in taking dimensions one should not be hasty, as mistakes may result. The importance of accuracy in sketching can not be overestimated, as serious results may be caused by carelessness or an oversight on the draughtsman's part while engaged in measuring some machine, building, or any of the innumerable things that he may be called upon to sketch.

It is well on a sketch not to use any of the many standard types of cross-sectioning used in draughting offices to designate different material, but to write the name of the material on the sketch instead. Except in cases where it is evident that surfaces must be finished, finish marks should always be put on a sketch. The principal idea to be followed in sketching may be briefly expressed as seeking to include everything that is necessary and omitting all that is unnecessary.

Another good point is to see that every measurement is written on the sketch as soon as it is taken. Never take several measurements and attempt to keep them in your head with the intention of writing them all down at once. Mistakes are very likely to result from such practices and will later cause trouble for whoever may have to work up the sketch.

In taking measurements the draughtsman often has to use considerable ingenuity to ascertain how to go about it, and sometimes original methods can be used which could not be described as they may be different for every different job. At times, also, the draughtsman has to be somewhat of a gymnast. At other times it is difficult to keep the sketches clean enough to be read afterward. For instance, to cite a personal experience, the writer found this difficulty while sketching the interior of one of the steam drums of a water tube boiler, where the grease in places was as thick as the boiler plate itself.

Sketches should preferably be made in sketch books, so that all the sketches may be together and handy for reference any time that the draughtsman or others may wish to refer to them. The largest size book that can be carried in one's pocket is probably the most convenient. Cross-section paper is well adapted for sketching as the squares are of great assistance in speedily getting the correct proportions.

Instruments used in sketching depend on the nature of the object to be sketched and the amount of exactness required. For instance, suppose it be proposed to couple a motor and a generator together, the generator shaft coupling being on hand, but the part of the coupling that must go on the motor shaft being absent or not connectable with the generator coupling, due to the machines being of different makes or for other causes. It is then necessary to make a sketch of the part of the coupling on the generator shaft in order to get one out for the motor shaft. As the bolts must be fitted the greatest accuracy is required in measuring their diameter and the bolt circle. This is only a simple case but serves as an example of where extreme care should be taken. On the other hand, suppose an entire machine or device is to be rebuilt from a present one, and drawings are to be made from it which will be standard in the future. In this case it is not essential that all of the dimensions of the new machine should be exactly the same as the first as long as the various pieces fit as they should. Curved outlines, such as occur in engine frames, sometimes cause considerable difficulty in measuring, but luckily they belong to that class which does not require all reproductions to exact measurements.

Ordinarily a rule and inside and outside calipers are sufficient to use, but in some cases a square, a straight edge, a plumb bob, or a surface gauge are also required. A surface gauge consists simply of a vertical rod which is secured to a cast iron base, with an adjustable scriber mounted on a vertical rod. This gauge is generally used for obtaining vertical distances where they can not be taken directly with a rule. Steel tapes are convenient for measuring distances of any length and sometimes for measuring circumferences where it is not possible to measure the diameter.

There are times when sketches should not be made in a sketch book, for instance when it is necessary to get a curved outline exact, which sometimes though rarely happens. A cam is a good example of this type. In such cases it is necessary to take a piece of paper large enough, lay the object on it, and trace its outline. Sometimes this method can not or should not be resorted to, and a template should be made.

A good check upon a sketch where the object is measured in successive steps, as, for instance, the centre to centre distance of bearings on a line shaft, is to measure the over-all length and note whether the dimensions previously taken produce this total.

But no matter how systematic a man may be, how careful, or how clever at freehand sketching, unless he have had a certain amount of experience, he is apt to waste much valuable time, thinking over what to do, or doing the wrong thing. With experience, however, he will be able to size up the job and know just how to undertake it, and will also have confidence, which counts in everything.

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The printing concern that publishes this magazine makes a practice of letting all its employees off at a quarter before 12 noon and a quarter before 5. Why? Just a little kindly thoughtfulness on the part of the employer, to give them a good chance to get seats at restaurants for luncheon and seats in the street cars to their homes at the end of the day's work.

# Pacific Gas and Electric Magazine

PUBLISHED IN THE INTEREST OF ALL THE EMPLOYEES OF THE PACIFIC GAS AND ELECTRIC COMPANY

JOHN A. BRITTON - - - - - - EDITOR
A. F. HOCKENBEAMER - - - BUSINESS MANAGER

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## EDITORIAL

**Why Are Typographical Errors?**

Did you ever wonder at typographical errors? If a two-page article in this magazine were translated and put into type in Chinese characters the oriental compositor would require six hours for the job, and during that time he would have to walk a distance of two miles going back and forth in the narrow alleyways among his 550 square feet of type-cases, selecting here and there the right characters.

The Chinese were the world's first printers to use movable type. No less than 11,000 different characters are required to express the Chinese language, but fortunately these characters are arranged in 214 groups of related words or phrases. English ordinarily requires less than fifty characters, including the twenty-six letters of the alphabet, ten figures, and the punctuation marks. The same two-page article in English, if set by the old hand process of picking one type at a time from its separate compartment and placing it properly in a small "stick" held in the compositor's left hand, would take a skillful typesetter five hours. With the now almost generally used linotype machine, which is run by electric power, operated like a typewriter, and casts a line of type like a bullet mold, one operator could set the two pages in about an hour and a quarter.

But whether it be by the Chinese process or the latest labor-saving linotype machine, there is always the possibility of error, of the selection of the wrong character, or getting it upside down, or omitting a letter or a punctuation mark or a space, or putting a line in the wrong place when arranging all the lines in sequence. A slightly abraised or worn type, making a G look like a C; getting an upside-down u for an n; making "of farm" read "off arm," by putting the space in the wrong place,—all such and a hundred other little things must be detected by the proofreader and be guarded against by the editor. By the old hand-set process it was only necessary to remove the wrong type and slip in the right one; but with the linotype process any defect in a line requires the resetting and recasting of the whole line. In setting up and casting a new line to correct some trivial error new errors may be made. Or perhaps some one takes the newly cast corrected line and puts it in the wrong place in the column. Repeated typographical corrections and revisions are not always proof against ultimate error somewhere. After all has been endorsed as correct a pressman may, in moving the forms, drop out a few lines and replace them where they seem to him to make connected reading.

On page 193 of the October number of the magazine the last two lines in the first column finally got in in reverse sequence. On page 184, near the end of the first column of the article on the history of the Folsom power plant the line reading "But in August of 1892 a controversy arose" should have read 1882, and on page 185, near the bottom of the first column of that same article, the line reading "July, 1882, convicts were put to work on the" should have read 1888. These corrections should be noted for historical accuracy. And so should the fact be noted that Zacheaus Floyd has served the San Francisco company continuously for 47 years, instead of 41 years.

The October number contained about 35,000 words, and that opened up a possibility of an aggregate of more than 200,000 chances of error in individual characters, spaces, and punctuations in the first long galley proofs, new chances in the revised proofs, and additional chances of error in the page proofs after the resetting of many lines necessary in narrow-measure columns down the sides of illustrations. But with all the monotonous rereading of word after word, is it to be wondered that a few errors get past all the watchers when there are more than a quarter of a million chances challenging human vigilance?

**Readings of Pressure Gauges**

The life success of W. R. Eckart, consulting engineer for this company, has grown largely out of the fact of his systematic thoroughness and mastery of details connected with the engineering profession. Often small but important additions to equipments are the effective means of overcoming real difficulties. But sometimes, because of their seemingly trivial nature, these things are forgotten or later overlooked, and when the remedy is needed it is not available for those who come after. W. R. Eckart's notes in this issue on the correct readings of hydraulic pressure gauges are a good illustration of the importance of such little things. Other suggestions will be gladly welcomed from the same prolific source.

## Roosevelt's African Venture

Roosevelt is being paid a dollar a word for the narrative of his African hunting experiences published in Scribner's Magazine. His November article contains a little more than 13,000 words. That means $13,000. His African articles will run through a year's issues, and will probably aggregate about 150,000 words. The expenses of the trip will possibly not exceed $30,000. Peary is to be paid $1.20 a word for his description of the trip to the north pole. These rates are unparalleled for long articles; and in addition the writers will each get royalties from the matter when it is later published in book form. Roosevelt got only $50,000 a year as president, and had to bear heavy personal expenses. In Africa he has about 300 black fellows along as carriers, but they are cheap. In one part of Africa, where wives are bought by the natives, a good half-dozen prospective wives can be purchased for about eighty cents' worth of print cloth! In other parts of Africa, possibly where "women's rights" are more recognized, wives come higher, way up to two and three dollars apiece! Roosevelt advises that the central highlands of Africa, under the equator, are a promising place for white men to settle, develop the natural resources, and get rich.

William H. Kline, tax agent, was at one time deputy assessor of San Francisco under Dr. Washington Dodge.

Little cards are out from Mr. and Mrs. William K. Cullen announcing the birth, October 9th, of their daughter Betty Melicent Cullen. The father is connected with the electric distribution department.

Announcement has been made to close friends that about the middle of November John D. Kuster, manager of the San Jose district, and Miss O'Brien of San Francisco (formerly of Marysville) would be married.

Cornelius ("Con") Deasy, foreman of the half hundred men employed upon the work of maintaining the company's underground electric system in San Francisco, was, at the city election of November 2d, elected one of San Francisco's eighteen supervisors. He was a nominee of the Union Labor party, and polled a big vote. He has been identified with the underground electric service for the past seventeen years.

# Lord Kelvin, the Great Engineer

THE picture on this page is of the late William Thomson (Lord Kelvin), the greatest electrical engineer of the age.

The photograph was made in 1902, while he was on a visit to America. Two interesting facts attach to this particular picture. It was taken while Lord Kelvin was holding in his hand and reading at the moment an illustrated article on the Colgate power plant and transmission system, published in the March (1902) number of "The Review of Reviews." He wrote his name on several of the large photographs of himself, and he presented one to F. V. T. Lee, now assistant general manager of the Pacific Gas and Electric Company. This small reproduction was made from the big framed original that hangs in the San Francisco office of the assistant general manager.

William Thomson is the man who invented the reflecting galvanometer, the ampere balance, electrometers, the syphon recorder, the marine compass, and the deep-sea sounding apparatus. His was the expert skill behind the laying of the early Atlantic cables. He was electrician for the Atlantic cables in 1857-58, when he was 33 and 34, and again in 1865-66; he was electrical engineer for the French Atlantic cable in 1869, for the Brazilian and Rio Plata cable in 1873, for the West Indian cables in 1875, and for the Mackay-Bennett cables in 1879.

Copyright by Falk, N. Y.

Kelvin May 9, 1902

He was born at Belfast, Ireland, June 26th, 1824, and his father was professor of mathematics in Glasgow University, Scotland. The son received his collegiate education at Glasgow University and at Cambridge University, graduating from St. Peter's College, Cambridge, with the rank of second wrangler. From the age of 22 till he was 75 he was a teacher in Glasgow University, most of the time with the title of professor of natural philosophy.

His greatest work was done in his maturer years. He was specially honored by the governments of France, Belgium, Prussia, Germany, and Japan for his splendid achievements in science and his wonderfully practical inventions, and when he was 68 he was knighted by Great Britian and given the title of Baron Kelvin.

His genius has been summarized as a rare combination of pure science and great common-sense. On the purely scientific side he was surpassed by Helmholtz and a few others, and in the field of actual mechanical achievement he was surpassed by Edison and others, but no man ever lived who accomplished so much in both fields in mechanics, heat, electricity, and magnetism. While a great scholar he was as frank and simple as a school boy; and so practical and outspoken was he that he argued that more good would accrue to humanity through the conversion of Niagara's 4,000,000 horsepower into useful energy than in preserving the mighty waterfall as a "mere scenic phenomenon to delight the eye and impress the mind." A. R.

## A Boy's Letter

From Fair View, a little town near Durban in the province of Natal, South Africa, came addressed to the "General Electric Light Co., San Jose, Cal.," the following boy's letter:

Fair View M. S.
Jan. 2, 09.

Dear Sirs:—Inclosed please find one shilling for an inner electric light globe that I broke after halloween 1907. Some other boys broke the outer one Halloween and another boy and I were throwing at the inner and we broke it. Please forgive me. I would send American money if I had it.

Sincerely,
John Kessel.

The original was sent to the magazine by John D. Kuster, manager of the San Jose district.

There are 60,000,000 cells in the human brain. Each one is a compartment for some bit of knowledge. How many have you that are still empty?

## Butler Made a Hit

One of the incidental features of the baseball game played in San Francisco September 4th by the officials of the Pacific Gas and Electric Company against the officials of the San Francisco Gas and Electric Company, was when Joe Butler, the auditor of the San Francisco company and the oldest and most

enthusiastic player on the field, first came to bat. The women at the headquarters building had purchased a huge bouquet. At the proper moment this was rushed out to the umpire, and he hurried forward and presented it to the veteran player. The accompanying illustration, from a snap shot made by E. Cady, shows what happened as the grandstand was applauding. At the left is P. M. Downing, engineer of hydro-electric operation and maintenance of the Pacific company, in his catcher's uniform, and at the right is F. V. T. Lee, assistant general manager of the Pacific company, who was officiating as one of the umpires. The tank has no personal significance; it just happened to be there.

A small boy arrived at the San Francisco home of A. P. Merrick of the gas and electric records department the 3d of October and weighed in for the human race at eight pounds.

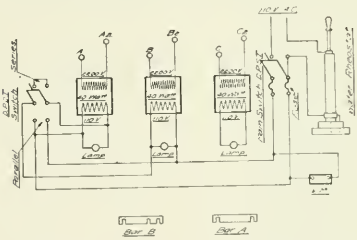
# Armature Insulation and Polarity Testing

By WELDY S. YEAGER, Foreman Colgate Power House.

Weldy S Yeager

**In the maintenance** of power-house generators it is necessary occasionally to rewind a part or all of the armature of the various generators. But before cutting a generator in on the bus bars, after rewinding, it is necessary, first, to subject the winding to high voltage to see if there are any defects in the insulation, and, second, to make polarity tests to determine if the connections are proper.

The accompanying drawing shows a convenient and flexible arrangement of transformers to make these tests. When mounted on a portable stand this device serves a very useful purpose about the power house.




Before using it for high-voltage tests remove from their sockets all the lamps indicated on the sketch. The apparatus that is to be given high voltage should be connected to terminals A and B2. In order to apply a maximum of 1,100 volts, connect A with B, and A2 with B2, and throw the DPDT switch to the "Up," or series, position. Then gradually cut the resistance out of the circuit by lowering the plunger in the water rheostat. This will raise the potential from zero to a maximum of 1,100 volts. Should it be desired to apply potentials from zero to 2,200 volts throw the DPDT switch to the lower, or parrallel, position, and work the water rheostat as before. To apply 4,400 volts as a maximum, connect A2 with B and leave the apparatus to be tested connected with A and B2. Gradually raise the voltage with the water rheostat until the full 110 volts have been applied to the secondaries of the transformers.

To show the potential across terminal A and B2, multiply the ratio of transformation by the voltmeter reading.

When using the arrangement for making polarity tests, open the main switch and the DPDT switch and insert lamps in each of the three transformers where shown in the sketch. With the generator running at normal speed and under normal excitation but not connected to bus bars connect through the switch terminals, A, B, C, to the three main leads from the generator. Then connect A2, B2, and C2 to the corresponding three leads on the bus-bar side of the generator switch. The lamps will then light up and go out intermittently, the rapidity of the "winking" depending on the frequency of the generator as compared to the bus bar. If the polarity is correct all the lamps will light up and go out together. If the polarity is not right the illumination of the lamps will appear in rotation.

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The trolley car system of Manila carried nearly 11,000,000 passengers last year. The concern took in $530,000 and cleared $245,000.

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They did n't keep chickens, but little Willie heard his papa at the telephone saying, "As soon as the old hen has gone into the country I 'll take you out in the machine."

# Keeping the Flumes in Repair

By W. E. MESERVEY, Foreman Nevada Water District.

W. E. Meservey

**Where torrents** of water flow constantly through great wooden flumes along the sides of cañons, across ravines, and on to power plants or to irrigating ditches, repair work is an important matter, costing a great deal of money and requiring much hurried labor by many men during a necessarily brief period of each year.

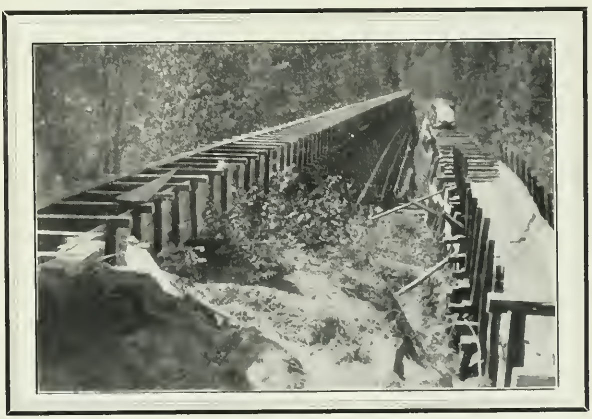
The main flumes in the Nevada County water district are commonly four and a half feet deep by six feet wide, and they are made in sections sixteen feet long. In familiar parlance each sixteen-foot section of flume is called a box, although the casual observer does not notice the division into these box lengths.

The South Yuba water system, owned by the Pacific Gas and Electric Company, consists of 450 miles of aqueducts, and the so-called main canal, here mentioned, is one of the two main arteries of that system. This particular part of the main ditch, with some of its bigger branches, is about thirty-five miles long. It takes water from the South Yuba river at an elevation of 4,500 feet and conveys it along the mountain sides to a sudden big drop through steel pipes down to the Deer Creek power house, which is at an elevation of 3,500 feet above the sea. There the torrents of water furnish the motive power for generating 5,500 kilowatts. The water then flows on undiminished and uncontaminated through more than thirteen miles of ditch to Nevada City, a place of 8,000 people, and also to Grass Valley, a city of 10,000 population, to be used in the mines and in the homes, and there and further down for irrigating orchards and farms.

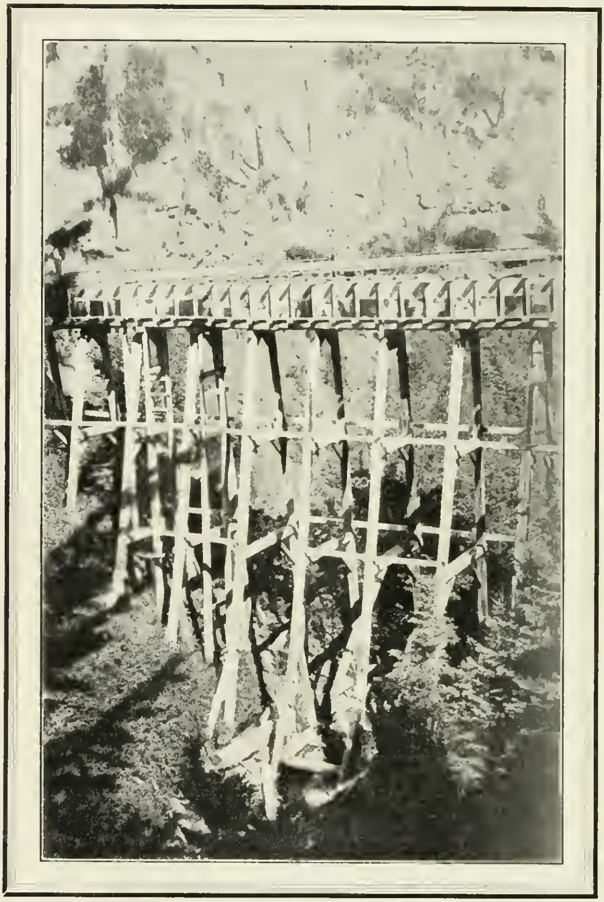
This article concerns the repair work on the upper part of this main ditch during the past four years.

In the summer of 1905 the condition of the old flume between Bear Valley and the big tunnel was such that the loss of water by leakage was estimated as a constant flow of 700 miner's inches, which is equivalent to the passage of 1,050 cubic feet of water each minute.

Frank G. Baum and James H. Wise, hydraulic engineers, accompanied the writer over the system late in the summer of 1905, and they agreed that the old flumes would have to be replaced with new ones as soon as possible. Some of the old flume had been continuously in use for more than thirty years,



A New Section of Flume Replacing the Old One, Shown on the Right



A Section of High Flume near Steep Hollow. Note Man on Top

to supply consumers. At that time of year there is from three to six feet of snow along the line of the ditch, and conditions are very disagreeable for the work. But the period of sufficient auxiliary flow outside the ditch lasts only about three weeks, so the work has to be rushed, despite the snow and the cold.

Above Bear Valley the flume runs along under a high rocky bluff, to which the flume itself is bolted with iron rods. Even with such substantial anchorages there have been some disastrous snowslides at that point, with sections of flume torn away. Many new iron rods have been put in as an additional precaution against the force of snowslides.

Just above the big tunnel there is a place marked by repeated annual landslides. It has caused a great deal of trouble. There a new flume has been built below the old one, with a span of sixteen feet above the bed of the creek to give the sliding earth and debris room to pass under without damaging the flume.

During the past four years of work in replacing and repairing the outworn old flume, 1,007 new boxes have been put in. That means a total length of a little more than three miles of new flume constructed during the few weeks of each spring when the snow is deep

and its age had made numerous repairs a regular necessity.

Most of the fluming was close to the ground and easily accessible, but at the north fork of Steep Hollow there was a section 280 feet in length that was more than fifty feet above the ground.

All the repair work on this flume and ditch system has to be done in the spring, usually the latter part of March, when there is other water below the big tunnel that can be used on the ground. The Chalk Bluff ditch was put in the best of condition two years ago so that it might supply water to the Deer Creek power house.

The flumes of the Cascade ditch were in such poor condition in 1904 that it became necessary to lease the Sargent ditch and run part of the water through that as far as Quaker Hill, whence it was conveyed again in the South Yuba ditch.

During 1905-06 more than 400 flume boxes were put in, so it has not been necessary during the past two years to use the Sargent ditch.

At Quaker Hill, which is below the Deer Creek power house, a new flume was built in November of 1908 alongside the old one, and when rainy weather began and interrupted operations the new part was temporarily joined to the old. The new section was 960 feet long and thirty feet above the ground at its highest point. Its construction required more than 50,000 feet of lumber. The building was done in a most substantial manner.

The Snow Mountain ditch was put in good condition in 1905; it was thoroughly cleaned, and at the lower end, usually called the Manzanita, more than sixty new boxes were put in. As this ditch carries the water used for domestic purposes in Nevada City, it is kept in the best of condition.

The water for the Grass Valley ditch is taken from the lower end of the Cascade, about two miles above the reservoirs that supply the Grass Valley district, and is run down Town Talk ridge to the city of Grass Valley. Most of this water is used for domestic purposes, so the ditch is cleaned every spring. In addition to the ditches already mentioned there are many miles of smaller ditches.

Summarizing the improvements and repairs during the past four years, 1,007 new boxes have been built and 850 feet of new ditch has been made on the main ditch line, 588

All Repairs Must Be Made When Snow Is Deep Along the Flume new boxes built on the Cascade ditch, and 84 new boxes on the Snow Mountain ditch. In new flumes that means a total length of a little more than five miles of flume and trestle work.

At Lake Spaulding the woodwork along the top of the spillway was thoroughly repaired, and at Lake Stirling an entire new dam was built, with the exception of the face planking, which was still good. The new dam at Lake Stirling is eighteen inches higher than the old dam and will hold about 75,600,000 cubic feet of water, or 8,640,000 cubic feet more than the old one. The present capacity of this lake is sufficient to produce a constant flow of 30,000 miner's inches every twenty-four hours.

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A New York lawyer was recently suspended from practice for one year as punishment for his having been found guilty of employing agents to pursue ambulances and sesure for him as clients persons injured in accidents. The court declared that in future such an offence would be punished with permanent disbarment.

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In the counties about San Francisco bay there are now about fifteen regular commercial wireless telegraph stations, and, in addition, there are about fifty stations maintained by amateurs for their own amusement. Many of these amateur stations are operated by high school boys, some of whom are already more skillful than some of the professional operators in the district. The air is so full of messages during the early hours of the evening that the professionals trying to take long-distance messages from vessels far at sea repeatedly signal "interference", "99", "kids", "repeat". But after about 10 o'clock and on till 2 or 3 or 4 in the morning the air is free of the amateurs, and then the professionals get in their best work.

## Over the San Francisco Counter

By Ecklin Williams.

"Look 'ere, I wants to find hout wot ails yer bloomin gawse, any 'ow."

"Why, is there anything the matter, my friend?"

"Hanything the matter! Well, I should sye! Me woife 'as a two-'ole stove, and hevery toime she loights one of 'em, she cawnt loight the hother, because the first bloody 'ole goes hout, ye know."

"Ah! probably something in the pipe. I 'll send you a man who will fix it for you at once."

"Look 'ere now, do n't be a stringin' of me, cause it 's my belief ye cawnt do it, an ye know ye cawnt. I've quite a moind to order it taken hout."

"Now, my dear sir, take my advice, and do n't be in a hurry. The self-same thing happened in our house about two months ago. I asked one of our men to attend to it. And it has worked like a charm ever since. You see, we have men who are specialists, in fact, veritable artists in their own individual line; and a little thing like that is a mere bagatelle to them. If you like, I 'll send you the same man who attended to mine."

"Young feller, yer all right; shake; and, I sye, me lad, if the blymin gawse yer gives awfter this, through yer blawsted poipes, is one arf as good as the kind ye pawse hover yer blumin counter, the next time I see ye I 'll treat yer to a bob's worth and tike me bloody 'at hoff t 'ye."

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Some men never do anything on time but quit when the whistle blows.

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Work was begun early in October on the new reinforced concrete substation building for the Pacific Gas and Electric Company at Petaluma. The site of the building occupies a whole block, bounded by First, D, and C streets and the river.

# American Gas Institute's Meeting

By HENRY BOSTWICK, Secretary to President.


Henry Bostwick

**The American** Gas Institute, the parent gas association of America and perhaps the foremost concern of its kind in the world, held its fourth annual meeting the 20th, the 21st, and the 22d of October, at Detroit, Michigan. More than 300 delegates were in attendance from a body of 1,333 members, representing the leading gas men of the country.

Of the nine officers elected for the ensuing year, one, a trustee, was John A. Britton, president of the San Francisco Gas and Electric Company and general manager of the Pacific Gas and Electric Company; and of the seventeen papers presented one was by Edward C. Jones, gas engineer of the Pacific Gas and Electric Company. Of this particular paper the American Gas Light Journal (New York, October 25th) expressed the following sentiment: "Mr. E. C. Jones of San Francisco now and these many years, but certainly of the east in his earlier days, then gave a well delivered summary of a most interesting paper on the 'Development of Oil-Gas in California.' It was written in excellent vein; his summarizing was perfect; and its lines well told how the gas men of the coast turned oil from enmity into comity so far as the gas business of itself was concerned. A resonant cheer caused the active coast man to know that his paper and his personality were much welcomed."

Seeing Detroit's gas works and factories, participation in a smoker, theatre parties, auto rides to the city's parks and the suburban farming country, and a steamer tour of the lake made up the social features for the gathering of delegates and the three score women of the party.

The business sessions were held in the beautiful, big Elks' hall.

The new officers are: W. H. Bradley of New York city, president; R. B. Brown of Milwaukee, first vice-president; John C. D. Clark of Chicago, second vice-president; A. B. Beadle of New York city, secretary-treasurer; and D. McDonald, I. C. Copley, J. B. Klumpp, John A. Britton, and R. C. Congdon, members of the board of trustees.

Something of the scope of the subjects presented is indicated merely in the following list of papers read:

Technical and Mechanical Progress of the Gas Industry, by Irvin Butterworth; Sliding Scale Regulation of Prices and Dividends, by Alfred E. Forstall; Lecture on Illuminating Engineering, by Dr. Edward P. Hyde; Illuminating Engineering in Its Practical Applications, by Norman Macbeth; Use of Tar on Roads, by Arthur D. Little; A Pound of Coal, by Charles D. Lawson; Vertical Retorts, by Walter G. Africa; The Development of Oil-Gas in California, by Edward C. Jones; Gas in the Modern Kitchen, by George W. Thomson; Commercialism, by Charles M. Cohn; The Solicitor, by Karl A. Schick; Sulphur Compounds in Illuminating Gas, by Charles J. Ramsburg; Identification of Gas Oils, by F. E. Park and L. E. Worthing; Power Plants for Gas Works of Medium Size, by Charles D. Robinson; Automatic Oiling Meters, by T. D. Miller; Booster System at Rochester, by Frank Helten; Acceptance and Interpretation of Data, by Robert O. Luqueer.

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Cinder in your eye? Roll soft paper up like lamplighter, and wet tip and touch it to cinder.

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M. L. Barnhart of 2647 Mission street in San Francisco, a watchman for the company at Hearst and Grant streets in Berkeley, was struck by a Berkeley local train, while crossing Shattuck avenue early in the evening of the 26th of October, and so seriously injured that he died two hours afterward. He was a Civil War veteran and a member of the G. A. R.

# BIOGRAPHICAL SKETCH

## W. R. ECKART

### The Company's Consulting Engineer, a Veteran Foremost in His Profession on the Pacific Coast

OHIO has produced more presidents than any other state. There may be something in the environment or something in the consciousness of the great achievements of her famous sons that impels a goodly percentage of Ohio-born men to advance to positions of prominence. The incentive of close example, the germ of ambition, whatever it be, the Ohio man at his best climbs above the average that start under like circumstances. Who today are the half-dozen great engineers on the Pacific slope? You can 't name them and omit W. R. Eckart from the front rank. For more than forty years his life has been identified intimately and exclusively with most of the great engineering problems and developments of this part of the world.

W. R. Eckart

He began life as an Ohian sixty-eight years ago, for he was born at Chillicothe June 17th, 1841. His mother's people had been pioneers in the settlement of that part of Ohio. His father was a merchant, with shipping interests in vessels on the great lakes.

First young Eckart attended private schools. Then his mother died when he was 12. After some public schooling in Chillicothe and Cleveland he took a special mathematical course in an academy at Cleveland in the hope of becoming a civil engineer, as he had a relative who was a civil engineer and president of the Marietta and Cincinnati Railroad, which was being somebody in those days! When the boy was in his early teens the father moved to Zanesville, where he had a managing interest in a flour mill. Now it happened that the power for this grist mill came from six water wheels. New wheels had to be installed. Young Eckart was assisting the millwright. And as he worked at setting up those wheels he was noticed. A member of a firm prominent in those days in general mill and steamboat work offered him a place as apprentice. The youth had voyaged a little on Ohio and on Mississippi river steamboats, and marine engineering had fascinated him. So he accepted the apprenticeship. The firm's junior partner was manager of the works; he was a master mechanic of great ability, and had been apprentice and foreman to Sir Joseph Whitworth in England, when the Whitworth works grew famous for machine tool construction. The manager became young Eckart's friend, his severest and most encouraging critic. No work was done "good enough"; it had to be finished as the best possible. That apprenticeship and those ideas laid the foundation of the Eckart thoroughness and efficiency as a practical engineer.

Participation in steamboat trial trips to test machinery further interested the apprentice in marine engineering. July 2d, 1861, he took the government examinations and passed them with the rank of No. 1 of his date. He was appointed a third assistant engineer and ordered to join the United States naval fleet at San Francisco.

During his three years of naval duty, from the time he was 20 till he was 23, he made the acquaintance in San Francisco and gained the lasting friendship of the foremost men then in the engineering profession in California—Paul Torqua, Joseph Moore, Irving M. Scott, Wallace Hanscom, Huttner, Specht. Because of poor health he resigned from the navy and decided to make his home in San Francisco. He secured employment in 1864 in the draughting room of H. J. Booth & Co., a concern that manufactured mining machinery and repaired coast steamships. Irving M. Scott was the company's chief draughtsman at that time. A year later Eckart, then 24, was chief draughtsman, and August 30th, 1865, the Booth & Co. shops turned out from Eckart's designs and drawings the first locomotive manufactured in California. The trial run was made that day on the railroad from San Francisco to San Jose, with the governor, state and city officials, and other notables as invited passengers.

In 1867 Eckart went east, passed the examinations that licensed him to be a first-class chief engineer in the merchant marine, and then returned to California and continued his work with Booth & Co. In February of 1869, after nearly five years with the concern designing mills and mining machinery, he resigned to accept the appointment as draughtsman to the steam engineering department at the Mare Island Navy Yard. That was when he was 27. He became foreman machinist, and was finally promoted to superintendent of steam machinery at the navy yard. He designed steam machinery, propellers, and dynamometers for the noted experiments made by the government with "steam launch No. 4."

When he was 30 he left the navy yard to become a partner in the Marysville foundry firm of Prescott, Scheidel & Co., later styled Booth & Eckart. The firm built a great variety of hydraulic and mining machinery. Because of his experience in the experiments with the government launch Eckart guaranteed a speed of 21 miles an hour when taking the contract to build the little steamer Meteor for the Carson Lumber Company's use on Lake Tahoe, and the Meteor made the speed and was at the time the fastest boat of its size in the world.

At 31 Eckart was appointed consulting engineer in the sinking of the four air shafts for the famous Sutro tunnel in Nevada. He spent months experimenting at Virginia City, collecting in his minute and methodical way data necessary to a commanding understanding of the whole situation. It was nasty, suffocating work, deep down in the mines, in a steamy, reeking atmosphere, where drops of subterranean water blistered the skin.

He had already designed the hoisting and drainage works for the Belcher, Yellow Jacket, Ophir, C. & C., and other historic mines.

In 1873 he established his residence in Virginia City as the consulting engineer for that remarkable quartette of bonanza kings, Mackay, Flood, O'Brien, and Fair.

About 1876 it became evident to the big operators on the Comstock lode that heavy and powerful pumping and hoisting machinery would have to be installed to operate at a depth of 2,000 or 3,000 feet below the 1,600-foot level to be tapped by the Sutro drainage tunnel, which was then in 15,500 feet and had about 5,000 feet still to go to reach the lode. Prescott, Scott & Co. and the Risdon Iron Works were keen competitors for the contracts to construct the desired machinery. The firm that could produce an acceptable design first usually got the job. So Prescott, Scott & Co. sent Eckart down to San Francisco to help Irving M. Scott with the designs. And there was where Eckart's earlier collection of minute data counted. While he did not design the great hydraulic pumps of the Comstock, his experiments in 1880 and 1881, while a member of the United States Geological Survey preparing his government report on the "Mechanical Appliances of the Comstock Lode," became classics for the information of engineers, as the problems involved things not before undertaken in engineering and difficulties of a peculiar nature because of the great depth and the subterranean hot waters encountered.

About 1880, when deep mining on the Comstock began to decline, Eckart, then 39, moved to San Francisco and opened an office as a consulting engineer, and for ten years designed or supervised the construction of works for many well-known mines in California, Utah, and old Mexico. He made the plans for the Anaconda Copper Works in Montana and the hoisting and reduction works for Haggin and Tevis. In 1896 he solved the problem of getting the water out of the Alliston Ranch Mine at Grass Valley, which had lain idle and its lower levels bafflingly submerged for thirty years.

When the Union Iron Works entered upon its great career of warship building Eckart was engaged as its consulting engineer, and as such he assisted in conducting most of the preliminary and official trial trips and in rendering the reports.

In 1899 he was appointed consulting engineer for the Standard Electric Company, now owned by the Pacific Gas and Electric Company, and then became its resident constructing engineer for all its hydraulic works, reservoirs, pipe lines, ditches, and power houses. Those were the days of pioneering in long-distance transmission of electric energy, and Eckart, who, more than a generation earlier, had taken so prominent a part in the work on the Comstock of getting the boiling water out of the depths of the Sierra Nevada mountains, was among the first to solve the problem of getting the melting snows from the tops of those same mountains down to hydro-electric plants that would transmit the energy on 200 miles to the local needs of the coast cities. Since 1907 he has been consulting engineer for the Pacific Gas and Electric Company.

His life has been busy but unobtrusive, his achievements in his profession many, and his recognition partly expressed by membership accorded him in the most prominent engineering societies of America and England.

A. R.

## A Bust of Peter Donahue

A life-size, bronze bust of the late Peter Donahue, founder of the gas business in San Francisco and builder of the first gas works ever established on the western slope of America, has been placed conspicuously in the main office of the San Francisco headquarters building, where thousands of consumers can easily see it when approaching the "information" counter, above which it makes an artistic ornament in nice harmony with the ornamental woodwork. The likeness is said to be excellent and much more natural than the old photographic print used on the first page of the August number of the magazine. The designing of the bust was the work of M. Earle Cummings, the well-known California sculptor.

A. L. Trowbridge, field engineer, was captain and outfielder of the Stanford varsity nine in the spring of 1905.

# Stockton's "Rush of '49"

By J. W. HALL, Manager Stockton Water District.

J. W. Hall

**The sixtieth** anniversary of the "Rush of '49" was celebrated by the city of Stockton during a period of five days in the latter part of October. It was the week following San Francisco's splendid festival that commemorated the discovery of San Francisco bay 140 years ago by Gaspar de Portola, who missed Monterey but found the great bay while on his overland way up the coast from old Mexico to begin his duties as Spain's first governor of California. San Francisco's carnival amazed; it surpassed every expectation in size, diversity, artistic attractiveness, and favorable weather, and had the city so crowded with approximately 1,000,000 people that the down-town streets at night were teeming with humanity good-naturedly scuffing along on sidewalks and pavements literally snowstormed with confetti.

Stockton, a hundred miles inland and on one of the two great rivers that debouch into San Francisco bay, caught the Portola overflow, got San Francisco's huge Chinese dragon for its parade, and had the greatest crowds in its history. A population of 30,000 was, like San Francisco's, doubled, and the last Saturday night probably 50,000 people were on the streets.

Stockton was one of the first locations of California's early gold seekers on their way to the mines, and many of the old timers are still living here and imbued with the old spirit. The towns of the southern mines also contributed largely toward making the celebration a great success.

Stockton's citizens changed themselves for a period of five days into a motley crowd of miners, cowboys, "greasers," and Indians, and turned themselves loose. There was something doing all the time.

Roaring Camp was pitched on Hunter Square, with a background of mountains constructed of canvas and paint. There was a real waterfall, and a considerable stream of water running through a gravel-strewn channel for a hundred feet or more, with real placer mining going on day and night. There were stockades, beaneries, hotels, saloons, gambling dens, dance halls, and a daily paper printed by an ancient small press. There were bull fights, stage hold-ups, shooting scrapes, lynchings, and fights with Indians. There were prairie schooners, ox teams, old stage coaches, and burro trains packed with mining outfits. There was a $20,000 mining exhibit, and a historical collection of ancient relics.

All the store windows were decorated with scenes of mining days and pans of nuggets, and everything was run "wide open," in typical mining-camp style, with no restrictions as to gambling.

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There is no such thing in the United States as a national holiday, not even the 4th of July. The President proclaims Thanksgiving, but only effectively for the District of Columbia and the territories. Each state makes its own holidays. In California there are nine legal holidays: January 1st (New Year's Day), February 22d (Washington's Birthday), May 30th (Decoration Day), July 4th (Independence Day), September, the first Monday (Labor Day), September 9th (Admission Day), November, the first Tuesday (General Election Day), November, usually the fourth Thursday (Thanksgiving Day), December 25th (Christmas).

# How to Make Out Requisitions

By JOHN H. HUNT, Purchasing Agent.

John H Hunt

**A great many** of the complaints that are constantly coming to the purchasing agent, because of delays in receiving materials, would, if analyzed, act as a boomerang on the manager who issued the requisitions. And these delays could be avoided by a little care on the part of the person who sent in the order.

If a district manager's experience has been that it takes a week or longer to get his supplies, why should he wait till he is ready to use the things before he puts in his order? Why should he delay so long that he then has to telephone to the purchasing agent to "rush by express," when a little forethought on his part would have warned him a week earlier that he would be needing the material?

In making out a requisition care should be taken to make plain exactly what is wanted. Very often a switch or some other piece of electrical apparatus is ordered by catalogue number, and the description given will call for something of an entirely different rating. Then letters have to be sent and received, and that much delay is caused before it can be known just what to ship.

Sometimes an order is received with only part of the dimensions, or with no dimensions at all, like these:

200 galv. washers.
50 ft. of 5-ply steam hose.
60 ft. of double leather belting.
500 dogs as per sample. [And no sample sent.]
10 ft. No. 4 duplex cable.

All those are actual orders that came in during one week in October. The size of washers, the size of hose, the size of belting—such little details were left to the imagination of the purchasing agent. And as sure as fate the senders of some of those orders would be telephoning in a few days demanding to know why they had not yet received the goods.

Another very important matter is to give complete and accurate shipping directions. Here is a copy of the directions that came in on an order received from Oakland and shipment on which went astray:

Ship to Pacific Gas and Electric Company, Oakland District, Oakland, Cal., by freight to Berkeley.

The car was received in Oakland.

When it is known that goods must come from the east, do not mark the orders "ship by express," unless you wish express shipment direct from the east.

The purchasing department tries to correct all evident mistakes before the orders leave the office. But some days more than a hundred orders are put through, and with so many it is hard to catch all the errors. During the month of September of 1909 there were 1,853 orders and 3,285 invoices put through the purchasing department of the Pacific Gas and Electric Company. That is an average of 80 orders and 140 bills for each working day. If the district managers will exercise a litttle more care along the lines herein suggested and not leave it to the purchasing department to discover and correct their errors on requisitions and to supply missing information, it will help some.

On the orders there is a space which reads "For Use In........." Do n't fill that out by writing "Item C of GM-246." Such formulae may be perfectly clear to the person who made out the order, but it is about as clear as mud to the purchasing agent. Do n't be afraid to give a little definite information as to what it is "For use in."

Perhaps the most disagreeable thing to the buyer, and certainly the one that causes the most confusion and mistakes, is the "Rush Order" that is telephoned in and is to be covered later by a confirming requisition. Very often a requisition arrives later without being marked "confirming," and unless it be recognized in the purchasing department or by the merchant with whom it is placed a duplicate shipment is made. This invariably leads to a lot of correspondence; the material has to be returned; and a readjustment of credits has to be made: all because the man that telephoned the rush order forgot to write the little word "confirming" on his written order.

## The Deer that Photographed Itself

This deer picture, sent in by C. E. Young, superintendent of the Marysville power division and himself a great hunter, was secured on a hunting trip in the mountains of northern California under remarkable conditions. It was a flashlight taken late at night, several miles from camp or any human being, and the deer itself operated the camera. Three ordinary sewing threads were stretched in parallel across a little pathway leading to a cattle salt-lick frequented by deer. When the deer's feet struck the first thread the camera shutter

was opened; when it touched the second that set off the flash, and when it struck the third thread that closed the shutter. The camera was set up by Charles Hughes of Red Bluff.

## The Iceman at Colgate

This is a picture of "Shorty" Walker and his "ice-wagon" at the Colgate powerhouse. The thermometer gets way up at Colgate dur-

ing the summer, and that rock-ribbed and forest-covered cañon of the Yuba river becomes decidedly warm. Ice is a necessity. It is made in a small machine in the power house, and "Shorty," who is a general utility man at the plant, has never been known to miss a day in the reguality of his rounds with ice. He is a man with a history; he served in the Sixth regulars as an Indian fighter under Crooks in 1869 and 1870; was a driver of overland stages before the days of the railroad; and, according to I. B. Adams, the superintendent, is personally the most popular man in the Colgate division.

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The most approachable men to interview are the really big men. Only the near-important are self-important.

# PERSONALS

John A. Britton, general manager of the company, returned to San Francisco October 28th, after a two-months' voyage to Japan.

L. J. Lisberger, engineer of electric distribution, built the street railway lines of San Antonio, Texas, before he was 25.

S. V. Walton, manager of the commercial department, was fruit buyer for the J. K. Armsby Company in the fall of 1904.

H. E. Cahill of the Colusa district put in four years on a government snag boat clearing the channel of the Sacramento river.

John O. Hansen, superintendent of the San Jose power division, used to be a varsity football player at the University of California.

D. H. Foote, secretary of the company, was at one time assistant manager of the American Beet Sugar Company at Oxnard, California.

C. J. Pierard of the closing bill department, San Francisco, was a first sergeant in the First Infantry of the Belgian army from 1876 to 1880.

D. A. (Gus) White was a cowboy for a year on a cattle ranch in Arizona, and a dozen years ago used to play football with the Olympic Club.

John P. Coghlan, manager of the claims department, was, previous to his admission to the bar a few years ago, engaged for several years in San Francisco journalism as a reporter on an evening paper.

Frank Pancera of the gas department at San Jose served in the Italian army from 1882 to 1886, in the Eighteenth Cavalry.

William E. Osborn, manager of the Woodland district, was in Guatamala from 1891 to 1895, in charge of the office of E. J. de Sabla, Sr.

John H. Hunt, purchasing agent, was assistant purchasing agent for the United Railroads of San Francisco for nearly two years preceding the fire.

J. D. Kuster, manager of the San Jose district, was principal of the Marysville grammar school from 1900 to 1902 and also a member of the county board of education.

W. B. Bosley, head of the law department, delivered a course of lectures at the University of California at Berkeley during two college years, commencing with the fall of 1901.

S. P. Babcock of the Oakland district served three years and four months in the Civil War in the 152d New York State Volunteers, in the Second Army Corps under General Hancock.

Ernest Curtiss, foreman of a gang of linemen in the Marysville district, and Miss Myrtle M. Anderson of Gridley, Butte County, were married in the Presbyterian church at Marysville October 27th.

O. Bloomfield of the closing bill department, San Francisco, was a first sergeant in the Thirteenth Infantry of Roumania, and for three years was in the Eighteenth Infantry of United States regulars.

Lewis P. Price of the mains and service department in Sacramento served six years in the British army in India, South Africa, and elsewhere, and was presented with a medal for bravery during the Zulu war of 1878 and 1879.

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Frank A. Leach, Jr., manager of the Oakland and Berkeley districts and son of the former director of the United States mints, began his career as a printer's devil, and then learned the trades of bookbinding, presswork, and photo-engraving.

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J. W. Hall, manager of the Stockton water district, was three years in charge of the Natoma Water Company's 2,000-acre vineyard near Folsom, one year in charge of the Hopkins orange plantation at Pasadena, and seven years in charge of the Barton vineyard at Fresno.

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A. B. Maguire, a street inspector for the San Francisco Gas and Electric Company, was thrown from a runaway buggy at Polk and O'Farrell streetts October 15th and sustained lacerations and contusions of the scalp and forehead, contusions of the chest and hip, and was somewhat hurt internally.

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James H. Wise, the company's hydraulic engineer, taught mathematics in the California School of Mechanical Arts (Lick School), San Francisco, during the year immediately following his graduation from the University of California in 1903.

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A. F. Hockenbeamer, treasurer and comptroller, was with the Baltimore and Ohio Railroad System two years, one year as assistant chief engineer of maintenance of way and one year as assistant general superintendent of motive power, and later he was confidential expert on railroad properties for the New York banking concern of N. W. Halsey & Co.

John Werry, manager of the Grass Valley and Nevada districts, was county recorder of Nevada County three successive terms, serving from 1892 to 1902 as a republican nominee; prior to that he had been chief deputy county assessor for six years and one year deputy postmaster under a democratic chief.

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George Scarfe, superintendent of the Nevada power division and manager of the Nevada water district, has, during his varied career, been a plumber, a sheet-metal worker, in the engine room of transatlantic steamships, chief engineer for an electric light company, and construction engineer on work in San Salvador, Central America.

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F. V. T. Lee, assistant general manager of the company, is off on a two-months' sea voyage for a rest. He left Vancouver, B. C., November 5th, in the steamship Marawa for Australasia. On the way, both going and returning, he will stop at Honolulu, at the Fiji Islands, at Brisbane, Sydney, and Melbourne, and at Auckland, N. Z. He expects to be back early in January.

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W. R. Arthur, manager of the Auburn water district, has submitted the following comparisions on California, clipped from an article in "The Coast Review:"

California's area is greater than the combined areas of Belgium, Denmark, Greece, Holland, Portugal, Switzerland, and Scotland; which countries support an aggregate population exceeding 30,000,000. Its area is about one-third greater than that of Great Britain with a population of 42,000,000; of Italy with a population of 32,500,000, and three-quarters as great as France or Germany, and more than three-quarters as great as Spain. San Bernardino County, with its area of 20,000 square miles, is larger than Belgium, Denmark, Holland, or Switzerland; and the Sacramento and San Joaquin valleys contain more arable land than is contained in Belgium, Denmark, or Holland.

# PACIFIC GAS AND ELECTRIC COMPANY

## DIRECTORS

F. B. Anderson
Henry E. Bothin
John A. Britton
W. H. Crocker
E. J. De Sabla, Jr.
F. G. Drum
John S. Drum
D. H. Foote
A. F. Hockenbeamer
John Martin
Louis Monteagle
Cyrus Pierce
Leon Sloss
Joseph S. Tobin
George K. Weeks

## OFFICERS

F. G. Drum ........ President
John A. Britton ........ Vice-Pres. and Gen. Mgr.
F. V. T. Lee ........ Asst. General Manager
A. F. Hockenbeamer ........ Treas. and Comptroller
D. H. Foote ........ Secretary
Charles L. Barrett ........ Asst. Secretary
W. R. Eckart ........ Consulting Engineer

## HEADS OF DEPARTMENTS

W. B. Bosley ........ Attorney
J. C. Love ........ Auditor
W. H. Kline ........ Tax Agent
R. J. Cantrell ........ Property Agent
S. V. Walton ........ Manager Commercial Dept.
J. P. Coghlan ........ Manager Claims Dept.
J. H. Hunt ........ Purchasing Agent
E. B. Henley ........ Manager Land Dept.
E. C. Jones ........ Engr. Gas Dept.
P. M. Downing ........ Engr. O. & M. Hyd.-Elec. Sect.
F. H. Varney ........ Engr. O. & M. Steam & Gas Eng. Sect.
J. H. Wise ........ Civil and Hydraulic Engr.
C. F. Adams ........ Engr. of Elec. Construction
George C. Holberton ........ Engr. of Elec. Distrib'n (Sect. 1)
S. J. Lisberger ........ Engr. of Elec. Distrib'n (Sect. 2)
George C. Robb ........ Supt. of Supplies
H. Bostwick ........ Secretary to President

## DISTRICT MANAGERS

Berkeley ........ F. A. Leach, Jr.
Chico ........ H. B. Heryford
Colusa ........ W. M. Henderson
Fresno ........ E. W. Florence
Grass Valley ........ John Werry
Marysville ........ J. E. Poingdestre
Marin ........ W. H. Foster
Napa ........ O. E. Clark
Nevada City ........ John Werry
Oakland ........ F. A. Leach, Jr.
Petaluma ........ H. Weber
Redwood City ........ L. H. Newbert
Sacramento ........ C. W. McKillip
San Jose ........ J. D. Kuster
Santa Rosa ........ Thomas D. Petch
Vallejo ........ A. J. Stephens
Woodland ........ W. E. Osborn

## MANAGERS OF WATER DISTRICTS

Auburn ........ W. R. Arthur
Nevada ........ George Scarfe
Placer Division ........ H. W. Cooper, Supt.
Standard ........ W. E. Eskew
Stockton ........ J. W. Hall

## SUPERINTENDENTS OF POWER DIVISIONS

Colgate ........ I. B. Adams (acting)
De Sabla ........ D. M. Young
Electra ........ W. E. Eskew
Marysville ........ C. E. Young (acting)
Nevada City ........ George Scarfe
North Tower ........ C. D. Clark
Oakland ........ William Hughes
Sacramento ........ W. C. Finely
San Jose ........ J. O. Hansen
South Tower ........ A. H. Burnett (acting)

## SUPERINTENDENTS OF ELECTRIC DISTRIBUTION

Berkeley ........ J. H. Pape
Oakland ........ C. J. Wilson
Sacramento ........ C. R. Gill

# Pacific Gas and Electric Magazine

Vol. I | Contents for December | No. 7



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*Through sorrow's gloom, or gala days,*
*A lovely woman's charms and ways*
*Give warmth and glow to life always.*
*Her smile to us is balm, or praise.*
*A toast: "To her", these holidays.*

# Pacific Gas and Electric Magazine

VOL. I DECEMBER, 1909 No. 7


## A Log-Drive on the American River

By J. W. HALL, Manager Stockton Water District.

J. W. Hall

**One fine morning** in April of 1891 the Boss decided that the time was ripe for starting "the Drive." For several days the weather had been getting warmer. Far up on the Sierra summits old Sol had been softening the snow. The water had seeped down through the white mass and begun to run off from under the edges in myriads of little rills that had daily been increasing in volume until now the gulches, creeks, and cañons had become filled with roaring streams. The river itself had reached the "driving stage"; had become a strong, turbulent, irresistable torrent that would continue to rage through the gorge as long as there was any snow left to melt.

The American, which but a few days before had been but a purling stream in a boulder-strewn channel, with inaccessible cliffs sloping directly from its depths up a thousand feet or more to the mesas above and walling in a solitude disturbed only by the denizens of the wild, was soon to become the centre of a carnival of action and life, and its rock-ribbed ramparts to resound with the boom of the logs and the shouts of the rivermen.

In the dead of winter the axmen had laid the towering green trees prostrate on the deep bed of snow. The fallen giants had been cut into lengths, peeled, sniped, scaled, and branded, and then the sections snaked out by the steam donkeys to the landings along the tracks. There they had been loaded on the cars, and thence transported on the tortuous little logging camp railroad to a point overlooking the river. From a height of 1,100 feet above the stream each log was sent down the 3,500-foot incline chute to make that two-thirds of a mile dash in thirty seconds and end it with a spectacular dive and a towering splash into the retaining basin behind a huge dam built of log cribs filled in with rock and encased with planking.

The logs darting down that slippery chute were of sugar pine and yellow pine and spruce and fir and cedar.

The course of the river for the forty miles from Slab Creek to Folsom is one of historic interest. Here was the scene of the first gold mining in California in the days of '48 and

[Editorial Note:—The writer has told this story out of a close personal knowledge of the old logging days on the American river, but there is a special interest attaching to this historical sketch by reason of the fact that the Pacific Gas and Electric Company now owns the scene of the old log basin and a considerable stretch of the American river itself, from the company's power plant at Folsom to a point three miles up-stream and including the Folsom dam and the two miles of canal down which the logs were floated to the old mill.]

The Forest Timber and the Big Peeled Logs

'49. Here were Mosquito, Chile Bar, and there Coloma valley, where stands Marshall's monument near Sutter's old mill; here Natural Bridge, Salmon Falls, and there Mormon Island.

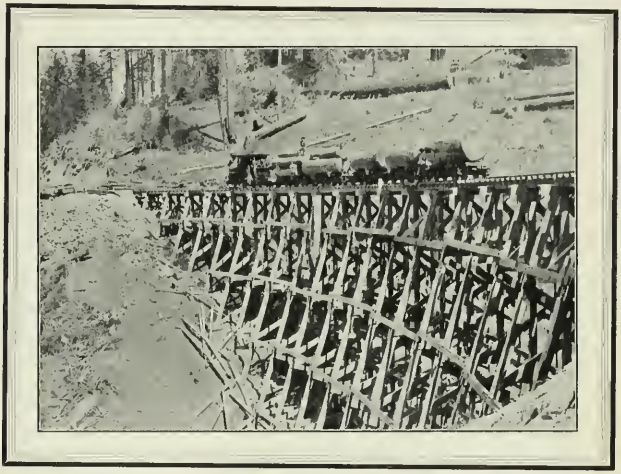
The sluice gates in the retaining dam had been opened the day before. The logs shot out into the stream. They scattered themselves for miles along its banks and bars. Some kept to the current. Others separated from the crest of the stream and lodged against the bars, the shores, the bends, in inextricable confusion.

To work these locked logs back into the current, to keep them moving toward the mill at Folsom, that was the business of the drive.

The camps had been prepared. The bateaux had been built, their crews selected. The logging Jacks had transformed themselves into woolen-clad drivers, with high laced boots having soles well studded with short spikes. The equipment was complete, yet the simplest possible, for along that inaccessible cañon not a superfluous pound must be carried.

With the first streak of dawn the men are in motion. They have breakfasted by lantern light. In gangs of from ten to fifty, every man with his peevie, they are wrestling with the logs. The bigger gang attacks the rear, "sacking" the logs by main strength off the shores. Other groups work upon those in the narrow or more obstructed places further down stream, poling them off as they come, keeping them from accumulating into jams.

The boat crews are at work on the centres, where the logs lodge against boulders in midstream, or in the eddies, where they must be withdrawn one at a time. All the work is of the most strenuous character. The men are in and out of the cold water from morning until night, frequently in danger, taking the greatest risks, shouting, heaving, and fighting with the logs like a lot of demons.



The Logging Camp Railroad

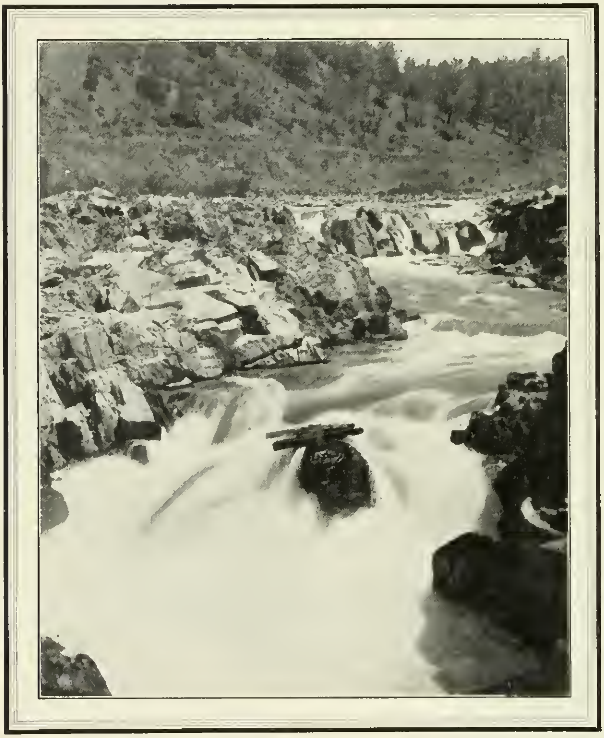
At 10 o'clock in the forenoon, in boxes on the backs of burros, comes the first lunch, and with it the first rest of the day. Half an hour suffices for this; and they are all up and at it again. The next lunch is at 3 o'clock in the afternoon; and after dusk their fourth meal is served upon their return to camp. Then bonfires are lighted and the drivers change their wet garments for dry ones and dispose of the wet ones about the fires. Many do not take the trouble to change, but tumble in without removing their half-dried clothing.

The Foot of the Chute, and the Geyser Raised by a Plunging Log

The camp is rough and crude, pitched in a small cove or flat offering room enough for the cook tent. Rows of saw-buck tables and rough benches in the open constitute the commissary. Sleeping tents, with a bale or two of straw strewn on the ground where the blankets are unrolled side by side, suffice for the dormitories. There will be no such thing as comfort or Sunday rest for these rivermen during the next thirty or forty days. But the grub will be good, for to insure good work the driver must be well fed; without it, he would not be able to endure the hardship.

Each day the drive is making progress, perhaps of a mile or more from the rear of the night before. Week by week the camp moves forward.

The sure-footed pack burro in caravans brings in the lunches, the tools, the powder, along the narrow trails of the river cañon. When the stream must be crossed the little burro is prodded into a bateau. There he



Upper Salmon Falls, with Hancock Ditch on Hillside

squats on his haunches in the bottom. He takes all his hard knocks with stoicism and gravity.

In the Coloma valley and at Uniontown, where the channel is wider, horses are used to snake the logs off the bars, and the men are relieved of that much of the hard work.

Each successive day brings some thrilling, perhaps some tragic, experience.

At the great whirlpool in the Horshoe Bend at Rock Creek the men's energy is taxed to the utmost to withdraw the eddying logs, gathered by the thousand in that treacherous swirl.

At Natural Bridge and at Salmon Falls the logs are sure to jam. When the jam is on then comes the tug-of-war. It may hold up the drive for days. By main strength, one at a time, the logs are pulled away until "the key log" is disclosed. Then a double charge of powder sets the logs in motion; the backed-up water behind the jam and the river drivers do the rest. It is a thrilling scene of riot and confusion. The rock-bound cañon, the tossing, grinding, groaning, even flying, mass of logs, the rush of the drivers, the roar of the river, are theatric and spectacular in the extreme. In the excitement the drivers take great risks. Today a man was lost. But what of that? They are all taking dare-devil chances. The drive must go on just the same, feverishly on, and on, for every day shortens the time of the snow-water, and every minute of daylight must be made the most of that the goal may be reached while the flood continues. Horses are disabled, lost. The drive can easier spare a man than a horse, for horses are harder to get.

The old River Boss anxiously inquires each night for his horses. Good horses are scarce; they cost money. But men are plentiful and are easily replaced. In the cold snow-water the body of a drowned man does not rise to the surface. Often it remains undiscovered until the dry season. Then it may be recovered from some brush heap or drift and with much difficulty be carried out of the cañon.

On one occasion the writer saw a man drowned in attempting to save a worthless dog that some thoughtless driver had thrown into the river. The unfortunate man reached out for the dog with his peevie from the edge

Lower Salmon Falls

of a gravel bar, overbalanced, went down, and was swept away in the wallowing flood.

At Salmon Falls the last jam is broken. Along in June the drive arrives at the boom in the back water above the Folsom dam. The boom piers are massive granite towers from forty to fifty feet in height and the booms are hung to them with massive chains. In this haven the logs remain in safety until ready for the mill, to which they are later floated down in the canal, along past the state prison and on to the log basin near the present site of the Folsom power house.

The saw mill is another story, but "the drive" is over. The drivers receive their pay, enter into the delights of dissipation, soon are separated from their money, and are ready to return to the woods for the next season's cut.

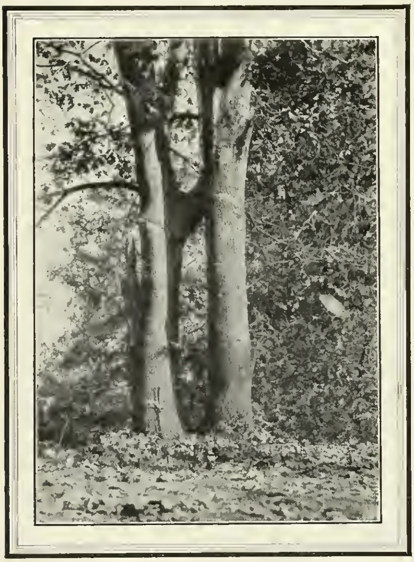
Since 1898 there have been no log drives in the American. The extension of the railroad nearer to the timber belt has changed the situation and discounted the river. The logs are now sawed into lumber in the woods, and the product is carried by rail to market.

The old log dam that once held the retaining basin at the foot of the spectacular chute has been replaced by a stone dam for

The Log Basin, near the End of the Canal at Folsom, Showing More than 1,000,000 Feet of Prospective Lumber—The River Is Down Between This Basin and the Wooded Hillside the diversion of water for the production of electric power. The picturesque and stirring scenes of "the drive" in the American are gone the way of all California's early days and scenes of vivid life in a glorious new country now almost completely tamed.

## Siamese Twin Oaks

On the mountain road from Nevada City to the Deer Creek power house in Nevada County are two remarkable black oak trees about two miles above the junction of the You Bet and Deer Creek roads. They stand close to the roadway and about a foot apart. About eight feet from the ground a



large branch of one has grown over into and amalgamated with the trunk of the other tree. The accompanying picture of this freak of nature is from a photograph taken in May of 1907 by A. L. Wilcox of the construction department. These twin trees are a landmark on the road.

## A Japanese Sword Contest

The accompanying illustration, sent in by J. W. Hall, manager of the Stockton water district, is from a photograph made near Stockton on one of the immense rented delta-

land ranches farmed by the so-called "Potato King," George Shima, a very wealthy Japanese.

It portrays a sword contest, the ancient but still the most popular form of fighting in Japan. The "swords" are big, split-bamboo clubs, and the points scored are on the theory of blows landed that would split or cut off the head or cripple the hand. The head, neck, and wrists are therefore heavily protected. Any one who has witnessed the fury with which the little Japanese engage in these oriental "prize-fights" can testify as to the need of the protectors. Very frequently one contestant or the other gets in a terrible smash on his adversary's arm or shoulder, which does n't score scientific points but must hurt a lot, as knockdowns are numerous.

Stupidity? There 's no hope for it.

Why not have the magazine sent to some friend interested in you or your work?

# Damage Claims—A Modern View*

By JOHN P. COGHLAN, Manager Claims Department.


John P. Coghlan

**Damage claims,** no matter in in what industry they arise, naturally divide themselves into two classes; those resulting from in-injuries to property and those resulting from injuries to persons. Injuries to property are easily disposed of; they involve only the damage or destruction of what has been or can be produced with money, and are satisfied when the loss inflicted is measured and paid for according to market standards.

But personal injuries involve all the human elements—the home, the relation of the individual to society, often life itself. Their causes and effects are as complex as our modern industrial conditions, and, like those conditions, are constantly in a state of evolution.

No one, perhaps, is more affected than the employer, for of all personal injuries, as he knows them, more than four-fifths occur to workmen in the line of their employment. Yet the employer seems to be the last to observe the change that is going on. Except in rare instances, he clings to the point of view of years ago; he still sees the relation between himself and his employee as those before him saw it in the days of the stage coach and the hand press.

This is largely due to the fact that in the beginning the law circumscribed both the employer and the employee. It assumed, because the employer purchased labor and the employee sold it, that the relationship between them was one of implied contract. As incidental to that contract it reasoned that, as the employer selected the place of employment, it was his duty to make it reasonably safe, and that as the workman chose to enter the trade or industry in which the employer was engaged, he assumed its ordinary risks and hazards. One of these ordinary risks and hazards was the negligence of fellow servants. The idea of the law was that the negligence of fellow servants was as likely to be known to the workman as to his employer, and that if he did not want to assume that and the other risks of his calling he could leave and seek employment elsewhere. Moreover, it was believed that both the ordinary risk of the employment and the negligence of fellow servants were perils that could be provided for in the rate of compensation.

This doctrine was the outgrowth of a time when the master and servant were close to each other and when most manufacturing was done by hand or with simple machinery. At that, it is not old as time is ordinarily measured. The first case involving damages to an employee was decided in England in 1837. It was a case growing out of injuries received in the overturning of a stage coach. The principles there laid down were brought over to this country, and, first in South Carolina, and then in Massachusetts, were applied to American conditions. In the Massachusetts case (Farwell versus the Boston and Worcester Railway Company) great stress was laid upon the rule that the employee assumed the risk of his employment and the negligence of his fellow servants. It projected a line of reasoning that was soon adopted by all the courts of the United States. As time passed the doctrine, instead of advancing, was being continually carried back to the first case. The

*This paper, before being somewhat condensed for publication here, was read before the Pacific Coast Gas Association at San Francisco, September 21st, 1909.

lawyers and judges of the country were looking behind for precedent, rather than ahead for progress and development.

Meanwhile the status of the employee changed rapidly. From a condition in which he worked under the master's eye and often at his side, he passed into a state in which he became but a part of a great machine. Instead of working with a few men, generally less than a dozen, he found himself one of many hundreds. For fellow servants he frequently had men he never saw or even heard of, many of them miles away. He had nothing to do with their employment, and knew nothing of their skill or want of it. Yet when injury befell him he found that he was regarded in the same light as when he worked with his hands and as the personal servant of his master. He learned that perhaps a superintendent or manager he had always considered in another sphere was his fellow servant, and that the mistake of that superintendent or manager was one of the risks he had assumed when he accepted employment. Or, perhaps, he found that he had assumed a hazard that came from the breaking of an immense machine, that he neither set up nor operated.

When the workman came to a realization of his position, his first effort was to shift more of the burden to the employer. His idea was that he would be relieved if he could put the negligence of his fellow servants and the risk of the employment upon his master. With that end in view, he began to influence legislation, and in a short time succeeded in England in having the risk of the employment transferred to the employer and the fellow-servant rule so altered as to exclude from it managers and superintendents and finally all employees engaged in different departments of labor than himself.

From England this modification, like the original doctrine, traveled to this country. It was adopted in Alabama in 1885 and in Massachusetts in 1887. Since then the modified doctrine has been accepted, with some minor changes, in twenty-eight states. Colorado has abolished the fellow-servant rule entirely. California has excluded from the fellow-servant rule all agents or officers superior to the employee injured and all employees engaged in other departments of labor.

This change in the relation of the employer to his employee was quite radical, but it did not establish any new basis of liability. It was merely taking the common law as it stood and declaring that when an injury happened through the hazards of the employment or the negligence of fellow servants it was more fair that the employer should bear the loss than the employee. While the change removed some of the burden from the workman it did not give him a new or more humane method of compensation.

The law-makers of England saw this very early, and looked about for a better plan. They found in Germany and other countries of continental Europe a system which provided compensation regardless of how the injury occurred. It was a system that differed essentially from anything England had known, as it disregarded entirely the old common-law principle of liability. It treated injuries to workmen as an incident to industry. It kept the burden of those injuries off both the workman and the employer, and placed it upon the trade in which both were engaged.

This system England adopted in 1897, and widely expanded in 1900 and 1906. As finally put into effect it provided a definite compensation for injuries of every character. To the employee temporarily incapacitated it furnished half pay; in case of death it allowed his dependents a sum equal to three times his annual earnings. The compensation was provided, no matter how the injury occurred, whether by the workman's own fault (unless by his "willful misconduct"), or by the fault of the employer, or by nobody's fault.

The English act departed from the German in one important point. It compelled the employer to provide the compensation. The Germans made the compensation payable out of an insurance fund maintained about equally by the employer and the employee. They reasoned that both would take it out of the industry in which they were engaged—the workman by obtaining a wage high enough to include his premium to the insurance fund, and the employer by adding his proportion to the cost of production.

So complete is the German system that each year compensation is awarded to something like 150,000 employees injured during the year, and to some 600,000 injured in previous years and still totally or partially disabled. In addition, compensation is awarded yearly in Germany to some 65,000 widows and 100,000 children of dead accident-victims. It is estimated that about 18,000,000 workmen are protected by this form of compensation against the consequences of industrial accidents in Germany.

The compensation plan has within a few years passed over all Europe. It has been adopted by every country in continental Europe and even in Australia, New Zealand, British Columbia, and the Cape of Good Hope. In one form or another it is now in effect in twenty-one countries. It is only a matter of a short time, I believe, when it will be generally accepted in the United States. In fact, the federal government has already put it into operation in favor of federal employees. Massachusetts, Indiana, and other states are on the verge of adopting it.

It is interesting to note that the development of this problem has been along the same lines in this country as in England. In the beginning both placed the risk of the employment and the negligence of the fellow servant upon the workman. Then both shifted these burdens to the employer. Then England adopted the plan of compensating for injury regardless of the fault or lack of it on the part of the employee. Now this country is accepting that policy; in fact, it has already adopted it in so far as the employees of the national government are concerned.

Independent of official action, employers with advanced ideas here and there throughout the United States are providing compensation plans on their own account. In some instances a sort of joint insurance has been adopted to which both the employer and the employee contribute. In other cases the plan has taken the form of a fund established by the employer out of premiums formerly paid casualty insurance companies. In each instance the effort has been to provide the injured with hospital and medical care; half or full pay during disability; often a pension for total incapacity, and not infrequently in case of death an allowance to dependents equal to the earnings of the deceased for one, two, or three years.

The employers who are doing this are far-sighted and constructive. They are not only preparing themselves and the industries in which they are engaged for a condition that is rapidly coming upon them, but they are adopting early the most scientific and humane plan yet proposed for dealing with this problem.

Wherever adopted the plan of compensation has given general satisfaction. It has proven the most equitable system that has so far been devised. It has in it elemental justice, since it compels each industry to bear its own cost in human life as well as in the wear and tear of machinery, a cost which in time will be so adjusted that it will fall upon the consumer and not upon the individual worker and his family or even upon the individual employer.

---

Why will a curly-haired man always wear his hair longer than other men? Ah! from babyhood up women have admired his curls, and they have turned his head till he believes the greater the curl the greater the admiration.

# The History of Gas Lighting in Vallejo

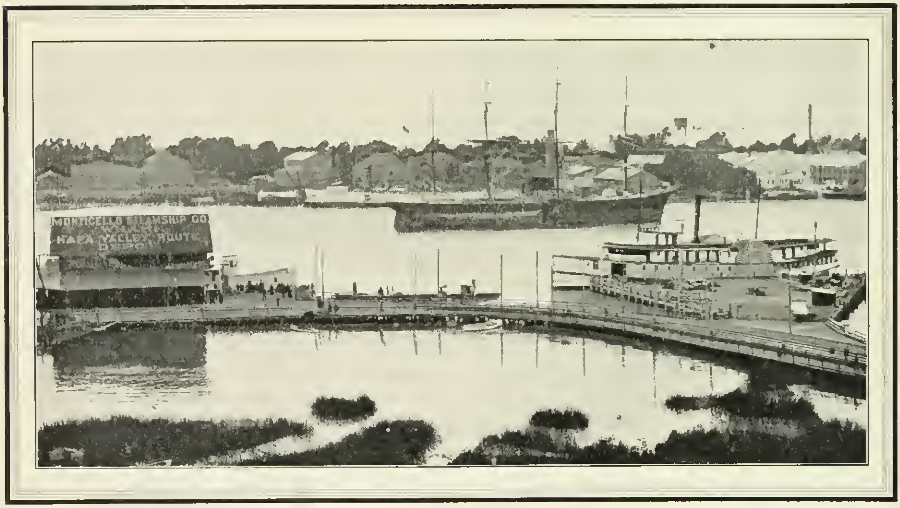
By E. C. JONES, Chief Engineer Gas Department.

E. C. Jones

**Vallejo was created** in the belief that it was to be the capital of California. In early days Santa Barbara and then Monterey had been the old Spanish and Mexican capitals. California's first legislature had met at old Monterey in the winter of 1850, and later, upon urgent solicitation and the extension of many glowing promises, had moved the seat of government to the more convenient town of San Jose, which proved too small to house the few score legislators that came in by stages and wagons in the rainy season.

Then came the princely offer of General M. G. Vallejo. He would give the state a site for a capital, and he would erect upon it a state house. For did he not possess an immense Mexican grant of 250,000 acres of land, including most of what is now Solano County and all of Mare Island, the reserve pasture where he kept his mares? In early days in California mares were always pastured, never worked. San Jose increased her bid; she would deed a park area of several city blocks. Ah! but General Vallejo would give the state a townsite up at the head of San Francisco bay, accessible both by land and by water and on the regular route between San Francisco and the mines and nearer to the centre of population in that pioneer period, when the tributaries of the Sacramento held their tens of thousands of gold seekers.

So, in January of 1852 the legislators converged upon the new state capital at Vallejo. They came by river steamers, in the rain, and they found only a long, wooden, barn-like building standing dismally at the edge of the tules that skirted the narrow strait, across which the city of Vallejo, with some 15,000 people, now looks boldly and un-




A Bit of Vallejo's Waterfront, Looking Across to the Mare Island Navy Yard

A Residence Section of Vallejo, as Viewed From the Waterfront

afraid at the warlike equipment of the Mare Island Navy Yard. Those early legislators shivered, they sneered, and perhaps some of them swore, for the town to be was not there yet. The wooden state house was about the only shelter in sight. Financial difficulties had come to General Vallejo, and he had not been able to fulfill his expectations. So the next year near-by Benicia became the capital, and had San Jose and Sacramento as hopeful rivals until Sacramento the next year won out with better promises. Again the fates had been unkind to the Vallejos.

Here it is of interest to introduce a bit of little-known California history as related in San Francisco a few years ago by Mrs. F. A. Van Winkle of Colusa, who as Miss Frances Anne Cooper of Howard County, Missouri, arrived in California with her father's family in 1846, and the 3d of October of that pre-pioneer year settled with the family at what is now Napa. Here is her story in part:—

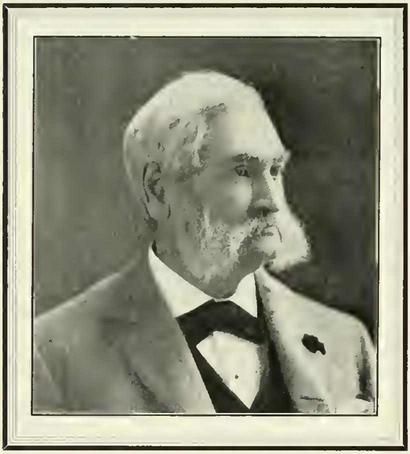
"Father had moved to San Francisco, now called Benicia, and had started a boarding house. Dr. Semple, who was a native of Kentucky, owned nearly all the land where the town is now. In those days that was thought to be the coming city. The present San Francisco was but an insignificant group of tents occupied by Spanish people and bearing the name Yerba Buena. Governor Vallejo had made Dr. Semple a present of half of Benicia, believing that he would build it up.

"I was married in Benicia in the fall of 1847. The ceremony was performed [by ex-Governor Boggs of Missouri] in the big dining-room of my father's boarding house.

"My husband, Dr. Semple, owned the only ferry-boat at Benicia. It was often said that he made enough money with it to sink that boat a half dozen times over, but he was one of the most remarkable speculators I ever knew, and went right through his money.

"Our town was San Francisco, but the people down here took the name away from us. Dr. Semple opposed them, but it did no good. They named this place San Francisco, and dropped the name Yerba Buena. So Dr. Semple called his town Benicia, after Mrs. Vallejo, whose maiden name was Francisca Benicia. We lived in Benicia just four years, then moved to what is now Colusa. My [first] husband [Dr. Semple] owned half of Colusa, old Colonel Hager owning the other half."

To be a state capital is not always the best thing for a town; not always its only excuse for existence. Vallejo grew any way, and by 1866 it had become such a good-sized community that then M. P. Young, who had been connected with the San Francisco Gas Company, went up to Vallejo and started a gas works. It was a good deal on the style of the Vallejo state house; short on architecture and stability, but long on



General John B. Frisbie, the First President

fresh air. In fact, it had no roof, no building. The apparatus was out in the open, and there was a 7,000-foot holder floating in a redwood tank that leaked so copiously that the fireman had to spend part of his time pumping water back into it, according to the story as briefly related by T. R. Parker, whose article on "Auld Lang Syne" before the twelfth annual meeting of the Pacific Coast Gas Association in 1904 has been freely borrowed from for this sketch.

Very properly Vallejo celebrated the 4th of July in 1866 by having her first gas lighting that night. They needed gas lights in Vallejo in winter. It was a mucky job for pedestrians groping about through deep, mushy, sticky adobe mud. Other California towns during the preceding twelve years had started using gas at the rate of about $10 a thousand, but Vallejo began modestly at $7.50. And what happened to the man who began the business on that basis? He discovered John Lee, a hotel proprietor, sidetracking the gas meter and stealing a supply direct, and the discovery cost Young his life, for Lee's vengeful bullet proved fatal a month after the shooting the 21st of August, 1867.

In 1867 H. M. Snow, one of the progressive business men of Vallejo in those days, started a new gas company and secured the coöperation of John W. Pearson of San Francisco and General John B. Frisbie, for whom the Vallejo passenger steamer General Frisbie is named. Their company erected a new gas works at the foot of Maine street. The plant consisted of three benches of 3's and a 20,000-foot holder. The producing capacity was about 30,000 cubic feet of gas a day. Peter F. Fagan was this company's first superintendent, and W. J. Tobin its first secretary. About $8,000 was expended upon the plant, and pipes were laid in Santa Clara, Georgia, Sacramento, and Marin streets, and twelve street lights were furnished the town free of charge. But the receipts from consumers were only about enough to pay the running expenses. After a year's operation Frisbie and Snow bought out Pearson. And the next year Snow became convinced that the business was not a paying investment, so he sold out his interest to Frisbie, who thus became sole owner.

John B. Frisbie came across the plains to California in 1849 as a captain in Stephenson's regiment, and when the Society of California Pioneers was formed in 1850, Frisbie was number 80 on the roll of its 500 charter members, among the 100,000 people that had rushed into California in 1849 and the 420 other Americans who had been earlier straggling in, from the first one who arrived in 1801 to the sixty-five who came in 1848.

In 1870 the gas works was moved to its present location, down at the waterfront on Maryland street, between Marin and Sonoma streets, and there a new works was erected with a capacity that could, it was thought, be enlarged to supply a city of 25,000 people. There were two benches of three retorts each, and these retorts were each nine feet long. At that time the service, through a system of 20,000 feet of pipe, supplied 200 consumers, about 800 gas burners, and fourteen street lights. It cost about $4.64 a thousand to make gas then, and Vallejo was being supplied at the comparatively low price of $6 a thousand.

It was not until 1871 that the transactions of the company began to appear of record on the minute book. The earliest entry shows that General John B. Frisbie was president, and that the capital stock was then $40,000. November 10th of that year the capital was increased to $250,000, and $75,000 of it was issued.

In 1876 a two-inch gaspipe line was laid across the bottom of the channel to Mare Island to supply gas to that place. The laying of this pipe was accomplished by J. R. Smedberg, an engineer identified with the San Francisco company. The advance end of the pipe was buoyed up by two empty barrels to keep the pipe from running foul of obstructions on the bottom or becoming clogged with mud. After the connection was completed an Otto gas engine and exhauster were used to force the gas through the pipe. A small holder was built on the Mare Island side from which to supply the consumers rather than subject them to the direct pulsating pressure of the pump.

November 10th, 1877, J. K. Duncan, who had been one of the early stockholders, was elected president of the company.

The 2d of June of 1882 E. J. Wilson, a prominent citizen of Vallejo, became president.

It was not until June 7th of 1883 that the business had become sufficiently profitable to warrant a dividend, and then the first one was declared, sixteen years after the founding of the company.

June 16th, 1886, the works was leased for a year to Alexander Badlam, who had been a well-known early San Franciscan, and it appears of record that June 3d of the following year the vote was to let the Badlam lease go on from month to month; but there is no entry as to just when it terminated.

At the annual meeting June 7th, 1889, they were considering the advisability of going into the electric lighting business, but it does not appear that they got any further than considering. At that meeting G. W. Wilson, now a bank president of Vallejo, was elected secretary.

At the annual meeting in June of 1895 S. C. Hilborn was made president.

In October of 1896 a unique and hitherto unattempted gas engineering feat was accomplished, when a second lift was added to the original 20,000-foot gas holder while the holder was still in use.* The old single-lift holder was changed to a telescopic, two-lift holder. A new holder would have cost between $5,000 and $7,000, and would have required new ground, or the removal of the old holder, but a double capacity was given the old holder at a cost of only about $1,700. The old holder was forty feet in diameter, sixteen feet high, and was suspended inside six redwood columns twelve inches thick and braced with wooden girders. As it was the only holder in the city at that time it was necessary to keep it in use during the change. The wooden columns were extended in height, and a staging was constructed so that the new holder could

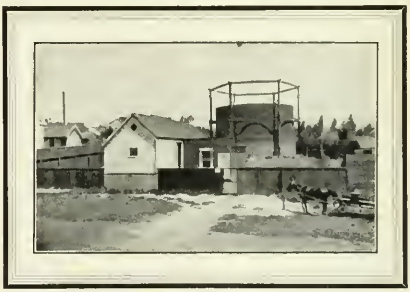
*Editorial Note:—The plan of this bit of engineering was conceived by E. C. Jones, though he modestly omits his connection with it.

be built. The difficult part of the problem was to build a cup under the old holder without interrupting its regular use. The bottom rollers were taken off, wooden rollers eight inches in diameter were fastened to the

The Old Coal-Gas Works at Vallejo; on the left the Purifying House, on the right the Retort House

columns about two feet and a half above the top of the wall, and some two-inch by four-inch pieces of wood were fastened vertically against the side of the holder for the rollers to run on. Thus the holder was kept from tilting. The bottom cup was made in six sections of four-inch channel iron, the outside sheet eighteen inches wide, the inside sheet twenty-four inches wide. Five sections of the cup were riveted and bolted together around the old holder before they were connected; the cup was then suspended to the holder by chains, and a turnbuckle was put on, and the cup drawn tightly around the holder, leaving only a section of about three feet to be put in after the five sections had been bolted to the old holder. The holes had been punched in the cup sheet, but those in the old holder were drilled, and, as rapidly as drilled, were temporarily plugged with wood. The bolting of the cup up around the old holder required the creation of an ingenious little contrivance designed for the purpose. It consisted of a U-shaped section of gaspipe, one end of which was slotted to hold the head of the bolt and leave the threaded end projecting toward the other arm of the U. Then the end holding the bolt was introduced under the holder, the U righted to the perpendicular, so that a pointer fastened in the outside arm of the U exactly opposite the slot on the inside arm, when advanced till it touched a wooden plug and then drawn directly back, would bring the screw end of the bolt exactly against the inside of the hole and a further backward pull on the U would bring the screw on through. The projecting end of the screw was then gripped, and the U device withdrawn from the head of the bolt, and the nut screwed on the outside. From bolt to bolt this process was continued. This whole plan of enlarging the holder capacity of a small gas works became a model for other comparatively small works that desired to increase their capacity without interfering with the workings of their plant. The mechanical construction of this work at Vallejo was carried through by the late L. F. Fogg.

June 6th of 1902 F. W. Hall became the president, and October 14th, 1904, S. J. McKnight was chosen to head the company, and November 11th the old minute



The Office, the Meter-room, and the Gas Holder to Which a Second Lift Was Added While In Use

book records the last meeting of the old company's trustees.

December 18th, 1905, the Vallejo company passed to the ownership of the California Gas and Electric Corporation, and twelve days later a deed conveyed it to the Pacific Gas and Electric Company.

Up to the time of the transfer of ownership to the California Corporation Vallejo's gas had been made from coal. But immediately after the works passed to the new owners a thoroughly modern equipment was substituted to manufacture gas from fuel-oil.

For the nineteen years from 1886 to 1905 John W. Thomas was superintendent of the Vallejo Gas Company, and served it faithfully, and ever since the transfer in ownership he has continued to be a reliable figure identified with the gas business at Vallejo.

As it stands today the works occupies both sides of Maryland street. The old purifying house, the retort house, and a fuel-oil tank are on the water side of the street, and have a small L-shape pier extending into the channel, where oil barges come up and discharge the fuel-oil that is now used in the manufacture of Vallejo's gas. Across the street is the original 20,000-foot holder, with its additional lift that makes its total capacity 40,000 cubic feet, and near by is a relief holder for 20,000 cubic feet.

## A Draughting-Room Decision

The draughting room decided to put a stop to the bickering by leaving the case to "Brick" Johnson, though Brown had been close enough to see the whole transaction better than any body else. It seems Pinger had let Hinton have two two-cent stamps, and Hinton, without Pinger's noticing the coin, had, in payment, slipped a nickel down on the edge of Pinger's drawing table. The question then as to who was a "grafter" was decided by Johnson, who rendered judgment thus: "Hinton took Pinger's stamps, but is innocent. Pinger, if he took Hinton's nickel, is also in-a-cent. But if Brown got the scent he is probably nine times more in-a-cent than Pinger." Then somebody hurled an ink bottle at the judge, and quiet again reigned in the draughting room. H.

## Fire!

### The Cause and the Remedy

The fire loss for the past ten years in the United States has averaged $250,000,000 a year. This amount is approximately equal to the government's revenue from the tariff, and it is five times as great as the annual fire loss of any European country. Statistics credit this tremendous destruction of property in the United States to two principal causes: one, carelessness of individuals, and two, ignorance in the application of proper precautions in the construction of buildings.

An example of personal carelessness was a recent fire caused by the storing of a barrel filled with damp straw. Five days later the straw ignited from spontaneous combustion.

Two fires have recently occurred because of faulty construction of wooden roof timbers; the timbers had been placed too close to smoke stacks.

The remedy: See that similar conditions do not exist in any of this company's properties. R. J. C.

## Cash Prizes for Employees

All employees of the Pacific Gas and Electric Company are hereby invited to tell briefly "How to Get New Consumers."

Prizes aggregating $50 will be given for brief articles containing the best suggestions. For the best article the cash prize will be $20, and for the three next best the cash prizes will be $10 each. If you have some good ideas, this is your chance. "Do it now."

Following are the conditions:

1. Write plainly, preferably with typewriter.
2. Use only one side of paper.
3. Limit yourself to 400 words or less.
4. Sign your name and address plainly.
5. Get your article in before February 1st.
6. Send it addressed—Pacific Gas and Electric Company, 445 Sutter Street, San Francisco.

# Pacific Gas and Electric Magazine

PUBLISHED IN THE INTEREST OF ALL THE EMPLOYEES OF THE PACIFIC GAS AND ELECTRIC COMPANY

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## EDITORIAL

**We Wish You This:**

To you who labor with your brawn, to you who work with eye and brain, to each of you at Christmas dawn, we wish you joy, a day urbane; we wish you health, with worries gone; we wish your wish you may attain; that lov'd ones' cheeks may not be wan; that sorrow, sadness, gloom, and pain—as dewdrops on a verdant lawn—may disappear, and then again show you smiling, braver, drawn on to be your best, with might and main.

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**Just a Little Kindlier**

Born in a barn, the child of a humble carpenter, the habitual gentleness of the Man of Many Sorrows was forecasted by the song the startled shepherds heard as angel voices singing from the sky, "Peace on earth, good will toward men." Down through nineteen centuries the phrase has been applied to the annual celebration of that man's birth.

"Peace on earth, good will toward men." What does it mean? Less of war and strife and bitterness, less of fighting and quarreling and anger, less of frenzied rivalry and destructive competition, less of unfair dealing and hard advantage, less of resentment and retaliation; and more of genuine gladness and good cheer, more of kindliness to kindred, more of consideration for the aged, more of courtesy and confidence in the family circle, more of what the word meant when it used to be written a "gentle man," a man in strength, a woman in tenderness.

"Peace on earth, good will toward men."

And a Happy New Year to all of you.

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**Pictures and Their Story**

In these days of kodaks and sketch artists and quick reproducing processes the printed page often tells half the story at a glance.

You may wonder whose is the picture that makes this month's frontispiece. We do not know. It is a photographic study that seemed so pleasing, so appropriate to the season, that it was chosen as a little inspiration for all of us.

The biographical page has a new illustrated heading. It is the work of a San Franciscan, a Stanford man who won the Portola poster prize contest in competition with some two hundred other artists when he created the rose-garlanded young woman who tripped lightly down the steps. Quite appropriately the new heading is a combination of sketches of the company's gas works at Sacramento and its electric power plant at Colgate.

And now, you who have interesting pictures, please remember that some of them may be useful in these pages; that your contributions of photographs, short items, and original articles must form the material for this magazine, which may be considered a progressive report on the province and the personnel of the company.

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That persons "electrocuted" can be restored to life is the claim of Dr. Louise G. Rabinovitch, a young Russian woman recently arrived in New York from Paris. Her demonstrations in restoring animals have amazed watching scientists and opened up a great hope for electrical workmen.

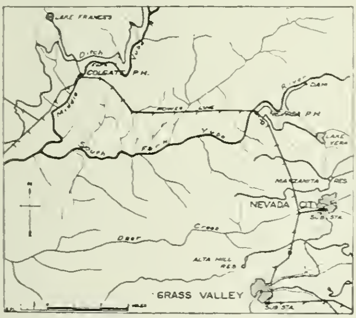
# The History of the Nevada Power Plant

By ARCHIE RICE.

Archie Rice

**In the heart** of mountainous Nevada County, where the miners' outlook is upon a green, corrugated world of Sierra ridges, tumbling up half a mile from the depths of winding cañons that carry the snow-water from the summits down toward the distant sea, there is a little hydro-electric plant, hidden at the bottom of a gorge and clinging just above the high-water mark of the South Yuba river.

There it has stood since the pioneering and experimental period of long-distance transmission of electric energy, and for the past thirteen years has continued constantly gener-




Where the Nevada Power Plant is Located

ating the subtle current and sending it five miles to the mines and homes of Nevada City and on three miles further to the mines and homes of Grass Valley.

Small, as measured by the standard of the gigantic plants of a later day, and comparatively more expensive of operation than those producing on a larger scale, this early arrival upon the scene of California's electrical development has gone on all these years generating night and day an average of 800 kilowatts, or nearly 1,100 horsepower, a product, if measured at one cent a kilowatt hour, representing earnings of nearly $1,000,000.

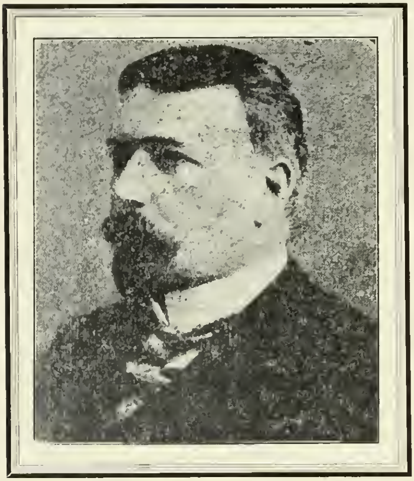
### THE NUCLEUS OF A GIGANTIC SYSTEM

Apart from the interest attaching to this installation in connection with the electrical development of a large number of rich mines on the mother lode, in the greatest gold-producing county in the Golden State, this Nevada power plant has a peculiar historical interest, because it was the nucleus of the Nevada County Power Company, which was conceived in 1891 and later (September 1st, 1900) combined with the Yuba Power Company to form the beginning of the Bay Counties Power Company, that grew until (March 1st, 1903) its possessions, with others, were merged into the California Gas and Electric Corporation, a great system which (January 2d, 1906) came under the control of a still more comprehensive concern, the Pacific Gas and Electric Company of today.

### ITS PURPOSE AND FOUNDER

The creation of that earliest plant, based upon the principle of generating power produced by water diverted from a river and then led to a point where it would fall from a great height, was the idea of Eugene J. de Sabla, Jr., a name associated intimately with many of the big hydro-electric enterprises of California.

"I owned some mining interests at Nevada City," he explained, "and I started by trying to get electric power for use in the mines. The problem was to take water by ditch from the South Yuba and, by a gradient less than the river's, carry it down to some point where a sufficient fall could be secured to operate electric generators. Land and water rights were acquired, plans made



Eugene J. de Sabla, Jr.

for the undertaking, a site selected for a dam, and, some three miles further down stream, a spot chosen for a power house at a point on the river about 1,500 feet above the level of the ocean.

"But it 's a joke—the calling of that little plant the 'Rome' power house. It is the Nevada power house. The nickname came about in this way: Romulus R. Colgate was associated with me later in establishing the plant at Colgate, over on the Middle Yuba. After that big one had been named for him, some of us got to referring to the little fellow over on the South Yuba as the 'Rome' power plant, 'Rome' being the familiar shortening of Colgate's first name."

### THE MAN BEHIND IT

Back of every enterprise there is some special man, and you can generally forecast its growth when you know the capabilities and personality of that individual. Among the French, it is always "Find the woman" in the case. But in modern business developments it is, Find the man!

In September of 1901 the present writer published an illustrated page article in the "San Francisco Chronicle," entitled "Having Many Irons in the Fire: the Busiest Men in San Francisco." There were six on the list at that time: James D. Phelan, George A. Newhall, John Bermingham, Prince Poniatowski, John Martin, and Eugene J. de Sabla, Jr. It happens that the last three were founders of the hydro-electric plants now comprising the chief mountain sources of this company's system. Eugene de Sabla has since turned his attention to other interests, but what was written of him then indicates the type of man he had become while developing some of California's most notable hydro-electric enterprises. This is what was published of him more than eight years ago:

Eugene J. de Sabla, Jr., is president and manager of the Bay Counties Power Company, an $8,177,000 concern, with 550 miles of pole lines in fourteen counties, about 4,000 miles of wire, and about 500 employees. He is president of the Yuba Electric Company, president of the Butte Power Company, a director of the California Central Gas and Electric Company, a director of a land company in Nevada County, a director of three gold-mining companies, two of them in northern California and one of them in another state, and he is a director of an oil company operating in the Kern fields. He is also an active member of the Pacific Union and Olympic clubs.

#### A CALIFORNIAN AND A MANAGER

Eugene J. de Sabla, Jr., is a native of California, and a tall man of powerful build. Apparently he is not yet 40, nor is he a college-trained man, but he has had seventeen years of broad business experience. It began when he was a partner in the firm of Eugene de Sabla & Co., importers of coffee from Central America. He has always been an employer and never an employee, and has perfected his methods entirely from experience as a managing director of affairs, rather than as a man who has worked up and known the difficulties and details of minor positions.

Five years ago the Bay Counties Power Company started as a plant with ten miles of pole line and 1,000 horsepower to furnish an electrical supply and light to Grass Valley and Nevada City, and today it has 184 miles of transmission, 550 miles of pole line, and 15,000 horsepower, all of which is practically being doubled. The concern is furnishing power and light to railroads, mines, twenty different towns, flour mills, ice-manufacturing companies, warehouses, and the Selby Smelting Company.

Usually de Sabla spends only about seven hours a day in his office, but he is always the last man to leave it. When he is out on a trip of inspection he works all day and travels at night, sleeps when he can and as little as he can, sometimes on a steamer, sometimes on a train, often in a buggy.

BUILDING THE RIVER DAM

The inception of the Nevada plant on the South Yuba dates back to 1891, when an effort was first made by de Sabla's proposed Nevada County Electric Power Company to

The River Dam and Headgate of the Flume in 1895

put a dam across the river and prepare for a ditch and flume system. But in the spring of 1892 this original dam of logs was swept away by the fury of the flood waters.

With E. J. de Sabla, Jr., as manager of the company and Alfred Tredgido as its superintendent another dam was started August 1st, 1895, and it was completed November 20th. This dam was of logs piled crib-fashion, and it was bolted firmly down to bedrock in the river. It was twenty-eight feet high and measured one hundred and seven feet across the crest from bank to bank at that point in the cañon. Before the cribs could be filled with rock and gravel ballast the river began rapidly rising, and the men had to abandon the work. Fortunately the "slickens" washed down from hydraulic mining districts formed so material a part of the turbid stream that every chink and cranny of the crib-work was soon packed solid with a deposit that made the dam more substantial than if it had been filled by man. Work on the flume for this dam had been started July 6th, and it was completed November 28th. The flume itself was made six feet wide and four and a half feet deep, and its construction took a force of 110 men working nearly four months and using 1,250,000 feet of lumber. The grade was a quarter of an inch to the rod, equivalent to a drop of 26$\frac{2}{3}$ feet to the mile, and the distance traversed was three and three-tenths miles. Through this flume a constant flow of 5,800 miner's inches of water was to be delivered into a steel pipe, three feet in diameter and 298 feet long, down the final slope for an actual perpendicular fall of 190 feet to the wheels. That was the full supply of water to the power house for the first two years of its operation.

During October of 1896 Alfred Tredgido was succeeded as superintendent by L. M. Hancock.

MAKING LAKE VERA

March 1st, 1898, a crib dam fifty-four feet high and 327 feet across the crest from bank to bank was started in Rock Creek to back water up into a partially excavated basin that had formerly been the scene of hydraulic diggings. It was completed November 27th. This reservoir area of about forty-two acres,

Constructing the Flume for the River Dam in 1895

larger than a city district three blocks one way by four blocks the other, was then named Lake Vera, for one of E. J. de Sabla's little daughters. Lake Vera had a storage capacity sufficient to furnish a constant flow of

The South Yuba and the Mountain-side Flume From the Dam Three and One-tenth Miles Up-River

1,000 miner's inches for a period of thirty days. A viaduct was constructed from this lake to convey water a distance of two and three-fourths miles through 2,340 feet of flume and 11,404 feet of ditch (most of it an old mining ditch) to a small forebay, on the hillside 1,870 feet from the Nevada power house and 785 feet above it perpendicularly. From this forebay the water shot down through a twenty-inch steel pipe to additional impulse wheels installed in the same building with those originally established. After the acquisition of the Lake Vera source the 190-foot fall secured through the flume from the dam on the South Yuba was called the low-head; and the 785-foot drop produced by the viaduct from Lake Vera, the high-head.

SOURCES OF THE WATER POWER

While the low-head flume is supplied chiefly from the river dam, it receives a supplementary flow from another ditch that takes water out of the South Yuba fifty or sixty miles further up-stream. The high-head supply of water by way of Lake Vera comes indirectly from an enormous watershed catchment area of 121 square miles of Sierra slopes and snow-capped peaks in the region northward of the Southern Pacific railroad between Emigrant Gap and Summit. A series of twenty-four storage reservoirs, holding an aggregate of more than 2,000,000,000 cubic feet of water, conserves the melting snows and the mountain rivulets of that vast area and forms the source of what is known as the company's South Yuba Water System of 450 miles of viaducts. Part of the product in these twenty-four reservoirs is conveyed to the Auburn side of the ridge, and is carried off down that way as a great irrigating system for 13,000 acres of hillside orchards.

Constructing the Lake Vera Dam in 1898

With the creation of the high-head supply from Lake Vera it was no longer necessary to maintain the low-head flow at the original maximum of 5,800 miner's inches, so the flume capacity from the river dam was reduced to 3,800 miner's inches, which is now its normal flow.

THE FLUME FROM THE LAKE

While the Lake Vera dam was being constructed in 1898 the flume and ditch leading from it were also made ready. This flume is three and a half feet deep by four feet wide,

The Ditch Flowing Into Lake Vera, Bringing Water from the Deer Creek Power House

The other part is conveyed toward Nevada City and Grass Valley for domestic and irrigating purposes in that region. This Grass Valley water supply comes down from Emigrant Gap through Main ditch, Chalk Bluff ditch, Cascade ditch, and Snow Mountain ditch, and first forms the motive power for the company's Deer Creek power plant, which is at an altitude 3,500 feet above the sea. After driving the Deer Creek impulse wheels, part of the flow is carried on several miles by ditch to form the main source for Lake Vera, which has a very small natural catchment.

Lake Vera in the Formative Period, Looking Eastward From the Dam and Showing John Martin in the Foreground

The River Dam As It Looks Today with Its Heavy Facing of Granite

and has a gradient so gradual that the water takes an hour and five minutes to run from Lake Vera, a distance of two and three-fourths miles, to the small forebay above the power house. About two-thirds of the way from the lake to the lower end of the ditch is Myer's Ravine, a big gorge, across which the water is conveyed in an inverted, or U-shape, syphon, a thirty-six-inch pipe 668 feet long, that crosses the cañon and connects the separated ends of the flume.

In July of 1900 George Scarfe succeeded L. M. Hancock as superintendent of the Nevada power plant, and, excepting one year, he has been the superintendent of that power division ever since.

BURSTING OF THE LAKE DAM

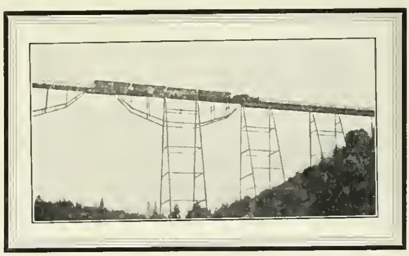
April 2d, 1905, a part of the Lake Vera dam, twenty-nine by thirty feet, gave way and permitted an outflow that dropped the water level at the rate of an inch a minute. When the break occurred the depth of water in the lake was fifty-two feet. A force of men was rushed to the work of repair, and the gap was closed with wood and cement. The dam is now but forty feet high, and the storage capacity of the lake is equivalent to a constant flow of 1,000 miner's inches of water for only ten days instead of thirty.

In 1908 the original crib dam three miles upstream on the South Yuba was substantially fortified with a granite wall on the downstream face, twelve feet thick at the base and tapering to a thickness of two feet at the top.

So much for the water power and its sources and channels.

THE COMMERCIAL SIDE

As a business proposition the enterprise started under the name of the Nevada County Electric Power Company. The contract for the construction of the dam, flume, and power house was given to John Martin, a name that in a few years was also to become widely identified with mammoth hydro-electric generating enterprises in California. The great installations that he and de Sabla created are all now owned by the Pacific Gas and Electric Company. The actual supervision of the construction of the dam and the flume was left to Alfred Tredgido, who became the



The Little Nevada County Narrow Gauge Railroad Across Ridges and Ravines to Nevada City

Nevada County company's first operating superintendent.

While John Martin was harnessing the South Yuba for this power, Eugene J. de Sabla, Jr., was busy in the Nevada City and Grass Valley mining districts interesting mine owners for the purpose of securing consumers for the proposed load. Many of the mine managers were skeptical as to the efficiency and practicability of this prospective transmitted river power, and during the first year of operation, there were but few customers among the mines. The W. Y. O. D., the Homeward Bound, and the Gold Hill mines in the Nevada district were the first to use the power, and they were followed by the Pennsylvania, the Brunswick, the Allison Ranch, and the North Star in the Grass Valley district, and then by the Mountaineer in the Nevada district. But no mine that installed a motor to take this electric power ever abandoned its use unless the mine itself was closed for some other reason. All that the enthusiastic de Sabla had promised came true. Those earliest installed electric machines are still doing the work in the mines.

#### DIFFICULTIES OF TRANSPORTING MACHINERY

The roads of Nevada County climb and dive and climb and dive again over ridges and through forests. They were built in the early mining days on the principle of "get there quick," without any attention to easy gradients or future permanence, and the same old

Where the Massive Machinery Was Unloaded at the Top of the Ridge to Be Skidded Down Half a Mile roads have continued in use with little improvement in grades.

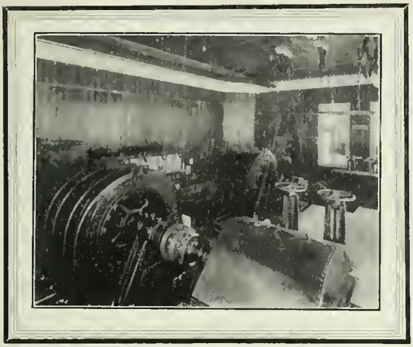
All the machinery for the Nevada power plant had to go by rail to Colfax, and thence

Hauling the Machinery to the Power House in 1895

on the little Nevada County Narrow Gauge Railroad across ridges and ravines to Nevada City. From there the problem was to get it to the site selected for the plant. The old wagon road for a distance of about three miles had to be widened in places and improved. It was all up grade. A stretch of nearly two miles of new road had to be built on up to the top of a ridge through underbrush, cactus, small pines and scrub oak, and it was hard work. Big teams, many of them twelve-horse, were used to haul the heavy pieces of machinery up to the top of the "slide," 1,700 feet elevation above, and half a mile from, the site of the plant. Each generator weighed 11,200 pounds, and that was some weight to pull all that way up to the top of the ridge, just beyond the crest of which the loads were deposited. Then began the tug-of-war with men and heavy hawsers and stout cables cautiously sliding the valuable machinery down hill on skids mounted on log rollers, while big tree stumps served as capstans, from round which slowly to pay out the rope and lower away the load. The first 400 feet down was by wagon. Then came the lowering by cables—400 feet at an angle of 25 degrees, 600 feet at an angle of 32 degrees, 80 feet at an angle of 35 degrees, and finally 220 feet at an angle of 39 degrees. In this laborious fashion, the machinery was delivered to the narrow ledge that had been scooped off at the edge of the river, down in the bottom of the V-shaped cañon. No plant could have been crowded into more cramped quarters than that Nevada power house and its boarding house. Each is hugging the river bank and backed into the wall of the cañon so tightly that they had to be placed on opposite sides of the stream, with a suspension bridge connecting them across the river itself. The

The Nevada Power House on the South Yuba River

At the left is the original building, on the right the larger part added in 1898. The pipe-line on the left is the lower-head from the river flume; the one on the right, the high-head from the Lake Vera flume. Note the steep pipe-line stairway on the extreme left, and the hanging stairway at the extreme right, leading to the wagon road that climbs out of the cañon and goes over the ridge to Nevada City.



The Two Original 300-Kilowatt Generators

rushing river water is their front yard, and there is no back yard.

THE POWER HOUSE AND ITS FOUNDATIONS

The power house foundations are on solid bedrock granite. Steel rods three-fourths of an inch thick are sulphured down into that virgin rock, and they rise perpendicularly through a bed of eighteen-inch solid concrete and come on up through heavy timbers to which they are bolted. Upon massive beams thus firmly secured rests the generating machinery.

Despite all the physical difficulties of the site, not a single mishap or delay occurred in the installation of that plant.

Along the last and steepest part of the "slide," the water pipes had to be laid and anchored to make them secure for the function of carrying the flume water swiftly down to drive the impulse wheels. As first installed, the low-head pipe went down in diminishing sizes to increase the density of the final jet. For the first 120 feet the pipe diameter was forty-eight inches; for the next 100 feet, forty-four inches; and for the last 100 feet, forty-two inches. This pipe discharged into a large steel receiver from which the water shot against the wheels.

THE ORIGINAL INSTALLATION

For the original installation there were two, 300-kilowatt, 133-cycle, two-phase, Stanley, inductor-type generators, making 400 revolutions a minute, and generating at 5,500 volts. Each was direct-connected to three-foot Pelton impulse wheels. Three of these Pelton wheels were used on one generator, and four on the other. The generators were guaranteed to have a commercial efficiency of 94.6 per cent. and an electric efficiency of 98 per cent. Each of the seven Pelton wheels had two nozzles, and the two generators together developed about 800 horsepower.

The first switchboard consisted of open-air, automatic circuit breakers. They were supposed to break the circuit, but, as George Scarfe relates, "they did not always do it, and at times there were many fine displays of fireworks." But the deficiencies of the equipment in those early days of hydro-electric generation have taught lessons that have been the means of producing many of the improvements and economies introduced into the plants later established.

From the switchboard the two-phase lines were carried out through the end of the power house to an eight-mile pole line ending at Grass Valley and having a midway branch to Nevada City. This pole line was run up hill and down in a right-of-way cleared sixty feet wide through a brushy and timbered country. Round poles, cut from the right-of-way and reaching thirty feet above the ground, were used, and on them

The Original Pole Line, as Built in 1895 were crossarms with triple-petticoat, white-porcelain insulators, manufactured by the Locke Company. These insulators are still in use, but the poles and crossarms have all been renewed.

When the power plant was being built Grass Valley and Nevada City were electric-lighted by a series system from a small plant owned by K. Caspar, now proprietor of an electric lighting system in Vallejo. The Caspar plant was bought by the new Nevada County Electric Power Company, and a substation established in Grass Valley and one in Nevada City. Step-down transformers were placed in these substations to reduce the 5,500-volt current from the new Nevada hydro-electric plant on the South Yuba to a voltage of 2,200 for use in the mines. The small house transformers stepped-down this 2,200-volt current to a 550-volt current for small motors used in a foundry and in a planing mill, and further transformed it to a 110-volt current for city and domestic lighting.

#### DEMANDS FOR MORE POWER

The original installation proved so successful that demands began to be made for more capacity. Then it was that the Lake Vera dam was built and the high-head water power secured as a supplementary supply for the Nevada power house. To make use of this new supply of water, a corrugated iron building was erected in 1898-99 next to the original power house, and Tutthill water-wheels were installed to operate two more Stanley generators of the same size and description as the original two. These new generators each developed 330 kilowatts.

The Switchboard in the Newer Part of the Power House

The high-head wheels were mounted on the same shaft as the low-head wheels that got their impulse from the river flume. A switchboard, with Martin open-air switches, was put in the new building so that all the machines could be operated in parallel.

When, in 1900, still more power was demanded, arrangements were made with the Yuba Power Company's plant at Colgate (now also the property of the Pacific Gas and Electric Company) by which a 23,000-volt current was brought over the ridges to Grass Valley, where four 200-kilowatt transformers were installed to lower the voltage from 23,000 to 5,500, so that it could be combined with the initial power from the Nevada plant. At that time 23,000 volts was high power to be sent over a mountainous district frequented in winter by heavy snowfall, and the old-time electric men used to go out at night occasionally and watch apprehensively to see how the insulators would endure under the coating of snowflakes.

**The Boarding House**

Note the suspension bridge from the power house. High water almost reaches this foot-bridge. The boarding house is 33x80 feet, has ten bedrooms, each with hot and cold water and electric heat and light, a clubroom, a dining room, a bathroom, and a kitchen.

In March of 1907, according to C. Boyd, its present foreman, the little Nevada plant held out through a terrific rainstorm that shut down all the other hydro-electric plants of the system.

#### PRODUCTION AND PRIDE AT THE PLANT

The constant average production of the Nevada plant is now about 1,200 kilowatts, or 1,600 horsepower, which is about one-third as much as is usually produced by the company's oldest plant, the one at Folsom, where a huge volume of water from the American river falls only fifty-five feet and then is used again after it falls half that distance.

The plant at Colgate is producing about 19,000 horsepower, and the one at Electra about 26,000 horsepower. But probably at no other station of the company's system is there to be found greater pride in their plant than exists among the employees hidden down in that narrow cañon at the place they affectionately call "the 'Rome' power house."

# Electrical Development in Nevada County

By J. E. CALVERT, Foreman Grass Valley Substation.

J. E. Calvert

**The first electric** power generated in Nevada County was at a small water-driven plant installed at the Charomat mine, near Nevada City, by W. C. Clark in 1887. In the evening of the 5th of August of that year arc lights were seen for the first time in Nevada City.

Fire bells rang, the population of the mining town assembled. Everybody wanted to see the wonderful new illumination. Nobody missed seeing it.

The plant consisted of three Westinghouse, direct-current generators, with a capacity of 2,000 candlepower at a 100-volt pressure. The circuit, which included both Nevada City and Glenbrook Park, was of No. 6 wire, covered with a white, weatherproof insulation and strung along on trees and on poles.

To celebrate this great event properly series arc lights were hung all around the course of the racetrack, and Nevada City enjoyed the novel sensation of watching horseracing at night!

The system was soon extended to Grass Valley, three miles over the ridge, and Saturday night, August 27th, Grass Valley had its first electric lights. Again curious crowds thronged the streets and proudly eyed the dazzling arcs, just as the people of Nevada City had done three weeks earlier.

But the plant was not very successful, because of the great loss of voltage in the line. By November it passed to the ownership of John Glasson, and he moved the generating machinery to the Idaho-Maryland mine, where the water pressure was about 200 pounds to the square inch.

As business increased the new owner began to look about for a higher head of water in order to generate more electric energy by the use of more machines. So in April of 1894 he moved to a new location on Deer Creek, four and a half miles westward from Grass Valley. There the plant was enlarged by installing a 2,000-volt, 133-cycle, single-phase, alternating-current alternator, built by the United Improved Electric Company. The exciting current of this new machine was supplied by a three-horsepower, Westinghouse, shunt-wound generator.

The new transmission line consisted of two wires of No. 0 bare copper for supplying single-phase power, while the series arcs were supplied by a circuit of No. 6 copper, covered with a white weather-proof insulation. The arc lamps were manufactured by the Westinghouse Company, with the exception of a few 50-candle-power Bernstein lamps.

Water was taken out of Deer Creek about three-fourths of a mile above the power house

Grass Valley, a Mining Town of 10,000 People and conveyed through the Excelsior Ditch to a wooden penstock about 300 feet above the power house. From the penstock a 12-inch sheet-iron, riveted pipe carried the water down to the nozzles of two four-foot Pelton wheels. One generator was direct-connected to one of these wheels, the other was belted to a counter shaft, driven by the other Pelton wheel.

March 20th of 1896 Glasson sold out his plant to the Nevada County Electric Power Company. This company operated the Deer Creek plant for three years before shutting it down and disposing of the machinery for junk. It was during the year 1899 that the writer became identified with the county's electrical development. He was operator in charge of the Deer Creek plant during the months just prior to its being abandoned.

In 1896, for the first time, electricity was brought from the Rome power plant, on the South Yuba river, into Nevada City, just three years before the old Deer Creek plant was abandoned.

It should be mentioned here that the Nevada County Electric Power Company had already established a plant at the corner of Main and Stewart streets in Grass Valley, in what was known as the Shubridge building, and there had installed two General Electric, 50-light, constant-current transformers, each rated at 5,000 volts and 133 cycles. Being constructed with movable secondary coils and fixed primary coils these transformers were entirely automatic and needed no attention.

The first electric motor run in Nevada County was installed at the Gold Hill mine early in the year 1897. There it was used to drive a 150-horsepower compressor. The equipment consisted of a two-phase, 180-horsepower, synchronous motor separately excited by a Westinghouse direct-current, five-horsepower generator. To bring it up to synchronism a Stanley, two-phase, 550-volt, 15-horsepower motor was belted to its shaft. Later this machinery was moved to and installed at the Homeward-bound mine.

The first induction motor used in Nevada County was a Stanley-type, two-phase, 550-volt, 40-horsepower machine, installed in Boston Ravine at the Rogers mill, better known as the Gold Hill mill. This same motor is now regularly used as a starting motor in the car barn of the Nevada County Traction Company. This company operates the trolley line between Nevada City and Grass Valley.

The Grass Valley Substation in the Shubridge Building in 1895

The first electric hoist in Nevada County was erected at the Homeward-bound mine in August of 1898. It was operated by two 250-volt, direct-current motors, which received their current from two rotary converters, the alternating current voltage of which was 220, while the direct current voltage was 250. The Homeward-bound also used a General Electric, 30-horsepower, 250-volt, direct-current motor to drive a Cornish pump. The rotary converters were not very successful, so, in September of 1898, they were taken out and a motor generator set substituted in their place. The capacity of the motor was 180-horsepower, and was rated at 5,500 volts, 16,000 alternations, two-phase. It was belted to a General Electric, direct-current, class MP, 250-volt generator, which ran the two 250-volt hoist motors and a 30-horsepower, General Electric, 250-volt motor belted to a Cornish pump. A similar hoist was also installed at the Gold Hill mine. This type of hoist continued in use until the newer alternating-current, variable-speed, 60-cycle, three-phase motors were introduced. These represent the latest practice, and are now used quite extensively in the Grass Valley mining district.

The first substation of the Nevada County Electric Power Company in Grass Valley was situated at the corner of Main and Stewart streets. The switchboard equipment consisted of a Stanley, four-pole, double-throw, open-break switch connecting the main 5,000-volt circuit from the Rome power house to the bus bars. There were also two double-pole, single-throw, open-break switches connecting the two town circuits to the 2,000-volt bus bars. The main line voltage was stepped down through four dry-type Stanley transformers of forty kilowatts each, 5,000 volts primary and 2,000 volts secondary. The transformers had regular taps on the secondary side, the regulation being obtained by cutting in and out resistance coils made of No. 9 galvanized-iron wire tapped to a home-made rheostat.

The mine circuit was not brought into the Grass Valley substation, but was tapped off at a pole at the corner of Auburn and Empire treets. To cut out a mine circuit, it was necessary to open the line by knocking out a brass tubing with a pole. The tubing was eighteen inches long and was fastened into two jaws made of one-eighth-inch by one-and-a-half-inch spring brass. This primitive type of switch was in use until the year 1900, when the company bought land at the corner of Auburn and Empire streets and erected on it a corrugated-iron building. A switch board fifty feet long was put in this new building, and seventy-two open-break, Martin switches were installed for use on the different mine circuits.

In the fall of 1900 electric power was first brought in from the Colgate plant to four Stanley-type, oil-and-water cooled, 200-kilowatt, 23,000-volt primary, 5,000-volt secondary transformers, and was paralleled with the Rome power plant.

Nearly all the outgoing circuits were operated at 5,000 volts, two-phase, 133 cycles

The Grass Valley Substation of Today

until the three-phase, 60-cycle circuit from the Colgate plant was constructed. The first important load was taken on at the Allison Ranch mine, where a three-phase, 60-cycle, 300-horsepower, Westinghouse induction motor had been installed.

As the 60-cycle came more into use the company built a new substation at Grass Valley, back of the old one. This new substation is forty feet square. At present it contains nine 300-kilowatt, 60-cycle transformers, stepping from 23,000 volts to 2,400 volts. They are oil-insulated and water-cooled, and, being connected in Y on the low-tension side, deliver 4,400 volts, three-phase current. The different mines are supplied through General Electric, three-pole, single-throw oil switches, of which there are sixteen, connected to two sets of bus bars in a concrete subway beneath the marble panels.

# Two Epoch-Makers in the Electric World

WHEN Guglielmo (William) Marconi was only 26 years old—he is now but 34—he became famous that memorable 12th of December, 1901, by receiving at his experimental station in Newfoundland distinct clicks sent across the Atlantic by wireless telegraph from his station in England. Thus he finally proved the practical application of wireless telegraphy to commercial uses. He did not invent the wireless.

Guglielmo Marconi

He was born in Marzabotto, near the city of Bologna in Italy. His father was an Italian, but his mother was Irish, a highly cultured woman with considerable talent for music and a member of the well-known Guinness family of Dublin, famous as manufacturers of ale. Young Marconi was given a good education, ending with a college course, and then took up electricity, a subject in which he had been much interested from early boyhood. He is a quiet, thoughtful man and a hard worker, and is the business head of the Marconi Wireless Telegraph Company, operating in England and America.

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A one-page ad run just once in "The Saturday Evening Post" costs $3,000. Why? The paper has a circulation of 1,250,000 copies, and the chances are that a considerable percentage of about 5,000,000 reading and intelligent people may see that ad. That is the theory of advertising: putting it where the right people will see it. If you wished to announce a special bargain sale at your local store, it would do you no good to scatter 10,000 handbills on some distant Indian reservation.

MICHAEL FARADAY discovered the principle of the dynamo. He died forty-two years ago, at the age of 76. He was born near London, September 22d, 1791. When he was 22 he was appointed an instructor in chemistry in the Royal Institute at London, and at the age of 24 began his great career of investigation and discovery in electricity and magnetism. In August of 1831, when he was nearly 40, he made five remarkable experiments extending over a period of ten days. All these experiments had to do with the principles of the generation of electricity, now so well known in connection with the electric dynamo.

Michael Faraday

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## Getting Experience

C. Bond, foreman at the Nevada power house, tells how years ago he was laid off for "monkeying with the machinery":—

"When I started to work as an oiler at the Rome power house November 14th of 1902 electricity and its ways were Dutch to me. But after I had been on the job two weeks I thought I knew a whole lot about the business. To prove this to myself I threw the switches in on a 'dead' machine and then opened them again on a 'dead' short. Whew! There was an arc that I shall never forget. For my trouble I was laid off for a month. When I resumed my duties at the power house I decided it would be better for me to learn from the experience of others instead of experimenting on my own account with powerful electric currents."

# College Men in the Company

AMONG the employees of the Pacific Gas and Electric Company are representatives from ten European, one Canadian, and thirty-three American colleges, making a total of one hundred and one different individuals with college experience. The ratio of college to non-college men is one to thirty-six, or less than 3 per cent. of the company's force.

Just how much a college training counts depends mostly upon the capacity of the individual and also to a great extent upon the quality of the college and the time spent there. It is of record that the little old "Univeristy of Hard Knocks" has turned out many a good man. But the product of a college is judged by its alumni who have been out in the world sufficiently long to have struck their pace in their chosen vocations.

The purpose of a college has been expressed as the training of men who are to rise above the ranks; it is to get a man ready to be a master adventurer in the field of modern opportunity. The college is intended to stimulate in a large number of men varied resourcefulness which would be stimulated in only a few if the development were left to nature and circumstances. The percentage of colleges that fall short of this ideal is perhaps no greater than the percentage of collegians that are not good subjects for development.

With these ideas in mind it will be interesting to look over the accompanying list of colleges and their products that have come into the company. Some persons, it will be seen, did not graduate; those who did, received their graduation degrees: A. B., bachelor of arts; B. S., bachelor of science; Ph. B., bachelor of philosophy; LL. B., bachelor of laws; M. E., mechanical engineer; M. S., master of science; D. D. S., doctor of dental surgery; M. D. V. S., doctor of veterinary surgery.

Very naturally half the college element has come from California's two big universities, the state university supplying thirty men and Stanford twenty.

The hydro-electric field with long-distance transmission of energy has offered comparatively a new vocation for the college-trained man, and that is why, perhaps, the class years show rather recent dates and so few early graduates from Berkeley, though California's state university turned out its first class way back in 1872. The very first class to complete the four-year course at Stanford, the "pioneer class" that graduated in 1895, has furnished the company four men; California's '04 class has furnished six men; and Stanford's '05 class, five.

That some college graduates of recent years are engaged in ordinary construction work is no reproach to their collegiate training. Most all the engineering chiefs have had to come up by that same practical route. The reproach comes when their college training does not enable them to advance faster than the average man who has not had university opportunities.

| NAME | CLASS YEAR | DEGREE OR TIME | WHERE EMPLOYED |
|---|---|---|---|
| LESHAFTS COLLEGE (St. Petersburg, Russia) | | | |
| B. H. Kuechen | | (1½ year) | San Francisco |
| MOSCOW UNIVERSITY (Moscow, Russia) | | | |
| B. L. Zellensky | | (1 year) | San Francisco |
| UNIVERSITY OF TURIN (Turin, Italy) | | | |
| Santiago Merle | | | San Francisco |

| NAME | CLASS YEAR | DEGREE OR TIME | WHERE EMPLOYED |
|---|---|---|---|
| San Augustin College (Madrid, Spain) | | | |
| F. J. Hodgkinson | | (3 years) | Fresno |
| Lycee Imperiale de St. Omer (France) | | | |
| J. E. Poingdestre | | (Completed various courses) | Marysville |
| St. John's University (Ireland) | | | |
| J. Fitzgerald | | | San Francisco |
| Grosvenor College (Carlisle, England) | | | |
| T. E. Marrs | | (3 years) | San Jose |
| King's College (London, England) | | | |
| T. E. Marrs | | (1 year) | San Jose |
| Marlborough College (England) | | | |
| H. C. Beauchamp | | | Nevada City |
| Vickery's University (England) | | | |
| H. G. Howard | | | Oakland |
| Montreal College (Canada) | | | |
| E. J. Roy | | | Oakland |
| New Hampshire State College (New Hampshire) | | | |
| C. W. Martin | | | Sacramento |
| Massachusetts Institute of Technology (Boston, Mass.) | | | |
| H. C. Blake | | | Construction Department |
| William R. Morgan | 1889 | M. E. | San Francisco |
| W. C. Spencer | | (2 years) | Construction Department |
| Yale University (New Haven, Conn.) | | | |
| W. B. Bosley | 1892 | A. B.; 1894, LL. B. | San Francisco |
| New York University (New York city) | | | |
| A. L. Wilcox | 1903 | B. S. | San Francisco |
| Vanderbilt University (Maryland) | | | |
| William H. Kline | 1890 | LL. B. | San Francisco |
| Stevens Institute (Hoboken, N. J.) | | | |
| George C. Holberton | 1891 | M. E. | San Francisco |
| Washington and Jefferson College (Pennsylvania) | | | |
| Paul W. Murphy | | (3 years) | Construction Department |
| Purdue University (Lafayette, Ind.) | | | |
| Earle B. Henley | 1904 | Completed Course | San Francisco |
| Valparaiso University (Valparaiso, Indiana) | | | |
| John Spencer | | | Construction Department |
| Armour Institute (Chicago, Ill.) | | | |
| Harold B. Winters | | | Construction Department |
| University of Michigan (Ann Arbor, Mich.) | | | |
| H. J. Brower | | (1 year) | Oakland |
| St. Mary's College (Kentucky) | | | |
| G. C. Thompson | | | Oakland |
| University of Tennessee (Tennessee) | | | |
| R. C. Compton | | | San Francisco |
| Tashio College (Tashio, Mo.) | | | |
| George R. Anderson | | (1 year) | Construction Department |
| University of Missouri (Missouri) | | | |
| A. U. Brandt | 1899 | B. S. | Oakland |

| NAME | CLASS YEAR | DEGREE OR TIME | WHERE EMPLOYED |
|---|---|---|---|
| **Western Veterinary College (Kansas City, Mo.)** | | | |
| J. A. Meacham | 1897 | M. D. V. S. | Construction Department |
| **Washington College (Missouri)** | | | |
| Paul M. Downing | 1891 | B. S. | San Francisco |
| **University of Wisconsin (Madison, Wis.)** | | | |
| D. M. Young | | | De Sabla |
| S. J. Lisberger | 1903 | B. S.; M. S. 1909 | San Francisco |
| **University of Minnesota (Minneapolis, Minn.)** | | | |
| Ove J. H. Michelet | 1894 | (2 years) | San Francisco |
| **Colorado Agricultural College (Colorado)** | | | |
| H. P. Kelley | | (2 years) | Oakland |
| **Utah Agricultural College (Utah)** | | | |
| J. R. Carl | | (2 years) | Electra |
| R. P. Crookston | | (1 year) | Electra |
| **University of Washington (Seattle, Wash.)** | | | |
| T. J. Ludlow | 1897 | | Construction Department |
| **Washington Agricultural College (Pullman, Wash.)** | | | |
| C. R. Gill | | | Sacramento |
| J. Z. Strauch | | | Sacramento |
| **Oregon Agricultural College (Corvallis, Ore.)** | | | |
| Don C. Ray | 1896 | | Grass Valley |
| **Columbia College (Milton, Ore.)** | | | |
| (Miss) Rose Frendig | 1903 | | San Francisco |
| **University of Southern California (Los Angeles, Cal.)** | | | |
| Walter R. Bisbee | 1899 | (2 years) | San Francisco |
| **Santa Clara College (Santa Clara, Cal.)** | | | |
| D. A. (Gus) White | | (later 80's) | San Francisco |
| O. D. Dewey | | (2 years) | San Jose |
| Walter J. Walsh | | (1 year) | San Jose |
| C. T. O'Connell | | (5 years) | San Jose |
| Joseph B. Kent | 1905 | | Construction Department |
| **Sacred Heart College (San Francisco, Cal.)** | | | |
| D. A. (Gus) White | 1892 | | San Francisco |
| J. D. Sweeney | | | Oakland |
| L. Melbourne | | | Oakland |
| E. J. Angelo | | | San Francisco |
| **St. Mary's College (San Francisco, Cal.)** | | | |
| D. A. (Gus) White | | (later 80's) | San Francisco |
| H. D. Hanifin | | | San Francisco |
| S. C. Wafer | | | |
| **St. Mary's College (Oakland, Cal.)** | | | |
| W. E. Bell | | C. E. | Oakland |
| R. Crossman | | | Oakland |
| **University of the Pacific (San Jose, Cal.)** | | | |
| C. A. Smith | | (7 months) | Construction Department |

| NAME | CLASS YEAR | DEGREE OR TIME | WHERE EMPLOYED |
|---|---|---|---|
| **University of California** (Berkeley, Cal.) | | | |
| W. E. Osborn | 1880 | Ph. B. | Woodland |
| C. E. Sedgwick | 1893 | B. S. | San Francisco |
| J. U. Smith | 1894 | B. S.; M. S. 1899 | San Francisco |
| Charles J. Nelson | 1898 | B. S | Oakland |
| Clarence D. Clark | 1899 | B. S | North Tower |
| R. J. Brower | 1900 | B. S | Oakland |
| I. E. Flaa | 1902 | B. S | San Francisco |
| John O. Hansen | 1902 | B. S | San Jose |
| R. J. O'Connell | | (3 years) | Construction Department |
| H. C. Vensano | 1903 | B. S | Construction Department |
| James H. Wise | 1903 | B. S | San Francisco |
| E. L. Lord | | (4 years) | Construction Department |
| T. J. Ludlow | 1904 | | Construction Department |
| Stanley V. Walton | 1904 | B. S | San Francisco |
| William M. Walton | 1904 | D. D. S | Construction Department |
| Wallace H. Foster | 1904 | (1 year) | San Rafael |
| G. S. Johnson | 1904 | B. S | San Francisco |
| C. H. Warren | 1904 | B. S | San Francisco |
| John Spencer | 1906 | B. S | Construction Department |
| H. T. Graves | 1907 | B. S | Sacramento |
| W. H. Cilker | 1909 | | San Francisco |
| Robert Sorenson | 1909 | B. S | San Francisco |
| I. C. Steele | 1909 | B. S | Construction Department |
| W. Taylor | 1911 | (1 year) | San Rafael |
| H. G. Howard | 1912 | (1 year) | Oakland |
| W. B. Barry | | (2½ years) | San Francisco |
| John D. Kuster | | (Summer School) | San Jose |
| P. A. Thompson | | | Oakland |
| C. T. Carr | | (4 years) | Construction Department |
| James K. James | | | Construction Department |
| **Stanford University** (Stanford University, Cal.) | | | |
| Arthur H. Burnett | 1895 | A. B. | Richmond |
| Paul M. Downing | 1895 | A. B. | San Francisco |
| Walter Hyde | 1895 | A. B. | San Francisco |
| Archie Rice | 1895 | A. B. | San Francisco |
| F. V. T. Lee | 1897 | A. B. | San Francisco |
| J. E. Murphy | 1898 | (4 years) | San Francisco |
| Frank R. Stowe | 1900 | (5 years) | Construction Department |
| Leo H. Susman | 1901 | A. B. | San Francisco |
| George H. Bragg | 1902 | A. B. | San Francisco |
| Robert J. Hughes | 1903 | (4 years) | Construction Department |
| Leonard L. Hohl | 1904 | A. B. | Construction Department |
| J. H. McDougal | 1905 | A. B. | Sacramento |
| James W. Coons | 1905 | A. B. | Construction Department |
| A. L. Trowbridge | 1905 | A. B. | San Francisco |
| Harvey Shields | 1905 | A. B. | Construction Department |
| F. H. Trowbridge | 1905 | | Sacramento |
| Lloyd Henley | 1908 | | Construction Department |
| W. T. Tyler | 1909 | A. B. | San Jose |
| W. C. Spencer | | (1 year) | Construction Department |
| Ralph L. Milliken | | | De Sabla |

# The Source of San Francisco's Electricity

By EDWARD STEPHENSON, Engineer of Station A.

Edward Stephenson

**Out beyond** the Union Iron Works, in the Potrero district, is a huge steam-driven plant that generates all the electric light and power used in the city and county of San Francisco. The east wall of the building adjoins the great Spreckels Sugar Refinery, because when this electric plant was established about ten years ago it was owned by Claus Spreckels, who also owned the substantially rock-ribbed shore land on which it stands. The natural solidity of the site accounts for the splendid manner in which the building and its foundations have stood earthquake tremors and the constant vibrations of the massive machinery.

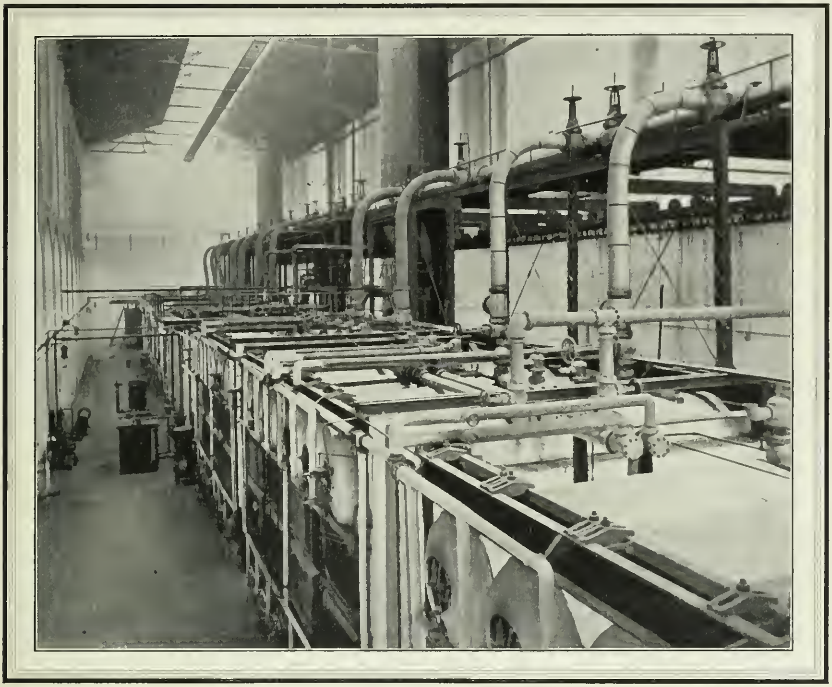
As there are eleven water-driven and eight steam-driven electric plants in the system controlled by the Pacific Gas and Electric Company this generating plant is designated as Station A.

In size and output it is the largest plant of its kind west of Chicago, and it requires the expert services of one hundred men to operate its machinery.

The building is an immense brick structure extending from street to street through a big city block. It is 450 feet long, 140 feet

**Station A, San Francisco**

It is at the corner of Twenty-third and Louisiana streets, and extends from Humboldt street (shown in the foreground) south to Twenty-third street. The smaller building is the office, with its main entrance on Humboldt street. The entire nearer part of the long double building contains the engine-room; the further part, the boiler room.



View in the Boiler Room, Looking South

wide, and 80 feet from its fireroom floor to its steel-ribbed roof of galvanized sheet-iron. A division wall runs the entire length of the building and makes of it two tremenduously big rooms of equal size.

The long room on the east side of this double building (the left-hand side in the picture) contains the twenty-seven steam boilers, the six boiler-feed pumps, the one salt-water fire-pump, the five economizers, the three auxiliary-exhaust feed-water heaters, the four fuel-oil pumps, the five fuel-oil heaters, and all the steam and water piping necessary to the operation of this big modern boiler plant, which has six smoke stacks and four induced-draught fans to accelerate the draft in the boilers and economizers.

The long room at the west side is the engineroom, and it also contains thirteen electric generators. Ten of the generators can supply San Francisco with all the electric light and power the city ordinarily uses. Three of the generators are used to supply the exciting current to run the ten others. The foundations for these big generators are built up fifteen feet above the main floor, and on a level with the tops of these generator foundations is the floor of the engineroom. On the main floor, which is below the level of the generators and the engineroom, are installed all the condensers, air-pumps, pipes, and such other equipment as can be placed below the engineroom floor.

Before the plant was finished it was sold by Claus Spreckels to the San Francisco Gas and Electric Company, and then the installation was completed.

The accompanying view of the outside of

the building conveys a very good idea of its massive construction and great size.

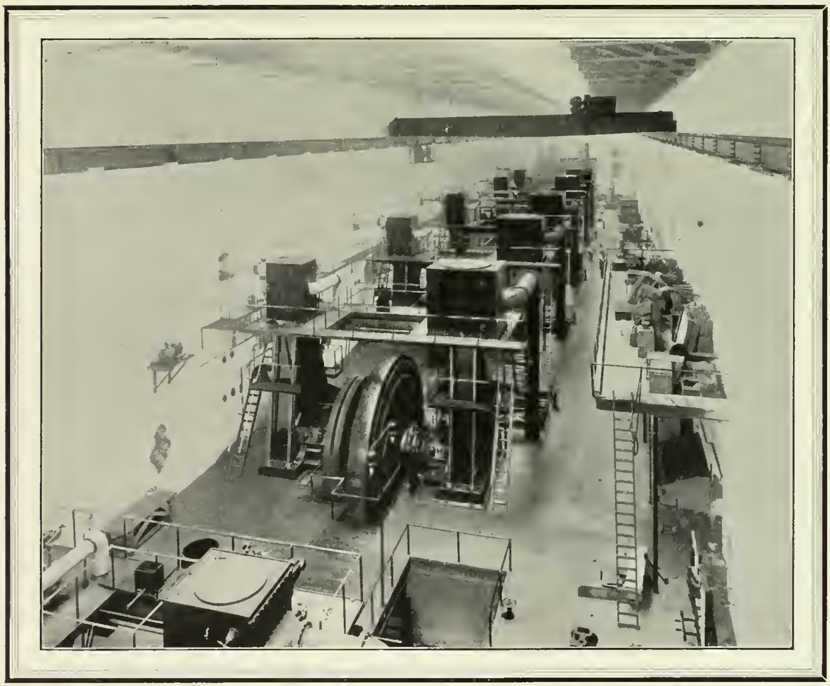
The boilers in this building are capable of daily converting 2,000,000 gallons of water into steam at a pressure of 200 pounds to the square inch. About thirty miles of four-inch boiler tubes are contained in the boilers and economizers. It is not often that the maximum capacity of the plant is needed, yet in winter time, during the period of short and dark days, it is quite usual to evaporate 5,000 tons of water a day and convert it into steam. The production of steam is the first step in a steam plant's generation of electric light and power.

To change 5,000 tons of water every twenty-four hours into steam at 200 pounds pressure requires an enormous amount of fuel. So much fuel is needed that if coal were used this great plant in itself would consume more coal every day than is now daily used in the entire city of San Francisco. Think of that. But fortunately the fuel is crude oil.

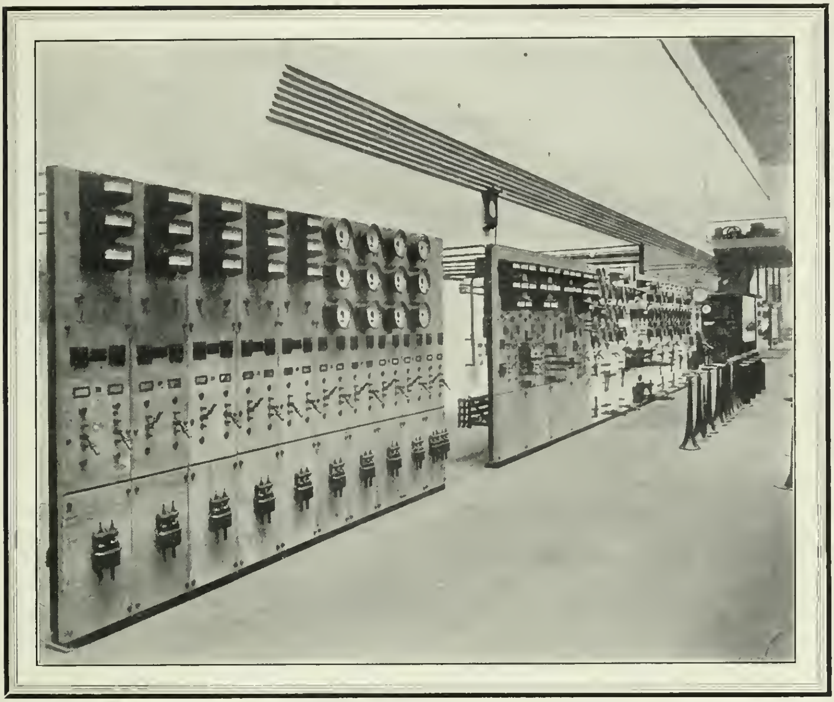
This plant uses 100,000 gallons of fuel-oil a day, when it is going some. But to handle this immense amount of oil happens to be about the easiest and simplest work about the station.

Of course fuel-oil can not be left round like coal. Elaborate containing tanks must be provided. They must be of a size sufficient to store a large reserve supply to protect the plant against the risks of delayed delivery.

Sometimes the railroad company can not get the oil-tank cars through from the wells. Sometimes the oil-carrying steamers are delayed. Sometimes the cross-country oil-pipe



View in the Engineroom, Looking South



Stationary Switchboard in the Engineroom

lines burst or need repairs. But despite any or all of these uncertainties Station A must keep going and keep giving to the people of San Francisco all the electric light and power they require.

The forethought of the company management in supplying such ample storage capacity at Station A has averted shut-downs. When the oil company has been short of oil the large reserve storage at Station A has given it a place from which to secure a temporary supply.

Steamships carrying 50,000 barrels, or 8,000 tons, of fuel-oil can come alongside the company's own wharf near its plant and discharge their oil cargoes directly into the storage tanks in about fifty hours. As there are two separate pipe lines the oil cargo from two oil-boats can be pumped out at the same time. Probably no other electric light and power plant in the world can handle its fuel in such large quantities and so quickly as can Station A. Fifty thousand barrels, or 8,000 tons, of oil can be received at one time in oil cars on the plant's own spur tracks, but the operation of pumping out the tank cars is slower than the pumping of the same amount of oil from the ships.

After the production of steam the next step in the making of electricity at Station A is the use of this steam to run the electric generators. Recriprocating engines are used to revolve the generators. Six of these engines are of the McIntosh and Seymour standard compound type of 2,200-horsepower capacity at normal load, two are of the Union Iron

Works triple-expansion type of 2,200-horsepower capacity, and two are of a Union Iron Works type and design similar to those used on the latest American battleships built by the Union Iron Works. These last two engines were rated by the Union Iron Works at 4,800-horsepower, but even after years of use the normal capacity of these two engines when working with the greatest ease and smoothness is about 6,300-horsepower, or more than 31 per cent. greater than the makers guaranteed them.

Every engine is supplied with condensers and air-pumps which are intended to receive and condense into water all the exhaust steam from the engines. This distilled water is then pumped back again into the boilers. Thus the cycle is maintained; the water condensed into steam, the exhaust steam converted again into water, and this water sent back into the boilers to be reconverted into steam, the endless round being maintained as long as the plant is operating.

Some idea of the length of time this operation has been unceasingly continued may be gained from the explanation that some of the engines have revolved more than 500,000,000 times since they were first installed.

In changing the exhaust steam from these engines back into water it is necessary to cool the steam until its latent heat has been abstracted. This cooling operation requires the use every day of about 75,000,000 gallons of salt-water. Think of it! That is twice as much water as the Spring Valley Water Company daily supplies to the entire city of San Francisco. To put it another way, Station A has to pump 150 gallons of water a day for each of the 450,000 people in San Francisco in order that the whole city may have all the electric light and electric power it needs.

The work of raising this salt-water requires four centrifugal pumps driven by electric motors. These four pumps are housed near the waterfront, about 1,000 feet east of Station A. The salt-water comes in from the bay 500 feet through a canal that is about fifty feet wide at the bay end and twenty feet wide at the pump end. The pumps are of the Byron Jackson type, and they work under a head of fifty feet. Three of them have a capacity of 30,000 gallons a minute, and the fourth has a capacity of 20,000 gallons a minute. They all discharge into a great thirty-inch cast-iron main, extending 1,000 feet to the electric plant. After this pipe reaches the station it has outlets at each condenser, at each cooler, and at any other places where salt-water may be required. Each outlet is provided with strainers of a standard pattern to intercept any dirt that may have passed the primary strainers at the suction end of each pump in the channel.

To keep all this system of machinery in repair and running smoothly requires the services of one hundred men, each an expert in his particular line. And when each man does his work well and gives full vent to his knowledge of the subject then Station A is entirely successful; and I am proud to say that this condition has been generally maintained. It is creditable to the men themselves that the efficiency at Station A is much higher as the years go by and the plant and the machinery grow older. This higher efficiency is due to the systematic way in which the men at this plant pull together and observe the rule that "a stitch in time saves nine." They not only put in the timely stitch, but, if the place be thin, they put on a patch in time and make things more secure. And the end is not yet, even after Station A has generated more than 500,000,000 kilowatt hours. She is still a big, sturdy, reliable producer of electric energy, because the men and the machinery keep working smoothly.

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Most baldness is caused by a derby or a high hat, the stiff, rigid rim of which tends to bind the head and retard the circulation of the blood to the scalp.

# The Fun in Handling Kickers

By S. A. WARDLAW, Counterman, San Francisco.

S. A. Wardlaw

**Nothing more** essentially contributes to the successful handling of complaints than a polite and agreeable manner backed up by a knowledge of the details of the business. The consumer must be made to feel that the company is always willing and ready to rectify any thing based on a legitimate complaint.

There are all sorts and types of people coming to the counter with their gas and electric troubles. They must be treated with tact, and on the general theory that honey catches flies, vinegar never. The angry and excited person who comes in full of the idea that the company is unreasonable must be met with "the smile that won 't come off."

While a great many complaints are unreasonable, there are many consumers who prove disposed and willing to learn the company's side of the story.

At times some humorous incidents happen, but during their narration the counter clerk must listen with respect and dignity.

An excited little Frenchman figets in. He has moved into a new flat without notifying the gas company. He has tried to turn on the gas himself to save ze trouble. And he has broken "ze pipe," which he now produces to prove his statement.

There is the amateur gas-fitter who goes down into his basement with a lighted candle to find out where the gas is leaking. He finds it, and he comes with a kick.

The Chinaman soft-pedals in and wants to know "what matter him gas clock?" And he 's right; the meter is a clock.

The Italian comes and gesticulates about "da meet, da meet," and he does n't keep a butcher shop either. He has had trouble with his meter, and has eaten garlic in order to come in and breathe defiance at the company.

Also there is the woman who has just about this to say: "I do n't see why my gas bill is bigger than any body else's on the block. Every woman I have talked with in our neighborhood has a smaller bill than ours and they have larger families!"

As an antidote for this feminine storm in comes the nice, kind, old lady who knows it is her mission in life to convert the counter clerk, and she takes time to it. But who can blame her? Take that either way you like.

No policeman is in sight, and so in comes this other woman to tell her troubles to the gas man, as she has known him as a patient listener before.

A colored man saunters in. He knows his business, well I guess yes! He kept every light lit in his boss's house while the family was away in the country because he was n't goin' to stay there all alone in the dark!

Occasionally the genus farmer plods in and kicks at having to put up "the forfeit," as he terms the deposit.

From time to time the newspapers publish in their joke column "funny ones" concerning gas. But these jokes are not all products of the imagination. If all the funny ones that actually happen at all the complaint counters in the country could be gleaned there would be funnier ones in print.

The hard thing is to make some people believe that you believe they believe what you are telling them when you know they do n't believe it. But to go through with the process and keep smiling is true diplomacy, and the counter clerk early learns that he must practice it on the public. While the consumer may think the counter man is making extravagant statements and promises, the consumer's feelings always respond to genteel and considerate treatment. "A soft answer turneth away wrath," and most people prefer taffy to epitaphy.

# How to Figure Cost of Electric Power

By S. V. WALTON, Manager Commercial Department.

S. V. Walton

**The purpose** of the accompanying tables is to enable any one to determine by them the cost of any amount of electric power. Suppose, for example, A has a plant to be equipped, say, with a 75-horsepower motor. He wishes to operate, say, 12 hours a day. He learns that he can secure electric current, say, at 3 cents a kilowatt hour.

He refers to the first table, and glances down the first column till he comes to 3 cents the kilowatt hour. Opposite that, in the next column, he sees 2.238 cents, which is the equivalent rate for one horsepower, since one horsepower equals 746 watts or .746 of one kilowatt. Then finding the column headed 12 and following it down to the line opposite the 3 cents of the first column he finds $10.95, which is the monthly cost, and opposite this, in the next column, is $131.40, which is the annual cost. Continuing on into the next column he finds $8.17, which is the monthly cost of one horsepower, and in the next column, just opposite, is $98.02, the yearly cost of one horsepower.

Multiplying these monthly and yearly horsepower costs by 75 he has the cost for his plant. Suppose now that he have his motor tested and find that it is taking only 60 horsepower. Then his power costs should be reduced accordingly, by figuring them at 60 horsepower instead of 75.

These tables save much figuring.

COST OF POWER (1 FULL MONTH - 730 HRS) ①

| HRS PER DAY | | 10 | | | | 12 | | | | 14 | | | | 16 | | | | 18 | | | | 22 | | | | 24 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HRS PER | | MONTH 304 | | YEAR 3650 | | MONTH 365 | | YEAR 4380 | | MONTH 426 | | YEAR 5110 | | MONTH 487 | | YEAR 5840 | | MONTH 548 | | YEAR 6570 | | MONTH 669 | | YEAR 8030 | | MONTH 730 | | YEAR 8760 | |
| RATE PER KW HR | RATE PER HP HR | COST | | | | COST | | | | COST | | | | COST | | | | COST | | | | COST | | | | COST | | | |
| (CENTS) | (CENTS) | KW HRS PER | | HP HRS PER | | KW HRS PER | | HP HRS PER | | KW HRS PER | | HP HRS PER | | KW HRS PER | | HP HRS PER | | KW HRS PER | | HP HRS PER | | KW HRS PER | | HP HRS PER | | KW HRS PER | | HP HRS PER | |
| | | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year |
| 3 | 224 | 91 | 10.95 | .68 | 8 17 | 1 10 | 13 14 | .82 | 9.80 | 1 28 | 15 33 | .95 | 11 44 | 1 46 | 17 52 | 1 09 | 13 07 | 1 64 | 19 71 | 1 23 | 14 70 | 2.01 | 24 09 | 1 50 | 17 97 | 2 19 | 26 28 | 1 63 | 19 66 |
| .35 | 261 | 1 06 | 12 78 | .79 | 9 53 | 1.28 | 15.33 | .95 | 11 44 | 1 49 | 17 89 | 1 11 | 13 34 | 1 70 | 20 44 | 1 27 | 15.25 | 1 92 | 23.00 | 1 43 | 17 15 | 2 34 | 28 11 | 1 75 | 20 97 | 2 55 | 30.66 | 1 91 | 22 87 |
| 4 | 298 | 1 22 | 14 60 | .91 | 10.89 | 1 46 | 17 52 | 1 09 | 13 07 | 1 70 | 20 44 | 1 27 | 15.25 | 1 95 | 23 36 | 1 45 | 17 43 | 2 19 | 26 28 | 1 63 | 19 60 | 2.68 | 32 12 | 2 00 | 23 96 | 2 92 | 35.04 | 2 18 | 26.14 |
| 45 | 336 | 1.37 | 16 43 | 1 02 | 12.25 | 1 64 | 19.71 | 1 23 | 14 70 | 1 92 | 23 00 | 1 43 | 17 15 | 2 19 | 26 28 | 1 63 | 19.60 | 2 47 | 29 57 | 1 84 | 22 05 | 3 01 | 36.14 | 2 25 | 29.55 | 3 28 | 39 42 | 2 45 | 29 40 |
| 5 | 373 | 1 52 | 18.25 | 1 13 | 13 62 | 1 83 | 21 90 | 1 36 | 16 34 | 2 13 | 25.50 | 1 59 | 19.06 | 2 44 | 29.20 | 1 82 | 21 78 | 2 74 | 32 85 | 2 04 | 24 50 | 3 34 | 40 15 | 2.50 | 29 95 | 3 65 | 43 80 | 2 72 | 32 67 |
| .55 | 410 | 1 67 | 20 08 | 1 25 | 14.98 | 2 01 | 24 05 | 1.50 | 17 97 | 2 34 | 28 11 | 1 75 | 20.97 | 2 68 | 32 12 | 2 00 | 23 96 | 3 01 | 36 14 | 2 25 | 26 96 | 3 68 | 44 17 | 2 75 | 32 95 | 4 01 | 48.18 | 3 00 | 35 94 |
| 6 | 448 | 1.82 | 21.90 | 1.36 | 16 34 | 2 20 | 26.28 | 1 63 | 19.60 | 2 56 | 30 66 | 1 91 | 22 87 | 2 92 | 35.04 | 2 18 | 26 14 | 3 29 | 39 42 | 2 45 | 29 41 | 4 02 | 48 18 | 2 99 | 35.94 | 4 38 | 52 56 | 3 27 | 39 21 |
| .65 | 485 | 1.98 | 23 73 | 1 47 | 17 70 | 2 37 | 28 47 | 1.77 | 21 24 | 2 77 | 33 22 | 2 07 | 24 78 | 3 17 | 37 96 | 2 36 | 28 32 | 3 56 | 42 71 | 2 66 | 31 86 | 4 35 | 52 20 | 3 24 | 38.94 | 4 74 | 56.94 | 3 54 | 42 47 |
| 7 | 522 | 2 13 | 25 55 | 1.59 | 19 06 | 2 56 | 30 66 | 1 91 | 22 87 | 2 98 | 35.77 | 2 22 | 26 68 | 3 41 | 40.88 | 2 54 | 30 50 | 3 84 | 45 99 | 2 86 | 34 31 | 4 69 | 56.21 | 3 49 | 41 93 | 5 11 | 61 32 | 3 81 | 45 74 |
| 7¼ | .541 | 2 20 | 26 46 | 1 64 | 19 74 | 2 65 | 31 76 | 1.97 | 23 69 | 3 09 | 37.05 | 2 30 | 27 64 | 3 53 | 42 34 | 2 63 | 31 58 | 3 97 | 47 63 | 2 96 | 35 53 | 4 85 | 58 22 | 3 62 | 43 43 | 5 29 | 63 51 | 3 95 | 47.38 |
| .75 | .560 | 2 28 | 27 38 | 1.70 | 20.42 | 2 74 | 32 85 | 2 04 | 24 50 | 3.20 | 38 33 | 2 38 | 28.59 | 3 65 | 43 80 | 2 72 | 32 67 | 4 11 | 49 28 | 3.07 | 36 76 | 5.02 | 60.23 | 3.74 | 44 93 | 5 48 | 65 70 | 4 08 | 49 01 |
| 7¾ | .578 | 2 36 | 28 29 | 1.76 | 21 10 | 2 83 | 33 95 | 2 11 | 25 32 | 3 30 | 39.60 | 2 46 | 29.54 | 3.77 | 45 26 | 2 82 | 33 76 | 4.25 | 50 92 | 3.17 | 37 98 | 5.19 | 62 32 | 3.87 | 46 42 | 5 66 | 67 90 | 4 22 | 50 64 |
| 8 | 597 | 2 43 | 29 20 | 1 81 | 21 78 | 2 92 | 35.04 | 2 18 | 26 14 | 3.41 | 40 88 | 2 54 | 30.50 | 3 90 | 46 72 | 2.91 | 34 85 | 4 38 | 52 56 | 3.27 | 39 21 | 5 35 | 64 24 | 3.99 | 47 92 | 5.84 | 70 08 | 4 36 | 52 27 |
| .85 | 634 | 2 58 | 31 03 | 1 93 | 23 15 | 3.10 | 37 23 | 2 32 | 27 77 | 3.62 | 45 44 | 2 70 | 32 40 | 4 14 | 49 64 | 3.09 | 37 03 | 4 66 | 55 85 | 3 47 | 41 66 | 5 69 | 68 26 | 4 24 | 50.92 | 6 21 | 74 46 | 4 63 | 55 54 |
| .9 | 671 | 2.74 | 32 85 | 2 04 | 24 51 | 3 29 | 39 42 | 2 45 | 29 40 | 3 83 | 45.99 | 2 86 | 34.31 | 4 38 | 52 56 | 3 27 | 39.21 | 4 93 | 59.13 | 3 68 | 44.11 | 6.02 | 72.27 | 4.49 | 53.19 | 6 57 | 78 84 | 4 90 | 59.81 |
| .95 | 709 | 2 89 | 34 68 | 2 16 | 25 67 | 3 47 | 41 61 | 2 59 | 31 04 | 4 05 | 48 55 | 3 02 | 36 21 | 4 63 | 55 48 | 3 45 | 41 39 | 3 21 | 62 42 | 3.88 | 46 56 | 6.36 | 76.29 | 4 74 | 56 91 | 6 94 | 83.22 | 5.19 | 62.08 |
| 1. | 746 | 3.04 | 36 50 | 2 27 | 27 23 | 3 65 | 43 80 | 2 72 | 32 67 | 4.26 | 51.10 | 3.18 | 38.12 | 4 87 | 58 40 | 3 63 | 43 57 | 5 48 | 65 70 | 4 09 | 49 01 | 6.69 | 80.30 | 4 99 | 59 90 | 7.30 | 87 60 | 5 45 | 65 35 |
| 1 1 | .821 | 3 34 | 40.15 | 2 50 | 29 95 | 4 02 | 48 18 | 3 00 | 35 94 | 4 69 | 56.20 | 3.50 | 41.93 | 5 36 | 64 24 | 4 00 | 47.93 | 6 03 | 72.21 | 4 50 | 53.91 | 7.36 | 88 33 | 5.49 | 65 89 | 8.03 | 96 36 | 5.99 | 71.88 |
| 1⅛ | .839 | 3 42 | 41 06 | 2 55 | 30 63 | 4 11 | 49 28 | 3 06 | 36 76 | 4 79 | 57 49 | 3 58 | 42 89 | 5 48 | 65 70 | 4 09 | 49.01 | 6.17 | 73 81 | 4 60 | 55 14 | 7.53 | 90 34 | 5.62 | 67 39 | 8.21 | 98.55 | 6 13 | 73 40 |
| 1 2 | 895 | 3 65 | 43 80 | 2 72 | 32 68 | 4 38 | 52 56 | 3 27 | 39.21 | 5 11 | 61 32 | 3 81 | 45 74 | 5 84 | 70.08 | 4.36 | 52 28 | 6.58 | 78.84 | 4 91 | 58 81 | 8.03 | 96 36 | 5.99 | 71.88 | 8 76 | 105 20 | 6.54 | 78 42 |
| 1¼ | .932 | 3 80 | 45.65 | 2 83 | 34 04 | 4 56 | 54 75 | 3.40 | 40.84 | 5 33 | 63 88 | 3 97 | 47 65 | 6 09 | 73.00 | 4.54 | 54 46 | 6 85 | 82 13 | 5.11 | 61 26 | 8 36 | 106.38 | 6 24 | 74 88 | 9.13 | 109 50 | 6 81 | 81 69 |
| 1 3 | 970 | 3 95 | 47 45 | 2 95 | 35 40 | 4 75 | 56.94 | 3 54 | 42 48 | 5.54 | 66 43 | 4 13 | 49 56 | 6 33 | 75 92 | 4.72 | 56 64 | 7 12 | 85 41 | 5 32 | 63.71 | 8 70 | 104 35 | 6.49 | 77 87 | 9 50 | 115 88 | 7 08 | 84 95 |
| 1 4 | 1044 | 4 26 | 51.10 | 3.18 | 38 12 | 5 11 | 61 32 | 3 81 | 45 74 | 5 96 | 71 54 | 4.45 | 53.37 | 6 82 | 81 76 | 5 09 | 61.04 | 7 67 | 91 98 | 5.72 | 68 62 | 9.37 | 112 42 | 6.99 | 83.87 | 10 22 | 122 64 | 7.63 | 91 49 |
| 1.5 | 1119 | 4 56 | 54 75 | 3 49 | 40.85 | 5 48 | 65.70 | 4 08 | 49.01 | 6.39 | 76.65 | 4.77 | 57.18 | 7 31 | 87 60 | 5.45 | 65 35 | 8.22 | 98.55 | 6 13 | 73.52 | 10.03 | 120 45 | 7 49 | 89 86 | 10.95 | 131 40 | 8 17 | 98 02 |
| 1 6 | 1194 | 4.86 | 58 40 | 3 63 | 43 57 | 5.84 | 70.08 | 4 36 | 52 28 | 6 82 | 81.77 | 5.08 | [illegible] | 7 80 | [illegible] | 5.81 | 69.71 | 8.77 | 105.12 | 6 54 | 78 42 | 10.70 | 128 48 | 7.99 | 95 85 | 11.68 | 140 16 | 8.71 | 104 56 |
| 1 7 | 1268 | 5.17 | 62 05 | 3 86 | 46 29 | 6.21 | 74 46 | 4.63 | 55 55 | 7 24 | 86.87 | [illegible] | [illegible] | [illegible] | [illegible] | 6 17 | [illegible] | 9 32 | 111.69 | 6 95 | 83 32 | 11.37 | 136.51 | 8.49 | 101 84 | 12 41 | 148 92 | 9 26 | 111.09 |
| 1¾ | 1305 | 5 32 | 63.88 | 3.97 | 47 65 | 6 39 | 76 65 | 4 77 | 57 18 | 7 46 | [illegible] | 5.56 | [illegible] | 8.52 | 02 20 | 6 36 | [illegible] | 9 84 | 114 98 | 7 15 | 85 77 | 11 46 | 140.53 | 8.73 | 104 83 | 12.78 | 153 30 | 9.53 | 114.36 |
| 1 8 | 1343 | 5 47 | 65 70 | 4 08 | 49 01 | 6.57 | 78 84 | 4 90 | 58 81 | 7 67 | [illegible] | 5 72 | [illegible] | 8 77 | 05.12 | [illegible] | [illegible] | 9 86 | [illegible] | 7.36 | 88 22 | 12.04 | 144 54 | 8.99 | 107 83 | 13 14 | 157 68 | 9.80 | 117 63 |
| 1 9 | 1417 | 5.78 | 69 35 | 4 31 | 51 74 | 6.94 | 83.22 | 5.17 | 62.08 | 8 09 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 6.90 | [illegible] | [illegible] | [illegible] | 7 77 | 93 12 | 12 71 | 152 57 | 9 48 | 113 82 | 13.87 | 166 44 | 10 35 | 124 16 |
| 2 | 1492 | 6 08 | 73.00 | 4 54 | 54 46 | 7 30 | 87.60 | 5.45 | 65.35 | 8 52 | [illegible] | 6 35 | [illegible] | [illegible] | [illegible] | 7 26 | [illegible] | 10 96 | 131 40 | 8 18 | 98 02 | 13 38 | 160 60 | 9.98 | 119.81 | 14 60 | 175 20 | 10.89 | 130.70 |
| 2 1 | 1567 | 6 38 | 76 65 | 4 76 | 57 18 | 7 67 | 91.98 | [illegible] | [illegible] | 8 95 | 107 31 | 6.67 | [illegible] | 10 23 | [illegible] | 7 63 | 81 49 | 11.51 | 137 97 | 8.58 | 102 92 | 14 05 | 168 63 | 10 48 | 125 80 | 15.33 | 183 96 | 11.44 | 137 23 |
| 2 2 | 1641 | 6 69 | 80 30 | 4 99 | 59 91 | 8.03 | [illegible] | 5.99 | [illegible] | 9 37 | [illegible] | 6 99 | [illegible] | 10.71 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 8.99 | 107 82 | 14 72 | 176 66 | 10.98 | 131.79 | 16 06 | 192 72 | 11 98 | 143 77 |
| 2¼ | 1678 | 6 84 | 82 13 | 3 10 | 61 27 | 8.21 | [illegible] | 6 13 | 73 52 | 9.59 | [illegible] | 7 15 | 85 77 | [illegible] | 131.40 | 8.17 | [illegible] | 12.33 | [illegible] | 9 18 | 110.27 | 15.05 | 180 68 | 11 23 | 134 78 | 16 43 | 197 10 | 12 23 | 147 03 |
| 2 3 | 1716 | 6 99 | 82 95 | 5 22 | 62.63 | 8 40 | [illegible] | [illegible] | 75 15 | 9.80 | 117 53 | 7 31 | [illegible] | 11 20 | [illegible] | 8 35 | [illegible] | 12 60 | 151 11 | 9 40 | 112 72 | 15 38 | 184 68 | 11 48 | 137 76 | 16 79 | 201 48 | 12 53 | 150.30 |
| 2⅜ | 1772 | 7 22 | 86 69 | 5 39 | 64 67 | 8.67 | [illegible] | 6 47 | [illegible] | 10.12 | [illegible] | [illegible] | [illegible] | 11 57 | 138 70 | 8.63 | 103 47 | 13.02 | 156 04 | 9 71 | 116 40 | 15 89 | 190 71 | 11 86 | 142 27 | 17 34 | 208 05 | 12 93 | 155.20 |
| 2 4 | 1790 | 7 30 | 87 60 | 5.44 | 65 35 | 8.76 | 105.12 | [illegible] | [illegible] | [illegible] | [illegible] | 7 62 | [illegible] | 11 69 | 140.16 | 8 72 | 104.55 | 13 15 | 157 68 | 9.81 | 117 63 | 16 05 | 192 72 | 11 98 | 143 77 | 17 52 | 210.24 | 13 07 | 156 84 |
| 2.5 | 1865 | 7 60 | 91 25 | 5 67 | 68.08 | 9.13 | [illegible] | 6 81 | [illegible] | 10 65 | [illegible] | [illegible] | 95 30 | 12 18 | [illegible] | 9.08 | 108.91 | 13 70 | 164 25 | 10 22 | 122.53 | 16.72 | 200 75 | 12 48 | 149 76 | 18 25 | 219 00 | 13.62 | 163.37 |
| 2 6 | 1940 | 7 90 | 94 90 | 5 90 | 70 80 | 9 49 | [illegible] | 7 08 | 84 95 | [illegible] | [illegible] | 8 26 | 99.11 | 12 66 | [illegible] | [illegible] | 113.27 | 14 25 | 170 82 | 10 63 | 127 43 | 17 39 | 208.78 | 12 98 | 155.75 | 18.98 | 227.76 | 14.16 | 169 90 |
| 2 7 | 2014 | 8 21 | 98 55 | 6 12 | 73 52 | 9 86 | [illegible] | 7 35 | [illegible] | 11.50 | [illegible] | [illegible] | [illegible] | 13.15 | [illegible] | 9 81 | [illegible] | [illegible] | 177 39 | 11 04 | 132.35 | 18 05 | 216 81 | 13 48 | 161 74 | 19.71 | 236 52 | 14 70 | 176 44 |
| 2 8 | 2089 | 8.51 | 102 20 | 6 35 | 76 24 | 10.22 | 122 64 | 7.62 | [illegible] | 11.93 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 10.17 | [illegible] | [illegible] | [illegible] | 11 45 | 137 23 | 18.73 | 224.84 | 13.98 | 167 73 | 20 44 | 245 28 | 15 25 | 182 97 |
| 2 9 | 2163 | 8 82 | 105 85 | 6.56 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 12.35 | [illegible] | 9.21 | 110 55 | 14 12 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 11 86 | 142.13 | 19 40 | 232.87 | 14 47 | 173.72 | 21 17 | 254 04 | 15 79 | 189 51 |
| 3 | 2238 | 9.12 | 109.50 | 6.81 | [illegible] | 10 95 | [illegible] | 8.17 | [illegible] | 12 78 | [illegible] | [illegible] | [illegible] | 14 61 | [illegible] | [illegible] | 130.70 | [illegible] | [illegible] | [illegible] | 147 03 | 20 07 | [illegible] | 14.97 | 179.71 | 21.90 | 262 80 | 16 54 | [illegible] |

## COST OF POWER. (1 Full Month = 730 Hrs.) (2)

| Hrs per day | | 10 | | | | 12 | | | | 14 | | | | 16 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hrs per | | Month 304 | | Year 3650 | | Month 365 | | Year 4380 | | Month 426 | | Year 5110 | | Month 487 | | Year 5840 | |
| Rate per K.W. Hr. (cents) | Rate per H.P. Hr. (cents) | Cost | | | | Cost | | | | Cost | | | | Cost | | | |
| | | K.W. Hrs per | | H.P. Hrs per | | K.W. Hrs per | | H.P. Hrs per | | K.W. Hrs per | | H.P. Hrs per | | K.W. Hrs per | | H.P. Hrs per | |
| | | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year |
| 3.1 | 2.313 | 9.42 | 113.16 | 7.03 | 84.41 | 11.32 | 135.78 | 8.44 | 101.29 | 13.21 | 158.41 | 9.85 | 118.17 | 15.10 | 181.04 | 11.26 | 135.05 |
| 3.2 | 2.387 | 9.73 | 116.80 | 7.26 | 87.14 | 11.68 | 140.16 | 8.71 | 104.56 | 13.63 | 163.52 | 10.17 | 121.98 | 15.58 | 186.88 | 11.62 | 139.41 |
| 3¼ | 2.424 | 9.88 | 118.63 | 7.37 | 88.50 | 11.86 | 142.35 | 8.85 | 106.19 | 13.85 | 166.08 | 10.33 | 123.89 | 15.83 | 189.80 | 11.80 | 141.59 |
| 3.3 | 2.462 | 10.03 | 120.45 | 7.49 | 89.86 | 12.05 | 144.54 | 8.99 | 107.82 | 14.06 | 168.63 | 10.48 | 125.80 | 16.07 | 192.72 | 11.98 | 143.77 |
| 3.4 | 2.536 | 10.34 | 124.10 | 7.71 | 92.56 | 12.41 | 148.92 | 9.26 | 111.09 | 14.48 | 173.74 | 10.80 | 129.61 | 16.56 | 198.66 | 12.35 | 148.12 |
| 3.5 | 2.611 | 10.64 | 127.75 | 7.94 | 95.31 | 12.78 | 153.30 | 9.53 | 114.36 | 14.91 | 178.85 | 11.12 | 133.42 | 17.05 | 204.40 | 12.71 | 152.48 |
| 3.6 | 2.686 | 10.94 | 131.40 | 8.17 | 98.03 | 13.14 | 157.68 | 9.80 | 117.63 | 15.34 | 183.96 | 11.44 | 137.23 | 17.53 | 210.24 | 13.08 | 156.84 |
| 3.7 | 2.760 | 11.25 | 135.05 | 8.39 | 100.75 | 13.51 | 162.06 | 10.08 | 120.89 | 15.76 | 189.07 | 11.76 | 141.04 | 18.02 | 216.08 | 13.44 | 161.19 |
| 3¾ | 2.797 | 11.40 | 136.88 | 8.51 | 102.11 | 13.69 | 164.25 | 10.21 | 122.53 | 15.98 | 191.63 | 11.91 | 142.98 | 18.26 | 219.00 | 13.62 | 163.37 |
| 3.8 | 2.835 | 11.55 | 138.70 | 8.62 | 103.47 | 13.87 | 166.44 | 10.35 | 124.16 | 16.19 | 194.18 | 12.07 | 144.86 | 18.51 | 221.92 | 13.80 | 165.55 |
| 3.9 | 2.909 | 11.85 | 142.35 | 8.86 | 106.20 | 14.24 | 170.82 | 10.62 | 127.43 | 16.61 | 199.29 | 12.38 | 148.67 | 18.99 | 227.76 | 14.16 | 169.91 |
| 4. | 2.984 | 12.16 | 146.00 | 9.07 | 108.92 | 14.60 | 175.20 | 10.89 | 130.70 | 17.04 | 204.40 | 12.71 | 152.48 | 19.48 | 233.60 | 14.53 | 174.26 |
| 4.1 | 3.059 | 12.46 | 149.65 | 9.30 | 111.64 | 14.97 | 179.58 | 11.16 | 133.96 | 17.47 | 209.51 | 13.03 | 156.29 | 19.97 | 239.44 | 14.89 | 178.62 |
| 4.2 | 3.133 | 12.77 | 153.30 | 9.53 | 114.37 | 15.33 | 183.96 | 11.44 | 137.23 | 17.89 | 214.62 | 13.34 | 160.10 | 20.45 | 245.28 | 15.25 | 182.97 |
| 4¼ | 3.170 | 12.92 | 155.13 | 9.64 | 115.73 | 15.51 | 186.15 | 11.57 | 138.87 | 18.11 | 217.18 | 13.38 | 162.01 | 20.70 | 248.20 | 15.44 | 185.15 |
| 4.3 | 3.208 | 13.07 | 156.95 | 9.75 | 117.05 | 15.70 | 188.34 | 11.71 | 140.50 | 18.32 | 219.73 | 13.66 | 163.92 | 20.94 | 251.12 | 15.62 | 187.33 |
| 4.4 | 3.282 | 13.38 | 160.60 | 9.98 | 119.81 | 16.06 | 192.72 | 11.98 | 143.77 | 18.74 | 224.84 | 13.98 | 167.73 | 21.43 | 256.96 | 15.98 | 191.69 |
| 4.5 | 3.357 | 13.68 | 164.25 | 10.21 | 122.54 | 16.43 | 197.10 | 12.25 | 147.05 | 19.17 | 229.95 | 14.30 | 171.54 | 21.92 | 262.80 | 16.34 | 196.04 |
| 4.6 | 3.432 | 13.98 | 167.90 | 10.43 | 125.26 | 16.79 | 201.48 | 12.53 | 150.30 | 19.60 | 235.06 | 14.61 | 175.35 | 22.40 | 268.64 | 16.71 | 200.40 |
| 4.7 | 3.506 | 14.29 | 171.55 | 10.66 | 127.98 | 17.16 | 205.86 | 12.80 | 153.57 | 20.02 | 240.17 | 14.93 | 179.16 | 22.89 | 274.48 | 17.07 | 204.76 |
| 4¾ | 3.543 | 14.40 | 173.38 | 10.77 | 129.34 | 17.34 | 208.05 | 12.93 | 155.20 | 20.24 | 242.73 | 14.75 | 181.07 | 23.13 | 277.40 | 17.25 | 206.94 |
| 4.8 | 3.581 | 14.59 | 175.20 | 10.89 | 130.70 | 17.52 | 210.24 | 13.07 | 156.84 | 20.45 | 245.28 | 15.26 | 182.98 | 23.38 | 280.32 | 17.43 | 209.11 |
| 4.9 | 3.655 | 14.90 | 178.85 | 11.11 | 133.43 | 17.89 | 214.62 | 13.34 | 160.10 | 20.87 | 250.39 | 15.57 | 186.79 | 23.86 | 286.16 | 17.80 | 213.48 |
| 5. | 3.730 | 15.20 | 182.50 | 11.34 | 136.15 | 18.25 | 219.00 | 13.62 | 163.57 | 21.30 | 255.50 | 15.89 | 190.66 | 24.35 | 292.00 | 18.16 | 217.83 |
| 5.1 | 3.805 | 15.50 | 186.15 | 11.57 | 138.87 | 18.62 | 223.38 | 13.89 | 166.64 | 21.73 | 260.61 | 16.20 | 194.41 | 24.84 | 297.84 | 18.52 | 222.18 |
| 5.2 | 3.879 | 15.81 | 189.80 | 11.79 | 141.60 | 18.98 | 227.76 | 14.16 | 169.90 | 22.15 | 265.72 | 16.52 | 198.22 | 25.32 | 303.68 | 18.89 | 226.64 |
| 5¼ | 3.916 | 15.96 | 191.63 | 11.91 | 142.96 | 19.16 | 229.95 | 14.30 | 171.54 | 22.37 | 268.28 | 16.67 | 200.13 | 25.57 | 306.60 | 19.07 | 228.72 |
| 5.3 | 3.954 | 16.11 | 193.45 | 12.02 | 144.32 | 19.35 | 232.14 | 14.43 | 173.17 | 22.58 | 270.83 | 16.84 | 202.04 | 25.81 | 309.52 | 19.26 | 230.90 |
| 5.4 | 4.028 | 16.42 | 197.10 | 12.25 | 147.04 | 19.71 | 236.52 | 14.70 | 176.44 | 23.00 | 275.94 | 17.16 | 205.85 | 26.30 | 315.36 | 19.61 | 235.25 |
| 5.5 | 4.103 | 16.72 | 200.75 | 12.48 | 149.77 | 20.08 | 240.90 | 14.98 | 179.71 | 23.43 | 281.05 | 17.47 | 209.66 | 26.79 | 321.20 | 19.98 | 239.61 |
| 5.6 | 4.178 | 17.02 | 204.40 | 12.70 | 152.49 | 20.44 | 245.28 | 15.25 | 182.97 | 23.86 | 286.16 | 17.79 | 213.47 | 27.27 | 327.04 | 20.34 | 245.97 |
| 5.7 | 4.252 | 17.33 | 208.05 | 12.93 | 155.21 | 20.81 | 249.66 | 15.52 | 186.24 | 24.28 | 291.27 | 18.11 | 217.28 | 27.76 | 332.88 | 20.70 | 248.32 |
| 5¾ | 4.289 | 17.48 | 209.88 | 13.04 | 156.57 | 20.99 | 251.85 | 15.66 | 187.88 | 24.50 | 293.83 | 18.26 | 219.19 | 28.00 | 335.80 | 20.88 | 250.50 |
| 5.8 | 4.327 | 17.63 | 211.70 | 13.16 | 157.93 | 21.17 | 254.04 | 15.79 | 189.61 | 24.71 | 296.38 | 18.43 | 221.10 | 28.25 | 338.72 | 21.07 | 252.68 |
| 5.9 | 4.401 | 17.94 | 215.35 | 13.38 | 160.66 | 21.54 | 258.42 | 16.07 | 192.78 | 25.13 | 301.49 | 18.74 | 224.91 | 28.75 | 344.96 | 21.43 | 257.03 |
| 6. | 4.476 | 18.24 | 219.00 | 13.61 | 163.38 | 21.90 | 262.80 | 16.34 | 196.04 | 25.56 | 306.60 | 19.06 | 228.72 | 29.22 | 350.40 | 21.79 | 261.39 |
| 6.1 | 4.551 | 18.54 | 222.65 | 13.84 | 166.10 | 22.27 | 267.18 | 16.61 | 199.31 | 25.99 | 311.71 | 19.38 | 232.53 | 29.71 | 356.24 | 22.16 | 265.75 |
| 6.2 | 4.625 | 18.85 | 226.30 | 14.06 | 168.83 | 22.63 | 271.56 | 16.88 | 202.58 | 26.41 | 316.82 | 19.70 | 236.34 | 30.19 | 362.08 | 22.52 | 270.10 |
| 6¼ | 4.662 | 19.00 | 228.15 | 14.18 | 170.19 | 22.81 | 273.75 | 17.02 | 204.21 | 26.63 | 319.38 | 19.86 | 238.25 | 30.44 | 365.00 | 22.70 | 272.28 |
| 6.3 | 4.670 | 19.15 | 229.95 | 14.29 | 171.55 | 23.00 | 275.94 | 17.15 | 205.85 | 26.84 | 321.93 | 20.02 | 240.16 | 30.68 | 367.92 | 22.88 | 271.46 |
| 6.4 | 4.774 | 19.46 | 233.60 | 14.52 | 174.27 | 23.36 | 280.32 | 17.43 | 209.11 | 27.26 | 327.04 | 20.33 | 243.97 | 31.17 | 373.76 | 25.25 | 278.82 |
| 6.5 | 4.849 | 19.76 | 237.25 | 14.74 | 177.00 | 23.73 | 284.70 | 17.70 | 212.38 | 27.69 | 332.15 | 20.65 | 247.78 | 31.66 | 379.60 | 23.61 | 283.17 |

| Hrs per day | | 18 | | | | 22 | | | | 24 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hrs per | | Month 548 | | Year 6570 | | Month 669 | | Year 8030 | | Month 730 | | Year 8760 | |
| Rate per K.W. Hr. (cents) | Rate per H.P. Hr. (cents) | Cost | | | | Cost | | | | Cost | | | |
| | | K.W. Hrs per | | H.P. Hrs per | | K.W. Hrs per | | H.P. Hrs per | | K.W. Hrs per | | H.P. Hrs per | |
| | | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year |
| 3.1 | 2.313 | 16.99 | 203.67 | 12.67 | 151.93 | 20.74 | 248.93 | 15.47 | 185.70 | 22.63 | 271.56 | 16.88 | 202.58 |
| 3.2 | 2.387 | 17.54 | 210.24 | 13.08 | 156.83 | 21.41 | 256.96 | 15.97 | 181.69 | 23.36 | 280.32 | 17.43 | 209.11 |
| 3¼ | 2.424 | 17.81 | 213.53 | 13.29 | 159.24 | 21.74 | 260.96 | 16.22 | 194.69 | 23.73 | 284.70 | 17.70 | 212.38 |
| 3.3 | 2.462 | 18.08 | 216.81 | 13.49 | 161.73 | 22.07 | 264.99 | 16.47 | 197.68 | 24.09 | 289.08 | 17.97 | 215.65 |
| 3.4 | 2.536 | 18.63 | 223.38 | 13.90 | 166.64 | 22.74 | 273.02 | 16.97 | 203.67 | 24.82 | 297.84 | 18.52 | 222.18 |
| 3.5 | 2.611 | 19.18 | 229.95 | 14.31 | 171.54 | 23.41 | 281.05 | 17.47 | 209.66 | 25.55 | 306.60 | 19.06 | 228.72 |
| 3.6 | 2.686 | 19.73 | 236.52 | 14.72 | 176.44 | 24.08 | 289.08 | 17.97 | 215.65 | 26.28 | 315.36 | 19.61 | 235.25 |
| 3.7 | 2.760 | 20.28 | 203.09 | 15.13 | 181.34 | 24.75 | 297.11 | 18.47 | 221.64 | 27.01 | 324.12 | 20.15 | 241.79 |
| 3¾ | 2.797 | 20.55 | 246.38 | 16.33 | 183.79 | 25.08 | 301.13 | 18.72 | 224.64 | 27.38 | 328.50 | 20.42 | 245.06 |
| 3.8 | 2.835 | 20.82 | 249.66 | 15.53 | 186.24 | 25.42 | 305.14 | 18.97 | 227.63 | 27.74 | 332.88 | 20.70 | 248.32 |
| 3.9 | 2.909 | 21.37 | 256.23 | 15.94 | 191.14 | 26.09 | 313.17 | 19.47 | 233.62 | 28.47 | 341.64 | 21.24 | 254.86 |
| 4. | 2.984 | 21.93 | 262.80 | 16.35 | 196.04 | 26.76 | 321.20 | 19.96 | 239.61 | 29.20 | 350.40 | 21.78 | 261.39 |
| 4.1 | 3.059 | 22.47 | 269.37 | 16.76 | 200.94 | 27.43 | 329.23 | 20.46 | 245.60 | 29.93 | 359.16 | 22.33 | 267.93 |
| 4.2 | 3.133 | 23.02 | 275.94 | 17.17 | 205.84 | 28.09 | 337.26 | 20.96 | 251.59 | 30.66 | 367.92 | 22.87 | 274.46 |
| 4¼ | 3.170 | 23.30 | 279.23 | 17.37 | 208.79 | 28.43 | 340.26 | 21.21 | 254.59 | 31.03 | 372.30 | 23.15 | 277.73 |
| 4.3 | 3.208 | 23.56 | 282.51 | 17.56 | 210.75 | 28.76 | 345.29 | 21.46 | 257.58 | 31.39 | 376.68 | 23.42 | 281.00 |
| 4.4 | 3.282 | 24.11 | 289.08 | 17.99 | 215.65 | 29.43 | 353.32 | 21.96 | 263.57 | 32.12 | 385.44 | 23.96 | 287.53 |
| 4.5 | 3.357 | 24.66 | 295.65 | 18.40 | 220.65 | 30.10 | 361.35 | 22.46 | 269.56 | 32.85 | 394.20 | 24.61 | 294.07 |
| 4.6 | 3.432 | 25.21 | 302.22 | 18.80 | 225.45 | 30.77 | 369.38 | 22.96 | 275.55 | 33.58 | 402.96 | 25.05 | 300.60 |
| 4.7 | 3.506 | 25.76 | 308.79 | 19.21 | 250.35 | 31.44 | 377.41 | 23.46 | 281.54 | 34.31 | 411.72 | 25.60 | 307.14 |
| 4¾ | 3.543 | 26.04 | 312.06 | 19.42 | 232.80 | 31.78 | 381.43 | 23.71 | 284.54 | 34.68 | 416.40 | 25.87 | 310.40 |
| 4.8 | 3.581 | 26.30 | 315.36 | 19.62 | 235.25 | 32.11 | 385.44 | 23.96 | 287.53 | 35.04 | 420.48 | 26.14 | 313.67 |
| 4.9 | 3.655 | 26.85 | 321.93 | 20.03 | 240.15 | 32.78 | 393.47 | 24.46 | 293.52 | 35.77 | 429.24 | 26.69 | 320.21 |
| 5. | 3.730 | 27.40 | 328.50 | 20.44 | 245.06 | 33.45 | 401.50 | 24.96 | 299.52 | 36.50 | 438.00 | 27.23 | 326.74 |
| 5.1 | 3.805 | 27.95 | 335.07 | 20.85 | 249.96 | 34.11 | 409.53 | 25.45 | 305.51 | 37.23 | 446.76 | 27.77 | 333.27 |
| 5.2 | 3.879 | 28.50 | 341.64 | 21.26 | 254.96 | 34.78 | 417.56 | 25.95 | 311.50 | 37.96 | 455.52 | 28.32 | 339.81 |
| 5¼ | 3.916 | 28.77 | 344.93 | 21.46 | 257.31 | 35.12 | 421.58 | 26.20 | 314.45 | 38.33 | 459.90 | 28.59 | 343.08 |
| 5.3 | 3.954 | 29.04 | 348.21 | 21.67 | 259.76 | 35.45 | 425.69 | 26.45 | 317.49 | 38.69 | 464.28 | 28.86 | 346.34 |
| 5.4 | 4.028 | 29.59 | 354.78 | 22.08 | 264.66 | 36.12 | 433.62 | 26.95 | 325.48 | 39.42 | 473.04 | 29.41 | 352.88 |
| 5.5 | 4.103 | 30.14 | 361.35 | 22.48 | 269.56 | 36.79 | 441.65 | 27.45 | 329.47 | 40.15 | 481.80 | 29.95 | 359.41 |
| 5.6 | 4.178 | 30.69 | 367.92 | 22.89 | 274.46 | 37.46 | 449.68 | 27.95 | 335.46 | 40.88 | 490.56 | 30.50 | 365.95 |
| 5.7 | 4.252 | 31.24 | 374.49 | 23.30 | 279.36 | 38.13 | 457.71 | 28.45 | 341.45 | 41.61 | 499.32 | 31.04 | 372.48 |
| 5¾ | 4.289 | 31.51 | 377.78 | 23.51 | 281.81 | 38.46 | 461.73 | 28.70 | 344.44 | 41.98 | 503.70 | 31.31 | 375.75 |
| 5.8 | 4.327 | 31.78 | 381.06 | 23.71 | 284.26 | 38.80 | 465.74 | 28.95 | 347.44 | 42.34 | 508.08 | 31.59 | 379.02 |
| 5.9 | 4.401 | 32.33 | 387.63 | 24.12 | 289.16 | 39.47 | 473.77 | 29.45 | 353.43 | [illegible] | 516.84 | 32.13 | 385.59 |
| 6. | 4.476 | 32.88 | 394.20 | 24.53 | 294.07 | 40.13 | 481.80 | 29.96 | 359.42 | 43.80 | 525.60 | 32.68 | 392.09 |
| 6.1 | 4.551 | 33.43 | 400.77 | 24.94 | 298.87 | 40.80 | 489.83 | 30.45 | 365.41 | 44.53 | 534.38 | 33.22 | 398.62 |
| 6.2 | 4.625 | 33.98 | 407.34 | 25.35 | 303.87 | 41.47 | 497.86 | 30.94 | 371.40 | 45.26 | 543.12 | 33.76 | 405.16 |
| 6¼ | 4.662 | 34.25 | 410.63 | 25.55 | 306.32 | 41.81 | 501.88 | 31.19 | 374.39 | 45.63 | 547.50 | 34.04 | 408.43 |
| 6.3 | 4.670 | 34.52 | 413.91 | 25.76 | 308.77 | 42.14 | 505.89 | 31.44 | 377.39 | 45.99 | 551.86 | 34.31 | 411.69 |
| 6.4 | 4.774 | 35.07 | 420.48 | 26.16 | 313.67 | 42.81 | 513.92 | 31.94 | 383.38 | 46.72 | 560.64 | 34.85 | 418.23 |
| 6.5 | 4.849 | 35.62 | 427.05 | 26.57 | 318.57 | 43.48 | 521.85 | 32.44 | 389.37 | 47.45 | 569.40 | 35.40 | 424.76 |

## COST OF POWER (1 Full Month = 730 Hrs) (1)

| Hrs per day | | 10 | | | | 12 | | | | 14 | | | | 16 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hrs per | | Month 304 | | Year 3650 | | Month 365 | | Year 4380 | | Month 426 | | Year 5110 | | Month 487 | | Year 5840 | |
| Rate per K.W. Hr. (cents) | Rate per H.P. Hr. (cents) | Cost | | | | Cost | | | | Cost | | | | Cost | | | |
| | | K.W. Hrs per | | H.P. Hrs per | | K.W. Hrs per | | H.P. Hrs per | | K.W. Hrs per | | H.P. Hrs per | | K.W. Hrs per | | H.P. Hrs per | |
| | | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year |
| 6.6 | 4.924 | 20.06 | 240.90 | 14.97 | 179.72 | 24.09 | 289.08 | 17.97 | 215.63 | 28.12 | 337.26 | 20.97 | 251.59 | 32.14 | 385.44 | 23.97 | 287.53 |
| 6.7 | 4.998 | 20.37 | 244.55 | 15.20 | 182.44 | 24.46 | 293.46 | 18.24 | 218.92 | 28.54 | 342.37 | 21.29 | 255.40 | 32.63 | 391.28 | 24.34 | 291.89 |
| 6¾ | 5.035 | 20.52 | 246.38 | 15.31 | 183.80 | 24.64 | 295.65 | 18.38 | 220.55 | 28.76 | 344.93 | 21.45 | 257.31 | 32.87 | 394.20 | 24.52 | 294.06 |
| 6.8 | 5.073 | 20.67 | 248.20 | 15.42 | 185.16 | 24.82 | 297.84 | 18.52 | 222.18 | 28.97 | 347.48 | 21.60 | 259.22 | 33.12 | 397.12 | 24.70 | 296.24 |
| 6.9 | 5.147 | 20.98 | 251.85 | 15.65 | 187.89 | 25.19 | 302.22 | 18.79 | 225.45 | 29.39 | 352.59 | 21.92 | 263.03 | 33.60 | 402.96 | 25.06 | 300.60 |
| 7.0 | 5.222 | 21.28 | 255.50 | 15.88 | 190.61 | 25.55 | 306.60 | 19.06 | 228.72 | 29.82 | 357.70 | 22.24 | 266.84 | 34.09 | 408.80 | 25.42 | 304.96 |
| 7.1 | 5.297 | 21.58 | 259.15 | 16.10 | 193.33 | 25.92 | 310.98 | 19.33 | 231.99 | 30.25 | 362.81 | 22.56 | 270.65 | 34.56 | 414.64 | 25.79 | 309.31 |
| 7.2 | 5.371 | 21.89 | 262.80 | 16.33 | 196.06 | 26.28 | 315.36 | 19.61 | 235.25 | 30.67 | 367.92 | 22.87 | 274.46 | 35.06 | 420.48 | 26.15 | 313.67 |
| 7¼ | 5.408 | 22.04 | 264.63 | 16.44 | 197.42 | 26.46 | 317.55 | 19.74 | 236.89 | 30.89 | 370.48 | 23.03 | 276.37 | 35.31 | 423.40 | 26.33 | 315.85 |
| 7.3 | 5.446 | 22.19 | 266.45 | 16.56 | 198.78 | 26.65 | 319.74 | 19.88 | 238.52 | 31.10 | 373.03 | 23.19 | 278.28 | 35.55 | 426.32 | 26.51 | 318.03 |
| 7.4 | 5.520 | 22.50 | 270.10 | 16.78 | 201.50 | 27.01 | 324.12 | 20.15 | 241.79 | 31.52 | 378.14 | 23.51 | 282.09 | 36.02 | 432.16 | 26.86 | 322.38 |
| 7.5 | [illegible] | 22.80 | [illegible] | 17.01 | 204.23 | 27.38 | 328.50 | 20.42 | 245.06 | 31.95 | 383.25 | 23.83 | 285.90 | 36.53 | 438.00 | 27.24 | 326.74 |
| 7.6 | 5.670 | 23.10 | [illegible] | 17.24 | 206.95 | 27.74 | 332.88 | 20.70 | 248.32 | 32.38 | 388.36 | 24.15 | 289.71 | 37.01 | 443.84 | 27.60 | 331.09 |
| 7.7 | 5.744 | 23.41 | [illegible] | 17.46 | 209.67 | 28.11 | 337.26 | 20.97 | 251.59 | 32.80 | 393.47 | 24.46 | 293.52 | 37.50 | 449.68 | 27.97 | 335.45 |
| 7¾ | 5.781 | 23.56 | [illegible] | 17.58 | 211.03 | [illegible] | [illegible] | 21.10 | 253.22 | 33.02 | 396.03 | 24.62 | 295.43 | 37.74 | 452.60 | 28.15 | 337.63 |
| 7.8 | 5.819 | 23.71 | [illegible] | 17.69 | 212.39 | 28.47 | [illegible] | [illegible] | 254.86 | 33.23 | 398.58 | 24.78 | 297.34 | 37.95 | 455.52 | 28.33 | 339.81 |
| 7.9 | 5.893 | [illegible] | [illegible] | 17.92 | 215.12 | [illegible] | [illegible] | 21.51 | 258.12 | 33.65 | 403.69 | 25.10 | 301.15 | 38.47 | 461.36 | 28.69 | 344.16 |
| 8.0 | [illegible] | [illegible] | [illegible] | 18.14 | [illegible] | 29.20 | 350.40 | 21.78 | 261.39 | 34.08 | 408.80 | 25.42 | 304.96 | 38.96 | 467.20 | 29.06 | 348.52 |
| 8.1 | 6.043 | [illegible] | [illegible] | 18.37 | [illegible] | [illegible] | 354.78 | 22.06 | [illegible] | 34.51 | 413.91 | 25.73 | 308.77 | 39.45 | 473.04 | 29.42 | 352.88 |
| 8.2 | [illegible] | 24.93 | [illegible] | 18.60 | 223.29 | [illegible] | [illegible] | [illegible] | 267.93 | 34.93 | [illegible] | 26.05 | 312.56 | 39.93 | 478.88 | 29.78 | 357.23 |
| 8¼ | [illegible] | 25.08 | [illegible] | 18.71 | [illegible] | [illegible] | 361.35 | 22.47 | [illegible] | [illegible] | [illegible] | 26.21 | 314.49 | 40.18 | 481.80 | 29.96 | 359.41 |
| 8.3 | 6.192 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 22.60 | [illegible] | 35.36 | [illegible] | 26.37 | 316.40 | 40.42 | 484.72 | 30.15 | 361.59 |
| 8.4 | [illegible] | [illegible] | [illegible] | 19.05 | [illegible] | 30.66 | 367.92 | [illegible] | [illegible] | [illegible] | [illegible] | 26.69 | 320.21 | 40.91 | 490.56 | 30.51 | 365.95 |
| 8.5 | [illegible] | [illegible] | [illegible] | 19.28 | [illegible] | 31.03 | [illegible] | [illegible] | 277.73 | [illegible] | [illegible] | 27.00 | 324.02 | [illegible] | [illegible] | 30.87 | 370.30 |
| 8.6 | 6.416 | [illegible] | [illegible] | 19.61 | [illegible] | 31.39 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 27.32 | 327.83 | 41.88 | 502.24 | 31.24 | 374.66 |
| 8.7 | [illegible] | [illegible] | [illegible] | 19.73 | [illegible] | 31.76 | [illegible] | 23.69 | [illegible] | [illegible] | [illegible] | [illegible] | 331.64 | 42.37 | 508.08 | 31.60 | 379.02 |
| 8¾ | [illegible] | [illegible] | [illegible] | 19.85 | [illegible] | 31.94 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 333.35 | 42.61 | 511.00 | 31.78 | 381.19 |
| 8.8 | [illegible] | [illegible] | [illegible] | 19.96 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 27.96 | 335.40 | 42.86 | 513.92 | 31.96 | 383.57 |
| 8.9 | 6.639 | 27.06 | [illegible] | 20.19 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 43.34 | 519.76 | 32.32 | 387.73 |
| 9.0 | [illegible] | 27.36 | [illegible] | 20.41 | [illegible] | [illegible] | [illegible] | [illegible] | 294.07 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 525.60 | 32.69 | 392.09 |
| 9.1 | 6.789 | 27.66 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 24.78 | [illegible] | 38.77 | [illegible] | [illegible] | [illegible] | [illegible] | 531.44 | 33.05 | 396.44 |
| 9.2 | [illegible] | 27.97 | [illegible] | [illegible] | [illegible] | 33.58 | [illegible] | 25.05 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 33.41 | 400.80 |
| 9¼ | [illegible] | 28.12 | [illegible] | 20.98 | [illegible] | 33.76 | [illegible] | 25.19 | [illegible] | 39.41 | [illegible] | 29.39 | [illegible] | [illegible] | [illegible] | 33.60 | 402.58 |
| 9.3 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 33.95 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 29.55 | [illegible] | [illegible] | [illegible] | 33.78 | 405.15 |
| 9.4 | 7.012 | [illegible] | [illegible] | 21.32 | [illegible] | [illegible] | 411.72 | [illegible] | [illegible] | [illegible] | [illegible] | 29.86 | [illegible] | [illegible] | [illegible] | 34.14 | 409.51 |
| 9.5 | 7.087 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 310.40 | [illegible] | [illegible] | 30.18 | [illegible] | [illegible] | 554.80 | 34.50 | 413.87 |
| 9.6 | 7.162 | [illegible] | [illegible] | 21.77 | 261.40 | [illegible] | [illegible] | 26.14 | 313.67 | [illegible] | [illegible] | 30.50 | [illegible] | [illegible] | [illegible] | 34.87 | 418.22 |
| 9.7 | 7.236 | 29.49 | [illegible] | 22.00 | [illegible] | [illegible] | [illegible] | [illegible] | 316.94 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 35.23 | 422.57 |
| 9¾ | [illegible] | [illegible] | [illegible] | 22.11 | [illegible] | 35.59 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 30.98 | [illegible] | [illegible] | [illegible] | [illegible] | 424.76 |
| 9.8 | 7.311 | 29.79 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 26.69 | [illegible] | [illegible] | 500.78 | 31.13 | [illegible] | 47.73 | [illegible] | 35.59 | 426.94 |
| 9.9 | [illegible] | 30.10 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 42.17 | [illegible] | 31.45 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 10.0 | 7.460 | 30.40 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 31.77 | [illegible] | [illegible] | [illegible] | 36.32 | [illegible] |

| Hrs per day | | 18 | | | | 22 | | | | 24 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hrs per | | Month 548 | | Year 6570 | | Month 669 | | Year 8030 | | Month 730 | | Year 8760 | |
| Rate per K.W. Hr. (cents) | Rate per H.P. Hr. (cents) | Cost | | | | Cost | | | | Cost | | | |
| | | K.W. Hrs per | | H.P. Hrs per | | K.W. Hrs per | | H.P. Hrs per | | K.W. Hrs per | | H.P. Hrs per | |
| | | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year | Month | Year |
| 6.6 | 4.924 | 36.17 | 433.62 | 26.98 | 323.47 | 44.15 | 529.98 | 32.94 | 395.36 | 48.18 | 578.16 | 35.94 | 431.30 |
| 6.7 | 4.998 | 36.72 | 440.19 | 27.39 | 328.37 | 44.82 | 538.01 | 33.44 | 401.35 | 48.89 | 586.52 | 36.49 | 438.63 |
| 6¾ | 5.035 | 36.99 | 443.48 | 27.59 | 330.82 | 45.15 | 542.03 | 33.69 | 404.35 | 49.28 | 591.30 | 36.76 | 441.10 |
| 6.8 | 5.073 | 37.26 | 446.76 | 27.80 | 333.27 | 45.49 | 546.04 | 33.94 | 407.34 | 49.64 | 595.68 | 37.03 | 444.37 |
| 6.9 | 5.147 | 37.81 | 453.33 | 28.21 | 338.18 | 46.16 | 554.07 | 34.44 | 413.33 | 50.37 | 604.44 | 37.58 | 450.90 |
| 7.0 | 5.222 | 38.36 | 459.90 | 28.62 | 343.08 | 46.82 | 562.10 | 34.94 | 419.32 | 51.10 | 613.20 | 38.12 | 457.44 |
| 7.1 | 5.297 | 38.91 | 466.47 | 29.03 | 347.98 | 47.49 | 570.13 | 35.44 | 425.31 | 51.83 | 621.90 | 38.67 | 463.97 |
| 7.2 | 5.371 | 39.46 | 473.04 | 29.43 | 352.88 | 48.16 | 578.16 | 35.94 | 431.30 | 52.56 | 630.72 | 39.21 | 470.61 |
| 7¼ | 5.408 | 39.73 | 476.33 | 29.64 | 355.33 | 48.50 | 582.18 | 36.19 | 434.30 | 52.93 | 635.10 | 39.48 | 473.77 |
| 7.3 | 5.446 | 40.00 | 479.61 | 29.84 | 357.78 | 48.83 | 586.19 | 36.43 | 437.29 | 53.29 | 639.48 | 39.76 | 477.04 |
| 7.4 | 5.520 | 40.55 | 486.18 | 30.25 | 362.68 | 49.50 | 594.22 | 36.93 | 443.28 | 54.02 | 648.24 | 40.30 | 483.57 |
| 7.5 | [illegible] | 41.10 | 492.75 | 30.66 | 367.58 | 50.17 | 602.25 | 37.43 | 449.27 | 54.75 | 657.00 | 40.85 | 490.11 |
| 7.6 | 5.670 | 41.65 | 499.32 | 31.07 | 372.48 | 50.84 | 610.28 | 37.93 | 455.26 | 55.48 | 665.76 | 41.39 | 496.64 |
| 7.7 | 5.744 | 42.20 | 505.89 | 31.48 | 377.38 | 51.51 | 618.31 | 38.43 | 461.25 | 56.21 | 674.52 | 41.93 | 503.18 |
| 7¾ | 5.781 | 42.47 | 509.18 | 31.68 | 379.83 | 51.84 | 622.33 | 38.68 | 464.25 | 56.58 | 678.90 | 42.21 | 506.45 |
| 7.8 | 5.819 | 42.74 | 512.46 | 31.89 | 382.29 | 52.18 | 626.34 | 38.93 | 467.24 | 56.94 | 683.28 | 42.48 | 509.71 |
| 7.9 | 5.893 | 43.29 | 519.03 | 32.30 | 387.19 | 52.84 | 634.37 | 39.43 | 473.23 | 57.67 | 692.04 | 43.02 | 516.25 |
| 8.0 | [illegible] | 43.84 | 525.60 | 32.70 | 392.09 | 53.51 | 642.40 | 39.93 | 479.22 | 58.40 | 700.80 | 43.57 | 522.78 |
| 8.1 | 6.043 | 44.39 | 532.17 | 33.11 | 396.99 | 54.18 | 650.43 | 40.43 | 485.21 | 59.13 | 709.56 | 44.11 | 529.32 |
| 8.2 | [illegible] | 44.94 | 538.74 | 33.52 | 401.89 | 54.85 | 658.46 | 40.93 | 491.20 | 59.86 | 718.32 | 44.66 | 535.85 |
| 8¼ | [illegible] | 45.21 | 542.03 | 33.73 | 404.34 | 55.18 | 662.48 | 41.18 | 494.20 | 60.23 | 722.70 | 44.93 | 539.12 |
| 8.3 | 6.192 | 45.48 | 545.31 | 33.93 | 406.79 | 55.52 | 666.49 | 41.43 | 497.20 | 60.59 | 727.08 | 45.20 | 542.39 |
| 8.4 | [illegible] | 46.03 | 551.88 | 34.34 | 411.69 | 56.19 | 674.52 | 41.92 | 503.19 | 61.32 | 735.84 | 45.75 | 548.92 |
| 8.5 | [illegible] | 46.58 | 558.45 | 34.75 | 416.59 | 56.86 | 682.55 | 42.42 | 509.18 | 62.05 | 744.60 | 46.29 | 555.46 |
| 8.6 | 6.416 | 47.13 | 565.02 | 35.15 | 421.49 | 57.53 | 690.58 | 42.92 | 515.17 | 62.78 | 753.36 | 46.84 | 561.99 |
| 8.7 | [illegible] | 47.68 | 571.59 | 35.57 | 426.40 | 58.20 | 698.61 | 43.42 | 521.16 | 63.51 | 762.12 | 47.38 | 568.53 |
| 8¾ | [illegible] | 47.93 | 574.88 | 35.77 | 428.85 | 58.53 | 702.63 | 43.67 | 524.15 | 63.88 | 766.50 | 47.65 | 571.80 |
| 8.8 | [illegible] | 48.22 | 578.16 | 35.98 | 431.30 | 58.86 | 706.64 | 43.92 | 527.15 | 64.24 | 770.88 | 47.92 | 575.06 |
| 8.9 | 6.639 | 48.77 | 584.75 | 36.38 | 436.20 | 59.53 | 714.67 | 44.42 | 533.14 | 64.97 | 779.64 | 48.47 | 581.60 |
| 9.0 | [illegible] | 49.32 | 591.30 | 36.79 | 441.10 | 60.20 | 722.70 | 44.92 | 539.13 | 65.70 | 788.40 | 49.01 | 588.13 |
| 9.1 | 6.789 | 49.87 | 597.87 | 37.20 | 446.00 | 60.87 | 730.73 | 45.42 | 545.12 | 66.43 | 797.16 | 49.56 | 594.67 |
| 9.2 | [illegible] | 50.42 | 604.44 | 37.61 | 450.90 | 61.54 | 738.76 | 45.92 | 551.11 | 67.16 | 806.92 | 50.10 | 601.20 |
| 9¼ | [illegible] | 50.69 | 607.73 | 37.81 | 453.35 | 61.87 | 742.78 | 46.17 | 554.10 | 67.73 | 810.30 | 50.38 | 604.47 |
| 9.3 | [illegible] | 50.96 | 611.01 | 38.02 | 455.80 | 62.21 | 746.79 | 46.42 | 557.10 | 67.89 | 814.68 | 50.65 | 607.74 |
| 9.4 | 7.012 | 51.51 | 617.58 | 38.43 | 460.70 | 62.98 | 754.82 | 46.92 | 563.09 | 68.62 | 823.44 | 51.19 | 614.27 |
| 9.5 | 7.087 | 52.06 | 624.15 | 38.84 | 465.60 | 63.55 | 762.85 | 47.41 | 569.08 | 69.35 | 832.20 | 51.74 | 620.81 |
| 9.6 | 7.162 | 52.61 | 630.72 | 39.25 | 470.51 | 64.22 | 770.88 | 47.91 | 575.07 | 70.08 | 840.96 | [illegible] | 627.34 |
| 9.7 | 7.236 | 53.16 | 637.29 | 39.65 | 475.41 | 64.88 | 778.91 | 48.41 | 581.06 | 70.81 | 849.72 | 52.83 | 633.88 |
| 9¾ | [illegible] | 53.43 | [illegible] | 39.86 | 477.86 | 65.22 | 782.93 | 48.66 | 584.05 | 71.18 | 854.10 | 55.50 | 637.14 |
| 9.8 | 7.311 | 53.70 | [illegible] | 40.06 | 480.31 | 65.55 | 786.94 | [illegible] | 587.05 | 71.34 | 858.48 | 53.37 | 644.41 |
| 9.9 | [illegible] | 54.25 | [illegible] | [illegible] | 485.21 | 66.22 | 794.97 | 49.41 | 593.04 | 72.27 | 867.24 | 53.92 | 646.95 |
| 10.0 | 7.460 | [illegible] | [illegible] | [illegible] | 490.11 | 66.89 | 803.00 | 49.91 | 599.05 | 73.00 | 876.00 | 54.46 | 653.48 |

# Tests with Pitot Tube on Salt-Water Main

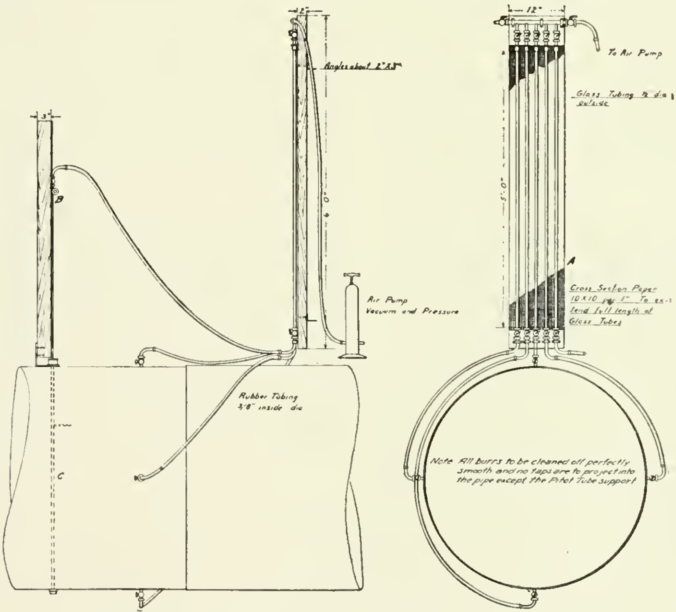
By A. L. TROWBRIDGE, Field Engineer.

A. L. Trowbridge

**When the steam turbine** plant of 9,000-kilowatt capacity at Station C, Oakland, was first put in operation some months ago it was desirable to determine how much salt-water was being used in its cooling system. As its salt-water supply comes direct from the nearby Oakland estuary, which is an arm of San Francisco bay, the flow varies with the height of the tide and it also varies with the electro-generating demands put upon the steam plant.

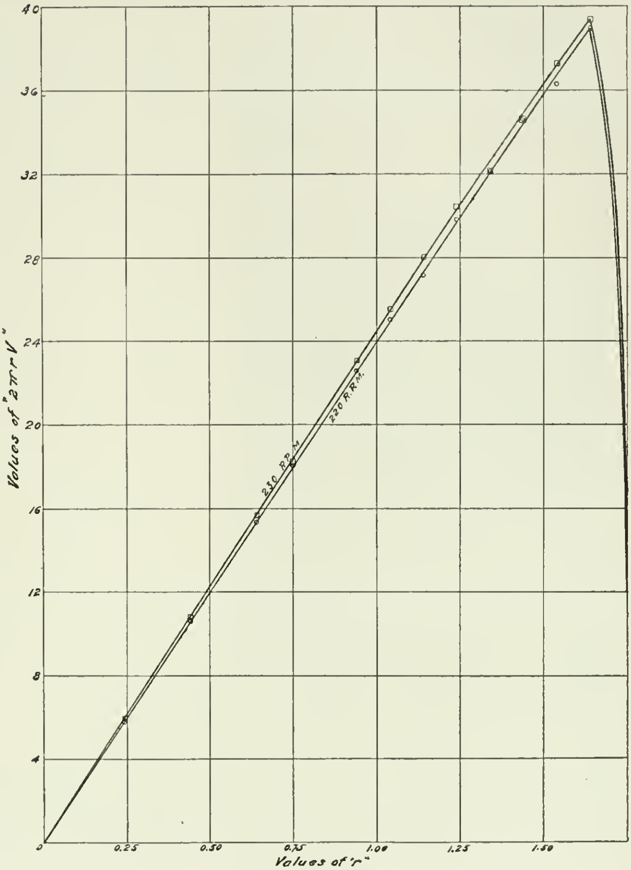
The salt-water is pumped through 675 feet of 42-inch cast-iron main by a 21-inch centrifugal pump, which is direct-connected to a compound engine measuring $13\frac{1}{2}$ inches by 2 inches by 12 inches. The pump is located just outside the boiler-room and at a distance of 540 feet from the intake end of the salt-water pipe. The discharge from the condenser is directly into the conveniently near outfall sewer in Grove street.

Because of the existing conditions the Pacific Gas and Electric Company's hydraulic engineer, James H. Wise, chose the Pitot tube as the cheapest and most easily applicable means of measuring the quantity of flow through the salt-water main, and he introduced an apparatus designed by himself but with its general arrangement like that used in similar tests made by William M. White, chief engineer of the I. P. Morris Company.




Pitot Tube Arrangement for Measuring the Velocity of Water in a Pipe

The large illustration on this page shows a drawing of the apparatus and the method of attaching it to the pipe where the flow is to be measured. The four taps equidistant, or ninety degrees, apart on the circumference of a circle perpendicular to the axis of the pipe give a static head reading as indicated in four of the glass tubes attached to the graduated board, where indicated by the letter A. The fifth tube on the board is connected with the Pitot tube. This fifth tube not only indicates the static head but also the head to which the velocity of flow is due. The five glass tubes enter a common chamber at the top, and that arrangement insures equal pressure in all the tubes. By means of the small hand pump attached to this manifold chamber the water columns in the glass tubes are kept within the limits of the graduated scale, which covers a length of five feet.



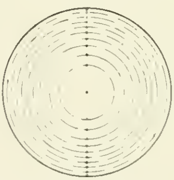

Curves Plotted From Pitot Tube Operations, Showing Total Discharge of Section

The rack and pinion, indicated at letter B, are used to make the Pitot tube traverse a diameter of the pipe while being held in position by a slotted guide tube, indicated at letter C. On a scale along the rack is indicated at any time the position of the Pitot tube along the diameter.

As the salt-water main lies beneath the solid concrete floor of the building of Station C it was necessary in attaching the Pitot tube to make the tests to select some point on the suction side of the pump. The Pitot tube was therefore attached at a point about 100 feet from the intake end of the main and just outside the bulkhead line of the estuary. In order to keep the water columns in sight in the tube it was found necessary to create at that point a vacuum of about fifteen inches. Some difficulty was at first experienced in making the apparatus sufficiently tight to maintain this vacuum. It was found necessary to replace the lever cocks, shown in the large illustration, with needle-seat gauge valves. It was impossible to obtain any reading from the glass tube connected to the top of the pipe, because at that point an air space exists even when the pump is running at high speed at high tide. So this top tube had to be kept tightly closed, as the entrance of air through it would destroy the vacuum in the other tubes.

When the apparatus was thus set up for any position of the Pitot tube a set of four readings was taken. The mean was taken of the readings of three of these tubes as indictating the static head. The value of $h$, or the head to which the velocity of flow is due, is found by subtracting the mean of the three readings from the reading in the glass connected with the Pitot tube.

To determine the mean velocity of flow for the entire cross-section of the pipe it is necessary to make a series of readings with the Pitot tube at different positions extending across a diameter, or at least along the diameter from the centre to the circumference. The velocity determined at any point a given distance from the centre is assumed to be the velocity throughout the annular ring having that radius. To make observations of equal value in computing the discharge of the section such intervals were selected along the diameter as would produce ten annular rings of equal size. The round illustration shows the positions occupied by the Pitot tube in this traverse of the pipe.



Three complete sets of observations were made the 4th of May, one set for each of the three stages of the tide. For each set of observations the pump was operated at five different speeds, and a traverse of the pipe was made with a Pitot tube for each speed of the pump.

To compute the velocity at each position of the tube this formula was used:

$$V = c\sqrt{2\,gh},$$

the assumption being that the co-efficient $c$ is unity for the form of Pitot tube used.

To determine the mean velocity and total discharge of the section the following formulæ are necessary:

Take the exact area of the cross-section of the pipe as gauged at the time the apparatus was installed. Then, on the assumption that the velocity is the same at all points equidistant from the centre of the pipe, at any distance, as $r$, from the centre, there will be an elementary annular ring of width $d\,r$, length $2\,\pi r$, and area $2\,\pi rdr$, throughout which the velocity, $V$, is uniform. The volume of discharge for this annular ring will be $2\,\pi rdr\,V$, or

$$dQ = 2\,\pi rdr\,V$$

$$\text{and } Q = 2\,\pi \int_0^R V\,rdr = V_m\,a$$

where $Q$ = discharge in cubic feet the second
$V_m$ = mean velocity of section
$a$ = area of section in square feet.

$$\text{From this } V_m = \frac{2\pi \int_0^R V\,rdr}{a}.$$

If a curve be plotted having for its abscissæ the values of $r$ and for is ordinates the corresponding values of $2\,\pi r\,V$, the area under this curve will be equal to $2\,\pi r \int_0^R V\,rdr$, which will be the total volume of discharge through the pipe. The mean velocity can then be obtained by dividing by the area of the pipe.*

One of the accompanying illustrations shows two such curves plotted from observations made at high tide and at high pump speeds. Under such conditions the results were the best, as errors in reading the value of $h$ then became relatively small, owing to the high velocity of the flow.

It was always necessary to have the tubes well throttled in order to control fluctuation. At low velocities, where the total value of $h$ fell, for instance, to one-hundredth of a foot,

*From W. R. Eckart's paper on "The Applicability of the Pitot Tube to the Testing of Impulse Wheels."

an error of 50 or even of 100 per cent. might easily be made in the reading.

For the purpose of establishing a permanent gauge that would indicate the quantity of water flowing into the condenser the following apparatus was installed: two taps were made on the salt-water supply pipe at a point in the turbine room where this pipe, reduced to a thirty-inch diameter, comes up through the floor to the condenser. One of these taps was fitted merely with a nipple and cock. Into the other tap was screwed a solid brass block three-fourths of an inch in diameter and having through its centre a one-eighth-inch brass Pitot tube extending about ten inches within the pipe. From these two taps rubber tubing was led to the two arms of a U-shape glass tube fixed to a board having a scale for indicating the difference in water-column heights.

At low tide the 15th of May a set of five observations was made with the Pitot tube at five different pump speeds. Simultaneously readings were made of the differences of head indicated by the U-tube in the turbine room. By this means the gauge was callibrated and a scale attached to it to indicate gallons a minute. This scale is so arranged that the zero can always be set at the elevation of the static head column and the gallons a minute at that time flowing can be read directly opposite the higher column.

The results of the Pitot tube tests at Station C were by no means all that could be desired, because of the low velocity of the flow and the numerous conditions affecting that flow. Much more accurate results are expected when the same apparatus shall be used on pressure pipes having a considerably higher velocity of flow.

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Any cloth or textile fabric may now be rendered fireproof by steeping it in a ten per cent. solution of phosphate of ammonia and then drying the goods in the open air.

## A Muddy-Road Mail Wagon

During the winter some of the mountain roads in the neighborhood of the great hydro-electric plants in the Sierras are so nearly impassible that no ordinary conveyance can get through with the mails. The accompanying

illustration, furnished by I. B. Adams, acting superintendent of the Colgate power division, shows a one-seated, two-wheel stage, or mountain mail wagon, used in muddy weather on the run between Marysville and Comptonville. The vehicle is surrounded by most of the important citizens and population of the little town of Dobbins, the nearest postoffice to the Colgate power house.

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There are two classes—producers and dependents.

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Out of his personal experience H. S. Worthington, general foreman of electric distribution in San Francisco, has contributed the following:

Complaint Clerk (at 'phone): Hello?

Consumer: Is this the gas and electric company?

Clerk: Yes.

Consumer: Well, this is number 2323 Blank street, and our electric heater won't work. My wife wants to take a bath, so will you please send an inspector?

# A Rail-Bonding Car

By C. W. McKILLIP, Manager Sacramento District.

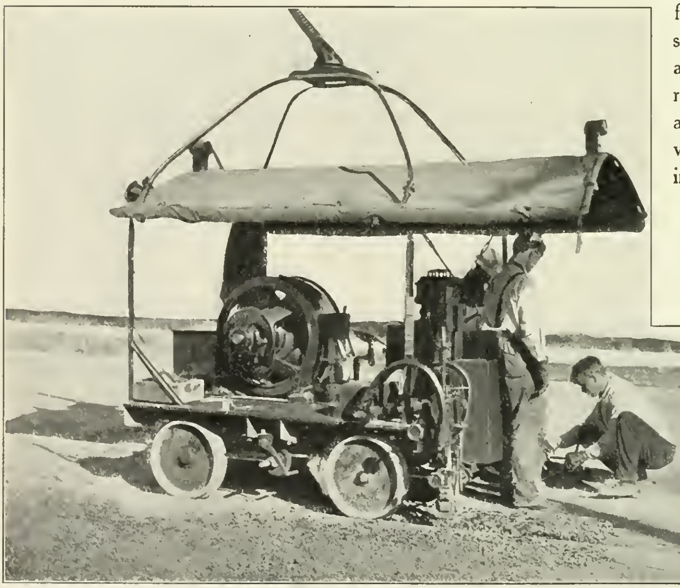

C. W. McKillip

**One of the most** troublesome things in connection with the proper maintenance of efficiency in an electric street-car system was to keep the joints of the rails so connected by a solid metal bond that there would be a continuous back circuit for the current, after passing through the trolley wire, the car motors, and the wheels, to return through the rails to the power house. The rails themselves must be slightly apart to allow for expansion during warm weather; otherwise a continuous, solidly-welded, steel rail might be used.

As these bonds were generally attached to the rails out of sight, just below the level of the roadbed, they used to receive scant attention, and the losses of electric power through a defective track-return circuit were sometimes considerable.

Then a rail-bonding device, mounted on a trolley car and operated by electricity taken from the trolley wire, was introduced. The purpose of this bonding car was to create intense heat at the point needed and then weld into clean, burnished spots on the two adjoining rails a connecting piece of heavy copper. The weld is so perfectly made by this means that no cracks or fissures are left to grow wider through wear and erosion. The junction thus formed is so complete that no force can tear away that bond; it is fused to stay. It can not be removed except after considerable mutilation and a lot of work with proper tools. The operation of brazing a bond to ordinary rails takes from forty-five to sixty seconds, using an alternating current of about 2,000 amperes at five volts, after converting and transform-


The Bond


The Electric Rail-bonding Car, and Foreman Shipley of the Company's Car Shops at Sacramento

ing about twenty amperes at 500 volts taken from the trolley wire.

The operation of brazing a bond to ordinary rails takes from forty-five to sixty seconds, using an alternating current of about 2,000 amperes at five volts, after converting and transforming about twenty amperes at 500 volts taken from the trolley wire.

All the necessary apparatus is mounted on a small trolley car. The accompanying illustration shows the bonding car used by the Sacramento street-car system, which is owned by the Pacific Gas and Electric Company. The man squatting down is holding the bond, but he is no "bloated bond-holder." That is Paul R. Shipley, the foreman.

The car is provided with a small portable electric grinder for burnishing perfectly smooth the spots to which the bond is to be fused. A brass-lined bonding clamp is adjusted. On the burnished side of the rail this clamp holds a carbon electrode pressing the copper bond against the spot where the weld is to be made, and on the opposite side of the rail the clamp holds close a copper electrode. Then, as the electric current passes from one electrode to the other, through the bond terminal and the rail, the carbon becomes incandescent and, combined with the great current density in the surface of the steel, generates the heat required to produce a perfect weld at the exact spot desired.

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J. W. Hall, manager of the Stockton water district, has been a grandfather six months.

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George Scarfe, manager of the Nevada water district, is a grandfather. The granddaughter arrived in Nevada City November 16th, at the home of Mr. and Mrs. George O. Scarfe. John Werry, manager of the Nevada City district, is also a grandpa; has been these four months! Grandpa Scarfe is 44 years young, and Grandpa Werry is way under 60.

## The Company's Deer

Near the northern outskirts of Sacramento the Pacific Gas and Electric Company owns an amusement grounds known as Oak Park. It is operated in connection with the company's twenty-nine miles of city trolley-car system. The park consists of an area of

tree-shaded lawns, a skating-rink building, a scenic railway, a theatre building, various nickel-getting sideshows, and the Sacramento baseball grounds and grandstand. The accompanying picture, from a snapshot taken when the buck was not defying the trespasser, shows the deer in the paddock near the skating-rink. The buck (on the right) was presented to the park about three years ago by George Wisseman, and its mate, eating with it, was presented by Charles Hart. The doe in the foreground is their young one, and was born at the park.

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A cubic foot of gold weighs 1,210 pounds, which is nearly twice the weight of a similar mass of silver.

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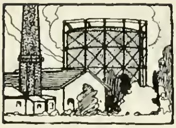
Tungsten lamp filaments are so featherweight that it takes 140,000 of the size used in a sixteen-candlepower light to weigh a pound.



# MEN OF THE COMPANY

## GEORGE C. HOLBERTON

### His Naive Account of What Happened Before He Became Engineer of Electric Distribution

BORN in New York City, schooled and college-trained in New Jersey, "summer-pastured" on his grandparents' farm in New England, "shop-tested" for nearly three years in the great works of the General Electric Company at Schnectady, and, when 23, launched to "go it alone" in the strange, new field of California; the first few months as a workman for a traction company in Oakland, the next year as a salesman for the General Electric Company's San Francisco branch, the next two and a half as an engineering employee of the gas companies at San Francisco, Oakland, Sacramento, and Stockton, the next half-year at Centralia, Washington, as general manager of the water company of that town; the next two years and a half at Bankok, Siam, in charge of the electric lighting of that oriental capital, and the past nine with the several California concerns that have been amalgamated into the Pacific Gas and Electric Company, and now, at the age of 39, engineer of electric distribution for this company's system in the cities of San Francisco, Oakland, Sacramento, Berkeley, and other places, and chief engineer for its water works in the city of Stockton, where pumping plants at seventeen deep wells supply water through many miles of mains to a community of 30,000 people.

There you have it, under heavy pressure to the square inch, the progressing career, up to date, of a successful young engineer, who resides at 3369 Jackson street, San Francisco, runs an automobile, is a sociable, good-natured, good-liver, married, the father of a boy and a girl, and recorded on the membership rolls of the Union League Club of California, and of the American Institute of Electrical Engineers as George C. Holberton.

When jokingly urged to reveal his past as a basis for a biographical sketch, he promptly sent in reply the following note, which tells the story in an original and entertaining way characteristic of the man himself:

I can hardly lay aside all my modesty and diffidence. Unfortunately I was born with quite a neucleus of these things rampant in my system, and I have never been able entirely to remove them. Also, I have no personal knowledge of my early life. But I have been told by my parents, in whom I have explicit confidence, that I was born on Twenty-third street, New York, the 6th of August, 1870. What I did from that first birthday until I started attending kindergarten is only hearsay; I have no personal recollection of ever having worn dresses or played with a powder puff.

But I remember the kindergarten very well, because my teacher's name was Katie, and our principal amusement was bringing into the school boxes of "Katie-dids," which we put in our desks. What happened to us Katie did! I grew too strong for that kindergarten, having licked everybody there, so I was lassooed and led to a public school, and served out my term till graduated in 1886.

I had inherited from my father and my grandfather, both of whom were artists, a tendency to palatte and brush. I still have the palate, but do n't really need the brush! My father informed me that there was very little real money in the artist business, and that if the tendency continued to show on me like mosquito bites he would take me out and shoot me rather than see me grow up artistically and paint myself to death for nothing.

So it was decided that I should not get shot, or even half-shot. Instead I was sentenced to Hoboken, to Stevens School, and did a year's time there till I was parolled with the graduating class in 1887. In the fall of that year I entered Stevens Institute in Hoboken, and in 1891 I came out of it a full-fledged mechanical engineer! I was full, the day I graduated, of a large assortment of technical and scientific knowledge, so I knew I would be much in demand. I was; I got a position right away with the General Electric Company in its Schnectady works at the large and remunerative salary of three dollars a week. Having an indulgent father, I was able to board at a respectable lodging house by touching dad for the difference.

After the first six months as an apprentice I was drafted into the draughting room, and a few months later was wafted into the engineering part, where I had charge of the construction of all the railway generators. I remember building the generators for the "Oakland, San Leandro and Hayward Railroad," and wondering where the deuce that road was, never dreaming that the next turn of fortune would find me railroading in that very part of the world. After approximately three years in the factory I felt that I had probably learned more about the business than they knew themselves. So I decided to seek other fields, to "Go West!"

In November of 1893 I came out to California. Having no rich relatives, influential friends, or other handicaps, I was permitted to dig for myself. I secured a position with the street railway company in Oakland as chief electrical cook and bottle-washer, my job being to do all the work that nobody else particularly wanted to tackle, such things as cleaning the motors, greasing the trolley wheels, and, whenever the weather was bad and the roads muddy, putting the cars back on the thin iron slivers they called the track.

I had n't been at this Oakland job very long before "Old Sleuth" or somebody at the Schnectady works tipped it off to the San Francisco office of the General Electric Company that I had escaped from the reservation, and the San Francisco branch dared me to be a salesman. That year that I was a salesman, to be exact, in July of 1894, it was my good fortune to attend in Sacramento the second annual banquet of the Pacific Coast Gas Association. There I first met some of the old-time Gas and Electric officers.

George C. Holberton

During 1895 and 1896 and part of 1897 I worked for the San Francisco, Oakland, Sacramento, and Stockton gas companies. I can now look back to that period with a great deal of pleasure. It was a pleasure to know the men then connected with these gas companies. Most of them, at least those who are still alive, are now with the Pacific Gas and Electric Company or in some of its subsidiary companies or departments.

In the summer of 1897 I took a trip into the Sierras for the purpose of making a report to the Capital Gas Company (now known as the Sacramento Electric Gas and Railway Company) on the water-power system then owned by Mr. Van Orden. On my return, and at the suggestion of J. B. Crockett, I applied for an electrical engineering position at Bankok, Siam. I hardly dreamed I would bag anything at such long range. While waiting for a reply from Siam I put in my time at Centralia, Washington, being everything from general manager to stoker for the Centralia Water Company.

In the fall of 1897 I went to Siam. There, during about two years and a half, I had an experience that was sometimes shocking, but at no time insulated against the bum climate of Bankok. All the work had to be done with "raw material," that is Chinese coolies and cast-iron. The Chinks had to be shown how to do everything. Often little models had to be made in wood; they could n't make heads or tails of mechanical drawings. For fuel we used the shell of the rice grain, or "paddy husk," as it is called out there. When I arrived they were lugging the paddy up to a loft above the boilers, so that it could be dumped down to the furnaces. I put in a blower system that would suck the paddy husk out of the boat and whisk it to the loft through a big pipe. The coolies were like silly kids; they 'd stand close and watch the paddy husks pulled in, so close that sometimes the suction pulled the flimsy pants clean off the Chinks. I kept three nationalities at work to be sure of having a force that would n't all be observing at once some of their numerous holidays. But I learned a whole lot at that job.

The best thing I did in Siam, though, was to wed Miss Katherine Bell Johnson in November of 1897. While in Siam I became the proud father of two children. I hasten to explain, however, that although they were born in Siam, they are not Siamese twins, the boy being somewhat older than his sister.

In addition to looking after the electrical industry of Bankok, so far as it concerned the Bankok Electric Lighting Company, I had the pleasure of mixing with royalty and doing much electrical work "In the Palace of the King." If the climate had been better, so that it were possible to live in Siam comfortably for any length of time, I would probably now be wearing some of the famous decorations of the Siamese government and be first electrical assistant or something to the king! But the climate made it impossible for my wife and children to remain in Siam. So, at the beginning of 1900, I sent them back to the United States, going with them myself as far as Hong Kong. After making a trip through China and returning to Bankok by way of Singapore I found things so lonely without a Holberton face in sight, except when I shaved, that I decided to return to the United States, and I did, arriving in May of 1900.

I was then made superintendent of the electric department of the Oakland Gas Light and Heat Company, a position I filled till that company was taken over by the Pacific Gas and Electric Company. After the consolidation I became engineer of electric distribution for the combination as well as superintendent of the Oakland division, and was also appointed chief engineer of the company's Stockton Water Works.

With all this varied experience I feel that I can now be counted as "one of the old Gas and Electric men," for when I take off my hat, behold! do I not qualify? And when I enter a barber shop and say, "I want a haircut," does the barber not ask, "Which one?"

I might mention that I once played baseball for the San Francisco Gas and Electric Company, but I get sore when I dwell on that, as I was called "out" and my reputation as a baseball star ruined, solely through the criminal near-sightedness of a bum amateur umpire!

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Construction of the company's new power line from Sutter City to Meridan in Sutter County is being delayed by a flood that has inundated Tule Basin, floated the poles laid along that course, and filled the holes with water.

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William Roche, an operator at Substation J, Sacramento street, San Francisco, was a steamship electrician sixteen years, serving on the liners "Lusitania," "Carpathia," and "Slavonica." He was shipwrecked in the "Slavonica" off the coast of Portugal at 2:30 a. m. of June 10th, 1909.

# San Francisco's Electric Pulse

THE accompanying diagram is not, as might be supposed, a profile map of the Sierra Nevada mountains, but the history of a San Francisco day through the medium of an electric light station.

The figures on the left indicate the kilowatts, or electric horsepower. To get actual

horsepower, increase them by one-third. For example, the 18,000 near the top of the diagram would be 24,000 horsepower.

The load line begins at the left-hand, lower corner of the diagram, at 6 o'clock in the morning of Saturday, November 13th. At that hour the load demanded by the consumers of the company was approximately 6,400 horsepower. The demand continued, constantly increasing, until at 8 o'clock, when the factories began their work, 11,000 horsepower was needed. The maximum of the morning load was reached at 10 o'clock, when about 14,000 horsepower was being used.

You can see how the demand for power began to fall off toward noon, and where it reached the minimum at 12 o'clock. At 1 o'clock, when the industries resumed work, the power again came on.

With the approach of darkness, the use of power actually increased until, within less than an hour's time, a demand was put upon the company for 26,000 horsepower. This enormous demand lasted but a few moments. Then, from 7 o'clock in the evening until 6 the next morning, the demand decreased, as indicated by the steady fall in the charted load line.

To provide during a few hours of each day for an increase in output from an average of about 12,000 horsepower to a temporary call for 26,000 horsepower, there must be in readiness engines, boilers, and men capable of giving more than double the average service.

The maximum demand during the period of twenty-four hours is called the "peak load," because the charted variations of the load line, as here shown in the diagram, produce an outline like a mountain peak. Some electric plants, owing to the peculiar nature of the demands of their consumers, may have two or more "peaks" during the twenty-four hours. But in San Francisco there is only the one pronounced "peak," when, toward evening, factories, office buildings, stores, and elevators are still using electricity, while all over the city electric lights are first turned on.

If any commercial enterprise maintained twelve clerks for the average hours of the day and required twenty-six during two or three hours, without any particular increase in business, could it afford to sell as cheaply as if it had steady work all the time for only twelve clerks?

If an electric company could keep down its "peak" demands so that, during every hour of the twenty-four, it would have to produce only the full average load, then it could sell its product much cheaper, as the efficiency of its plant would be constant. Sometimes an electric company encourages those of its consumers who can do so to avoid using power during the "peak" period and to take it during the hours when the general demand is comparatively small. Electricity can not be made and then stored in a reservoir to be taken, like gas, when needed. The machinery generates the mysterious current, and unless that energy be used that very instant then it is wasted. So an electric plant has to be kept running just the same all the time, steadily using the same average operating force and equipment, and generating enough electricity every moment for all its customers. It must keep up to that average, and it must have enough reserve equipment to carry it over the "peak."

## A New Power Plant

A new hydro-electric plant has recently been completed in Placer County, on the north fork of the American river, at a point known as Horseshoe Bar, which is three miles from Michigan Bluff. It was at Michigan Bluff that Leland Stanford, then a young lawyer from Wisconsin, located in 1850, built with his own hands a small split-shake, two-story building, and conducted in it a general merchandise store. The profits from this mining camp store formed the neucleus of the subsequent fortune of more than $30,000,000 that is now the endowment of Stanford University. This new power plant is to furnish energy to the well-known Cash Rock mine, a few miles down-river, and is also to supply power to various mining and other industries further southward in Placer County. The plant is the private property of John A. Britton, general manager of the Pacific Gas and Electric Company.

Since January 1st, 1909, saloons have been legislated out of business in this country at the rate of seventy a day, or a total of 11,000; and now in 70 per cent. of the area of the United States licensed liquor traffic is forbidden.

## Talk About Horsepower!

This is a picture of an 18-horsepower team recently engaged in toiling up the steep incline from the Colgate power plant to the top of the ridge. The distance is but a mile and a half, but parts of the road have a 15-per cent. grade. It required two whole days for this powerful team to haul the load up that one hill. On the truck was one 300-

kilowatt transformer, and that machinery and the conveyance together weighed 18,000 pounds. Two of these transformers had to be hauled from Colgate about twenty-five miles over mountain roads to the Alaska mine, one of the new customers in Nevada County of the Pacific Gas and Electric Company. The photograph was sent to this magazine by I. B. Adams, acting superintendent of the Colgate power division.

During the past six weeks the Pacific Gas and Electric Company has been removing its poles and transformers from the streets of Marysville and placing them in rear alleys, and replacing the old transformers, which ranged from one to fifteen kilowatts, with new ones, ranging from fifteen to fifty kilowatts. The improvement has meant the expenditure of about $5,000, and has included reconstruction throughout the city, all multiple lights being placed on the arc system, so that every street light can be controlled by one switch at the substation.

# PERSONALS

I. C. Steele of the general construction department used to play on the University of California baseball team.

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Don C. Ray of the Grass Valley district saw a year's military service in the Philippines during the Spanish war.

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Dr. William M. Walton of the construction department is a graduate in dentistry from the University of California.

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E. L. Moon of the bookkeeping department in San Francisco served eight years with the British army in the East Indies.

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E. C. Weston of the supply district at Sacramento spent thirteen years with the Fifth Royal Scots regiment of the British army.

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E. W. Crosby of the supply district at Sacramento served nine months in the Philippines with the Fifty-second Iowa Volunteers.

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R. Wheeler, a mine foreman in the general construction department, was in seven pugilistic contests during his earlier days; he also served in the British army.

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Paul W. Murphy of the general construction department, a Washington and Jefferson College man, served three years in the Philippines, first with the First Colorado Volunteers and then with the United States scouts.

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August Fessler of the operation and maintenance department at Sacramento served four years in the German army (1891-1895) and one year in the United States army, during the Spanish war.

H. Root of the Oakland power division was with the Thirtieth United States Infantry during the Spanish war.

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S. B. Harris and J. C. Thompson of the Oakland power division each put in four years as electricians on United States war vessels.

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S. P. Babcock of the Oakland office served three years and four months in the Civil War in the 152d New York Volunteers.

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H. A. Davies, J. C. Williams, and J. C. Gullikson of the company's street-car shops at Sacramento are veterans of the Spanish war.

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B. L. Zellensky of the gas and electric records department in San Francisco served one year in the Russian army; he also attended Moscow University.

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R. A. Hawkins of the North Tower power division spent a year and a half in the Philippines with the Fourth United States Cavalry, and then a year and a half in the shops at the Mare Island Navy Yard.

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R. L. Milliken of the De Sabla power division served during the Spanish war as a private in the Fifty-second Iowa Volunteers in the Philippines and later attended Stanford University.

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T. J. Ludlow, a superintendent in the general construction department, put in two years at sea on the Pacific and five consecutive seasons on the Yukon river; he was also a student for a while at both the University of Washington and the University of California.

F. J. Hodgkinson of the Fresno district served with the Sixth United States regulars and then with the Eighteenth Infantry three years.

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Robert S. Sorenson of the engineering department played on the University of California football team two years and on its basketball team four years. He has been playing Rugby this season with the Barbarians.

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James H. Wise, civil and hydraulic engineer, and A. L. Wilcox, civil engineer, are members of the Commonwealth Club of San Francisco. While a student at New York University, Wilcox played on the football team against Columbia and other big elevens.

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J. A. Meacham, an assistant foreman in the general construction department, is a graduated veterinary surgeon, and served in the United States army in the Philippines as quartermaster and veterinary surgeon from 1901 till 1904.

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J. F. Lee, a signal man in the general construction department at Colfax, is a Civil War veteran (Company F, Twelfth Iowa Volunteers); was in several hot battles, was captured, parolled, and exchanged, and then went back and mixed in more military scraps with the Rebs.

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Charles L. Barrett, secretary of the San Francisco company, sometimes receives notes from ladies. Here is one, just as it came, but with the signature suppressed:

San Francisco Nov 9, 1909 Dear Sir: my gas is something terrible I have to use almost a lamp in the store and it looks a fright. Would you be so kind and come to pump the meters and the lady up stairs—— has the same complaint Send them out add mitely to

S. A. Wardlaw, counterman in the San Francisco office, was an actor three years in New York city and quit because of parental objections to the stage; was a cowboy for a while on a Nevada range; and then came to California. He is counted on by the San Francisco office force as a ready and versatile entertainer whenever the fellows dine out.

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E. B. Hinz of the supply district at Sacramento served three years as third assistant engineer on the British battleship Condor and a year and a half as second assistant engineer on the passenger steamer Islander; and was on duty in the engine room the day the Islander was wrecked and completely demolished.

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The November number of "Public Service," a Chicago magazine, republished in its entirety the article on "Water Power Developments in California," by John Martin, a director of the Pacific Gas and Electric Company, but gave the matter the title "Public Benefits Derived from Water Power Developments." The whole article was also reprinted by the San Francisco Chronicle and signed "An Engineer."

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"Mike" Hardy, a powder-man in the general construction department at Colfax, is a Civil War veteran; served the entire four years; was in both the first and second slaughtering engagements at Antietam; was a mining prospector in Mexico from '79 till '81, and at the time of the Hillsboro massacre in the Black Range of Mexico was shot five times by the Apaches but escaped, though his six partners were all killed. In the '70's he worked on the first Santa Fe tunnel through the Raton Pass, and there had a partner named Pete Mooney; and it so happens that after all these years the two old partners are again working together, helping in the construction of the company's Bear River dam. Hardy is 62.

# Pacific Gas and Electric Magazine

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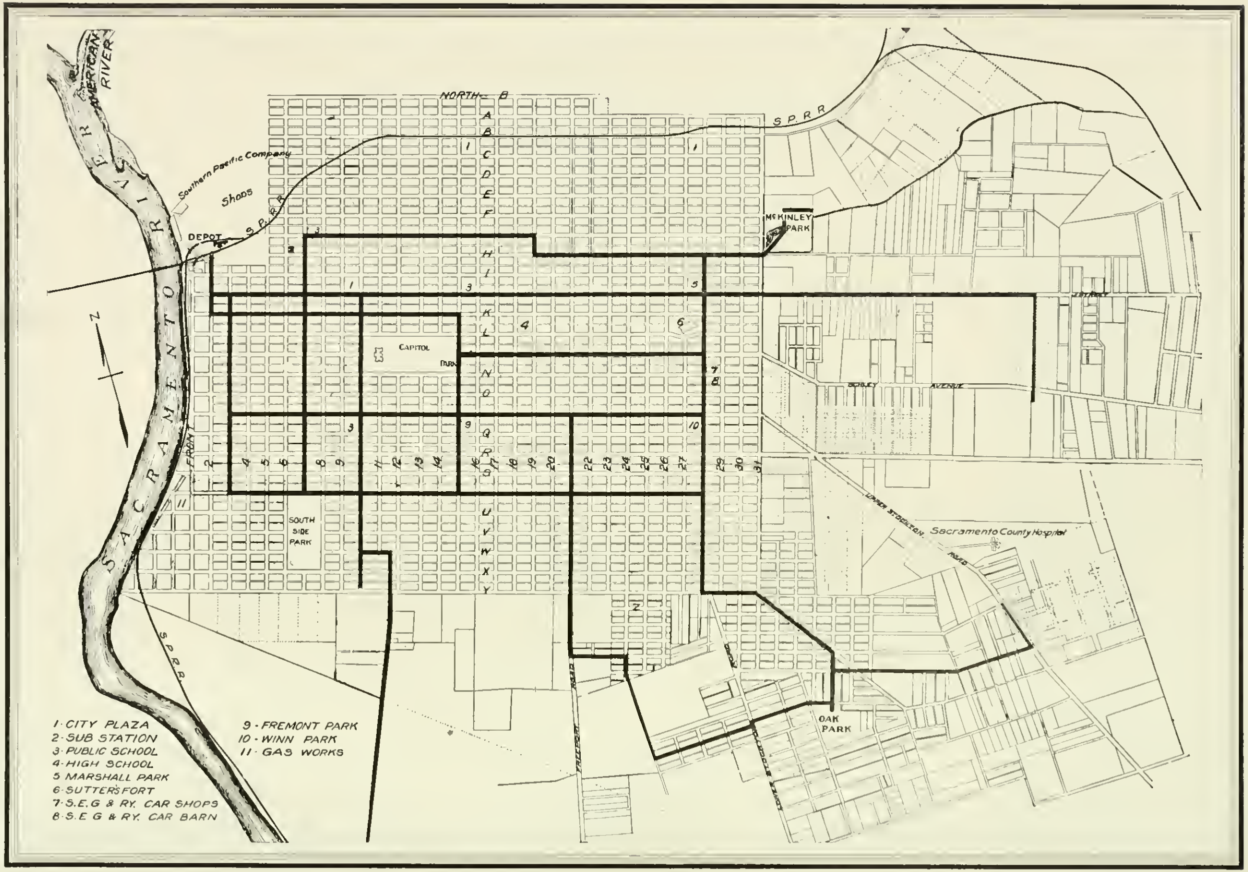



MAP OF THE CITY OF SACRAMENTO, SHOWING THE STREET-CAR LINES AND THE LOCATION OF OTHER PROPERTIES OWNED BY THE PACIFIC GAS AND ELECTRIC COMPANY

# Pacific Gas and Electric Magazine

VOL. I JANUARY, 1910 No. 8

## Sacramento's Street-Car System

### Being a Little History of Transportation in a City Where This Company Has Large and Varied Interests

By ARCHIE RICE.

Archie Rice

**A good system** of transportation within the confines of a city is a sure sign of its modern development. Engineers who are competent to judge have declared that Sacramento has the best-equipped street-railway service in the United States. There are twenty-nine miles of single track gridironing in the most desirable manner an entirely flat area that claims a population of more than 50,000 and contains real and personal property that in 1909 was assessed at $30,450,-000. The Pacific Gas and Electric Company owns Sacramento's street-car system, with its franchises, roadbeds, and passenger cars, and its big car barns and car shops, at Twenty-eighth and N streets; owns the Sacramento gas works, near the river bank at Front and U streets, and its distributing system; owns the electric plant and substation at Sixth and H streets, and its distributing system; and owns Oak Park, an eight-acre pleasure resort at the southeastern outskirts of the city, containing tree-shaded lawns, the local baseball grounds and grandstand, a theatre, a skating rink, a scenic railway, and a variety of amusement features. By the aggregate of the several million dollars in these investments the company is financially interested in Sacramento and its prosperity. The company's diversified holdings are of such a character that their value and earning power must depend directly upon the population and success of Sacramento. Whatever is good for a city as a whole is good for those that supply the citizens with gas, electricity, and transportation. And by that measure this company may be said to be vitally interested in whatever may concern the welfare of Sacramento.

The great interior valley of California suggests a huge platter, the sloping outer edges of which are the foothills that are banked up against a solid surrounding wall of high mountains framing a level plain some 500 miles from north to south and about sixty miles wide. Midway of the western side a piece of the rim of the platter is broken out. There the foothills taper down and the mountains dwindle and part to accommodate San Francisco bay and to make of that spacious inland sea a common drainage basin for the two long rivers that meander slowly from opposite ends of the great valley. Hundreds of miles they flow between low and inadequate

**The Service Veterans of the Sacramento Street-Car System**

Upper row—"Jack" Elliot, William Craig, John Cleave, G. B. Redman.
Bottom row—Otto D. Druge, William Dean, Barney Harr.

banks, and together pour their earth-tinted floods back again into the blue waters of the old ocean. From that ocean the western sunbeams feed the clouds that float inland and deliver their moist cargoes as rain or snow to form anew the sources of all the contributing branches of the Sacramento and the San Joaquin.

Northeastward from San Francisco, perhaps seventy-five miles in a direct line, about ninety by rail, but a distance of 130 miles by bay and river channel is the city of Sacramento. It is a level, valley town, with tree-skirted streets and spacious lawns and gardens, and it is close-girt on its western and northern sides by rivers. It lies just below the angle formed where the American comes in from the eastward and turns its flood into the parent river that was early christened by the devout Spanish with the name the city later adopted for herself. An artificial ridge nearly twenty feet high rims the edges of these two water courses and forms there an angular bulwark against the old menace of inundation. Back in January of 1850 and again in 1862-1863 floods so swelled these rivers that they poured their surplus shoulder-deep over the town and forced the inhabitants to take to second stories and row-boats till the muddy waters had subsided. A year ago another of those excessive flushings from tens of thousands of acres of melting snowfields along high Sierra ridges started two big wallowing freshets on a long race toward that meeting point, right there where Sacramento lies close behind her levees. Fortunately the American river arrived first and turned the high crest of her waters safely down the main channel before the Sacramento's overload came defying delays. What might have been had the two over-burdened rivers met there at the same moment and forced each other back the people of Sacramento do not like to consider, because it is within the bounds of possibility that just that thing may happen sometime. And Sacramento already has more than $60,000,000 in local property that would feel the force and effect of that calamity.

How such a chance may be definitely defeated is very thoughtfully expressed in an interesting monograph recently written for the American Society of Civil Engineers by Superintendent Foote of the North Star mine of Nevada County, a gigantic producing property that has already yielded $30,000,000 in gold. An eminent civil engineer himself, familiar with the details and cost of the great inundating and drainage systems built for the valley of the Nile in Egypt and for places in India, Foote contends for a comprehensive government system of dykes across the great California valley every five miles or so, for a drainage channel to be dredged into the centre of Tulare lake to reclaim those thousands of acres of rich submerged lands, and for a regular, systematic, gentle spreading of the spring floods over the land that they may deposit their enriching mud and then drain only water back into the improved river channels. He estimates from the cost of similar works that the project would require an expenditure of about $160,000,000. But he declares it would increase the value of the productive land alone to the amount of more than $600,000,000, to say nothing of the assured permanent protection of Sacramento and other flood-fearing communities. He would have valley lands annually enriched by the silt that for more than half a century has been forced to clog up the lower channels of rivers that have been too much confined by levees. He would have farming independent of the old gamble with inadequate or uncertain rainfall and a gradually less productive soil, and possibly freed, Egypt-like, of the toil of plowing.

Along in 1849 and for a dozen years thereafter Sacramento was the miners' Mecca.

A Recent Group at the Company's Car Shops of the Men that Make and Repair the Cars

It was the meeting point between the river-boat traffic with San Francisco and the wagon and pack-mule traffic with the mines. The regular population of the place ranged from 2,000 to 10,000, but the ebb and flow of travel coming and going between San

The Electric Power House and Substation

Francisco and the mines formed a transient army of perhaps 25,000 people. And they always spent at least one eventful night in Sacramento. The town was "wide open," and the street crowds carried interest far into the night. Gambling houses were numerous. From 1852 to 1863 few visitors to Sacramento failed to enter Keith's great gambling place near what is now the junction of Second and J streets. On an opposite corner was the El Dorado gambling house. Noted for their games of faro, rouge et noir, vingt-un, keno, and monte, and for "The Elephant" and two or three other games never since played or known, these resorts were the music halls of their time. At Keith's Mart Simonson, a violinist, was the great attraction, and to hear him play "The Wrecker's Daughter" was the primary object of many a first visit. In those times even the racing river trip was full of excitement, aside from the steady gambling aboard the boats. The price for passage between San Francisco and Sacramento was at first $50, later $30, then $15, $10, and $5, till latterly for many years it has been but $1.50. In the days before railroad competition the river trip did not take ten to fifteen hours and mean half a hundred landings. The best record was five hours nineteen minutes, made by the "Chrysopolis," which is none other than the well-known, big, bay, ferryboat "Oakland" of today, gradually reconstructed until probably not one of her original timbers remains.

Sacramento was the commercial and outfitting centre for most of the mining districts. That was why in 1854 the legislature, after having experimented with Monterey, San Jose, Vallejo, and Benicia for one annual session at each place, moved to Sacramento as California's permanent capital, a position in which the city has been seriously challenged but twice—first about fifteen years ago by San Jose and then two years ago by Berkeley.

Late in 1858, after its second biennial reception of the legislators, Sacramento had so far evolved toward modern conveniences that a bus line was developed to slosh through the winter mud from Third and R streets to Second and K streets and thence out to a pleasure resort known as Hubbard's Park. The fare for the whole or any part of the route was twenty-five cents. As early as

Showing Half of the Double Car Barns

1861 a street-car franchise was granted, but when the flood of 1862 came, turning the whole American river through the town, the bus line went permanently out of business and the proposed car line was forgotten. In 1868 Sacramento became the western terminal of the first transcontinental railroad, a project due entirely to the enterprise and initiative of four of Sacramento's most famous citizens — Stanford, Huntington, Crocker, and Hopkins. Then a new bus line, known as the City Omnibus Company and owned

The Car Shops

principally by Thomas Berkey, for many years assessor of Sacramento, began operating its horse conveyances between Front and K streets and Sutter's Fort, out on Twenty-eighth street.

Sacramento was rapidly assuming too important a position on the map to remain content with a mere bus line. Her permanent population had grown to nearly 25,000, and the town had settled down to something of the dignity of a well-established modern city. The legislature—and it had the power in those days—had, March 27th, 1868, approved an ordinance for a street-car line, and three months later the county supervisors had granted a twenty-five-year franchise to Z. L. Davis to operate horse cars from Front and K streets out to Twentieth and G streets by way of J and Tenth streets. J was then the principal street. The fare was not to be more than ten cents.

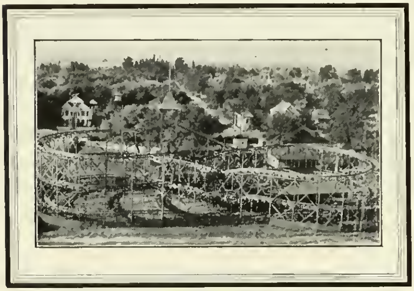
Two years and a half passed before actual construction work was begun. Meanwhile the company had been reorganized, had been renamed the City Railway, had elected N. L. Drew president, retaining Davis as one of the officials, and had secured J. C. Garland from Chicago as its new superintendent. Garland sought and secured further franchises, and then rushed construction work. June 13th of 1870 he began by digging a shallow channel at Front and I streets for the reception of the ties and rails. An order for eight little cars had been placed with the Kimball Manufacturing Company of San Francisco. The San Francisco Daily Alta California in its issue of August 17th, 1870, in a news article declared: "An advance step has been made in Sacramento by the establishment of a street railroad. Two excellent cars, manufactured in this city, were yesterday shipped to the state capital."

The entrance to these little cars was at the front end. There stood the driver of the two horses, and he was also the conductor, for he kept a watchful eye on a small glass-partioned box hanging just inside the door and saw that the fares deposited tallied with the number of passengers before he worked a lever that dropped the cash or tickets into a lower receptacle. It was not difficult to make the count, as each one of these cars could seat no more than a dozen persons.

August 20th, 1870, the line was first formally opened to the public with two cars.

The Car System's Mill and Paint Shop

The superintendent of streets had protested against the condition in which the company was leaving the roadway and had ordered that not a car should be run till the street was first restored to its original smoothness. The city trustees backed this up with a special prohibitory ordinance. But the cars started just the same, and kept right on running regularly, although Superintendent Garland and two relays of drivers were arrested. That first day from 8 to 12 in the forenoon and from 2 to 6 o'clock in the afternoon



The Scenic Railway at Oak Park

women and children were carried free. The public wanted street cars. August 28th two more cars arrived, September 2d two more, and before the end of September the last two of the eight had come and been put into service. From the first the fare was five cents. But it was not till 1878 that Sacramento's street-car business made enough to pay expenses.

In 1880 further franchise privileges and increased population caused the construction of fourteen blocks of new line along Tenth street from K to the city cemetery. And that same year the line on Front street was extended to the old Central Pacific Railroad station.

The transition to electric service came in 1889, with storage batteries installed under former horse-cars of a larger size than the original "bobtails." October 10th of 1892 street railway franchises were secured by Albert Gallatin and Horatio Livermore and promptly transferred to the new Sacramento Electric Power and Light Company, which was incorporated November 4th of that year with a capital of $1,500,000 and with Gallatin, Horatio Livermore, Charles Livermore, A. J. Ralston, and Joshua Barker as directors. In January and February of 1893 this new concern bought up practically the entire stock of the street railway company and of the East Park Association and secured a collection of little old horsecars. It then ordered five larger and more modern cars built at the Carter Brothers' shops in Newark, for it had secured a fifty-year franchise for a line on P street. In October of 1893 this new Sacramento Electric Power and Light Company bought the exclusive water privilege of the Folsom Water Power Company on the American river near Folsom for $900,000. By the summer of 1895, with the completion at Folsom of California's pioneer hydro-electric plant for long-distance transmission of energy, current came through a twenty-two-mile power line down to Sacramento to operate the company's street cars and supplement its lighting service.

April 3d of 1896 Gallatin, the Livermores, and their financial associates had incorporated the Sacramento Electric Gas and Railway Company. In June of that year this new concern absorbed the Sacramento

One of Sacramento's First Street Cars, as It Looks Today

Electric Power and Light Company. Then it organized with J. W. Hall as its first president, the same Hall who is now manager of the Pacific Gas and Electric Company's Stockton water company. In May of 1899 this new Sacramento company also absorbed the Capitol Gas Company. In 1902 it established its own car shops in Sacramento and began the construction of the fifty-seven big, fine, modern cars with which the system is now equipped. Then in June of 1902 John Martin and Eugene de Sabla of the

One of the Later Horse Cars Run By Storage Battery

Bay Counties Power Company secured financial control of the Sacramento company. Thus it grew to be a part of the California Gas and Electric Corporation, which, early in 1906 was absorbed by the new Pacific Gas and Electric Company, although it still retains its local individuality under the familiar title of the Sacramento Electric Gas and Railway Company, an enterprise managed by C. W. McKillip, who is himself a native of Sacramento and has developed in the business from the days when he was a boy employed at the gas works.

Nothing more picturesquely illustrates the development of Sacramento's transportation system than a comparison of those first primitive little bobtail horsecars of 1870 with the huge, double-truck, modernly appointed, trolley cars of today. An engineer would smile now at the type of construction used thirty and forty years ago for the roadbed. On that first line from Front and I streets to Twentieth and H streets the original construction consisted of half-foot-square wooden ties, seven feet long, laid six feet apart, and held together by long four- by six-inch wooden stringers upon which were laid and spiked the thin, flat, nineteen-pound rails, spaced for a five-foot gauge. As the jolt of the wheels on the ends of the rails would gradually work loose the spikes a sledge hammer had to be carried on each car to pound down any up-curving rail end to avoid the danger of having it rip up into the bottom of the passing car. The process was called "pounding down snake heads." When the O-street line was opened nineteen-pound T rail was used with a little thinner ties, the same kind of wooden stringers, and outside the stringers blocks of wood on each tie as a foundation for a foot-wide plank, which helped brace and maintain the gauge and also served as a dry and substantial outside path for each horse, the car animals having been trained to tread the plank, even on the run, and avoid the deep winter mud of the roadway. By 1881 construction had developed to twenty-five-pound T rail with the same style wooden stringers grooved into the old-type ties and both dogged and spiked down so firmly that the outer plank was not used, except at turnouts.

During the construction of the line from the Southern Pacific station along Third and J to Twenty-eighth and out to Oak Park a thrifty contractor who wanted firewood de-

Typical Car Now in Use

cided that seven-foot ties were really a foot longer than necessary, so he had that foot sawed off and sent to his home. Twenty-two-pound T rail had been used on this line, but soon it had to be changed to thirty-five-pound T rail in some places and in others to thirty-five-pound, second-hand girder rail to provide the heavier foundation needed for the change to electric cars.

All these evolutions had tended toward bringing the ties closer and closer together for a firmer foundation. Then came forty-pound girder rail with a four-inch chair spiked down to the old cross ties, a style of construction made necessary on certain streets by reason of the cobble paving. But with the building of the Twenty-first-street line from P to Y streets fifty-one-pound rail on six- by eight-inch ties eight feet long was deemed necessary. Then, following a public demand for a noiseless pavement, seventy-four-pound rail was introduced with the asphalt on J and K streets. But even this proved too light, and the eighty-seven-pound groove rail of today had to be substituted and close-rimmed by a six-inch strip of basalt rock laid on a six-inch bed of concrete and surface-covered with two inches of bitumen. On Sacramento's streets having macadam pavement the standard roadbed construction is now a sixty-pound T rail on six- by eight-inch ties eight feet long and placed sixteen inches apart on a six-inch stratum of crushed rock, with another course of crushed rock seven inches thick, the three-inch top layer oiled and packed solid with a fifteen-ton roller until the surface has the appearance of an asphalt paving.

Not infrequently a stranger's impressions of a town are based on the treatment he receives or the conduct he observes in the comparatively few people with whom he is brought directly in contact during a brief visit. So it is a pleasure here to record that of all the times I have been in Sacramento, an unknown stranger on her treet cars, I have never seen among the one hundred and seventy-six motormen and conductors anything but uniform courtesy, attention, and cheerfulness toward all sorts of passengers. And that is a pretty good indication that Sacramento is a community not possessed of a pessimistic grouch or engendering and tolerating a personal attitude that makes for general discontent. A city can have no better advertisement than a cheerful and contented people.

## "For Men Must Work"

This unusual picture shows machinists at work rolling in back-header nipples in a

water tube boiler. The original photograph was taken by Wallace H. Foster, manager of the San Rafael district.

John Cleave, possibly the best-known character on the car lines of Sacramento, began his service on the little old horse cars, way back in 1879. He always works twenty-nine days a month, except in December, when he takes a trip to San Francisco to visit relatives. It is said of him that he has never had an "oversleep" against his name during his thirty years of service and in all that time has never smoked a cigarette, been under the influence of liquor, or used profanity; and that is going some, considering what a carman has to face!

# The History of Gas Lighting in Sacramento

By E. C. JONES, Chief Engineer Gas Department.


E. C. Jones

**Sacramento,** the capital of California, derived its name from the Spanish of the ecclesiastical word sacrament, meaning "an outward and visible sign of an inward and spiritual grace." The story of how the Sacramento valley was explored and settled by Captain John A. Sutter recalls the experiences of the pilgrims who first made their homes on the shores of Massachusetts bay nearly three hundred years ago. This pioneer settler of California was confronted by all the hardships, disappointments, and dangers of the Puritans, with the single exception of the wonderful advantages of California climate. But the troubles of the California Pioneer were ever tempered by sunshine and warmth. Seventy years ago, and well within the memory of many who are still living, the site of the present city of Sacramento was little known to white men and was occupied by hostile tribes of Indians.

Captain Sutter had received information in his Missouri home as to the mildness of California's climate and the productiveness of its soil, and he was filled with enthusiasm to be among the first to settle in so attractive a country.

He left Missouri in April of 1838 with a small company bound for California. The overland journey was slow and full of difficulties. He attempted to reach California by way of the old Oregon trail. But when he reached the Willamette river his men deserted him. So he took passage on a Hudson Bay Company's vessel that was going to the Sanwich islands. He hoped that he would be able there to reship to the coast of California. But he was disappointed, and left the islands in a vessel bound for Sitka. After some delay he came down the coast in the brig "Clemintine" and arrived at Yerba Buena (now San Francisco) July 2d of 1839. As Monterey was then the only port of entry he was compelled to go to that point before the vessel could be formally entered in accordance with the Mexican custom house regulations.

At Monterey Captain Sutter explained to Governor Alvarado the interest he had long felt in California, and expressed his desire to settle in the Sacramento valley.

The Indians of the northern part of California had all along been hostile to the settlement of Mexicans in their territory, so the proposition of Captain Sutter to locate in that dangerous region was favorably received. He was given permission to explore the rivers and to select and take possession of any location that pleased him, and was assured that after one year from the time of settlement he would be given title to the lands. With this encouragement, he returned to Yerba Buena, chartered the schooner "Isabella," purchased some small boats, and began the exploration of the Sacramento river. He was eight days in discovering which was the main channel of the river, and then he sailed up stream to within ten miles of the present city of Sacramento. He was met by armed and painted Indians. But he succeeded in satisfying them of his peaceable designs, and a treaty was made. He was allowed to proceed up the river, accompanied by two Indians, and he ascended in his schooner as far as the mouth of the Feather river, and in small boats went on up the Sacramento some distance further. After exploring the country he returned to his little schooner and found his men in a state of mutiny. They demanded that he should abandon so foolhardy an expedition


The State Capitol at Sacramento

in that useless wilderness. But Captain Sutter was determined to succeed, and he returned to the mouth of the American river, which he entered August 12th of 1839. He ascended the American river about three miles, discharged there the cargoes of his boats, pitched his tents, and mounted small canons as a means of defense and to intimidate the Indians. Here he broke the spirit of insubordination among his men, but the party was divided. Three white men decided to remain with Captain Sutter. Although satisfied as to the bad faith of the natives, he hoped to gain their assistance in carrying out his designs.

The Indians were scattered over the country in tribes and had their rancherias located at various points in the valley, along the course of the streams. At the time of Captain Sutter's arrival one of the most powerful of the tribes were the Nemshous, who ranged between the Bear and American rivers. Across the Sacramento were the Yolos, and on the north side of the American were the Bashonees. The Indians found by Sutter were degraded and worthless, inhabiting miserable mud holes or adobe huts, and subsisting on fish, acorns, roots, and small game. They were too lazy and stupid to hunt the larger game, which was so plentiful in the country at that time.

The first site Sutter selected on the American river was a place now known as Stewart's. But it was not entirely satisfactory. So Captain Sutter began in 1840 building Sutter's Fort at its present location. In 1841 an adobe building was constructed at the first landing, a place known later as the Tan Yard. Soon after that Sutter constructed a good-sized adobe house of two stories and three smaller houses, all surrounded by a wall, and these comprised Sutter's Fort. This work was accomplished by enlisting the labor of friendly Indians, whom he had succeeded in partially civilizing. These Indians were then employed in opening a road through the chaparral to a landing point on the Sacramento river two miles distant and called the Embarcadero. This name was retained until 1849, when it was changed to Sacramento.

Captain Sutter had enclosed a large tract of land with a ditch, and had commenced the cultivation of the soil. In two years he had established himself in power and authority. He surrounded himself with the best obtainable mechanics. Work of various kinds was carried on within the walls of the fort. He also formed a company of soldiers, selected from the best of the natives of the country. And when Fremont, "the pathfinder," arrived from the East he found at Sutter's Fort forty Indians in uniform, thirty employed white men, and twelve pieces of mounted artilery. Sutter's Fort was then capable of holding one thousand men, and there were two vessels at the Embarcadero belonging to Captain Sutter.

During the rebellion in 1844 Captain Sutter was called upon to aid in sustaining the Mexican government. As a result of that little revolution Pio Pico was made governor, and he retained the office until the war with the United States. A revolution later broke out among the Americans, who, before the Mexican war, took possession of Sutter's Fort and raised the first flag of independence. This movement was known as the Bear Flag Revolution, from the revolutionists' banner, on which was painted an emblem representing a grizzly bear. During this encounter General Vallejo and other Mexicans were held as prisoners at Sutter's Fort for about three weeks.

The war between the United States and Mexico began in May of 1846, and Commodore Sloat was directed to occupy the


Sutter's Fort, Now Within the City of Sacramento

**An Old Group at the Sacramento Gas Works**

Left to right—John Hines, Jim Cousins, Harry Keefe (in white), James Apple, Supt. George W. Jackson, Engineer Dennis Brophy, John Logue, John Brophy (hat at chin), Pat Spain, James McGunigan, J. Francis, Con McCann (bare arms), John Quigley, James Quillinan (shovel), John Roach.

ports of upper California. The 7th of July the American flag was raised in Monterey, the 9th of July at the plaza at Yerba Buena, and soon after at Sutter's Fort and other places.

After the arrival of James Marshall, a millwright, Captain Sutter determined to build a sawmill. They selected a location far up on the American river at what is now Coloma. This place had all the natural advantages necessary for the successful operation of a sawmill. Marshall, with seventeen men, began in the winter of 1847 to build the mill. In January of 1848, while Marshall was employed in enlarging the mill-race, he made the first discovery of gold in California. Marshall hastened on horseback to report his discovery to Captain Sutter at the fort, where he exhibited about two ounces of scale-like particles of gold. Captain Sutter desired to keep this discovery a secret, as he was depending on the mill at Coloma for lumber which he needed for building operations. But it was impossible to conceal a fact so important and interesting. Despite all precautions the quiet mining operations were discovered. A general stampede resulted. The discovery of gold caused a rush to the diggings. Seekers of gold made their way up the Sacramento river. The first party of these gold-seekers landed at the Embarcadero November 2d of 1848. There was not a house there. The only place of business of the future Sacramento was an old store-ship laid up by the bank of the river. But Sutter's Fort was the great centre of trade, and a little town in itself. It was rented to merchants at $60,000 a year. The principal establishment was the general store of Samuel Brannan & Co. At that time flour was sold at $60 a barrel, pork at $50 a barrel, and sugar at twenty-five cents a pound.

In December of 1848 Captain William H. Warner surveyed and laid out what is now the city of Sacramento. The first building in the new town was erected by Samuel Brannan, and it was completed January 1st of 1849. It was located on the corner of J and Front streets, and stood there until the fire of 1852. During all this time the town of Sacramento remained under the nominal government of an *alcalde*, or mayor. But with the 1st of August of 1849 a meeting of a town council was held, and after six weeks' deliberation the councilmen submitted a draft of a city charter. This proposed charter was defeated by 146 votes, but was afterward approved by a majority of 295 votes.

The population of Sacramento October 1st, 1849, was 2,000, and at that time there were forty-five wooden buildings and three cloth houses in the town.

One evening in January of 1850 the town was suddenly inundated by a rise of the river. So high did the water come that vessels of ordinary size could sail as far in as Sutter's Fort, and the entrance to the City Hotel was from boats landing at the second-story windows. This flood lasted but a few days. The 7th of April the waters again flowed into the town, and the day following the city council voted an appropriation for constructing a temporary levee. When this work was accomplished the principal business districts of Sacramento were protected against flood water.

This enterprising young city was the second in the state of California to introduce illuminating gas. Many interruptions prevented the completion of the gas works. July 15th, 1854, the city was nearly destroyed by a fire which consumed ten entire blocks in the central part of the town with more than two hundred frame buildings. During that year a new levee was constructed, one thousand new houses were erected, one hundred and fifty of which were substantial brick improvements, and the streets of Sacramento were raised and planked to a grade above the high-water mark. Had it not been for unforseen events the gas supply would have been the first public utility in Sacramento, then a town of some 8,000 people. But

The Old Office Building at the Sacramento Works

during 1854 a water works was first installed. This was the first city water works established on the Pacific coast.

The 25th of February, 1854, an act passed the legislature declaring Sacramento the capital of the state, and March 1st, 1854, the governor, state officials, and the legislature arrived and were received by the city corporation, the Sutter Rifles, and the assembled citizens.

June 5th of 1854 a Scotchman named William Glenn obtained a franchise to build and operate a gas works in Sacramento. This was the same year that gas was introduced in San Francisco. But Glenn did not proceed with the building of the works. He sold his right to others who organized August 18th, 1854, under the name of the Sacramento Gas Company. Angus Frierson was elected the first president, and N. W. Chittenden, the secretary.

October 20th, 1854, Mayor R. P. Johnson took the initial step in the construction of the gas works by turning the first soil in excavating for the gas-holder tank. The progress of the work was seriously interrupted, and the undertaking was abandoned March 7th, 1855, on account of the rise of the American river and the submerging of Slater's Addition, where the new gas works was being built.

But August 14th, 1855, work was resumed, and was carried to a successful completion.

Sacramento was first lighted by gas the evening of December 17th, 1855. At that time the officers of the company were R. P. Johnson, president; P. B. Normai, engineer; H. W. Watson, secretary; D. O. Mills, treasurer; and James Murray, W. F. Babcock, L. McLean, Jr., R. P. Johnson, and W. H. Watson, directors.

The retort house was a brick structure fifty-four feet long, fifty-one feet wide, and twenty-one feet high, covered by an iron roof. The adjoining purifying house was thirty-five feet long, twenty-five feet wide, and eighteen feet high in the clear. The purifying house had a water-tight cellar built on arches. The meter house and offices occupied a building thirty-seven feet long, twenty-five feet wide, and two stories high. A great deal of pride was taken in the gas works' chimney, which was built of brick and was eighty-five feet high.

The gas-holder tank was fifty-two feet six inches in diameter and twenty feet deep. It was made of brick and rested on a pile foundation. The buildings and brick-work were constructed by Carr and Winons of San Francisco, and all of the iron-work was furnished by James and Peter Donahue of San Francisco.

In 1856 the average daily output of gas was from 8,000 to 10,000 cubic feet. The selling price was $15 the thousand, and there were one hundred and thirteen consumers.

In 1863 the number of consumers had increased to six hundred, and then the city contracted for forty-five street lamps at $9 a month each, the lamps to be lighted only

General View at the Sacramento Gas Works during the session of the legislature! A new gas holder was constructed in 1869 with a capacity of 60,000 cubic feet.

February 1st, 1870, the price of gas was reduced to $7 the thousand cubic feet, and there were at that time 33,000 feet of street mains in use. During that same year the price was further reduced to $6 the thousand, at which rate it was held for several years.

In 1871 there were 50,000 feet of gas mains in the streets of Sacramento. The officers of the company at that time were Charles E. McLane, president, and H. B. Forbes, secretary, and John Q. Brown was the superintendent. January 8th, 1872, opposition came into the field under the name of the Citizens Gas Light and Heat Company. The trustees of this new concern included many well-known men of Sacramento, and the first officers were W. E. Brown, president; Robert C. Clark, vice-president; Albert Gallatin, treasurer; and J. W. Pew, secretary. This Citizens Gas Company proceeded to build a works on a 600x240-foot area on the river-front, between T and U streets. The erection of the works began there in February of 1873, and the plant was completed in December of that year. Eighteen miles of street mains were laid. The plant included a substantial retort house, containing five benches of five retorts each, a purifying house, and all the apparatus necessary for a complete coal-gas works, also a brick office building, which contained an eight-foot station meter and rooms for the directors and for the transaction of the regular business of the company. This gas works was the nucleus from which has grown the present well-equipped works of the Sacramento Electric Gas and Railway Company of today.

January 1st, 1875, the Sacramento Gas Company and the Citizens Gas Light and Heat Company, were consolidated under the name of the Capitol Gas Company, with a capital stock of $2,000,000 in 40,000 shares of $50 each. The gas-making operations of the new combination company were carried on at the works of the Citizens Gas Light and Heat Company, between T and U streets and Front street and the river-front. At this works there were three 60,000-cubic-foot gas holders for the storage of gas. These holders continued to be the sole dependence of the company until the construction in 1908 of the 500,000-cubic-foot modern gas holder.

Pier on Sacramento River Where Fuel-Oil Is Delivered at the Gas Works

In 1878 the retort house of the Sacramento Gas Company was sold and converted into a warehouse, and the railroad company bought the old gas holder and the land on which the holder had stood. So the plant of the Sacramento Gas Company, with the exception of its street main system, passed out of existence.

When the present state constitution was adopted the capital stock of the company was reduced to 10,000 shares, at a par value of $50 a share.

The report of the superintendent, John Q. Brown, for the year ending 1876 gives the amount of gas made that year as 36,033,000 cubic feet, with a leakage of 17 per cent. It deals with the re-arranging of the mains and services due to the consolidation of the two companies, and states that all of the apparatus at the old works was taken down and that those parts in good order were utilized for improvements and additions to the new works.

During 1876 quite extensive improvements were made to the works that had been acquired by the consolidation, and five branches of retorts were added, making ten in all. That year there was constructed a new coal shed, 40x120 feet. This shed remained in use until it was dismantled during the month of December, 1909.

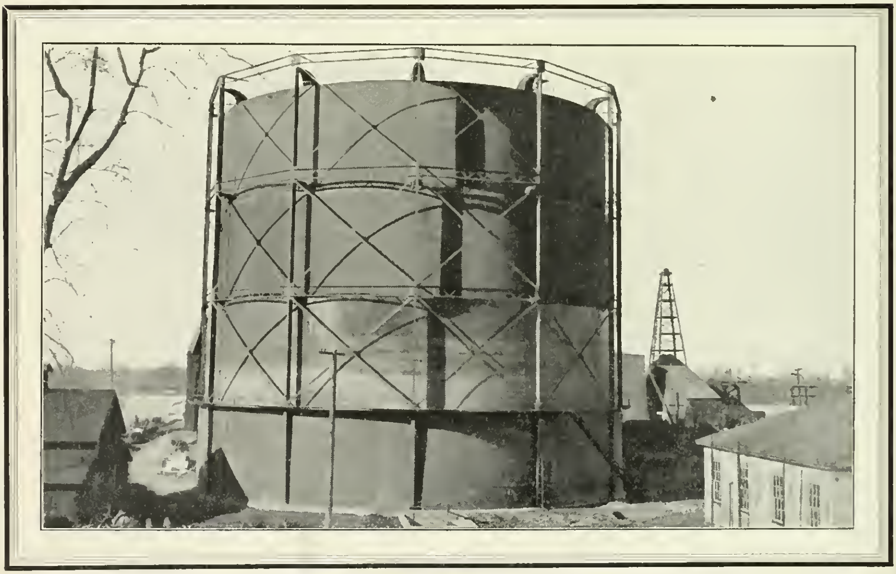
In 1876 the gas was made from Sydney coal, costing $12 the ton, enriched with "Kerosene Shale" from Australia, and costing $25 the ton.

In 1887 the officers of the Capitol Gas Company were B. U. Steinman (afterward mayor of Sacramento), president; Oliver Eldridge, vice-president; and C. H. Cummings, secretary and treasurer.

March 21st, 1887, John Q. Brown resigned as superintendent of the gas works to accept the position of state gas inspector, and was succeeded temporarily by J. R. Watson, who, in turn, was succeeded September 1st of that same year by George W. Jackson as temporary superintendent. Jackson was then clerk of the company, and J. C. Pierson was appointed the permanent superintendent. Pierson retained this position until 1894, when he retired to attend to his mining interests. He was succeeded as superintendent by George W. Jackson.

July 1st, 1887, the Capitol Gas Company consolidated with and absorbed the Thomson-Houston Electric Light Company, thereby disposing of a competitor and combining the electric lighting and the gas business.

In 1896 the Sacramento Electric Gas and Railway Company was formed by the consolidation of the Sacramento Electric Power and Light Company and the Folsom Water Power Company, and in 1902 this company acquired by purchase the Capitol Gas Company.



The 500,000-Cubic-Foot Gas Holder at the Sacramento Works

In March of 1903 the Sacramento Electric Gas and Railway Company was acquired by the California Gas and Electric Corporation. During the many changes in corporate title and the advancement in the art of gas-making the method of making gas was also changed.

A plant for the manufacture of water-gas from anthracite coal and petroleum was constructed, and it was used in connection with the coal-gas works. As petroleum became more plentiful and cheaper, water-gas displaced coal-gas.

In 1903 another advancement in the process of manufacture was made by the introduction of crude-oil water-gas, using California petroleum exclusively for the manufacture of gas. With the development of the process of making gas the quality was improved, and the price was reduced to $1 the thousand cubic feet, which is the rate now charged in Sacramento.

The late George W. Jackson was succeeded as superintendent of the gas works by R. P. Valentine, and when the company passed into the hands of the California Gas and Electric Corporation the late Albert Gallatin was made its manager. Then in turn came Frank A. Ross and F. E. Fitzpatrick as managers.

In January of 1906 the Sacramento Electric Gas and Railway Company became a part of the Pacific Gas and Electric system, and is now under the management of C. W. McKillip, with Edward S. Jones as superintendent of the gas works.

Since the Sacramento works has passed into the hands of the Pacific Gas and Electric Company great improvements have been made in the plant, new and larger sets of oil-gas generators have been installed, new purifiers have been constructed, and a 500,000-cubic-foot storage holder has been built. The street-main system has also been extended to keep up with the growth of the city, and a high-pressure gas system has been installed at Oak Park, a large and rapidly growing suburb of Sacramento. Recently it was decided to increase the oil-storage capacity at the gas works, and a 10,000-barrel steel oil-tank was placed upon a barge in San Francisco and towed up the Sacramento river, moved over the levee, and placed upon a foundation in the yard at the gas works.

In preparing this article the writer has drawn freely from a little book entitled "Sacramento Illustrated," published in 1855 by Barber and Parker.

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## Fire! A Cause and a Remedy

An ordinance was recently passed by the city trustees of Chico prohibiting the use of gasoline in any building, room, or enclosed shed within the corporate limits of that city. This prohibition emphasizes the danger of gasoline; it shows the growing tendency toward restricting this commodity, because sad experience has taught that gasoline is even more generally dangerous than the highest modern explosives; that even the fumes have been known to ignite when coming in contact with an open light, though the tank containing the gasoline was many feet away.

A recent inspection of one of the Pacific Gas and Electric Company's plants showed three comparatively new lines of hose rotted (one entirely off) at the valve connection. This rotting had been caused by water dripping into the first loop of the hose. A blueprint can be had from the office of the property agent, showing the proper method of installing drip cocks to obviate this trouble. Examine your hose lines monthly, and try them out.

R. J. C.

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At the annual dinner of the National Commercial Gas Association held at the Hotel Astor in New York the night of December 15th, forty-two of the guests represented interests capitalized at $600,000,-000.

# Pacific Gas and Electric Magazine

PUBLISHED IN THE INTEREST OF ALL THE EMPLOYEES OF THE PACIFIC GAS AND ELECTRIC COMPANY

JOHN A. BRITTON - - - - - - - Editor
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## EDITORIAL

**Going After New Business**

One man working alone may evolve a great idea. But when many men at the same time take it up and begin to work at it, then results come. Thus it has been with inventions, and thus with all reforms in government. The power of numbers, seeking, moving, eager for some one thing. And in the end the majority always rules.

Apply this cumulative force to a great business enterprise. Some one man may get an idea. He alone can not accomplish its fullest results. But when a considerable number of men become possessed of that idea, believe in it, talk about it, and work for it, then it grows to be a developing power.

Forty years ago where was gas used in California and how extensively? Twenty years ago where was electricity used? Why have they grown to such wide popularity in steadily displacing candles and kerosene lamps and wood and coal? The reasons for the change are because they are more convenient, more cleanly, and comparatively cheaper, where physical and mental annoyances are reckoned in the cost or comfort of human life.

In Mexico and all through South America winter-warmed houses, stoves, and fireplaces are a rarity, and gas and electricity are mostly innovations for the foreigners. The American who would there introduce modern methods of any kind goes up against a wall of provincial preference for things as they are; encounters that shrug with which they tell you, "*Pero no es custombre.*"

In the progressive, commercially advancing, and inventive United States people are ever ready for what is new and better. Where at first gas and electricity were used rather as luxuries, today they are a domestic and a business necessity, because they save time and space and money. And the only limit to their more comprehensive use in every community is the limit permitted by the representatives of the producing companies in being content with taking new business as it happens to come without going forth and helping to create unanimous use, to hurry the day when American homes may be the freest in the world of unnecessary toil and dirt, with their attendant annoyances to home-blessed American womanhood.

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The highest masonry dam in the world will be that for the Shoshone irrigation project in northern Wyoming—325½ feet.

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The Pacific Gas and Electric Company has more than 1,500 employees in the city of San Francisco alone, and in the outside districts of the company's territory there are regularly at work from 1,500 to 2,000 or more men, according to the amount of construction and repairs.

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A San Francisco man residing out on Page street lost $250 in December. He had hidden it under his gas meter, which he had come to believe was a lucky place, since he knew the meter was registering slow and saving him money. Was it retribution or just the usual fate of those who rely on luck?

# Getting New Gas Business

## Following Up Advertising

IT IS now necessary for a gas company to advertise, as necessary for a gas company as for any trade. The present keen electric competition and the countless fuel-gas and cooking appliances have called into existence live and active gas advertising. We must reach out for new consumers, and we must educate our consumers in the uses they make of gas. Since we can not exhibit our goods, except in a restricted sense, we must avail ourselves of all the publicity possible. So declares Thomas R. Elcock in the July bulletin of the National Commercial Gas Association.

Continuing: In a large sense, our advertising is the effect produced on the public by the treatment received from every department of a company. This article, however, deals with advertising in the limited sense of public notices with a view to sale.

The good of advertising in daily papers varies according to local conditions, the character of the papers, and the size of the population. In large cities, approximating a million or more, where the papers are large, and crowded with the full-page displays of department stores, the efficacy of your message is uncertain. It is likely to be fitted in with undesirable associates or crowded into inconspicuousness. The best one can do is to condense the print, and either leave the surrounding white space for a mat, or draw a frame of broad black lines. The minimum space for effectiveness in a large paper is fifty lines deep, across two columns.

In a smaller city newspaper advertising can be of undoubted value. The copy should accord with your display, and should be seasonable and dignified, never bizarre or humorous. Let it show at first glance that the "Gas Company" is speaking, and its authority will have weight with the consuming public. Let your convictions as to the merits of your goods be strongly expressed. YOU are convinced that there is nothing in the world to equal a gas range or a gas water-heater, and you will write convincingly. Lay before the public a simple explanation of the article, and emphasize its claim, the saving of labor, of time, and, whenever possible, of money. Do not despise the certain well-defined lines of gas talk, the old expressions "no dust," "no ashes," "no dirt." These are cardinal points of merit, strong talking points, and women contemplating the purchase of a range like to hear of these features. Make the public absolutely familiar with the appliance, and never forget to state the three basic principles of satisfaction to the reader—where it can be seen, what it costs, and what, if you sell on terms, the payments are.

While the best newspaper copy is seldom unerringly strong enough to mould a reader into a prospect, it does make the public familiar with your goods, and so, like signs, painted and illuminated, bill-boards, posters, and street-car advertising, is a good investment.

It is the following up of this publicity that demands our most serious thought. Your advertising department and your new business department must act as one. Their purpose is identical. The most effective follow-up system is based on data secured from the live files kept from your solicitors' returns. The canvass covers your entire territory. As the data is returned, it is noted on cards, whether there is a complete non-use of gas, or whether there is a non-use of some particular appliance. The two classes of cards are filed separately, and, from their data, the mailing of advertising matter is begun. A consumer, who has not installed a certain appliance, receives a call from a salesman; then, probably a week later, an illustrated folder, attached to which is a return postal-card. The folder should apply to the trade you desire to supply. There should be one covering domestic appliances, another for restaurant appliances, another for blast furnaces, et cetera. The personal letter may be done by the multigraph and the address typewritten. The return of the postal, of course, stirs us to immediate action. The silence of the prospect places his or her name in the file for a second call by the salesman. Should the sale then be effected, the file card is complete. But, if the sale be not yet effected, there should be a personal letter signed by the district sales manager, another call from the salesman, and possibly another personal letter. Care must be taken not to antagonize the prospect, your salesman being able to guide your attitude in this respect. By such a system, complete, live data are maintained for every residence in your territory.

If thoroughly done, such a campaign must give results. What you attempt in advertising, do on as good a scale as possible. Issue one sample of merit rather than many of indifferent appearance and hasty compilation. The printed matter you send your consumers is but an extension of your display.

## Detroit's Gas Kitchens

To secure "all-gas kitchen" business from hotels, clubs, restaurants, and cafes, writes Clark R. Graves in the September 1st issue of "Progressive Age," omit the argument of economy; talk superior service; then prove it. The gas man has educated the housewife to use gas for cooking. To secure the business of the hotels and cafes is the next step: first-class accounts, and steady users, during three hundred and sixty-five days of the year, of gas appliances and gas supply. But remember that the restaurant-keeper always advertises "service," and it is "service" that you must help him give. When he speaks of coal at forty dollars a month and gas at seventy-five, talk superior service to him.

The arguments that have secured the Detroit City Gas Company a good hotel business, and which will help in any search for hotel business, are:

1—Service (the public's demand)
2—Convenience (ready to serve)
3—Saving of space (valuable to restaurants and hotels)
4—Saving of labor (no firemen needed )
5—Cleanliness (no ashes, no coal dirt)
6—No excessive heat (nearby rooms are not affected, and bring in better revenue)
7—Economy (indicated by above items, and by saving in repairs)
8—Satisfied help (a chef will stay where gas is used)
9—Reliability (ready to operate, no danger of fire from overheated kitchen).

To prove the foregoing advantages, lose no opportunity of getting some one appliance, no matter how small, into a kitchen. Do not bribe a chef, but show him that you are making his work one of pleasure and perfection, and one that will bring him increased salary, many times over what you could hand him "to swing the deal." Educate the chef and the proprietor, gain their friendship and confidence, and every "all-gas kitchen" gained helps you to another, as chefs and help move about the city, and talk amongst themselves.

We have given an annual exhibit for two weeks each year, showing the latest appliances, sending to all proprietors, cooks, and others interested a neatly printed invitation to call, inspect, and be our guests. This gives opportunity for those using gas to meet with non-users, and so many new consumers are gained.

After the installation, service must be rendered, and continuous business maintained. We have a first-class maintenance man, capable, willing, accommodating, and pleasing. He wins the confidence of the steward or chef, and keeps the appliances clean and adjusted. He drills the range and broiler burners, and permits no drop below the original service. Repairs are made at cost, but no charge is made for this man's time. This efficiency of service is the secret of hotel gas revenue. No complaint ever reaches the hotel office, the manager is willing to pay, and never returns to coal.

We sell old coal ranges in the country, away from our mains. Sometimes a small, side-street restaurant can be sold a combination coal and gas range at a smaller rate than that for a new coal range. The gas section will then be used for cooking, and the coal section for a cellar, or for storage of cooking utensils.

In selling appliances, get the money; do your own collecting. You will be surprised how much better satisfied a man is with an article after he has actually parted with his money for it.

To settle the complaints about high bills, have your salesman, and your maintenance man likewise, carry a loose ledger index book, wherein monthly readings are recorded. When the consumer insists that a month's bill is out of all proportion, show him the amount for the corresponding month of the preceding year, and for every month of the interval. When he sees that you know what you are talking about, he becomes more reasonable.

Agree to watch his kitchen, and take daily readings. Convince him that his reliable chef is using the amount recorded, and complaints will cease. In securing an order for an introductory appliance, gain permission to run a good-sized feed pipe to take care of the balance necessary for an "all-gas kitchen," and so prevent an additional cost from cropping up when you ask the proprietor to spend a hundred and seventy-five dollars or more for a range. The following appliances must be installed before you have an "all-gas kitchen":

1—Hotel gas range
2—Broiler with elevated oven
3—Bake or pastry ovens
4—Combination cake griddle and toaster
5—Coffee urns
6—Gas water-heaters
7—Gas burners under stock kettles
8—Gas burners under steam table
9—Gas burners under automatic egg timers
10—Gas burners for dish warmer.

The combination flat broiler, cake griddle, and toaster, makes a fine trial appliance, as a coffee urn, for instance, would not. The former is economical, does three things with one fire, takes up little room, and is always in use, winter or summer. It educates a consumer to the use of appliances, until a seventy-five-dollar gas bill seems cheap.

In summing up the hotel business, I will say that thirty per cent. of the eating houses of Detroit are saving money through our service, thirty per cent. find the cost of gas no more than that of coal, and forty per cent. are paying more for fuel, but figure that our service makes their mode of cooking unequalled. They are happy, and so are we.

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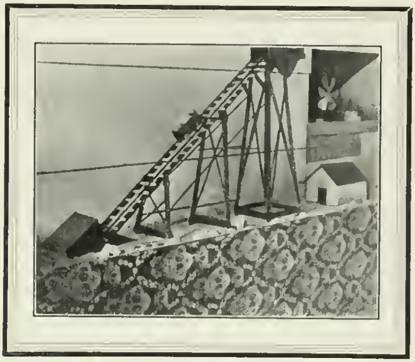
There are about 148,000 persons confined in the public and private insane asylumns of the United States, and it is estimated that during the average time of their confinement each of these persons costs the state about $6,000 and deprives the state of about $2,000 in personal productiveness, or a loss of $8,000 net on each person so maintained and uncured. In Belgium the insane are very successfully treated in small family groups, all given occupations, and made self-maintaining till returned to self-reliant citizenship.

## A Miniature Hoisting Works

In one of the rooms at the "Rome" power house is an ingenious little contrivance devised and constructed by George Ostermann, a young switch-tender. As may be seen in the accompanying illustration, it is a



miniature hoisting works, with a shaft and a powerhouse. It is operated by a small motor. As the car with its load of ore reaches the top of the incline, a trigger on the car strikes a cross-beam, and the bottom of the car falls open and dumps the load into the chute. In its descent the car strikes a lever which throws the bottom up into place, and the trigger catches and holds it there.

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George Dixon, a foreman in the general construction department at Colfax, was formerly a professional actor. He was the original Dixon of Mason and Dixon, a vaudeville team known through Europe, North America, and South America as the "American Eccentrics." Dixon played for nine years in Paris and for four years in the British Isles, and was an old chum of Chauncy Olcott's. He has a collection of programs, newspaper clippings, passports in different languages, and other interesting evidences of his theatrical wanderings.

# MEN OF THE COMPANY

## J. E. POINGDESTRE

### Longest in Service of All Those in the Electric Department

"THE only difference being that I have a little less hair at present," is the laconic comment accompanying his "only photograph," which had to be slipped from the family album to illustrate this page.

John Edmund Poingdestre is manager of that unit of the company's properties designated as the Marysville district and including the electric service and the gas works of Marysville, a centrally located Sacramento - valley town of about 5,000 people, close to the river.

In length of service he is the company's oldest electrical employee, having begun his work as bookkeeper and accountant for Eugene J. de Sabla's first little electric plant at Nevada City eighteen years ago.

J. E. Poingdestre

But his very first appearance was in London, England, the 22d of June of 1853. So, let 's see, he must have celebrated his fifty-sixth birthday last summer. Although he was born an Englishman, with a French-sounding name, and completed his collegiate education at the Lycée Imperiale de St. Omer in France and writes a significantly French hand, he waited till he was 41 and had dwelt in the state of California a decade before he entered the state of matrimony. Then it was that his calmer judgment focused his attentions strongly upon San Jose, which thereby received one more deserved endorsement to its reputation as a California city specially noted for its attractive women.

"First employment—British government, House of Commons; other occupations too numerous to mention: including surveying, railroading, mercantile business, et cetera, and of late years mining, and lastly the gas and electric business; also newspaper work in the past." There he gives it, in the barest skeleton, without time or place or incident.

"Newspaper work in the past"! Was it as foreign correspondent limited to brevity cablegrams when the tolls were high? Thus would the baffled biographer rebuke this diffidence and modesty that are evidently standing right in the way of the publication of what shows all the symptoms of being a really interesting story that would give the reader something of the personality and the life-pilgrimage of the man.

His experience in the company may be said to have been in three stages, but not in automobiles. And it has been marked by ups and downs. First stage—up in the Sierras, as bookkeeper and accountant at Nevada City and then as manager at near-by Grass Valley; second stage—down on the San Francisco peninsula, in charge of the business at Redwood and San Mateo; third stage—the happy medium at Marysville. Up in the mountains was where he acquired his love for mining; down on the peninsula was where his love turned to matrimony; and, on the level, there are no little Poingdestres in Marysville to bear the Poingdestre arms, or to be borne in the aforesaid arms, as the lawyers would say.

Frequent change of occupation and location is one of the marked characteristics of those born under that sign of the zodiac covering the period from June 21st to July 22d. If the subject of this sketch conform as closely to the standard in other respects, he should be a man of persistent and determined will, be extremely sensitive, fond of travel, possessed of an excellent memory; be a lover of home life; be of a mechanical turn; devoted and efficient under responsibility but restive under the direction of others; kind in times of illness and trouble, fond of the beautiful and artistic, generally neat and orderly; and of medium stature, with large torso, round face, small features, and light or grayish eyes.

That these characteristics do or do not suggest J. E. Poingdestre is for those to judge who know him personally or by sight, a pleasure that the writer of these lines has never had. A. R.

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The Pacific Gas and Electric Company has eleven water-driven and eight steam-driven-electric generating plants and one hundred electric substations.

## The Next Baseball Game

Seeking satisfaction in a return game to remove the sting of a 9-3 November defeat, the combined talent of the Pacific Gas and Electric Company and the San Francisco Gas and Electric Company is planning to go against the Gas Workers Union some Sunday afternoon late in January or early in February on the grounds at Twelfth and Mission streets. The convenience of this location carries with it a rental charge of about twenty-five dollars, so the promoters have decided to collect a modest fifteen cents from each man spectator and welcome the women free.

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## A Fish Story

At 5:53 a. m. of November 7th, 1909, the Smartsville-Marysville line of the Pacific Gas and Electric Company burned down where the line crosses the Yuba river near Hammonton. Both ends of the wire, according to C. E. Young, superintendent of the

**Two (Hook - and -) Line Men**
T. F. Blackhart, operator, and B. H. Wilcox, accountant, testing a load at the Colgate Power Plant.

A. Beauchamp, an operator at the Nevada Power Plant, and a trout he caught there 22 inches long and weighing 3½ pounds.

Marysville power division, fell into the water, and, from every indication, killed five bass, one about 10 inches long, the others smaller. These bass were found there floating on the water, and evidently had been killed but a short time. No cause of death other than by electric shock could be discovered.

# How and When Gas-Lighting Started

By V. HOWARD, Engineer North Beach Gas Station.

V. Howard

**Inflammable gas** is formed in tremendous volumes within the earth in connection with deposits of coal and petroleum. Such gas, escaping through natural fissures or brought to the surface in pipes, may be collected and used for fuel or illumination.

On the shores of the Caspian Sea, between Europe and Asia, there is a place where internal fires have been burning from remote ages, burning gas that has been constantly coming up there for thousands of years from petroleum deposits.

In the province of Szechuen in China the natives have long been using natural gas from depths of 1,500 or 1,600 feet and conveying it some distance from the wells by means of a pipe system of bamboo tubes. It is claimed that the Chinese were using this natural gas as an illuminant long years before gas-lighting was introduced among European nations.

But by general consent the discovery and application of gas-lighting is credited to Great Britian. The earliest European records of the distilling of coal in a retort for the production of artificial gas concern the experiments conducted about the year 1691 by the Rev. John Clayton. That was about 218 years ago.

Next came Lord Dundonald, who began experimenting with gas in 1787. He was using a patented process for obtaining coal tar and tried to see what would happen to the gas created during the process. The result was that he used it for lighting up the hall of Culross Abbey.

The real commercial development of coal gas as an illuminant began in the year 1792, one hundred and one years after the British discovery of artificial illuminating gas and one hundred and seventeen years before the present time. The name of Murdock, a Scotsman, stands conspicuously identified with the new industry.

Over in France, a Parisian named Lebon began in 1801 making gas from wood, and introduced the new illuminant into his own home. The success of Lebon's gas-lighting in his house in Paris attracted so much notice that many supposed he was the originator of the idea. The Frenchman's interesting experiments did one thing though; they happened to attract the interest of a man named F. A. Windsor, who took up the enterprise in a business-like way and in 1803 had gas-lighting introduced into the Lyceum Theatre in London. Not till seven years later was Windsor able to inspire sufficient business confidence in gas-making to attract others and get a company organized for the commercial manufacture of gas.

By 1813 Westminster Bridge in London was first lighted by gas, and three years later gas-lighting had become quite common in London. So popular had gas become within the course of a few years after its first public use in London that all the most important cities and towns in Great Britian and Ireland were using the new illuminant for lighting streets, shops, and public buildings. But the introduction of gas-light into private homes was a much slower process. Some people were afraid of it; some did not wish to be bothered by the odor and the annoyance that were early associated with faulty installation and defective fittings. But that was almost one hundred years ago, and there have been vast changes and improvements since then.

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A busy glad-hander is generally a tireless leg-puller.

# Where Hope was Small But Grit was Great

## The Vivid Description by an Eye-witness of the First Sea Fight of the Russian-Japanese War

By P. H. HILLEBRAND, Division Foreman, Marysville.

P. H. Hillebrand

**The first sign** of approaching hostilities between Russia and Japan was toward evening of the 8th of February, 1904. Then it was that we saw a squadron of Japanese warships convoying three Japanese transports, with 3,000 Japanese troops and their military supplies aboard, come steaming into the harbor of Chemulpo, Korea. The Japanese cleared for action, and lined up within short range of two Russian men-of-war, which had been peacefully lying at anchor there with a French, an English, and an Italian cruiser and an American gunboat, the "Vicksburg," on which I was at the time an electrician of the first class.

In that Japanese fleet were sixteen fighting ships, under command of Rear Admiral S. Uriu. Russia's force to oppose this formidable array consisted only of the cruiser Varyag and the gunboat Koreetz.

The little Koreetz had already prepared to leave Chemulpo. She was actually steaming out of the harbor when she suddenly met the large Japanese squadron headed in from sea. A signal from the Japanese admiral's flag-ship ordered her to put about and return to her anchorage. She had undoubtedly intended to go to Port Arthur, there to join the Russian fleet. But now her doom was sealed.

At 8 o'clock that night, obscured by the wintry darkness and with all the Japanese lights extinguished, the three transports silently felt their way further into the harbor and anchored near the city itself. Then began the hurried landing of troops and stores. We guessed what they were doing there in the dark, but we could not see. Nor was there sound or light. All night long the rush of that smothered disembarking continued, and over the black waters could be distinguished omninous little torpedo boats darting hither and thither, evidently on picket duty to protect Japan's soldiers and ships from a possible Russian surprise.

When darkness dissolved at the break of dawn that 9th of February there lay twenty-two warships representing six of the world's greatest nations, all silent, still, but growing more and more distinct with the development of the full light of a day that was destined to show a scene of desolation before the coming of another darkness.

The 3,000 Japanese soldiers were all safely ashore and ready. The whole Japanese fleet was aswarm with men hurrying about decks. The grating noise of their hoisting anchor chains came to us over the tranquil waters of the bay.

Slowly but in a way that meant a mighty menace, their great black-barrel guns pointing back like many huge spyglasses all focussed upon the two Russians, the Japanese ships steamed away silently in single file and turned to the right behind Yo-Dolmi Island, out there at the harbor entrance. They were gone, but we all knew they were only waiting.

Presently a launch made the rounds of the foreign warships, visiting each; and to the "Vicksburg's" commander also it brought the Japanese admiral's warning:—

HIS IMPERIAL JAPENESE MAJESTY'S SHIP NANINA

CHEMULPO ROADSTEAD,

February 8th, 1904.

Sir:—I have the honor to notify you that as hostilities exist between the Empire of Japan and the Empire of Russia at present, I shall attack the men-of-war of the government of Russia stationed at present in the port of Chemulpo with the force under my command, in case of the refusal of the Russian senior naval officer present at Chemulpo to my demand to leave the port of Chemulpo before noon of the ninth of February, 1904, and I respectfully request you to keep away from the scene of action in the port so that no danger from the action would come to the ship under your command. The above mentioned attack will not take place before four o'clock p. m. of the 9th of February, 1904, to give time to put into practice the above mentioned request.

I have the honor to be, sir, your most obedient servant,

S. URIU,

Rear Admiral, commanding a squadron of the Imperial Japanese Navy.

The Russians had been given until noon to go out and fight hopelessly against those sixteen Japanese warships lying in wait for them behind the island. Or they could choose the best position and remain grittily in the harbor and defiantly wait for the enemy to crowd in and do its worst right there. Or they could use the time to abandon and destroy their two ships and then take their chance on shore against that larger and better armed and better prepared force of Japanese soldiers that was waiting somewhere and would outnumber the Russian sailors three to one. Or these Russians could simply wait and sensibly surrender with the honors of war in the face of overwhelming odds that could mean nothing but the valorous sacrifice of human life by those who might attempt to fight either part of that outnumbering foe.

At 9 o'clock the little Russian gunboat Koreetz was alive with preparations. Men were clearing her decks. Topmasts were being chopped down. Skylights were being smashed loose. Every movable thing, whatever was breakable or inflammable and not absolutely necessary to the fighter was being cut away, stripped off, and thrown overboard. The little Koreetz was preparing to go into a fight!

At 11:20 a. m. the cruiser Varyag and the Koreetz hoisted their anchors and grimly and silently started out of the harbor, their flags flying, their men at their stations.

They were going bravely to take the hardest chance of all, to meet the Japanese who were already waiting in a chosen position to riddle them as they would try to reach the open sea.

As the Russians came abreast and were steaming past the cruiser Pascal, from the Frenchman's decks rang thrilling shouts of encouragement and applause. Almost instantly the men-of-warsmen on the decks of the English cruiser Talbot and the Italian cruiser Elba broke into a resounding chorus of tremendous cheering for the brave fellows that were faring forth to an unequal battle.

Little did we on the "Vicksburg" realize as we stood watching. the solemn departure of those two Russian vessels going grimly out to fight with sixteen Japanese warships hidden only two miles away what would be the aspect of Russia's men and ships when next we should see them at close range.

They were approaching Yo-Dolmi Island. The little gunboat Koreetz was now moving ahead on the left of the Varyag. Her intention became evident to all of us. She would take the lead, draw the aim of the Japanese full upon her, receive the first fury of the fire, and give the larger and more valuable Varyag just that slim chance of running the gaunlet and somehow fighting her way through for a clear dash to sea and then a long race to Port Arthur. It was a forlorn hope, a desperate move.

The Russian Gunboat Koreetz Just After the Explosion

At 11:50 a. m. the first shot was fired. It was a Japanese shell aimed at the little Koreetz. On the "Vicksburg" we heard its roar for almost a second before we saw a white geyser suddenly burst up out of the sea a hundred yards short of the Koreetz but in direct alignment for her side.

The Koreetz almost instantly returned the fire with her starboard battery. We saw the flash.

The next moment thunder began roaring. The cruiser Varyag had got along to a point where she too became visible to the waiting Japanese fleet, out there behind Yo-Dolmi Island. Her right side became the target for a hurricane of Japanese fire. Some of the missiles struck her, and the water all about her was being slashed where the Japanese cannonade with small ammunition was just missing the mark.

The whole fury of the Japanese attack seemed now to be concentrated upon the big Varyag. She was being showered with a perfect rain of sharpnel that was splashing the water as with hailstones. The Japanese were evidently trying only to kill off gun crews with that small shot and force the Varyag to surrender as a valuable prize of war.

For about fifteen minutes the little Koreetz and the big Varyag were in thickening black clouds. We only knew they were still afloat and fighting as we saw the intense red blurrs of fire as their guns belched forth in that pall of smoke and kept hurling back defiance in the face of destruction.

On went the fight in its thundering fury, its flashes, its terrific detonations, and its increasing obscurity from the thick powder smoke that hung low over the water.

Then out of that stiffling cloud suddenly emerged the big Varyag, headed back into the harbor, keeping Yo-Dolmi Island between her and the Japanese fleet. And over there, turning to the left and emerging from the grayish gloom, we saw the little Koreetz also coming back.

But the Japanese had detected the move despite the smoke. One of the Japanese battleships nosed out from behind the island into our line of vision and opened fire with ten-inch shells meant now to tear the big Varyag to pieces. And the huge projectiles struck her with telling effect.

From 11:50 a. m. till 12:40 p. m. the storm of battle had roared incessantly. Fifty minutes is not long for some occasions, but when every second of those fifty minutes is filled with the intensity of the fury fight of nations it is as hours in times of peace.

The crippled Vayrag, her port quarter all afire, her hull and superstructure all battered and smashed, came on in and dropped anchor.

Medical assistance from all foreign men-of-war in port was quickly sent alongside in the little steam launches to render aid to the wounded.

While we were yet a city block's distance from the Varyag we could hear the uncontrollable screams and yells of men crying out in their agony.

The Varyag's decks were like some terrible slaughter-house. Limbs of human beings were strewn about. The warm blood was still trickling from the dismembered parts. Here and there lay men with arms and legs completely torn away by shot and shell, the blood gushing forth where life still lingered.

One poor fellow was being lowered from a fighting top. He had been shot through in several places. His agonized groans from the torture of his pain brought a choking lump up into the throat of every man of us. We too were all fighting men of the sea, but this thing was heartrending and terrible. Just as they placed him gently on the reeking deck his cruelly wounded body convulsed spasmodically with each of several gasping screams, and then he lay still, a sacrifice to his country's call.

Surrounded by all this slaughter and shrieking and the sickening silence of dead bodies, the survivors still stood at their guns, ready to fight on, to obey, to do their duty in their Emperor's cause. Their faces were black with the grime of powder, smeared through the sweat of toil. Some wept in sheer desperation, in their strange frenzy to fight on. If there had been any personal fear it had all gone in the first fury and excitement of that fight that was pre-ordained to spell slaughter for the small Russian force that went heroically out to battle.

Meanwhile the little Koreetz had anchored, but the Varyag signaled to her, and so she steamed further into the harbor and anchored again, this time clear of the other vessels. From the movements aboard the Koreetz it was now evident that her crew was preparing to abandon her.

The wounded from the Varyag were being tenderly taken to the foreign men-of-war. In twenty minutes they had all been transferred to places of safety and surgical attention.

It became plain now to every watcher that the crippled and flaming big Varyag was doomed and could not shelter human beings. Boats from every man-of-war in the harbor were rushed to her to take off her crew and officers and get them safely aboard the neutral foreign warships. In ten minutes this hurried relief was concluded.

Then we turned from the abandoned Varyag to see what had become of the apparently unharmed little Koreetz. There she lay three hundred yards off to the right of the "Vicksburg," ominously silent, still, deserted. There was a fascination about it all that kept our eyes strained to the scene, to that fighting ship that had significantly hunted a clear space. Without comment we all seemed instinctively to expect something. And then it came!

The Koreetz suddenly boosted herself almost bodily up out of the bay. And as she rose, two quickly succeeding and terriffic explosions shook the air, ripped the little vessel asunder, sent the scattered parts skyward in a million slivered pieces. They went up like sime mighty funnel and curved and came down like some huge aerial umbrella dripping streams of dirty water and shedding showers of debris. And when the air cleared there lay all that remained of the once sturdy little

Koreetz—some tangled wreckage, a battered smokestack, and part of a distorted hull protruding above the waterline.

About three hundred yards to the right of the exploded Koreetz lay a Russian merchant steamer. Her crew also had abandoned ship. To make sure that she would not fall into the hands of the Japanese as a trophy of victory her sea valves had been opened so that the waters might rush in and sink her. Slowly, gradually, she was going down at the stern. The big Vayrag was now also settling, tilting more to the left as she sank lower and lower into the sea. Fire was spreading rapidly over her stern. The flames were licking up the scattered ammunition along her bloody decks. The resulting explosions were as a fitful fusilade. At 6:01 she keeled further over to the left, her smokestacks almost touching the water. The ammunition and the other heavy articles left about her decks could be heard nosily thumping and bumping as the vessel rolled and wallowed to adjust herself in her cold coffin.

Just then the bugle on the English cruiser Talbot cut the crisp night air clearly with the first mournful notes of "taps," sounding the soldier's requiem for the men that lay dead on those doomed decks.

As the bugle's mournful wail carried clearly over the water then in truth did every listening man-of-warsman see the thing close, through tear-dimmed eyes that were directed toward that coffin ship which would any moment now go down into the sea, carrying in her the gallant fellows that had fought by her to the death.

The bugle notes faded, died away in the distant echo, and our ears caught only the hissing of steam and the rumbling of heavy things shifting uneasily in the dying Varyag. Then came a louder murmur, like the last groan of some expiring giant, and the big Varyag slipped down into the sea and was gone.

The Russian merchant steamer was sinking too slowly to suit those that had abandoned her. One of her small boats pulled back alongside, and men went up and into her. In fifteen minutes they quickly departed. Presently a glimmer of light showed through one of her cargo portholes. In ten minutes more she was a complete mass of flame. She burned as a great battle beacon on into the night till 2:45 o'clock, then she slipped down to join Russia's thirty dead men that went to the bottom in the Varyag, from which fifty-six wounded men had earlier been rescued.

These poor wounded survivors were the maimed and mutilated human evidences that civilized nations have not yet developed far enough out of barbarity to arrange among themselves that peace and national pride may be maintained without the barbaric slaughtering and crippling of some of their physically best and bravest men, and without the destruction of enormously valuable property that takes the savings and contributions of millions of innocent people to produce.

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Frederick C. Jones, the company's chemist, is a Harvard graduate, having received the degree of A. B. in 1895.

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The Pacific Gas and Electric Company owns gas works in eighteen cities, fifteen subsidiary electric light and power companies, the water works of the city of Stockton, the twenty-nine miles of street-car system of the city of Sacramento, the steam railroad from Folsom up-river to the state prison, an amusement park with its theatre and baseball grounds at Sacramento, and the South Yuba and the Auburn irrigation systems with their aggregate of more than 633 miles of water ditches and twenty-eight miles of flumes from more than thirty mountain lakes and reservoirs that also belong to it, together with several thousand acres of mountain side as a catchment area and timber supply, as the company owns and operates two sawmills.

# PERSONALS

Fred W. Schimmielffenig, engineer of the Stockton Water Company, has a little daughter, born the 23d of October.

C. A. O'Conner, assistant superintendent at the Potrero gas works, was a student at the University of California in 1905 and 1906.

Otto D. Druge, a veteran in the Sacramento street-car service, is depended upon for songs and funny stories whenever the boys have a smoker.

Fred C. Birkenstock, an operator at Substation J on Sacramento street in San Francisco, served with the Second United States Cavalry in the early '70's.

H. C. Parker, secretary in the general manager's department in San Francisco, was graduated from the University of California in 1908 with the degree of B. S.

J. W. Dooley, first operator at the Centerville power house and an employee there since March of 1907, was married December 2d, his bride being Miss Vera Owens of Redding.

William Craig, who wears motorman's badge No. 1 in Sacramento, has been in the company's service since 1889, when he controlled one of the first electric cars operated by storage battery.

E. H. Perry, first operator at the de Sabla power house and an employee of the company for the past three years, was married at Oroville, December 4th, his bride being Miss Frances Pickler of Stirling City.

The company's oil barge that carries fuel-oil up to Petaluma for use in the gas works there is named John A. Britton, after the general manager.

The two excellent photographs of the state capitol and Sutter's Fort that illustrate Sacramento's gas history were taken by Superintendent Merrill of the company's Sacramento car system.

Nelse Kjar, a collector for the company's gas, electric, and street railway business in Sacramento, was attacked December 14th by two Greeks wielding monkey wrench and butcher knife because Kjar called to collect the gas bill. The belligerent Greeks were arrested for assault with deadly weapons.

San Francisco has decided to have a world's fair in 1915 to celebrate the completion of the Panama Canal, and John A. Britton, general manager of the Pacific Gas and Electric Company, has been chosen as one of the committee of two hundred representative men to develop the enterprise.

Joseph P. Baloun, chief draftsman for the Pacific Gas and Electric Company, was, about twenty years ago, an arc lamp trimmer and wireman at the Union Iron Works; then he served his mechanical apprenticeship in the shops, and, after a few years of outside experience, re-entered the great ship-building works as a draftsman, and continued in that capacity until three years ago, when he left to become the head of this company's drafting department. During the eight years from 1898 to 1906 he was also instructor in mechanical and naval architectural drawing and mechanics at the San Francisco Evening High School.

# The Magazine, Its Circulation and Its Critics

THOSE who write for or are interested in this magazine may have wondered who are its regular readers. In addition to the circulation intended for some 3,500 employees of the company, scattered through scores of towns in twenty-seven counties, comprising the middle third of California, there are already (by Christmas, 1909) paid subscribers outside of the company who receive the magazine in six cities of four foreign countries and in fifty-four cities of twenty-nine states and territories, not counting California, which has in thirty towns paid subscribers who are not employees.

New York city shows thirty-four subscribers; Boston, eight; Philadelphia, five; Manila, three; and Los Angeles, thirteen.

Here are the places where outsiders interested in gas, or electricity, or in you and your work are regularly receiving this magazine:

SWITZERLAND—Geneva.
ENGLAND—London, Manchester.
JAPAN—Tokio, Yokohama.
PHILIPPINES—Manila.
BRITISH COLUMBIA—Victoria.
ALABAMA—Birmingham.
ARKANSAS—Helena.
COLORADO—Manton, Denver.
CONNECTICUT—New Haven.
DISTRICT OF COLUMBIA—Washington.
GEORGIA—Columbus.
ILLINOIS—Chicago, Rockford, Litchfield, Oak Park.
INDIANA—Logansport.
IOWA—Waterloo, Davenport.
MAINE—Portland.
MARYLAND—Baltimore.
MASSACHUSETTS—Boston, Malden.
MICHIGAN—Detroit, Grand Rapids, Kalamazoo.
MINNESOTA—Minneapolis.
MISSISSIPPI—Vicksburg.
MISSOURI—St. Louis.
NEVADA—Tonopah.
NEW JERSEY—East Orange, South Orange, Paterson, Long Island City, Elizabeth.
NEW YORK — New York, Albany, Brooklyn, Poughkeepsie.
NORTH CAROLINA—Wilmington.
OHIO—Dayton.
OREGON—Portland.
PENNSYLVANIA—Philadelphia, Chester, Morristown, Pittsburg, Bradford, York, Wyncote.
SOUTH CAROLINA—Charleston.
TEXAS—Galveston.
UTAH—Salt Lake City, Provo.
WASHINGTON—Spokane, Olympia.
WISCONSIN—Duluth, Milwaukee.
CALIFORNIA—Alameda, Auburn, Bakersfield, Berkeley, Cherokee, Cisco, Colfax, Dutch Flat, Electra, Fresno, Gilroy, Jackson, Los Angeles, Oakland, Oroville, Palo Alto, Petaluma, Potter Valley, Sacramento, San Francisco, San Jose, San Luis Obispo, Santa Barbara, Santa Clara, Santa Cruz, Stanford University, Stockton, Sebastopol, Ukiah, Vallecito.

In addition to all these there are scattered to various cities thirty complimentaries for directors and public libraries, forty-two for advertisers, and fourteen as exchanges for gas, electrical, technical, and commercial publications. So, there is how far the new magazine has already reached.

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New subscribers are asking favors that we are no longer able to grant without the co-operation of some of the old subscribers. They want back numbers, and the reserve supply is now reduced to this condition:—

| MONTH | COPIES |
|---|---|
| June | 300 |
| July | none |
| August | 3 |
| September | none |
| October | 130 |
| November | 1 |
| December | 2 |

If any one in the company, who is not preserving a complete file, have spare copies that he does not want, they would be thankfully received by the magazine as a small contribution to help replenish the depleted stock.

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From the "Electrical World" (New York), issue of December 16th:—

The Pacific Gas and Electric Company, San Francisco, has commenced the publication of a monthly organ, named the "Pacific Gas and Electric Magazine," which differs materially from the usual central-station publications. A number of pages is given to excellently illustrated descriptions of parts of the company's plant, which is so extensive and varied that this feature can be continued over a long period.

There is also in each issue a number of articles of a technical character likely to be of value to the employees of the company, and the August issue includes a well-written and illustrated history of gas lighting in San Francisco. Another feature is a biographical sketch in each issue of a member of the company's staff. About half of the contents relates specifically to the routine operations of the company. In typographical appearance, illustrations, arrangement of matter, and evidences of editorial skill, the publication is much in advance of other central-station organs of this country, which considerations appear to justify the policy of the company in attaching a subscription price and aiming at a general circulation for the periodical.

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From a civil engineer of Olympia, Wash.:

I have just been looking over the October number of your magazine, and I want to say that it has been quite some time since I have seen anything as good in its line. It is bright and newsy and withal has lots of the good, solid stuff hidden away in it. I wonder what the chances are for an outsider to get on the subscription list. I am enclosing stamps in hopes.

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From Wells Drury, secretary Berkeley Chamber of Commerce, and formerly managing editor San Francisco Call:

The admirable magazine * * is certainly unique and most attractive. I notice you use a great many halftones, and the idea occurred that you might like an article concerning Berkeley, properly illustrated.

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From "The Gas World," London, December 18th:—

The Pacific Gas and Electric Company of San Francisco is evidently a believer in the merits of printer's ink. It issues monthly "The Pacific Gas and Electric Magazine," of which No. 6, Vol I, has just reached us * * * . The number, which is well printed on good paper, contains the full text of Mr. Jones's paper to the recent meeting of the American Gas Institute on "The Development of Oil-Gas in California," a short paper by Mr. W. R. Eckart, the veteran consulting engineer to the company, on "Hydraulic Pressure Gauges," and many other interesting contributions on technical and general matters.

From the Nevada City "Miner-Transcript" of December 22d:—

John Calvert, foreman of the Grass Valley substation for the Bay Counties Power Company, wrote an article for the monthly magazine issued by the Pacific Gas and Electric Company that is full of interesting information and well put together. Mr. Calvert is an electrician who understands his business, and his description of the [electrical] development of this county lacked none of the essential details.

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In their issues of December 28th Vallejo's three daily papers contained articles concerning the December number of the magazine. The morning Times had a half-column commenting favorably on E. C. Jones's history of gas lighting in Vallejo, closing with this sentence: "The article will be interesting to many in this city, as it deals with other bits of early history not generally known by the public." The evening News also had a half-column referring to the gas history of the town and making a point of how Vallejo lost the state capital; and remarked, "The article is edited by E. C. Jones, who is chief engineer of the Pacific Gas and Electric Company, and shows a remarkable amount of study into the conditions as they existed as early as 1850." The evening Chronicle contained a shorter notice, making mention of the history of gas lighting in Vallejo.

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From Sacramento "Leader", January 2d:—

In the December number of the Pacific Gas and Electric Magazine * * an interesting article appears on "A Rail-Bonding Car." It was written by Supervisor Charles McKillip, manager of the Sacramento Electric Gas and Railway Company * * *. The article is handsomely illustrated.

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From the managing editor of "Selling Electricity", New York, January 4th:—

You certainly have struck a fast pace, and I wish you all success. I would be interested to know whether your circulation extends beyond the employees of the company.

# Pacific Gas and Electric Magazine

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Yearly Subscription 50 cents | Single Copies each 10 cents

The Men at the Head of the Several Thousand Employed by the Pacific Gas and Electric Company

[See ''The Lee-Wise Dinner,'' page 400]

# Pacific Gas and Electric Magazine

VOL. I FEBRUARY, 1910 No. 9


## History of San Jose and Its Gas Business

By E. C. JONES, Chief Engineer Gas Department.

E. C. Jones

**In a letter,** dated June 3d, 1777, Don Felipe de Neve, the third Spanish governor of all Upper California, requested authority from the viceroy of Mexico to establish a pueblo on the banks of the river Guadalupe, near San Francisco Bay. Receiving no response from the city of Mexico and realizing the importance of having a settlement in the beautiful Santa Clara Valley, close to the Mission of Santa Clara which had been established January 18th, 1777, Governor Neve ordered Don Jose Moraga, lieutenant-commander at the Presidio of San Francisco, to detach from that garrison soldiers skilled in agriculture and others to make up a little band of fourteen settlers. These settlers, headed by the lieutenant-commander, located on the present site of San Jose November 29th, 1777. They designated their camp as a pueblo, and took for its protective divinity Saint Joseph (in Spanish, San Jose). The establishment of this new pueblo by Governor Neve was approved by the King of Spain in a letter dated March 6th, 1779.

The 24th of December, 1782, Don Jose Moraga was appointed a commissioner to go to San Jose and, in the name of His Majesty the King of Spain, was instructed to give title and legal possession to the nine founders of all their cultivable lands, house lots, and the iron brands to mark their cattle.

November 20th, 1792, Captain George Vancouver visited the Santa Clara Valley, and in his sketch of the trip he described it thus:

We considered our course parallel to the sea coast, between which and our path the ridge of mountains extended to the southeastward; and as we advanced, their sides and summits exhibited a high degree of luxuriant fertility, interspersed with copses of various forms and magnitude, and verdant open spaces encircled with stately fruit trees of different descriptions. About noon we arrived at a very pleasant and enchanting lawn, situated amid a grove of trees at the foot of a small hill, by which flowed a very fine stream of excellent water. We had not proceeded far from this delightful spot when we entered a country I little expected to find in these regions. For almost twenty miles it could be compared to a park which had originally been planted with the true old English oak; the underwood, that had probably attained its early growth, had the appearance of having been cleared away and had left the stately lords of the forest in complete possession of the soil, which was covered with luxuriant herbage and beautifully diversified with pleasing eminences and valleys, which, with the lofty range of mountains that bounded the prospect, required only to be adorned with neat habitations of an industrious people to produce a scene not inferior to the most studied effect of taste in the disposal of grounds.

The Spaniards informed this distinguished English voyager that the Indians were in a state of inactivity and ignorance. These Indians were the discoverers of the cinnabar deposits which eventually became the New Almaden Quicksilver Mine. They used the red pigment to adorn their faces and bodies. This coloring matter was highly decorative, but its use resulted in all the symptoms of mercurial poisoning, with disastrous results.

The buildings of the first pueblo were located about a mile and a quarter north of the present city of San Jose. The limits of the pueblo included the ground covered by the present city and extended far beyond.

The first houses were built near the little stream crossed by the first bridge on the road leading from San Jose to Alviso. In 1798 the house of the *ayuntamiento* was built. This was a one-story adobe building having three rooms. It was located on what is now Market street, near the corner of El Dorado street. Its rooms were used as a court as well as a jail, and one of them was the office of the *alcalde*. This old building was torn down in 1850.

The good Fathers of the Mission of Santa Clara realized the wonderful agricultural advantages of this valley, and sowed the seeds from which the harvest is now being gleaned. The beautiful trees which line the Alameda between San Jose and the Mission of Santa Clara were planted in 1799 by Father Maguin de Catala, assisted by two hundred Indians. These rows of willow trees are now the pride of "the Garden City."

The first permanent foreign settler in the valley was John Gilroy, a Scotchman, who landed in Monterey in 1814. At that time San Jose had only about twenty houses. Gilroy finally settled on a ranch, about thirty miles south of San Jose, near the town now bearing his name. Before the year 1820 there was but little business in the valley. The manner of living was primitive. This condition continued until the Americans came in 1846.

In 1831 San Jose had a population of 524. After the revolution of 1836, Governor Alvarado came into office. At that time Monterey was the Mexican capital of California. He was desirous that his name should be connected with the pueblo of San Jose. He insisted for a while in leaving off

Looking North through the business centre toward the railroad static the name Guadalupe, the patron saint of Mexico, and substituting the name Pueblo San Jose de Alvarado. This change, however, was short-lived.

It was in San Jose that Jose Castro, a lieutenant-colonel of cavalry in the Mexican army and the acting general commander of the department of California, received the proclamation of Commodore Sloat the 9th of July, 1846, declaring that thenceforth California would be a part of the United States, and that its peaceful inhabitants would enjoy the same rights and privileges and the same protection accorded in any state in the union. The 13th of July, 1846, the first United States flag was raised on the pole which had been erected by the Mexicans in front of the house of the *ayuntamiento*.

The discovery of gold in California in 1848 nearly depopulated San Jose. Crops that were sown that year were never harvested. It was then that Don Luis Peralta, one of the first settlers of San Jose, gave this sound advice to his sons: More would be gained by remaining on the ranches and raising grain to feed the miners than by deserting the beautiful valley in search of gold.

When the convention to form a state constitution was held in Monterey in September, 1849, the people of San Jose exerted every influence to have San Jose selected as the permanent seat of government. Dr. Robert Semple, president of the convention and member from Benicia, urged that the first session of the legislature be held at Benicia, but forever after at San Jose. This did not meet with the views of the San Jose delegates. A vote was carried in favor of San Jose, and the first formal meeting of California's legislature was held at San Jose Saturday, December 15th, 1849.

In 1850 a tri-weekly stage line to San Francisco was established. The fare was $32, or as it was then expressed, "two ounces." Before that the fare by way of Alviso had been $35. During the following ten years the growth of the town was rapid and substantial.

By 1860 San Jose was large enough to warrant the introduction of illuminating gas. October 6th of that year James K. Prior, Thomas Anderson, and James Hagan formed the San Jose Gas Company. This corporation had a capital stock of $21,000, and was incorporated for a period of forty years from the date of filing the certificate.

San Jose, a "garden city," claiming a population now of 58,000

General View of the Gas Works at San Jose

Gas was first lighted in San Jose the 21st of January, 1861. It was supplied to eighty-four consumers. There were seven street lights. The price of gas was $10 the thousand cubic feet. The sales of gas for the first year amounted to 165,000 cubic feet.

An exclusive privilege to supply gas in San Jose had been granted to the incorporators on certain conditions. One of these conditions, contained in the ordinance granting the franchise, was

Section 8—That if it shall appear at the expiration of five years from the date hereof that gas can be furnished for less than now, having reference to the price of labor and material used in the manufacture of gas, coal now being rated at fifty-three dollars a ton, it shall then be lawful for the city authorities to make such reduction as in their discretion shall seem just, so that the rates shall not be less renumerative than they would be now; and at the end of ten years a like reduction may be made, should labor and material still further reduce.

Railroad communication between San Francisco and San Jose was not established until 1865. Before that date coal was brought to Alviso in sailing vessels or in barges, and from the Alviso landing it was hauled to San Jose, a distance of about nine miles, over roads which were in bad condition at all seasons of the year and during wet weather were impassible owing to the overflow of the streams which enter the bay at or near Alviso. During the periods of overflow the coal used for gas-making was carried from Alviso on pack mules. It is recorded that often these mules with their burden of coal would be swept away by the torrent while fording some stream, and both mule and coal lost beyond recovery. So there is probably quite a deposit of coal and mules somewhere in the Alviso flats.

The first gas-holder built in San Jose had a capacity of 8,000 cubic feet. The material used in the construction of its tank was redwood planks three inches thick. This gas-holder was in continuous use twenty-eight years. When torn out in 1888 the redwood tank was found to be in as good condition as when it was built. Some of those very redwood planks were then used in the construction of buildings about the gas works.

In 1865 a special committee of the city council made an investigation of the business and profits of the San Jose Gas Company. The report showed that the original investment of the gas company in 1860 was $21,000; that during the first five years of its existence the total expenditure for betterments, materials, and labor in the business of gas manufacture was $55,637.93; that the receipts from gas sales during that period amounted to $75,617; and that the three founders of the company had divided in dividends within the five years $19,979.52, or almost the equivalent of their original investment.

The formal history of the various light companies in San Jose is best given in the following short extracts from the county clerk's records:

165. James K. Prior, Thomas Anderson, and James Hagan formed a corporation by the name of "The San Jose Gas Company" for the purposes of manufacturing gas in the city of San Jose and supplying the city with same, gas to be manufactured from coal and other substances. Capital stock $21,000, divided into 210 shares, $100 each, for a period of 40 years from date of filing of certificate. Principal place of business of the company, city of San Jose. Dated October 6th, A. D. 1860.

240. Amended certificate of Incorporation of San Jose Gas Company, dated February 25th, 1879. James K. Prior, Thomas Anderson, and James Hagan incorporate, that the name of said company is and shall be the San Jose Gas Company. Capital stock is $600,000, divided into 6,000 shares, par value $100 each; to continue in existence for period of 40 years from and including October 6th, 1860.

215. Increase of stock of the San Jose Gas Company 9th day of June, A. D. 1877, increased to $600,000. The whole of the original capital stock, to wit $20,000, has been paid in, and said corporation has no liabilities. Austin Roberts, Secretary.

272. San Jose Brush Electric Light Company. Art. of Incorp. to carry on business of lighting the city of San Jose by means of electricity, etc. Term 50 years. Capital stock $100,000, 10,000 shares, $10 each.

| DIRECTORS | RESIDENCE |
|---|---|
| James A. Clayton | San Jose |
| Pedro de Saiset | San Jose |
| Thomas Rea | San Jose |
| T. S. Whippel | San Jose |
| Geo. H. Roe | San Francisco |

Dated Feb. 25th, 1882.

390. Articles of Incorp. of Electric Improvement Company. Place of business of said corp. City and County of San Francisco, State of California. Term 50 years.

| DIRECTORS | RESIDENCE |
|---|---|
| Frank Butterworth | San Francisco |
| Aug. J. Bowie, Jr. | San Francisco |
| Wm. H. Howard | San Mateo |
| J. B. Randol | New Almaden |
| Louis T. Haggin | San Francisco |
| Frederick Sharon | Belmont |
| Henry C. Dreger | |

Cap. stock $5,000,000, div. 50,000 shares $100 each. March 30th, 1887.

The Company's New Office in San Jose

Prune trees in blossom in foothill orchards, near San Jose

The large white mass in the background is Alum Rock, in a famous picnic cañon

440. Electric Improvement Company of San Jose. Art. of Incorp. To engage in business of electricity in every branch connected with it in any and every shape, form, manner, or purpose whatsoever &c. Term 50 years, place of business San Jose.

| DIRECTORS | RESIDENCE |
|---|---|
| C. W. McAffe | San Francisco |
| T. C. VanNess | San Francisco |
| A. J. Bowie | San Francisco |
| H. J. Edwards | San Jose |
| James W. Rea | San Jose |

Cap. stock $100,000; 5,000 shares, $20 each.

440. Creation of Bonded Indebtedness March 29, 1889, $60,000.

357. Amended Art. of Incorp. of the San Jose Brush Elec. Light Co. to generate, transmit, and sell electricity, electric light, and power, to manufacture, purchase, and sell gas, to purchase, lease, sell, and rent lands, tenements, and hereditaments. To buy, hold, and sell shares of stocks in any and of any corporation. Dated May 16, 1887. Principal place of business San Jose. Term of years 50 from and after incorporation. Same directors for first year. Cap. stock $100,000, div. into 10,000 shares, $10 each.

428. Art. of Incorp. of the San Jose Light and Power Co. To manufacture, purchase, and sell gas, to generate, transmit, and sell electricity, electric light, and power. Principal place of business San Jose, Santa Clara County, Cal. Term 50 years.

| DIRECTORS FIRST YEAR | RESIDENCE |
|---|---|
| Chas. Otter | San Jose |
| H. H. Kooser | San Jose |
| E. W. Clayton | San Jose |
| Chas. A. Hagan | San Jose |
| H. J. Edwards | San Jose |
| C. T. Ryland | San Jose |
| Amasa Eaton | San Jose |

Cap. stock One Million (1,000,000) Dollars, div. into 10,000 shares, $100 each. Dated June 20th, 1889.

473. Certificate of creation of bonded indebtedness San Jose Light & Power Co., passed resolution 16th day of Aug., 1890, to raise money to enlarge capacity for manufacturing gas, electric light, and power. Created bonded indebt. of $60,000. Sixty bonds, each of the face value of $1,000, to run 10 years, bearing interest 6% per annum, payable semi-annually.

709. Articles of incorporation San Jose Lighting Co. June 3d, 1895. To build, construct, own, &c plants for manufacturing gas and lectricity for lighting, heating, power, &c. and sell and distribute gas, electricity, &c, to lay down mains and erect poles lines &c in San Jose. Term 50 years. Cap. stock $250,000.

| DIRECTORS | RESIDENCE |
|---|---|
| Chas. F. Wilcox | San Jose |
| Joseph R. Patton | San Jose |
| William H. Summer | San Jose |
| Reinhardt L. Stock | San Jose |
| J. J. Sontheimer | San Jose |

1158. Articles of Incorp. United Gas and Electric Co., purposes to engage in the business of manufacturing, generating, and purchasing gas, electric current, and electric energy &c. Principal place of business, San Francisco. Term 50 years.

| DIRECTORS | RESIDENCE |
|---|---|
| C. E. Green | San Mateo |
| W. Gregg, Jr. | San Francisco |
| C. H. Pennoyer | San Carlos |
| C. O. Poole | San Francisco |
| J. E. Green | San Francisco |

Cap. stock $2,500,000; div. 25,000 shares, $100 each. April 17th, 1902.

729. (709) San Jose Lighting Co. Cert. copies of resolution of board of directors changing principal place of business of said company from San Jose, Santa Clara County, Feb. 1st, 1904, to City and County San Francisco, California, room 1014 Mutual Savings Bank Bldg., 708 Market street.

July 1st, 1902, the Electric Improvement Company and the San Jose Light and Power Company were acquired by the United Gas and Electric Company. In merging these two companies a lease was acquired of the building on Market street, formerly occupied by the "Evening Herald." The building was fitted up for offices, then the offices of the Improvement Company on West Santa Clara street and those of the San Jose Light and Power Company on Fourth street were vacated. There was also a concentration of all the gas interests of the new corporation on San Augustin street, on the former site of the gas plant of the San Jose Light and Power Company. At that time the intention was to build a high-pressure pipe-line up the peninsula as far as San Mateo, but the project was never undertaken.

Many names familiar to the gas men of the Pacific slope are connected with the history of gas-lighting in San Jose. Charles W. Quilty, who was the second president of the Pacific Coast Gas Association, was for many years president of the San Jose Light and Power Company; and Harry J. Edwards, affectionately spoken of by his friends as "genial Harry Edwards," was intimately connected with the lighting interests of San Jose almost from the inception of the business. Harry Edwards, one of the moving spirits and the manager of the Electric Improvement Company, was afterward manager of the United Gas and Electric Company, and the district manager at San Jose of the Pacific Gas and Electric Company until his death, which occured July 10th, 1909.

James K. Prior remained in the gas business in San Jose until March, 1899. The reason he gave for resigning from the company was that he was desirous of bringing about a consolidation between the San Jose Light and Power Company and the Electric Improvement Company. The negotiations fell through, but eventually the consolidation was accomplished.

The position of superintendent of the gas works at San Jose has been filled by many men well known to the gas fraternity. John Fullager was superintendent from 1889 to 1890. Then came Peter E. de Mill, Jr. He was the son of Peter E. de Mill, of Detroit, Michigan, the founder and first vice-president of the American Gas-Light Association, the first meeting of which was held in Cleveland, Ohio, in September, 1872. It was while Peter de Mill, Jr., was superintendent of the San Jose works that modern coal benches were installed and the present storage holder was built. Following de Mill came O. M. Gregory, from 1892 to 1901; H. O. Byerly, from 1901 to 1903; J. R. Thompson, from 1903 to 1904; and R. H. Hargreaves from 1904 to the present time.

The United Gas and Electric Company, which now manufactures the gas supplied to San Jose, is a part of the Pacific Gas and Electric Company.

The progress of gas-making in San Jose has kept abreast of the times. San Jose was one of the first cities on the Pacific slope to introduce the manufacture of water-gas. The works is now equipped with a modern oil-gas process, and a new storage gas-holder of 500,000 cubic feet capacity is being erected.

The gas business in San Jose has grown from its eighty-four consumers in 1860 to its 5,942 of today. The city is covered by a network of seventy-eight miles of street-mains, supplying these consumers. During the fifty years the price of gas has been reduced by successive stages from $10 the thousand cubic feet to the present rate of $1.25. The price of gas in San Jose now is as low as in many of the large eastern cities. This is due to the refinement of the process of manufacture and to the use of California petroleum, which produces a gas of excellent quality.

Although it may not be considered good form to refer to the catastrophe of 1906, yet it must be touched upon in order to give credit to men who worked so faithfully and unselfishly at the time of the great California earthquake. San Jose was almost on the geological fault line, and suffered as much as any town in the path of the earthquake. A glance at the accompanying picture taken at the works shortly after the disaster will give some idea of the devastation of property belonging to the gas company. The damage to the gas works was so great that Superintendent Robert E. Hargreaves found it necessary to turn the gas off from the city because the relief holder, the purifiers, and the scrubbers were in a dilapidated condition. The evening of April 18th the gas generator was heated up, ready, without the loss of a day, to make gas. But the gas services and house fixutres throughout San Jose were in such condition that it was not deemed advisable to turn on the gas until April 24th. By the 26th of April more than seven hundred gas meters were in use. During those strenuous days Harry Edwards, ably assisted by Robert Hargreaves, almost performed miracles in repairing the gas works and the distributing system so that gas could be supplied to the city of San Jose after an interruption of but six days.

After the death of Harry Edwards his mantle fell upon the shoulders of John D. Kuster, who was formerly manager of the Pacific Gas and Electric Company's Fresno Gas and Electric Company. John Kuster is an able man of force, and possesses many of the qualities which endeared Harry Edwards to the people of San Jose, so that no more happy selection of a successor could have been made.

The company has recently moved its offices into modern and well-equipped quarters, under the direction of John Kuster.

What the Earthquake Did at the Gas Works in San Jose

During the coming spring months the gas distributing system of San Jose will be enlarged and improved so that no city in California will have better gas service.

The writer in preparing this article has drawn freely from the "History of San Jose" by Frederic Hall (1871) and "Auld Lang Syne" by T. R. Parker.

# How to Get the Best Results from Workmen

By C. Y. FERGUSON, Foreman Santa Rosa Substation.


C. Y. Ferguson.

**To get the best** results from your employees let them know you have confidence in their ability and integrity. Aim to show your appreciation by your actions toward them. A cheerful "good morning" when you meet them will always create in them a kindly feeling toward you.

Put all employees on their good behavior and let them know that you are interested in their welfare, and that just so long as they do the best they can their positions are secure.

In fact, act on the Golden Rule principle, doing unto them as you would wish to be done by if your positions were reversed. For are we not all of one great family, each striving in his particular position to make one grand success of this gigantic corporation? Each is a necessary part of the great whole.

An employee who, under these conditions, would take an unfair advantage of your confidence in him is not worth much to you, and the sooner you are rid of him the better you are off.

We all, from the head of any great concern down to the humblest position, have some pride in our work, and each is happier when he knows his efforts are appreciated. Do n't wait until one is dead to extoll his good qualities; let him know them while he is living. You will feel better for it, and his joy will be increased.

The first mistake of any man does n't necessarily deserve a discharge. He may be from that time on more valuable than if that mistake had never occurred. To err is human; to forgive, divine. None of us is perfect. If we were, we would be too good for this earth.

Carelessness is one of the worst sins of an employee. Trouble caused from it is a hard thing to condone. A good, gentlemanly talk to the careless one instead of a "— — — be more careful," is certainly the best way out of the difficulty. If that does n't bring favorable results, then a time-card is the only remedy. But for habitual stupidity there is no hope.

Let the president or any other official of a concern visit one of the many plants belonging to that concern and if, in going among the men, he be thoughtful enough to say to them, "How are you, boys?" I can assure him that he never can know how they appreciate it. I have overheard many a man say after they have been recognized by a superior, "He seems to be a fine gentleman; he is n't too proud to speak to a working man."

On the other hand, if your employees are never noticed, or noticed only by a scowl or a cross word, you never will get the results from them that can be obtained by the one who gives them a pleasant greeting.

As we go through this life the question is n't so much Is he a gentleman? as Am I?

# The Selection and Care of Men

By FRANK G. BAUM.*

Frank G. Baum

**Volumes have been written** about the selection of machinery and materials to perform certain functions, and much has been printed on the care and life of machines and the cost of producing certain commodities. But until a few years ago there was little real study of the selection and care of the men that are required to supply that human interest so necessary to the carrying out of a method in its planning and in its daily operations.

Every industrial enterprise depends for its success upon the method, the men, and the money employed to attain practical results. In developing an enterprise every dollar of capital is equally efficient with every other dollar. Hence, assuming the capital is sufficient, the success of any industrial venture depends upon the soundness of the scheme and also upon the human interest of the inventor or the promotor, upon the interest of the directors and the manager, of the engineers and superintendents, and of the foremen and workmen who put their brains, wits, and muscles to the task of producing something of use.

If one review the history of any very successful enterprise he will find, generally, as the cause of the success a very unusual and successful man capable of projecting himself into his work, and by his enthusiasm and energy carrying with him many men who would follow only such a leader. The west has developed many such men and enterprises. If the reasons for the successes of these men and their undertakings be analyzed it will be found that the organizers had not only keen perception of the business but a keen appreciation of good men and a great ability to select and to hold them. Since the human interest plays such an important part in any enterprise, why is it that not more attention is paid to the selection of men? and why are most of us such woeful failures as organizers?

When a man selects a piece of machinery or certain materials he has definite ideas of what he wants, and will generally choose the best he can find for the work to be done. He does not take cast-iron when steel is required, because what he wants is a material that is strong, pliable, and resilient. But if he need the same characteristics in a man, he is liable to employ one who has no resilience, no pliability for a working organization, one strong, perhaps, but lacking the ability to use his strength in team-work. When a man selects a horse he gets about what he wants, but his judgment of men is not so accurate.

Almost any one can take out a pair of horses and in a short time be able to tell if one of them is slow, lazy, or vicious. But, even after employing a man for a lifetime, an employer may not learn that that man is a sneaking, lazy, incompetent fellow who shifts his work on to others. The reason for

*[Editorial Note—Frank G. Baum, now an independent consulting engineer, was this company's electrical engineer in 1902 and from 1902 till 1907 was its general superintendent and hydraulic and electrical engineer. During that time he supervised the construction of most of the de Sabla power plant, added 10,000 kilowatts to the productivity of the Electra plant, put in additions to the Colgate and Centreville plants, and started the Deer Creek plant. He also built the Martin Station plant, and invented the outdoor switches used throughout the company's system. His oil-tub switches are familiar devices in many of the substations. He has written a book on "The Transformer"; is the inventor of an alternating-current calculating device; and is the author of various articles on calculation of electrical transmission systems. He was born at St. Genevieve, Missouri, in 1870, earned his way through Stanford University, and was graduated there in 1898.]

this is that the sneaking, lazy, incompetent man usually has in his make-up the ability to lie and to talk. Man's woeful lack of skill in judging men correctly is mainly due to the fact that men are able to talk and by their talk prevent an accurate measure of their real worth. The first evidence of incompetence and procrastination is lying and the wasting of valuable energy. By these signs one should learn to know this class of men.

But care must be taken not to injure a good man through misjudging him. It is more serious to misjudge a good man than to keep an incompetent one. The injury thus done a good man may affect his whole future, deprive us of his services, and give other men less confidence in our justice and our ability to judge men correctly.

In a machine—an organization of mechanical parts—we are dealing with definite materials definitely arranged, but in an organization of men we are dealing with human beings of variable characteristics and rather indefinitely cöordinated. When it is a question of selecting certain mechanical materials to produce certain results one can with confidence say "I will," but when human materials are to be employed to produce certain results one can in modesty only say "I will try."

In engineering work we are careful not to strain materials beyond a certain point lest we exceed the elastic limit and weaken the material or deform its structure. Men also have a limit beyond which, if forced, they will sustain an injury. It is not logical to employ a factor of safety to materials and to work men to ultimate fatigue. The careful foreman or superintendent does not coddle the lazy and urge on the willing worker.

The strength of a piece of wood or steel lies in the way the fibres are organized to resist applied force and in the composition of the fibres themselves. The power of a machine lies in the selection and organization of its parts. And in the same way the strength and power of an organization depends upon the selection and working relations of its members.

In a successful machine or structure we often require materials having different properties; so also in an organization different characteristics are required. That is why a large organization can employ some men to advantage who could not get along by themselves or in a small company. The real strength of the foreman or organizer is shown by the way he is able to select his human material to fit the conditions and to harmonize the differences. He does this by recognizing the different characteristics and abilities of the men and in directing their natural qualifications along certain lines. Far-sightedness and a continuous study of the men is required in order to do this. The ideal foreman or organizer sees conditions in the organization far ahead, and he begins to select and train and mould his men accordingly.

But when the one who selects the men and directs their organization is a second-class man, incompetent and dishonest, with the usual attributes of egotism and snobbishness, nothing but failure can be expected for the organization which he directs. Only men of his kind or men looking for favors will continue working for such a man. That type will not get very close to his men, and can not win their respect. Where there is no respect there can be neither cöoperation nor loyalty. The average man wants to be loyal to his superior, to his employer; he likes to be able to feel, to think, and to say "I am working for a fair and square man, a fair concern." Men will not be loyal merely to a salary or to a position. They want to be loyal to a principle, to an ideal, to a man.

Fortunately, the spirit of the modern well-directed corporation is to conduct the business as an enterprise in which the employees, as well as the owners, are interested. It is recognized that all power is energy released and directed; that in an organization, as well as in mechanics, misdirected energy vents itself in loss or destruction.

The interest of a foreman, a superintendent, or a manager in his men must be real and not feigned. Children and animals detect insincerity by instinct, and so do men. One can not expect power from an organization built on a wrong principle or an illusion. We pity the man who tries to maintain mechanical power from a perpetual-motion machine, or we send him to an asylum; but our knowledge of human nature is often so limited that the man who is insincere and who feigns interest and runs a bluff is occasionally advanced in position and salary. Generally the man who is least sincere in his dealings with men gives himself credit for having the greatest possible amount of "tact," that very desirable quality of which we all have so little and of which we boast so much.

To advance, whether as manager, engineer, superintendent, foreman, or ordinary employee, it is necessary for one always to look to the organization of which one is a part, and continually to try to maintain and, if possible, to improve it. History teaches us that there are in every organization forces (sometimes "knockers") tending to wreck it; that the tendency of every organization is toward degeneracy or disruption, just as the tendency of everything is toward a lower potential, or from a highly organized state to a lower, because it is easier to go down hill than up.

Enough energy and thought must be put into an organization to make for a continuous standard or for improvement. Maintenance and up-keep are as necessary for the human as for the physical elements of a system.

We should be as quick to recognize a good man as a good device, and then should choose the best. Drive the laggard. But do not urge the man who is already going at top speed; you may break his stride; he may falter and fall. We must be careful not to make mistakes, but when we make one we must be big enough to acknowledge it. We must continually review and check our actions toward the men above and below us, just as we check and review our methods and our calculations in engineering, reasoning the matter out in various ways, reviewing it from all sides and angles, to see if we arrive at the same conclusions.

We must know our work and do it in a competent way, as only the competent man can win the respect of those under him. For success, it is as important that we have the respect of those under as those over us. We are all here to try to increase the efficiency and happiness of life. "We must not whine" in doing our part, but recognize that the spirit of the age is sincerity, cöoperation, speed. We should study every problem as a condition of facts, eliminating personal elements; then consider, then decide, and then accomplish the result.

We must be thorough and to do that which we have to do our very best. Our ability to do a big task is often judged by giving us a little one first. Because we are not acquainted personally with the general manager or the superintendent does not mean that we are not being appreciated.

We must not hold our job, but make our job hold us. If we do n't like our work we should get out and select some other. We should be reasonable and not grouchy and cranky. To be a crank is not a sign of genius, though some geniuses may have been cranky.

The best way to be contented is to keep busy, think, read, be up to date, be effective, be ready. There is a better place for us if we are prepared. If we do n't reach it, we will be better for having tried, for during the trying we will have improved ourselves.

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In Turkey there are more aged people to the thousand than in any other country.

# The Electra Plant's Abloom with Babies

By WILL T. JONES, Accountant.

Hidden up here in Amador County,
Where the Mo-kel-um-ne's harness'd for power,
We who work for the plant at Electra
"Must waste lots of time?" "by kilowatt hour?"

No! "by record of actu'l production!"
Right here is "a station that works overtime";
Has four new babes to report as a starter!
Is that no excuse for boasting in rhyme?

In several issues of the magazine have appeared announcements of new arrivals at various other plants, but what of Electra? The information here presented should establish a mark which will easily give Electra the lead over all the ten other hydro-electric stations in having followed Roosevelt's ideas of "national greatness," and incidentally in establishing Electra's claim to the "Premium Station" for the year 1909.

July 25th the stork left an eleven-pound boy at the home of J. R. Carl, who is in charge of one of the shifts in the power house. Of course, Carl junior will put in an application to headquarters for a position as operator, but they say the young man has a weakness for his bottle, and that may have to be overcome before he gets a job.

August 25th the big bird again flew up the cañon, and left a ten-pound son at the home of "Bill" Jones, the bookkeeper. Jones is a veteran at receiving the bird; he now boasts the banner family in camp, two sons and a daughter. He is seriously thinking of acquiring a small farm where all the little Joneses can grow up and other things.

October 28 Superintendent Eskew and his wife were presented at Marysville with a girl. Heretofore horses have been Eskew's particular hobby, but he is now becoming quite an expert discussing "Mellin's Food" and other dope of that kind. He states that he has made reservation for Miss Eskew at Mills Seminary for the term beginning in 1925.

November 14th Alex Moran, a lineman here, appeared with a big smile, the reason being the arrival of a daughter in his home. If it had been a boy Moran had figured on having another lineman for the company, but, since his calculations were upset, he has not yet decided just what his plans will be. Of course, he tells us all that he wanted a girl.

This makes a total of ten children in camp. "Mayor" A. P. Clark has called an election to bond the town in order to build a schoolhouse. He will shortly present a petition to Mr. Britton asking that the company furnish the teacher when the schoolhouse is built.

Under the supervision of Mrs. Clark, wife of the "mayor," a baby show was held at Electra, January 26th. The clubrooms were tastefully decorated. One of the features was a large sand-hill crane. It had been stuffed by L. Flagg, the local taxidermist, and had received the nomination for the office of stork. Some pleading looks were cast at it, but it just craned its neck and made no promises.

There were to be three classes for babies: the largest, the smallest, and the prettiest. Considerable rivalry was shown among the proud parents. All four babies were entered in each class.

For some time it had been a much-mooted question as to who would be the judge. Finally, John D. Walker, foreman of the big ditches, was selected. He had the qualifications necessary for an unbiased judgment, his family consisting of himself, his wife, and a small dog.

Walker is quite a diplomat. The babies all looked to him so small, yet so pretty, and so big for their age that he declared it a draw in all classes, and awarded the prizes accordingly.

So here 's to Electra!
By the Stork not forsaken.
She 'll make a good showing
When the census is taken.

# The First and Only Electric-Run Sawmill

By J. W. HALL, Manager Stockton Water District.

J. W. Hall

**The snarl of the sawmill** as it rips logs into lumber! It is the swan-song of the once towering trees of the forest.

California is a state where nature painted her pictures on a big scale. Not the least of her landscapes are her great forests of pine. They sweep more than five hundred miles along the western slopes of the Sierras, a mighty green panel midway between the golden grain of the long level valley and the lofty snow-crested peaks of the mighty sawtooth range that forms the inland rampart against storms from the east.

When the Argonauts swarmed over those summits and down through the timber belt they halted a moment in wonderment at the magnificent conifers; then hurried on down to stake out their claims in the golden sands along the streams in the foothills. The forests were soon drawn upon to provide them with shelter. Sawmills were started here and there at the lower edges of the timber zone.

It was a long and expensive haul to bring the lumber out from its comparatively inaccessible sources to the settlers in the valleys. After the transcontinental railways were extended into the mountains larger mills were constructed, further afield. But the railroads penetrated only a small part of the timber area. So other means were resorted to for bringing out the lumber.

Down the Klamath, American, and Mokelumne rivers logs were driven to mills near the large valleys. At other points mills were located in the forests, and the lumber was floated down to the valleys in big V flumes.

In all sawmills there are enough waste products to provide the mill with fuel. Where fuel is cheap steam is the natural motive power. But with steam power there are long lines of shafting and counter-shafting and belting, and they deduct much from

Up-stream end of the old Folsom Sawmill, with the log basin in the foreground, the log slide from the canal at the left, and a log going up on the endless chain to be sawed into lumber

Down-stream end of the old Folsom Sawmill, showing horse-drawn lumber cars, and the railroad leading to the lumber yard; to the left the sawdust chute down into the river; and in the background the Folsom steel bridge across the American river

the efficiency of operation. Deterioration is rapid, and there is the ever-present danger of fire.

The sawmill at Folsom, in the early nineties, so far as the writer knows, was the first and only large mill ever equipped to be operated entirely by electric power. It was thus established partly from sentiment. The new electric power house was near at hand, and the water for its operation was running to waste through the penstocks. Then, too, because of its nearness to markets the owners thought the waste products, generally used for fuel, could be sold for more than enough to pay for the electric power bills. In this estimate they were nearly correct. There were other advantages. The mill could be built more compactly and inexpensively if electric power were to be used. The various machines would be operated by individual motors; there would be but little line shafting; and the danger of fire would be eliminated.

So the Folsom mill was built with three decks. On the lower one was located most of the motors, and they were belted to the machines on the floor above them. What little line shafting and counter shafting there was, was also located on the bottom floor. The line shaft was used to operate the cut-offs, the sawdust conveyor, and the live rolls.

On the second floor was the mill proper, open from end to end, and containing the log carriage, the saw, the resaws, the edger, the cut-offs, and other lumber-making machinery.

The third floor was the filing room. There the great band-saws were sharpened and repaired.

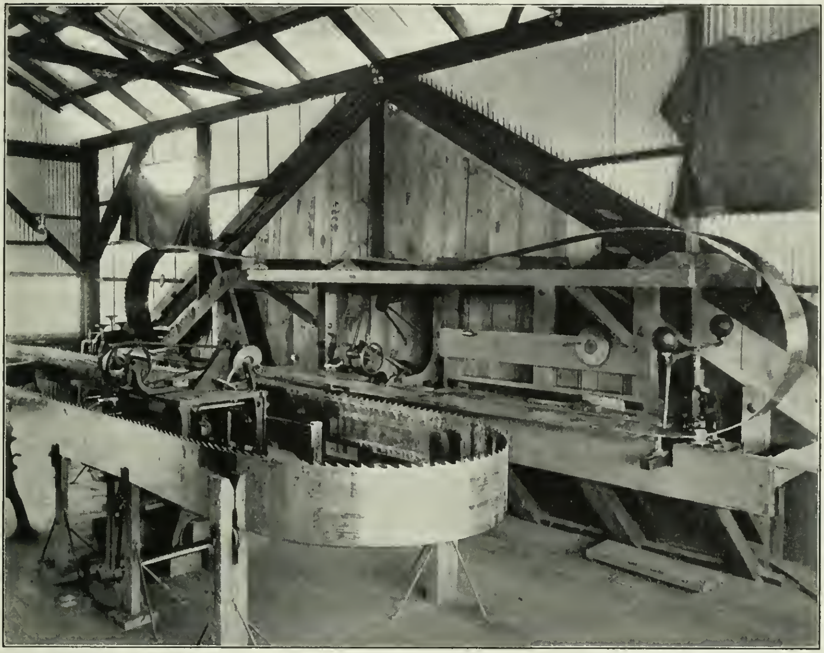
An endless chain slide running from the log basin up the incline to the log deck delivered the logs into the mill. They were then rolled down a gentle incline to the log carriage, and as they rolled they were critically examined for bits of broken steel dogs or for pieces of gravel that might have been imbedded in them during their rough journey down the rock-ribbed American river.

If too large to be handled by cant-hooks, a line from the bull-wheel placed them on the carriage. If the sawyer desired to turn them over at any stage of the sawing, he did it instantly by merely throwing on the "Nigger" that would thrust itself up through the floor at the side of the carriage. The log-carriage was operated by its own motor. This motor had an ingenious system of belting and countershafting and friction pulleys, to give the requisite reverse motions to the carriage, which was controlled by a lever in the hand of the sawyer.

There was a forty-foot band-saw, twelve to fourteen inches wide. It ran over two pulleys, in a vertical position, one high above the other. One of these pulleys was driven by a spur gear on its own shaft. This gear meshed into the cogs of its companion wheel on the end of the motor shaft. One of these gear wheels was provided with lignum-vitæ cogs to deaden the noise.

A band-saw is operated at a high rate of speed. It is a rare thing for an accident to happen to it. But when the mishap comes it is cause for momentary panic. If that sharp-toothed ribbon of steel speeding round at a terrific rate encounters an undiscovered broken piece of a steel dog imbedded in the log, either the teeth will be stripped from its edge or the saw will be broken in twain and sent like a streak of blue lightning writhing through the mill, a terrible instrument of destruction, endangering life and machinery until its momentum is exhausted. But one such accident ever happened at the Folsom mill. Its announcement was with a crash heard high above the snarl and hum of the machinery. At the warning all hands instinctively ducked for safety. But the saw did not come whipping and lashing through the mill. Every one waited and wondered. It was gone! It could not be found! Fur-

A view inside the old Folsom Sawmill—in the foreground the motor that operated the endless chain pulling logs up out of the pond; in the centre the motor that operated the edger; on the right the small amount of shafting that operated the cut-off, the sawdust conveyor, and the live rolls



A band-saw in position on the automatic filing machine at the old Folsom Sawmill

ther examination disclosed just a single broken pane of glass in one of the windows. The forty-foot length of tearing steel teeth had gone out tandem through that small space. It was found tangled up in a heap on the ground outside the mill.

When these big band-saws are broken or dulled they are brazed and repaired in the filing room, and sharpened automatically on a machine. They are placed on an oval-shaped carriage, with the teeth projecting upward. A shifter moves the saw along the space of a tooth at a time. A small revolving emery wheel, adjusted above it, drops on each tooth for a few seconds, then lifts, and drops on the succeeding one, as the shifter brings each tooth along to place. All this at the Folsom mill was operated by a small motor. The man in charge governed the operation.

The lumber traveled on the live rolls from the saw to the edger, which in turn was operated by its own motor. The edger man must decide at once into what subdivision each board or slab shall be cut, so as to save the clear lumber and get all there is out of it. Then, adjusting his levers, he speeds it through to the cut-offs, where two men adjust saws and trim the ends, giving the boards or scantlings the merchantable lengths. After leaving the cut-offs the lumber travels again on the rolls to the sorting tables. There it is loaded on the small cars, and is hauled on a horse railway to the yard.

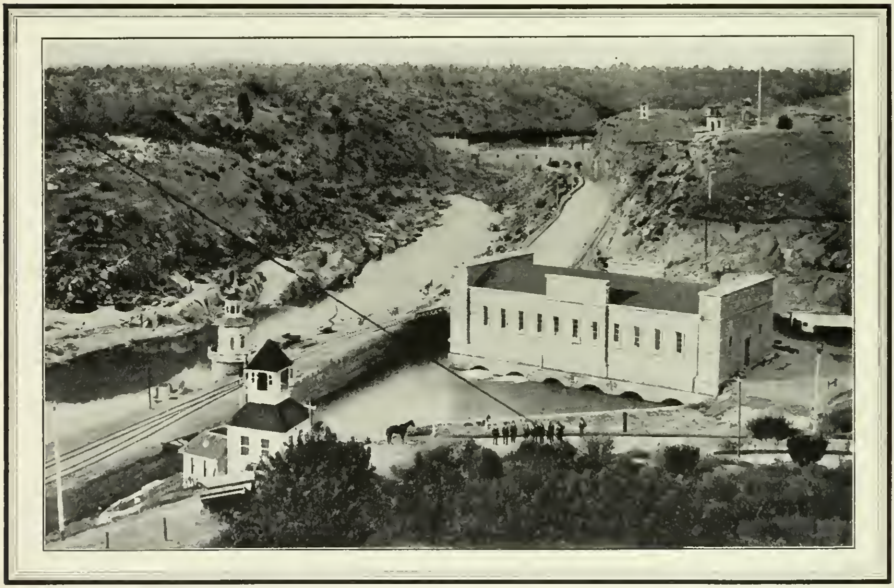
Turntables and tracks led into every alley in the yard, at the Folsom mill, and at the opposite side other turntables and tracks led to the box factory at the lower end of the yard.

The curve-sided slabs from the outside of the logs were sent on other rolls to cut-offs, and were made into cord-wood. Later this cord-wood was hauled to the nearby railroad for transportation, principally to Sacramento, twenty-two miles down-river.

The rated capacity of the Folsom mill was about 120,000 linear feet of lumber a day.

In the operation of a sawmill it is a case of "hurry up" all the time. From the tap of the gong, when the lumber begins to leave the saw and to stream through the mill, every man Jack has his hands full to keep it in motion until it leaves for the yard. If anything goes wrong and the lumber piles up anywhere the mill has to be shut down for readjustment. The machinery is quieted, but not the curses of the disappointed men.

The men are selected for their experience and ability, and each is ambitious to be a "top-notcher" in his specialty. The healthful scent of the fresh clean lumber gets in a man's blood. He does team-work with his fellows to make the "Ole Mill" turn out more lumber than her rated capacity. And generally the crew at that electric-run Folsom sawmill made her hum and snarl and come close to doing all she could possibly do in a day.



The Folsom Prison Power House, showing the company's dam up-stream and from it the canal along the near bank of the river—the small buildings are watch towers for the alert guards with repeating rifles

The world has no kind of use fer him that 's always glum;
The man who has a grievance is the man all people shun;
For folks have troubles of their own; your woes just merely bore;
Brace up, keep mum, an' grin, old sport, an'
Do n't get sore.

For the man who wins is the man who works,
Who neither trouble nor labor shirks,
Who uses his hands, his head, his eyes;
The man who wins is the man who tries.

* * * * * *

A man with his health
Is a mine jammed with wealth.

## Pacific Gas and Electric Magazine

PUBLISHED IN THE INTEREST OF ALL THE EMPLOYEES OF THE PACIFIC GAS AND ELECTRIC COMPANY

JOHN A. BRITTON - - - - - - - Editor
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## EDITORIAL

**California Needs Rate-Fixing Commission**

Rate-fixing is a duty sometimes imposed on city or county officials. It is not the personal desire of the men themselves. Popular election does not endow the victors with more knowledge of business affairs than they previously possessed.

The average county supervisor is just an average citizen, a good deal like the rest of us. Aside from his private business he must give a small part of his time to the management of public matters that in the aggregate represent investments and conditions of far greater magnitude and diversity than his own. There arise hundreds of civic subjects for his consideration. Some of these matters require the exact knowledge and skill of a specially trained expert.

Yet our average citizen is expected to solve them off-hand. As soon as he is elected to a supervisorial or municipal board he is expected to be able to grapple with the manifold items and complications connected with the cost of the manufacture and distribution of gas. But it takes an expert to analyze the subject. An expert can do it with a degree of exactitude and fairness—if he be given scope and time.

According to the present plan in California and many of the other states, the changing party officials must annually fix the rates for water, gas, and other service. The result is this: If the rate-fixers reduce the rates (no matter how inaccurately their predecessors may have reduced them) these new officials are then public benefactors! If they raise them they are then corporation hirelings!

In some of the states where public questions are gradually receiving a more scientific and exact treatment, the subject of rate-fixing has been delegated to a state commission. Thus it is now in Massachusetts, Wisconsin, and New York. The commission is composed of specially qualified men of known integrity. They investigate and report. When such men under such conditions set a local rate it is influenced by neither sentiment nor partisanship, by neither gallery nor graft. It is a fair rate based on local conditions in each city.

Let us have such a commission in California.

## More Time for Prize Suggestions

The cash-prize contest on "How to Get New Consumers" has been extended. Individual manuscripts not exceeding four hundred words in length will be received as late as March 31st. The first prize will be $20 and the next three prizes will be $10 each. From among thirty-five hundred employees in twenty-one districts but thirteen contributions were received. The hope was to secure representation that would in the aggregate supply the company not only with the real prize winners but with the ideas of other thoughtful men familiar with the specific methods and conditions of their particular localities. Then, in the aggregate, the company would have a splendid fund of effective methods for use in the getting of new business. The localities represented by the thirteen contributors, all of whom have been notified that they may now, if they wish, recall and revise their papers, are San Francisco headquarters building (2), San Francisco at large (2), Oakland (2), Alameda, Ocean View, San Mateo, Santa Rosa, Sacramento, Electra, De Sabla.

# The Lee-Wise Dinner

JANUARY 29th was a Saturday, and all that day the district managers and the division superintendents of the Pacific Gas and Electric Company, gathered from points within a radius of two hundred miles, had been in joint session in the assembly room of the San Francisco headquarters building participating in one of their monthly conferences. So it came about very conveniently that they and other officials and the department heads of the company assembled that evening for an informal dinner that was to be their "good-by and good luck" to two retiring engineers.

Eighty men were present in their business garb, and but two of the managers or superintendents were absent. The gathering was probably the most complete representation of the company's managing forces ever assembled.

When it came time for the speeches John A. Britton, the vice-president and general manager, in announcing the resignation of F. V. T. Lee as assistant general manager and of James H. Wise as civil and hydraulic engineer, paid each a feeling tribute and specified the valuable services each had rendered the company.

To F. V. T. Lee was then presented a large photograph album bound in black morocco, the corners clasped with heavy silver work containing the trademark of the company illuminated in blue enamel. On the first of the forty or more heavy detachable leaves was a presentation sentiment from the signers, the lettering being beautifully hand-illumined in old English script, with the name Francis V. T. Lee in colors and centrally conspicuous. Following the tribute were two more pages covered with the autogarphs of the eighty and a few others afterward added. The subsequent pages will, as soon as the work is completed, contain a comprehensive pictorial collection of all the company's power plants, many of its substations, places of interest throughout the system, and pictures of the men who signed. To James H. Wise was given a portable flat camera in a dark leather case. Each memento was selected as the specific token that would most practically appeal to the recipient, who would value it for its associations and not for the intrinsic investment.

Both men made speeches expressing their thanks but tinged with a little embarrassment and something akin to sadness at leaving. For four years Lee had been with the company, and Wise's term had been six.

After impromptu speches had been made by Frank G. Drum, president of the company, by Garret W. McEnerney, E. C. Jones, A. F. Hockenbeamer, Paul M. Downing, George C. Holberton, and J. E. Poingdestre the key-note of the occasion, despite the orchestral airs, had become an expression of sad farewell to two well-liked and well-valued men mixed with a pretty general incidental tribute to John A. Britton as the inspiration to good work.

A flashlight picture was taken of the assemblage. A halftone reduction of the photograph is used as a frontispiece in this number of the magazine. The naming is generally by rows from right to left, starting with the long row standing. Just back of the central table are seated J. H. Wise, President Drum, and F. V. T. Lee.

The picture shows:

George C. Holberton, E. B. Henley, J. F. Butler, F. E. Oldis, William Hughes, J. D. Butler, Leon B. Jones, W. B. Barry, C. J. Wilson, H. C. Vensano, G. C. Robb, A. H. Burnett, J. H. Pape, A. C. McDavid, F. E. Cronise, C. W. McKillip, F. S. Gray, R. J. Cantrell, H. C. Parker, H. B. Heryford, George B. Furness, A. R. Parratt, S. V. Walton, George N. Stroh, J. P. Coghlan, D. M. Young, C. E. Young, W. M. Henderson, W. E. Eskew, J. H. Hunt, W. E. Osborne, F. A. Leach, Jr., Thomas D. Petch, Wallace H. Foster, Leo H. Susman, F. H. Varney, John A. Britton, D. H. Foote, George Kirk, P. M. Downing, I. B. Adams, H. C. Bothin, H. W. Cooper, F. V. T. Lee,

W. R. Arthur, Joseph P. Baloun, Harry Bostwick, S. J. Lisberger, C. F. Adams, J. O. Tobey, O. E. Clark, C. D. Clark, C. R. Gill, J. E. Poingdestre, A. J. Stephens, W. C. J. Finely, Archie Rice, J. O. Hansen, J. W. Hall, F. R. George, John D. Kuster, E. W. Florence, George Scrafe, Frank G. Drum, James H. Wise, W. R. Morgan, J. C. Love, Garrett W. McEnerney, Sherwood Grover, John Werry, A. C. Beck, L. H. Newbert, W. H. Kline, C. L. Barrett, John S. Drum, A. F. Hockenbeamer, E. C. Jones, F. D. Stringham, Gus White, George H. Bragg.

# MEN OF THE COMPANY

## F. V. T. LEE

### Retiring Assistant General Manager

IT MAY be set down as a general proposition that it is difficult to write of a man whom you know well, but more particularly difficult to write a biographical sketch. Justice can not be done to the past life of one whom you have known only during a certain number of years, and it should not be the aim of the biographer to "accentuate or set down aught in malice."

The subject of this sketch has been closely allied to the writer for four years, thinking each day the same thoughts and trying to work out the same problems. Men so connected in any business are probably more closely associated than in any other relation of life; the fads and foibles, the even and uneven points in each are generally well brought out and thoroughly understood.

Friendships thus formed are more lasting than those made by casual acquaintance or occasional contact. When the tie that binds is loosened then the biographer while writing feels that the things that might be said can not well be expressed.

The following sketch is based on information and personal knowledge, but while it does not do justice to the subject, it may answer the purpose for which it is intended, that of saying good-by to a friend through the medium of the company's magazine.

F. V. T. Lee? Oh yes, every one in the Pacific and San Francisco companies knows Mr. Lee, and a great aggregation outside of these companies knows him, but very few know his full name, so here it is—

Francis Valentine Toldevy Lee.

This was given to him by his parents, pater F. V. T., senior, mater Frances Dorinda Byrnes. From his father, a British army officer, he inherited his desire for discipline; from his mother his gentleness; and from both his good breeding.

He was born in Winchester, England, in 1870. This is an unimportant detail, but mentioned to establish his maturity. He was deprived at the age of seven of a mother's love and care and grew to youth under the guidance of his father. Traveling with this parent he early saw Greece, Italy, and other parts of Europe. Then he went to school, in Paris, but at the early age of fourteen he lost his paternal guardianship, and was forced to a new view of life.

Resourceful and ambitious, he came to America when seventeen years of age, seeking health first. In the wilds of Canada, with the vanguard of the Canadian Pacific Railroad builders—those men who in privation blaze the way for posterity—he caught up with his disappearing physical stamina, and in rough living and in the endurance of hardships he linked it to himself again.

At twenty he dared the field of work in the demanding city of New York, and as the assistant of E. E. Stark, superintendent of the Manhattan Electric Company, he found

F. V. T. Lee

himself. Seeing the possibilities in the then comparatively new field of science, he, on friendly advice, determined to take a college course, and entered Stanford University in 1893. Incidentally he worked his way through, for when he took up life for himself the silver spoon was not in his mouth. He solved the moot questions as to whether or not a successful man would be more successful with a college education, or whether a college education should precede or follow a business or scientific career. He toiled up the hill of labor, and near the crest took his degree of A. B. to make his hold fast.

Leaving college, where he had been the secretary and companion of the late Dr. F. A. C. Perrine, he allied himself with that builder of men and enterprises, John Martin, and became an individual factor in the installation of many hydro-electric plants.

In 1899, feeling the need of help in his onward march, he took as a helpmeet—that 's the word right here—Edith K. Bonnallie, and the union has brought two spots of sunshine into the home—Ruth and Margaret.

Until 1906 his experience in business and engineering matters grew through affiliations with John Martin & Co. and the Stanley Electric Manufacturing Company.

"Alphabetical" some of his friends jokingly call him, others say "Mathematical." He is mathematical in exactitude to the extent of the length, breadth, and thickness of a gnat's whiskers.

In 1906 he entered the employ of the Pacific Gas and Electric Company, and for four years, as assistant to the president, has made a record, has builded plants and organized men, has slaved and toiled as only men who work for a large corporation do, and has left enduring monuments to his engineering ability. But, best of all, in his leaving to chase again that elusive physical betterment that escaped him once more, during the eternal daily grind of the business, he has left only friends in his associates.

F. V. T. Lee has not been a "jiner," but has affiliated himself with the institutions that are for the betterment of men, such as

American Institute Electrical Engineers,
American Society Mechanical Engineers,
American Gas Institute,
American Electro-Chemical Society,
American Society of Civil Engineers,
Pacific Coast Gas Association,
National Electric Light Association,
Institution of Electrical Engineers (London).

Perceptive in his qualities, critical in his concept of himself, artistic by nature, with a love for literature, music, and the arts, his fads are mathematics and photography. His habits are the usual ones of such a man—neither good or bad nor indifferent; his peculiarities are many, so are yours and mine—a man without habits or peculiarities would be a misfit somewhere.

Above all, F. V. T. Lee is a friend-getter and -keeper, with high moral aims and purposes. Relieved from the strain of public-service-corporation work, watch for him to do things, for he possesses the requisites of youth and purpose. J. A. B.

## JAMES H. WISE

### Retiring Civil and Hydraulic Engineer

MANY a head-piece is merely a hang-out for hair. Often you have to guess whether a man is posing as a poet or boycotting the barbers. Occasionally the top of the hedge is bristled to produce the effect of height. But generally the more curl (just short of the real kink), the longer the locks, and the greater the looks from love-lorn lassies!

But here 's a subject who wears little on his head to deceive the most credulous. He uses neither high-heels nor pompadour. From the pavement to the top of his dome of thought is exactly six feet. Add to this the fact that he is not yet thirty or taken, but "has more women friends than any other man ever in the Pacific Gas and Electric Company," and you gather that hair is not the main thing, that curly locks do n't always count the most with Cupid.

He has personality plus, and the winsomeness of his ready smile is so effective that it is said that wherever in the mountain hotels of California there are waitresses this young hydraulic engineer is always brought the choicest dishes.

It was preordained that he should be wise and take a high position in the world. His father was Wise before him, and where "Jimmy" first located the land is a mile high. That 's the way they refer to Denver when advertising it as a convention city. It was the 27th of February when James first caught his breath in Colorado's capital. The date is not significant except to those who may be crocheting neckties and embroidering hat-bands and hoping that some time they too may be called Wise.

James H. Wise

During the first ten years of his life he saw something of the mining regions of Colorado and New Mexico while accompanying his father, who was a mining man.

At 12 he arrived in California, and in Alameda completed the grammar-school course. Then he entered the Lick School in San Francisco, and was graduated at 19. "He was a crackerjack in mathematics and used to lend us pocket-money" is the comment of one of his classmates at Lick.

The next scholastic move was back across the bay to Berkeley. He entered the University of California, specializing in the college of mining, and in June of 1903 was graduated with the degree of bachelor of science. "The crackerjack in mathematics" was then invited to come back to the Lick School and be an instructor. For a year he taught high-school mathematics, that brain-drill that makes for reasoning power, that equips the student with the means of arguing from cause to effect, of applying the mind to think out the solution of a problem.

After one year as a teacher "the crackerjack in mathematics" entered the employ of what is now the Pacific Gas and Electric Company. He came at the instigation of J. D. Galloway, at that time the company's consulting engineer. At first he served as an instrument man, then as a surveyor under the consulting engineer, and in the construction department under Frank G. Baum; surveying, doing field work, engaged in power-plant installation—first at De Sabla, then at Electra, then for seven or eight months upon the Hendricks ditch system that supplies the De Sabla plant, then at the Centreville plant, and finally at the Deer Creek plant. Following this practical field work he was summoned to headquarters and made assistant to Baum in his office, and served as such till that former superintendent resigned from the company to become a consulting engineer. When Baum went, Wise was made hydraulic and civil engineer. And finally, after six years with the company, he too became attracted by the lure of private practice, and the first of the year tendered his resignation to become a partner with his friend Frank G. Baum, who, like Wise, came up through this company and attained distinction in its service and left it with the best wishes of his associates and chiefs.

At his graduation from the state university James H. Wise was elected to membership in the honorary technical society of Sigma Psi, which enrolls each year the foremost tenth of the class, and very recently he has been elected to the honorary society of Tau Beta Pi at Berkeley.

Those in the engineering world who know "Jimmy" Wise well say, "Wait and watch that man, because he is a wonder in his specialty and he will make his mark high." But aside from his efficiency as a hydraulic engineer, there is about him that something which is better than special knowledge—a big, kindly humanness and a cheery gentleness that make him a man's man despite the fact that feminine telephonic calls elect him by a great plurality to the title of the "ladies' man."

When Mrs. Wise arrives may she be wise enough to preserve that winning sunniness and smile, and never change them to a look of sadness. A. R.

## A Busy Baseball Season Planned

"Play ball" is in the air again about the headquarters building in San Francisco. The local talent of the Pacific and San Francisco companies has been consolidated, and an ambitious schedule of games has been outlined for a prolonged season. Matches have been arranged with Santa Clara College, St. Ignatius College, Gas Workers Union, Stanford University, U. S. Marines at Mare Island, and Spring Valley Water Works, and arrangements are being made for games with University of California, Olympic Club, Naval Training Station at Yerba Buena Island, Pensacola, Presidio Post, Fort Miley, Fort Baker, Labor Council, and other teams. The San Francisco aggregation challenges any of the other districts or divisions, and suggests Oakland or Sacramento as a neutral meeting place.

# Interviewing Dissatisfied Customers*

By JOHN CLEMENTS, Solicitor, Oakland District.

John Clements

**How to deal** with dissatisfied customers is a hard problem. It is especially so when the person registers a kick against the public service corporation. As a rule such complainers come with a predetermined verdict against the company. They feel or assume to feel that the corporation is constantly planning how it can get the advantage. As proof positive of this the kicker will cite articles he has read in the newspapers, showing up the corporation's base methods. Yet when questioned closely as to his general belief in the truth of many statements made on other subjects by the press, he will frankly acknowledge his doubts; many are for purposes of agitation. But agitation is truly an American method. All or nearly all of our laws are the result of agitation. Many of the good things which we receive at the hands of our public servants are the result of agitation. Note the many so-called congresses that meet throughout this country; note the so-called chambers of commerce; note the district and ward improvement clubs in every town and city. None of them has power to act, but they agitate; and often very good results come of this agitation.

The effect of all this tends to make the public service corporation more watchful of its business interests, more careful in its treatment of complaining consumers.

The complaining consumer usually begins by telling you that you have charged him (or her) for more gas, electricity, water than he ever used. "I know! I have not used! any such an amount! and I tell you right now! that I will not pay any such bill! What are you going to do about it?"

Now what will we do about it? We are going to investigate the complainant's claim. We are going to see if the fault lies with us. We are going to see if the meter readings have been correctly returned. If we find the readings correct we will further investigate by testing the meter. If the meter prove correct we will help him then to look for any fault in the installation that may be the cause of the trouble, and will advise him what best to do to reduce his bills.

Many times persons have said to me: "I can not believe that you really care anything about me or the size of my bill as long as you can get all the money out of me that you think I will stand." Such remarks may be supplemented with many harsh words and impossible charges as to the methods of the public service corporations in general and this one in particular. But I say: "Now let us reason together. We have not come to demand of you anything more than is justly due. We would much prefer that your bills were smaller, for then you would be a better satisfied consumer, and a satisfied consumer usually says good things of those with whom he has dealings and the result is a favorable advertisement. A dissatisfied customer is a bad recommendation. Public service corporations are just as eager, and try just as hard, to please you as people in other lines of business. There is no other foundation on which they can stand and long continue in business."

A reasonable person will listen with respect to a statement of the case from the standpoint of the public service corporation. In extreme cases of discontent the personal interview redounds to the benefit of the corporation using this plan.

*Digest of paper read before the seventeenth annual convention of the Pacific Coast Gas Association at San Francisco in September of 1909.

The man or woman who comes downtown to make a complaint has generally warmed up to the occasion before leaving home, and is fully determined to have it out with the company.

One day not very long ago a letter was handed me by the district manager. The author of that letter was evidently in a calorific state of mind. He warned us that we had this time picked out the wrong man to rob; demanded an immediate investigation; his gas bill was too high. The sum involved was less than two dollars for the month. But of course we would investigate. I called at his house and learned that he was employed in a planing mill; that he would not be home until 5 o'clock. I left word with his wife that I would call again later in the evening; and I did. I found this young man, as I have found many other persons who pen harsh letters, to be a very pleasantly disposed person. I introduced myself as the representative of the gas company. I told him I had called to see if I could in any way help him out of his trouble, and I assured him that I was really eager to do so. I did not in any way refer to his letter or the harsh words he had used toward us. I found that the young couple had a small gas range and a circulating water heater of the ordinary type. The appliance had been in use only a short time and was of standard make, so there was no fault to be found with it. It was therefore a case of reasoning with these young people and taking an interest in their welfare. They had been told that, as there were only the two in the family, their fuel bill should not be more than half as much as a neighbor in whose family were double the number.

"Suppose," I said, "you are preparing a meal for two and you boiled potatoes. The time required is usually forty minutes. Now for two persons, we will say, you put in the boiler three potatoes. Your neighbor, having four in the family, uses six potatoes; she, like yourself, cooks them in just forty minutes. Again you are going to bake a dozen biscuits, enough, we will say, for two persons at a single meal. Now you would warm up your oven, say, for five minutes, place the biscuits in the oven, and in from fifteen to twenty minutes they would be ready for the table. Your neighbor, having four in the family, bakes two dozen biscuits in just the same time that you do, and uses the same amount of fuel as you do."

This required a little time and patience, but proved quite convincing to this man who had demanded investigation but had not investigated for himself. As I was leaving the house he referred to the letter he had written to the company and wanted me to say to the manager that he was sorry he had not been more reasonable in his demands for investigation. This visit made a friend of a man who might, under other conditions, have remained an enemy and an agitator.

I called on a professional man, an M. D., who had refused to pay his bills for the good and sufficient reason that he knew he had not used as much gas as usual; in fact, for the time covered by the bills in question he had not used any at all. If necessary, he could prove this to any one willing to be honest and listen to the truth! The truth is what I want to find in all such cases.

"Now," said I to this doctor, "let us get down to the truth; let us investigate. I have been over your account in the company's books, and fail to find an error; your meters have been tested and found to be in correct registration. The last statement I have myself compared with the readings of today, and it proves to be correct. There must be some other item to be looked into."

I had noticed that two months' bills were unpaid. His reason for this was that he deemed it necessary that some adjustment be made by the gas company. One of the bills was too high, because he had not used the gas! I asked him to give me the proof that he had said he could give. At this request he smiled and said: "Now I have you in a corner. The reason I know I did not use the gas is that I bought and had installed a coal range."

"Well, well!" I said, "so you are not using any gas? You have not used any gas for any purpose for more than two months?"

"Oh yes, we used some gas. We have a small bedroom heater and a small plate on the coal range. But you know they would not use any such amount as you have charged me for. So you see you have lost your case."

"It does look rather dark," I said, "but let us open it up again; let us have a retrial. Would you mind letting me see the bill for the coal range and the expense for installing it." He said he would be pleased to have me see the bill as that would be proof of dates. "But," he remarked, "the bills are at my office."

"Very well," I said, "the proof of date is what I want."

I gave him my address and telephone number and asked him to call me up as soon as he had found the bills relating to the coal range and that then I would be pleased to call again. He never called me up. But a check came in a few days for his account in full. I met him several months afterward on a street car. He recognized me and laughingly said he was all wrong about the date of the installation of that coal range. "Another thing I want to tell you," he said, "is I have a better opinion of the gas company since you called on me and took so much pains to clear the matter up."

Then there was a college professor who wrote a very sarcastic and very firm letter. He knew the company was trying to take undue advantage of him. It was impossible for two persons to use the number of cubic feet of gas with which he had been charged!

When I called on him it was in the evening, and it was in the rainy season. Handing my card to a son of Nippon, I was ushered into the sitting room, or den, as these great scholars call it. It was a very pretty home of the bungalow type, a nice modern gas grate was burning in the room where I was seated, and through the portiers in another room I could see gas grate number two burning. In addition to these I afterward found a standard make of gas range and a waterheater. Presently the professor came into the room. I told him I had come in answer to his letter of complaint. He laughed and said, "Well, I suppose you fellows in the office, knowing that it is near annual dividend time, are trying to make as good a showing as possible! At least, it would seem so, as I find there is a general complaint of excessive bills; much higher than they were a month or two ago."

I said, "My dear sir, I hope you will pardon me if I do not make any answer to your little joke, for I surely can but regard such a statement as a joke."

Then I went on and told him that we had made a thorough investigation of his account, had tested his meters, followed up the meter statement, and verified it.

"Professor," I said, "to prove that you are sound in the position you take in this matter of two persons not being able to use so much gas as you are charged with, allow me to submit a simple problem. Suppose that you and I, or any other two persons, enter this room at, say, 7:30 a. m.; we feel chilly; we consult the thermometer and find the temperature to be, say 40 degrees Fahrenheit. Now, in order to make the room comfortable we must raise the temperature, say 30 degrees. How much gas or any other fuel should it take to do this for two persons? How much, say, for six persons? The answer to this problem answers your letter. I may go into your kitchen and apply the same rule there."

"Never mind doing that," he said, "but what would you advise me to do in order to reduce my bills?"

I replied by asking if he thought that by using coal or wood in each of the places where he was then using gas his bills for fuel would be any less. He frankly answered "no."

"If you exercise watchfulness and care," I said, "you may be able to reduce the cost. A gas fire is one that you can control much better than any other when you have the desired temperature in your rooms; you can cut down the flame so that the maximum heat may be maintained at the minimum of cost; in the kitchen when water has been brought to the boiling point or the heat in the oven has reached the desired point for baking, you can control it in the same manner. By a little close attention to these points the operator will soon become really skillful, not only in doing good work but in the matter of keeping down the cost. Read your meters, check them with the statements rendered by the company. Here is a card which will give you full information on this point. We shall be pleased at any time and at all times to do whatever we can to satisfy you to the fullest extent of our ability."

He was profuse in his thanks for the visit and for the interest taken by the company.

Enough has been cited to show that in many instances a personal interview redounds to the best interest of the public service corporation. Many a man or woman appreciates a little personal attention, and after receiving it becomes the company's friend.

## "Bucking the Tiger"

THIS is not a meeting of the vestry. These men, according to J. W. Hall, manager of the Stockton water district, are engaged in the formerly well known pastime of "bucking the tiger." The picture shows a "faro layout" in palmy mining days on the old Tuolumne river. Faro, common to all new mining camps, has been described as the squarest gambling game a man can tackle, if he must gamble; but in police-regulated communities faro is supposed to be prohibited. Hence this glimpse behind the scenes for those who have only read of the game, a favorite of the old-time miner in the early days of California.

# The Company's Private Talk-Line System

By R. J. CANTRELL, Property Agent.

R. J. Cantrell

**The train dispatcher's** office is the nerve-centre of a railroad's operating system. The dispatcher is one of a group of expert telegraphers sitting silently in a big room where every instant, day and night, the clatter of the telegraph clicker reports from hundreds of stations the progress of trains. It is the dispatcher's business to keep his head, to facilitate the movement of traffic, to avoid blockades, to prevent collisions. And he must do it by lightning-flash orders back to the stations to hold this train till that one passes, to side-track that freight at such a point, instead of further on, to clear the track for an express that has just been reported a little delayed.

The chief dispatcher, with his corps of attentive telegraphers, feels every pulse-beat of the system. It is his lookout to keep the traffic moving with the least possible delay; to regulate the flow of trains so as to avoid confusion and mishaps.

An electric company with one generating plant may do business for a long time without a stop. Then its troubles may come in a close series. Twice, thrice in a week accidents may happen, and lights fail. Excuses do not restore the profits that storekeepers lose by enforced darkness. They want service; they have their own troubles. It is up to the electric company to deliver the goods all the time, or the merchant will adopt some surer method of lighting.

In developing its system the Pacific Gas and Electric Company combined and then joined by copper wire nineteen electric plants and more than one hundred electric distributing stations. Then it established a load-dispatcher's office at Oakland, and it connected that office by a special telephonic service with the nineteen generating plants and the hundred substations. The load-dispatcher, like the railroad train-dispatcher, is ever on duty. He is intently watching his electric voltmeters, every clock-like dial telling by the sway of its sensitive hand the flow of current from a certain plant, the increasing or decreasing use of energy in a certain section. He watches, and as he watches he uses the telephone. He operates switches. He turns more current here, less there. If a generating plant suddenly fail, he closes a switch and lets some of the mighty system's energy flood back that way to relieve the shortage.

Everywhere the consumer must get service, no matter what may be the local mishap at the nearest generating plant.

THE COMPANY'S TELEPHONE CORPS AT CENTRAL

May C. Mulvey, Florence Austen, Margaret Gray, Crissie Austen, Katherine Gilmore, Anna Joesten, Addie Frey

In perfecting this method a private telephone system was a necessity. In addition to all the facilities of the commercial telephone companies, the electric company established a special service consisting of a private submarine cable across San Francisco bay and a trunk line running zigzag to various stations along a route more than four hundred miles in length.

It created lines of quick conversational communication with the nineteen electric plants and their hundred substations, with the company's eighteen gas works, with its water works in Stockton, with its street-car system in Sacramento, with its two extensive irrigating systems along the slopes of the Sierras, and with its two mountain sawmills. It spun a web embracing many mountain reservoirs, scores of miles of flumes, and hundreds of miles of pole lines and their scores of ever-watchful patrolmen. It joined its San Francisco headquarters building with all these places and with the private offices of the managers of its twenty-two territorial districts in twenty-seven counties, with the offices of its twenty-one division superintendents, and with the stations or homes of its scores of section foremen. Then it weaved into this interconnecting network the private homes of all its officers, all its heads of departments, and its corps of special electric, hydraulic, mechanical, civil, and gas engineers, so that any one needed could be reached at any hour of the day or night. The scheme was perfected to make it possible for the company to live up to its slogan "At your service day and night."

In the headquarters building on Sutter street in San Francisco was established the operating centre of this comprehensive plan of intercommunication. A light, airy room was reserved for the special switchboard, and adjoining it was provided a rest-room and other conveniences for the comfort of the staff of seven central telephonic operatives whose services run in relays throughout the twenty-four hours of every day-and-night period. They are ever ready. If by any mishap the private telephone line fail they switch to the commercial lines. Every part of the mammoth system in twenty-seven counties, from Chico to Fresno, from the crests of the Sierras down to the sea, is tapped by a talk-wire. In the main office in San Francisco alone the private service consists of ninety local telephones. There are nine in the supply warehouse at Fifth and Tehama streets, so that rush orders can be started from there with a rush. In the headquarters building the various officials and departments on the six floors are connected by a house system of twenty private telephonic stations, supplemented by the latest perfected whisper-phone system for exclusive communication between departments. In the San Francisco complaint department there are also four telephone operatives stationed at a specially constructed board to receive and instantly to assign each complaint to the proper department.

The human element that keeps this telephonic system ever ready, day and night, weekdays and Sundays, workdays and holidays, is the corps of seven young women whose pictures illustrate this article. Their alertness and cheerfulness is the key to the circuit, and the perfection of the system is the realization of the company's desire to be "A House of Courtesy" "At your service day and night."

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Frank J. Griffin, chief accountant at San Rafael for the Pacific Gas and Electric Company, has been appointed agent at Mill Valley.

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The Pacific Gas and Electric Company representatives in San Francisco are out with a challenge to the San Francisco Gas and Electric Company to get into a bowling tournament.

# PERSONALS

Sherwood Grover is a graduate of the University of Pennsylvania.

Charles J. Sellner of the electric meter department at Oakland studied four years, ending in 1901, at Polytechnicum Cothen and Ilmenau in Germany.

A. Eliason of the electric meter department at Oakland is a University of California graduate, class of 1899, and received the degree B. S.

A. B. Sanderson, an engineer at the Martin Station gas works, near San Francisco, is a mechanical engineering graduate of Stanford University, class of 1905.

E. C. Jones, chief engineer of the gas department and librarian of the Pacific Coast Gas Association, has been elected to membership in the California Library Association.

F. V. T. Lee delivered an address at Stanford University February 7th embodying practical advice to students in the engineering department, from which he was graduated thirteen years ago.

W. P. Taylor, an employee in the Marin district, has resigned his position as stenographer at San Rafael to be secretary to John C. Kirkpatrick, manager of the Palace Hotel and other Sharon estate properties.

Latest additions make the report of college men in the company read thus: total 109, representing thirteen European, one Canadian, and thirty-five American colleges, with the University of California represented by thirty-two, and Stanford by twenty-one men.

Otto A. Knopp, who is at the head of the electric meter department in Oakland, spent two collegiate years at Polytechnicum Cothen, and three at Techiusche Hochschule at Charlattenburg, Germany, where he received the degree E. E. in 1900.

Nevada City and Grass Valley begin the day earlier than any other towns in all California. Mountain stages and the little narrow-gauge train leave before the world is awake, and hotel breakfasts are always by lamplight. So it happened as a matter of course when Daniel C. Stewart was married at Grass Valley February 3d it was a 4 A.M. ceremony with an early wedding breakfast and an early-started bridal trip by train to the coast cities. "Dan" Stewart has been with the Pacific Gas and Electric Company in Nevada County longer than any other employee. He is popular with men, and he proved so popular with the women that in selecting the present Mrs. Stewart, who was Miss Mary Upton, an acquaintance since their childhood days in Grass Valley, he got a wife of whom the "Daily Transcript," in writing of the wedding and its company of relatives, declared: "Mrs. Stewart is one of the sweetest of Grass Valley's young women. She was born in this city, graduated with honors from the Grass Valley high school, took up nursing and completed her course a few months ago at the Lane Hospital in San Francisco. Quiet and unassuming in her manner, sweet and gracious to all with whom she came in contact, and untiring in her devotion to her friends and family, she has won a place in the hearts of those who know her that will cause them to love and respect her." The article also mentions some of the young man's good points, but who 's interested in a groom!

# PACIFIC GAS AND ELECTRIC COMPANY

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John A. Britton
W. H. Crocker
E. J. De Sabla, Jr.
F. G. Drum
John S. Drum
D. H. Foote
A. F. Hockenbeamer
John Martin
Louis Monteagle
Cyrus Pierce
Leon Sloss
Joseph S. Tobin
George K. Weeks

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John A. Britton........Vice-Pres. and Gen. Mgr.
A. F. Hockenbeamer........Treas. and Comptroller
D. H. Foote........Secretary
Charles L. Barrett........Asst. Secretary
W. R. Eckart........Consulting Engineer

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W. H. Kline........General Agent
R. J. Cantrell........Property Agent
J. H. Hunt........Purchasing Agent
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S. V. Walton........Manager Commercial Dept.
E. B. Henley........Manager Land Dept.
F. E. Cronise........Manager New-Business Dept.
Archie Rice........Manager Publicity Dept.
E. C. Jones........Engr. Gas Dept.
P. M. Downing........Engr. O. & M. Hyd.-Elec. Sect.
F. H. Varney........Engr. O. & M. Steam & Gas Eng. Sect.
H. C. Vensano........Civil Engineer
C. F. Adams........Engr. of Electric Construction
George C. Holberton........Engineer
S. J. Lisberger........Engineer
George C. Robb........Supt. of Supplies
H. Bostwick........Secretary to President

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Colusa........W. M. Henderson
Fresno........E. W. Florence
Grass Valley........John Werry
Marysville........J. E. Poingdestre
Marin........W. H. Foster
Napa........O. E. Clark
Nevada City........John Werry
Oakland........F. A. Leach, Jr.
Petaluma........H. Weber
Redwood City........L. H. Newbert
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Woodland........W. E. Osborn

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Standard........W. E. Eskew
Stockton........J. W. Hall

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De Sabla........D. M. Young
Electra........W. E. Eskew
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Nevada City........George Scarfe
North Tower........C. D. Clark
Oakland........William Hughes
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Oakland........George Kirk

# Pacific Gas and Electric Magazine

Vol. I | Contents for March | No. 10



Yearly Subscription 50 cents | Single Copies each 10 cents

**THE PACIFIC GAS AND ELECTRIC COMPANY'S COLGATE PLANT ON THE YUBA RIVER**

At the right is the flume, feeding the pipe-lines down to the power house; at the left, the steep wagon-road climbing out to Lake Frances and the little town of Dobbins. Nothing is on the level at Colgate!

# PACIFIC GAS AND ELECTRIC MAGAZINE

VOL. I MARCH, 1910 No. 10

# The Story of Colgate and Yuba Power Plants

By ARCHIE RICE, Publicity Manager.

Archie Rice

**Nowhere in the world,** probably, is a huge, modern, hydro-electric development more graphically shown at one glance than in a general view of the famous Colgate power plant, on the Pacific side of the Sierra Nevada Mountains, in the northeastern part of California, some one hundred and forty miles by power-line from the cities of San Francisco bay. There, where the Yuba River gushes down between thousand-foot evergreen ridges in Yuba County, a long stone building squats close along the water's edge, with its back to a steep, rugged slope. Straight up that incline for a quarter of a mile the eye traces five enormous black pipe-lines that obviously come into the power house from a great wooden flume that is seen clinging high along the side of the mountain.

### THE RIVER DAM

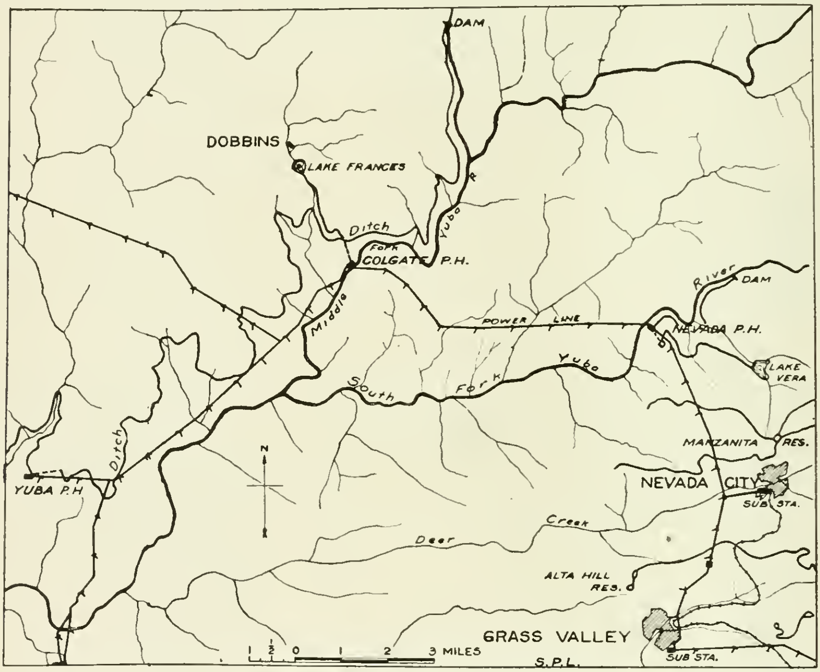
Eight miles upstream from the power house is a massive, granite diverting dam across a narrow point in the river cañon. The river has hurried over its rocky, gold-sprinkled bed for thousands of years, descending by many little rapids in making an aggregate drop of one hundred feet to the mile. But the big flume that ingenious man devised winds majestically along the precipices and slopes like a scenic railway, and by nice engineering preserves a gradual fall of twelve and two-thirds feet to the mile. So, by the time the flume water has arrived opposite the power house it is ready to take a single perpendicular drop of seven hundred and two feet, or more than four times the height of Niagara Falls.

That gentle diversion of an impetuous river to produce an artificial fall at a given spot and there convert the water power into definite energy, spouting from nozzles against water-wheel buckets, is the main principle of hydro-electric engineering. The greater the fall and volume of water, the greater the hydraulic power that can be obtained to turn the wheels of the big magnetic devices that generate electric current.

### THE FLUME

That remarkable flume is seven and six-tenths miles long, and it is seven feet wide and five feet deep. It is almost level full of water that rushes along with a flow of 12,000 miner's inches a second; a flow so swift that a man must be a Marathon runner to keep up with it; and so powerful that neither man nor animal ever gets out of it alive, if, perchance, the feet slip off the double plank which runs midway along on top of the cross beams that strengthen the box-like structure. Day and night watchmen walk those planks that are laid almost on the surging rush of water and half a thousand feet above the bed of the river.

When that flow of 23,000 cubic feet of water a minute comes down the hillside through all five of those thirty-inch pipes, tapered to nozzle-ends the thickness of a man's arm, the water shoots out in four-inch streams more terrific in force than any fire with a force of three hundred and four pounds to the square inch, a steady three-hundred-pound blow on every little space the size of a silver quarter-dollar, a constant ten-ton thrust against each water wheel. Such is the power of the water at the Colgate plant. And that tremendous battery of shooting streams turns the wheels




Showing the location of the Colgate and Yuba Power Plants, the ditches, dams, rivers, and power-lines

engine ever produced, escapes with an impulse so great that you can strike the stream with a big sledge-hammer as though on an anvil. That silvery projectile of solid water will rend a board to splinters, or hurl a big rock clear across the cañon and shatter it to fragments in transit. Such is the force of those condensed columns of water. They strike a horizontal undershot blow into the powerful steel buckets of the man-high impulse wheels, down under the power house, that steadily generate nearly 20,000 electrical horsepower. Lessening demands for electric energy way off down in the big cities automatically deflect those movable nozzles so that only part or none of the stream strikes the buckets. And what escapes shoots free far across the cañon.

### THE WATER SUPPLY

The catchment area above the dam,—the high mountain ridges and forest slopes that drain the winter's rainfall and the summer's myriad springs and melting snows down into that particular cañon,—is equivalent to a square tract of country a little more than twenty-three miles on each of its sides.

But to make sure of constant water power for the Colgate plant, to guard against any unforseen subsidence in the river's flow above the dam or against any accident to that long, wooden flume, — through breakage, landslides, snowslides, or forest fires,—there is an artificial lake up between the ridges, off to the left, two miles and a half behind the power plant, and three hundred and eighty-two feet elevation above the top of those five big pipe-lines that come down the ridge to shoot water against the wheels.

It is called Lake Frances, and it covers an area of one hundred and five acres and holds 92,870,000 cubic feet of water all the year round. It is as large as about fifteen city blocks. During the rainy season it catches the water drainage from the minor surrounding slopes, but its principal source of supply is the river flume itself. During hours when the cities are not using much current some of the electric energy generated down at the big plant is turned to the work of pumping water from the flume and sending it off over a ridge through two miles of pipe-line to that lake. Thence it can be instantly drawn upon in an emergency to flow back and operate the plant.

**Romulus Riggs Colgate**

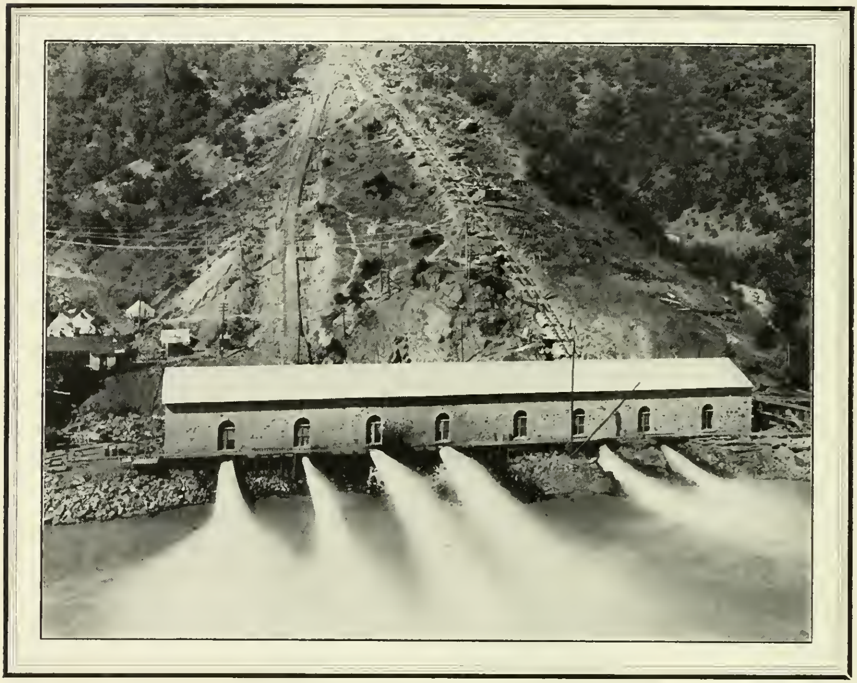
For whom the Colgate plant was named and the Nevada plant nicknamed "Rome"; he was the first president of the California Gas and Electric Corporation.

THE YUBA POWER HOUSE

Eight miles below the Colgate power house is the Yuba power plant, with a generating capacity of nearly one thousand horsepower. Historically, commercially, and sentimentally this smaller enterprise is the parent of the great Colgate plant. They produce and turn current into the same long-distance power-line, and they get their water power from the same source. A generous part of the flume flow must ever go on past Colgate to preserve the original rights of the Brown's Valley ditch. Twenty-two miles of winding ditch brings the flow to a point above the little Yuba plant, and there it takes a perpendicular drop of two hundred and ninety-two feet through a single big forty-two-inch pipe. That water gushes against the Yuba impulse wheels and then, its fighting force expended, it flows gently on through twenty-five miles or more of winding ditch, traversing Brown's Valley, and doing only the quiet and peaceful work of irrigating lowland orchards and farms.

CALIFORNIA'S WEALTH OF WATER POWER

To understand why it is that California is so wonderfully rich in water power you must bear in mind that there is a dozen or more of rivers rushing down from sources high in the lofty Sierras. Wherever water can be diverted and made to flow gradually along



**The Colgate Power House**

When the jets of water are deflected down and shooting free of the wheels. The building is as long as a city block

the side of a river cañon to produce a single plunge of several hundred feet, there power can be developed to run an electric generating plant. How splendidly California is supplied with these steep rivers is indicated in the accompanying table, which gives the foot-drop to the mile for several well-known eastern rivers and for some of those in California. In this connection it will be recalled that the Yuba River slopes down an average of a hundred feet to the mile between the dam and the Colgate power house, and that the diverting flume is given a drop of less than thirteen feet to the mile. That flume slope is much greater than is really necessary. The mighty Mississippi goes to the gulf with a drop of only a little more than seven inches to the mile.

| River | Miles Long | Feet Descent | Foot-drop to Mile |
|---|---|---|---|
| Eastern: | | | |
| Mississippi ...... | 2,300 | 1,500 | .6 |
| Ohio .......... | 1,000 | 700 | .7 |
| Connecticut ..... | 375 | 2,000 | 5.3 |
| Kennebeck ..... | 150 | 1,000 | 6.6 |
| Rio Grande ..... | 1,800 | 12,000 | 6.6 |
| Hudson ........ | 300 | 4,300 | 14.3 |
| Missouri ....... | 2,340 | 4,000 | 17.0 |
| California: | | | |
| Calaveras ...... | 68 | 1,000 | 14.6 |
| Sacramento ..... | 400 | 7,000 | 17.5 |
| Feather ........ | 136 | 4,678 | 34.4 |
| Tuolumne ...... | 155 | 8,000 | 51.6 |
| Stanislaus ...... | 113 | 8,000 | 70.8 |
| American ...... | 118 | 8,500 | 72.0 |
| Yuba .......... | 90 | 6,700 | 74.4 |
| Cosumnes ....... | 93 | 7,500 | 80.3 |

The steep descent of most of the California rivers enables power developers to locate more than one plant on the same diverted water system by leading the discharged water from the upper plant down by easy gradients to some point where another big drop can be produced.

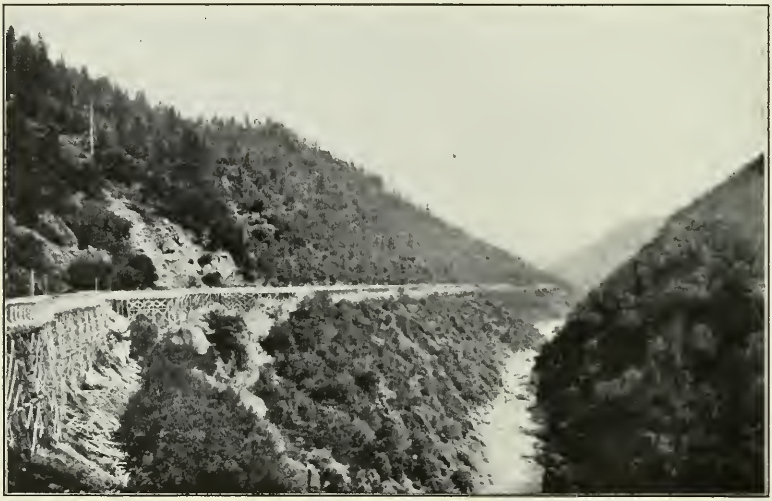
#### EARLY HYDRO-ELECTRIC DEVELOPMENTS

Having in mind now the peculiar fitness of California rivers for mountain power-development, it is easier to see how the plants progressed after a start was successfully made and long-distance transmission had become commercially possible. That the mysterious current could, without too much loss in power, be sent through a wire to a considerable distance from the place where it was generated was first demonstrated to the world in 1886 by the hydro-electric plant at Tivoli in Italy sending current seventeen miles to the city of Rome.

Thirty or forty years before that Italian plant had proven the city value of distant mountain water power California's miners had constructed amazing diverting ditches and had begun using the flow of mountain rivers to operate terrific hydraulic giants in tearing away hillsides and dissolving them to mud and stones in quest of settling gold. After the Sacramento River channel had been alarmingly filled in with these torrents of man-made mud and the farmers in the lowlands had been successful in having laws passed against unchecked hydraulic washings the costly mining ditch systems looked like a dead loss to those who had put money into their construction. Next came irrigating schemes and a period of partial usefulness for the old mining ditches.

**Interior View of Colgate Power House, Looking Upstream**

On the right are the mighty generators that, swiftly revolving, make the electricity; on the left, the transformers that intensify it for delivery to the high-voltage power-lines



Four Miles of the Colgate Flume in Sight

THE OLD BROWN'S VALLEY MINING DITCH

Then came hydro-electric power plants! The very flume system that now supplies Colgate, the same ditch system that runs on more than a score of miles and supplies the Yuba plant and goes another score further with irrigation, has been in operation for years as the Brown's Valley ditch, carrying water for hydraulic mining in Brown's Valley.

In the spring of 1895 the city usefulness of distant water power was first demonstrated in California with the completion of the power plant on the edge of the American River at the town of Folsom. Its electric current was successfully sent through a twenty-two-mile power-line into the city of Sacramento. Then, in February of 1896, after five years of effort in acquiring and developing the necessary water power, the Nevada power plant was started on the edge of the south fork of the Yuba River, down in a deep mountain ravine in Nevada County. And then that plant began sending electric current through an eight-mile power line to the towns of Nevada City and Grass Valley and their famous deep gold mines.

DE SABLA AND MARTIN AND COLGATE

Eugene J. de Sabla, Jr., was the principal man behind the little Nevada plant on the south fork of the Yuba, and John Martin had taken the contract for its general construction.

Hydro-electric power was a new thing, but it did not take de Sabla and Martin long to see that it was a good thing, and that not many miles away was that Brown's Valley ditch and a prospect of taking a good fall out of it. So, in September of 1897, they incorporated the Yuba Power Company, and had as a partner with them R. R. Colgate of New York city. Martin and de Sabla were San Franciscans.

QUICK WORK AT YUBA PLANT

Not a day was wasted on this new scheme. Within the record-breaking time of four months and five days after they decided to build the Yuba plant the thing was completed, was generating electric current, and, at the then almost appalling strength of 16,000 volts, was sending it on down twenty-two miles to the city of Marysville on the been removed, leaving the plant with two, and a productive capacity of a little less than one thousand electrical horsepower. A big forty-two-inch pipe eight hundred and fifty feet long descends the oak-dotted hillside and ejects its flood of water through a large box-

**The Yuba River Dam from which Colgate Is Supplied**

This is a solid granite wall forty feet high and 167 feet across the cañon, with a wing-dam leading to concrete headgates that open into the long flume

Sacramento River, where the Yuba joins the main stream.

It was in April of 1898 that this Yuba plant began operating. They had constructed a frame building covered with zinc-coated corrugated iron, and it stands there yet in a narrow, lonesome, tiny, upland valley between Dry Creek and the Yuba River and eight miles from the little town of Smartsville. The original installation then consisted of three 300-kilowatt Stanley generators. One of these generators has since like compartment, along the outside of the power house, the undershot flow revolving the two sets of wheels that turn the generators inside the building.

YUBA SUCCESS LED TO COLGATE

Within a year after the completion of the Yuba plant business had so increased and electric prospects so expanded that the promoters reorganized with a capital of $1,000,000 with which to buy out the Yuba Power Company and go in for bigger

The Tramway and its Suspension Bridge, which delivered 8,000,000 feet of lumber for the flume

hydro-electric development further up on the Yuba River. They called this new concern the Yuba Electric Power Company.

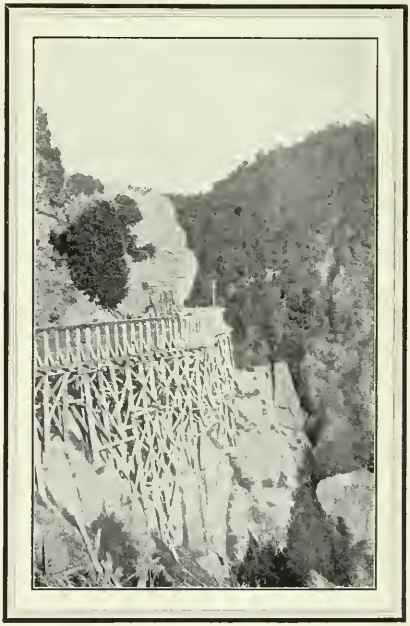
With an eye still on the course of that Brown's Valley ditch, they picked out a place on the middle Yuba where they could get more than twice the fall they had down at the little Yuba plant.

### SITE FOR THE NEW PLANT

The spot selected was where the old Missouri Bar trail crossed the Yuba on the route between Dobbins and French Corral. Then they engaged W. R. Eckart to give his expert experience to the development of the flume for a greater flow. So the old flume that had wound along the cañon side and been in use for ten years was supplanted by one almost twice as big, erected right along above it; and the diverting dam up-river on the north fork of the Yuba was strengthened and raised ten feet in height. As the dam stands today it spans one hundred and sixty-seven feet across the ravine and is forty feet high. It has a long wing sweep that diverts the water through concrete headgates, which open into the great flume.

### GIGANTIC TASK OF FLUME CONSTRUCTION

The construction of the dam was not so difficult. The native granite was right there. Only tools and dynamite and cement had to be packed up the river cañon. But the building of those eight miles of flume, with all the necessary scaffolding, trestles, and the use of tons and tons of lumber was a real problem. Lumber mills were a long way off, and mountain roads steep. Ten miles across

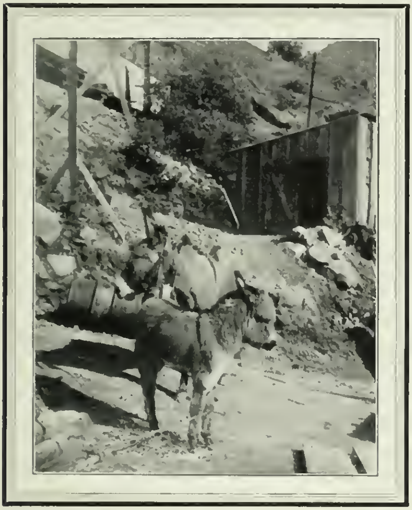


**A Difficult Point**

Where the flume goes round a turn in the precipice as sharp as a thin woman's elbow the thousand-foot ridges to the eastward of the dam was a good forest region, over in Nevada County, thick with cedar, spruce, yellow pine, and sugar pine of good size.

A SAWMILL ERECTED

There a sawmill was established to turn out lumber for the new flume. The company stills owns and operates that sawmill. They cut 11,000,000 linear feet of lumber, and then picked out the very best of it, the hearts of the logs, to use for the flume. Across the highlands that lumber was hauled and on to the top of the ridge, almost above the dam. Then they built a steep tramway coming down the mountain 1,275 feet like a narrow ladder reaching from the depths of the gorge right up to the blue vault of heaven. And the lower end of that ladder they curved into a dizzy suspension bridge that would deliver the well-strapped little carloads of lumber right over on the flume-side of the cañon, where a space had been gouged out of the rock as a sort of landing shelf.



One of the old burro brigade used in packing dynamite and cement up the flume at Colgate

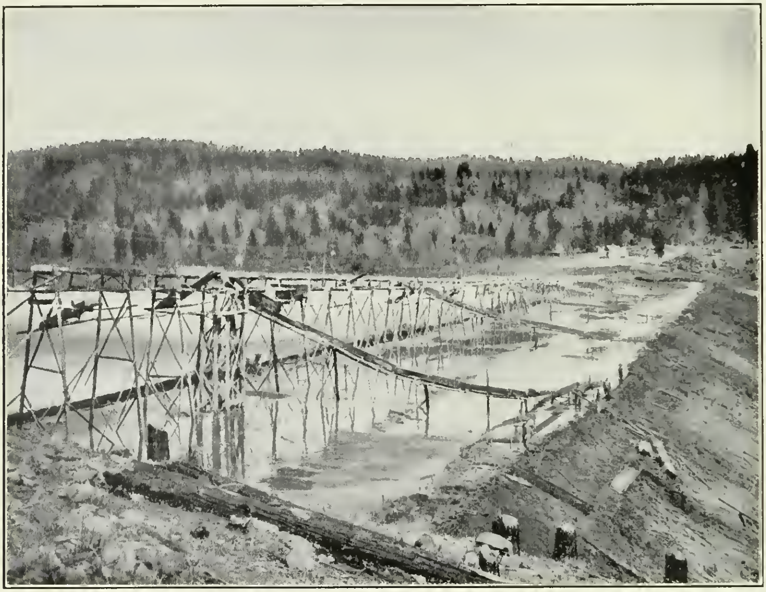
LUMBER POURED DOWN

Day after day, day after day, lumber poured down that chute tramway out of the sky, and the flume slowly stretched on down the cañon, mile after mile, until they had used up just 8,000,000 linear feet of lumber, if you know what a lumber pile that makes! In places they blasted away the solid granite cliff and made a shelf, on turns they used long steel rods and bolted the flume securely to the native granite wall, and all along the way they braced it and gave it a foundation like a railroad trestle.

CAMPS ALONG THE FLUME

Then every two miles or so they scooped a little shelf and built on it a small house, with a porch overlapping the flume. These houses were the permanent camps for the flume tenders, the forest-fire crews, the repair gangs of many carpenters that work along that structure for weeks in the summer. Later they stretched along the side of the flume a private telephone line with numerous stations from which to sound an alarm or to notify the plant that the flume had broken and that the water power would cease coming. One day a

The suspension bridge across the Yuba River at the Colgate plant—for man and horse



**Lake Frances in the Making**

Hydraulic power was used to tear a hillside away, and flumes and sluices built to carry the mud to form a great embankment

workman in a repair gang slipped and dropped a box of dynamite into the flume and then rushed to the telephone to warn the fellows down at the power plant to "look out" as it was hurrying their way. But the long watery trip must have safely soaked and diluted the explosive before it reached the penstock gratings and screens.

### A ROAD FOR THE MACHINERY

While the carpenters were rebuilding the great flume other gangs of workmen were carving a steep mountain road down from the direction of the little hamlet of Dobbins to deliver the heavy machinery. As the loads were to come down, the graders did not bother about any future loads that might have to be hauled up that terrible slope. So that road remains as a tedious, toilsome climb. While the roadmakers and the flumemakers were busy masons were getting ready the building. The high-walled cañon daily resounded with the cannonading of dynamite where all three gangs were blasting out rock and clearing a way for operations. They dug down forty and fifty feet to get a virgin granite base on which to erect the Colgate power house, and then they built it solidly of granite and cement and lined it inside with cement and braced it with steel girders. The building, now twice its original length, is two hundred and seventy-five feet long and forty feet wide, has a cement floor, and it is absolutely fireproof.

The original part of the Colgate plant was completed and current from it was sent through sixty-one miles to Sacramento the 5th of September, 1899.

STILL FURTHER GROWTH

But even while operations were hurriedly going on to complete the Colgate plant electric demands so increased that the promoters began to see something of the great possibilities they were opening up for the valley and populous districts of California, where power was needed and wanted. So, in June of 1900, they reorganized again, this time with their capital stock $5,000,000, instead of $1,000,000. They called the new enterprise the Bay Counties Power Company, and, September 1st, 1900, they absorbed the Nevada power plant, over on the south fork of the Yuba. Eugene de Sabla was chosen as the first president of this enlarged concern, with William M. Preston as vice-president and attorney, and C. A. Grow as secretary and treasurer, and the directors were J. C. Coleman, Richard M. Hotaling, R. R. Colgate, and George A. Batchelder—all San-Franciscans but the last two, and they were New-Yokers, Batchelder being the representative of an eastern banking house that had advanced $2,250,000 for the project.

COLGATE PLANT DOUBLED

Within two years after the completion of the original Colgate plant the building was doubled in length and in producing capacity by an addition to the upstream end. The 27th of April, 1901, the Colgate plant did a historic thing in California power development. That day through its twin wires—one aluminum, one copper—it first transmitted high-voltage electric energy way through to the city of Oakland, a distance of one hundred and forty miles by the pole-line; and

**The Stave Pipe-Line from Lake Frances to Colgate**

This line consists of 8,502 feet of redwood-stave pipe three feet in diameter, then 936 feet of thirty-inch cast-iron pipe, and finally of 2,870 feet of open rapid-flume three feet wide and a foot deep yet not a newspaper mentioned that epoch-marking fact. Again the company reorganized and expanded to keep pace with business prospects, and (March 1st, 1903) took the name California Gas and Electric Corporation, with R. R. Colgate as president. And finally (January 2d, 1906) it became a part of the great Pacific Gas and Electric Company, with its present total of nineteen electric plants and eighteen gas works.

A section of rapid-flume from Lake Frances

THE EQUIPMENT AT COLGATE

As it stands today the Colgate power plant contains six great electric generating machines and twenty-three transformers, and it has radiating from it five different high-voltage pole-lines traversing mountain ridges and valleys for more than 450 miles, and carrying enough big copper wire to span the American continent from San Francisco to New York. Two lines run through to Oakland, two go over the ridges into Nevada County, and one extends to Sacramento, all of them carrying a glisten of gold and silver threads spun as far as the eye can see through the clear air above the green Sierra ridges.

THE GREAT WATER WHEELS

There are eleven impulse wheels at Colgate taking the drive of water from the five great pipe-lines that are anchored to solid cement blocks down the mountain side. Three of these wheels are eight and a half feet high, and turn at the rate of two hundred and forty revolutions a minute. Four of them are an inch under six feet high, and make three hundred and sixty revolutions a minute. Along beneath the building its entire length is a concrete-lined subway seven and a third feet wide by eight feet high and carrying all the bus bars and wiring of the entire station.

THE GENERATORS

The installation at Colgate consisted first of three 900-kilowatt, 2,400-volt, sixty-cycle, three-phase Stanley generators and one 720-kilowatt, 2,400-volt, 133-cycle, two-phase Stanley generator. But when the plant was

**A Glimpse Across Lake Frances**

This mountain reservoir is an auxiliary supply for the Colgate plant, and was named for a daughter of John Martin.

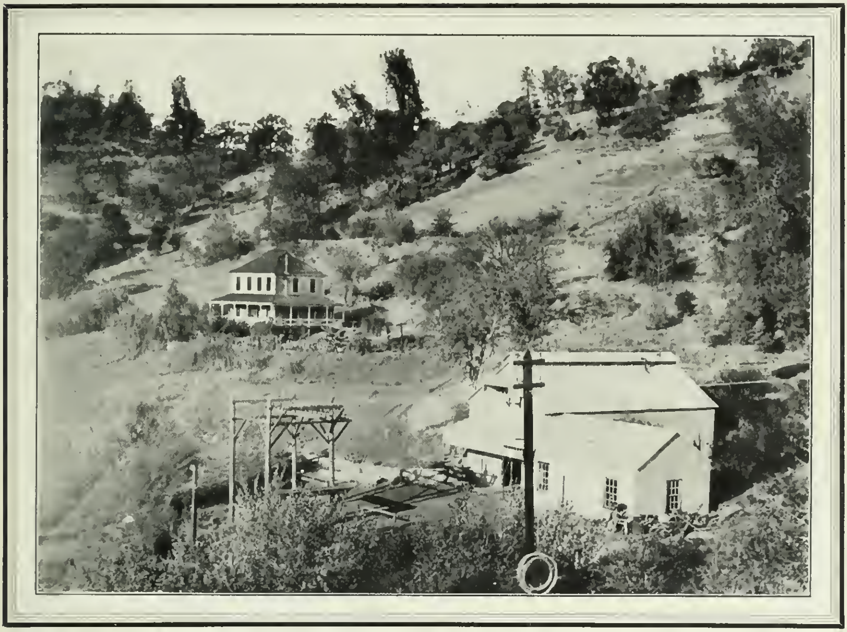
enlarged a year later a 2,000-kilowatt, sixty-cycle, three-phase, 2,300-volt Stanley generator was added; and in 1906 the 720-kilowatt generator of the original instillation was moved and established at the upstream end of the building, and in its place was set a new 5,500-kilowatt, sixty-cycle, three-phase, 2,300-volt Westinghouse generator. All these generators are still in use.

THE PIPE LINES

The hydraulic instillation consisted at first of two thirty-inch pipe-lines, with Risdon impulse wheels, two wheels on a shaft for each of the four generators. Later two more thirty-inch, cast-iron pipe-lines and one thirty-inch riveted steel pipe-line were added, with twin Risdon impulse wheels to drive each of the additional generators. And this general hydraulic equipment is also still in use.

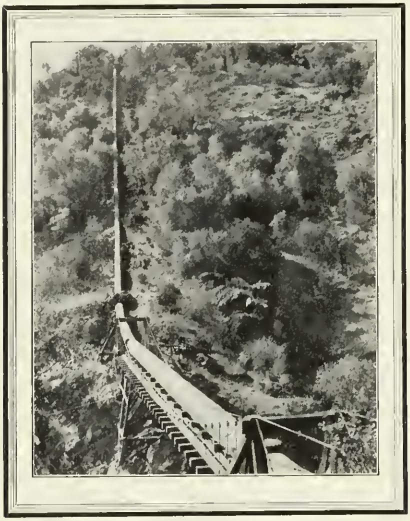
THE TRANSFORMERS

The transformers at first consisted of four banks, and three banks were added when the plant was enlarged. These transformers have been used in raising the generated voltage from 2,400 for delivery through different power lines first at 24,000 volts, a year later at 40,000 volts, two years later at 50,000 volts, and during the past seven or eight years steadily at 60,000 volts for all the high-tension lines. By thus making the voltage more intense the electric energy may be more economically sent through a smaller and less expensive copper wire and then at the delivery end, by means of reducing transformers, it



**The Yuba Power House and (at the left) the Superintendent's Residence**

The pipe-line comes down at the right and operates along the left side of the building, emptying into an irrigating ditch extending along to the left



An inverted syphon carrying the Brown's Valley ditch across a cañon below the Yuba power plant

may be lowered for various commercial needs. Thus experience has shown that in long-distance transmission of electric energy it is cheaper to have more transformers at both ends of the line and be able to send high voltages through the many intervening miles of smaller copper wire, since pure copper runs into money.

All the transformers in the Colgate plant are oil-insulated and water-cooled. The exciters originally installed at Colgate are still in use, after nearly eleven years' service.

THE SWITCHES

The generator and transformer switches originally installed at Colgate in 1899 were of the air-break, knife-blade type. But when the plant was enlarged in 1900 they were all changed to Stanley oil-switches, and a little while afterward Stanley high-tension switches were put on the 40,000-volt lines. Two years later all the Stanley switches were replaced by Kelwan switches, but the Kelwan switches lasted only about four months. One was opened on a short circuit and caused a fire and a lot of damage in the building. So, in 1904 Baum oil-switches were placed on all the high-voltage lines, and they have been in constant use ever since. These switches were invented by Frank G. Baum, formerly electrical engineer and then superintendent of the Pacific Gas and Electric Company.

## "The Best Horse at Colgate"

He was on duty at the Deer Creek plant, over in Nevada County, but "got to kicking," and in kicking nearly amputated a hind leg against the edge of a big steel pipe. They did n't shoot him, but figured he 'd die any way. He lingered and got well enough to limp along with his rack of bones. They then sent him over to Colgate to pasture and die. After nearly a year he picked up, which is a boost for Colgate as a health resort (for mules), and then they tried to sell him for five dollars, but no one would have him. Last spring he completely regained his strength. He is the idol of the man who drives the team, for this mule friskily goes double with "Nigger," the proud black horse of the camp. The mule delights in hurrying up that killing grade

at Colgate at a pace that makes "Nigger" puff and lather, and he comes down at a gallop, because he never slips or stumbles. The driver claims that this mule that would n't die is the best animal of all the scores owned by the Pacific Gas and Electric Company. Five dollars!

Pacific Gas and Electric Magazine

PUBLISHED IN THE INTEREST OF ALL THE EMPLOYEES OF THE PACIFIC GAS AND ELECTRIC COMPANY

JOHN A. BRITTON - - - - - - - Editor
ARCHIE RICE - - - - - - - - - - Editor
A. F. HOCKENBEAMER - - - Business Manager

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## EDITORIAL

**Public Effect of Personal Neatness**

There is a railroad that always keeps its seats and floors so clean that people prefer to travel on it. They tell others why.

There is a hotel where the rooms are kept airy and fresh, the linen and furniture always clean, and neither dust nor smudge is on anything. Travellers go forth and comment favorably, and indirectly increase its business.

There is a restaurant where there are no lurking odors or flies, the table-clothes, the napkins, the glasses are spotless, and the waiters look like close friends of soap and water. Particular people enjoy eating amid such surroundings, and tell others about the place.

There is a barbershop where the barbers always have clean hands and are free from the smell of nicotine, and the combs and brushes and towels look spick and span and germless. Careful men return to it again and again.

There is a great company with many employees. But the public comes face to face with only a certain few, the collectors or the counter clerks whose work neither dirties the hands nor soils the clothes. The public knows the company only through the representatives it meets. If the clerks wear mourning in their finger tips or on their teeth, tiny realty and food souvenirs on their clothing, distill a personal essence of cigarettes, chewing-tobacco, or garlic, show signs of a neglected razor, or have about them any of the other suggestions of a last-year's birdsnest, they are quietly piling up proof that the company really does n't care what the public thinks of it, or it would take pains to put forward a more agreeable personal impression on the line where it comes in close contact with the people.

## Fire Do n'ts

Do n't hesitate a second in sounding an alarm of fire. The blaze may be of minute proportions, but the next second it may communicate with some inflammable material and be impossible to overcome.

Do n't go to a fire simply as a spectator. Pick up a fire extinguisher, a bucket, an ax, a powder tube, or drag a hose on your way.

Do n't throw water on an oil fire. Use a chemical extinguisher, a powder extinguisher, sand, earth; or smother the fire out with a sack, a blanket, or a coat.

Do n't get the idea that your particular plant will not burn down, or can 't burn down. It can.

Do n't forget that a fire means loss not only to your company but that it may mean a loss to you and to the whole community. What a fire destroys is gone forever.

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A fire (of incendiary origin) recently occurred in Sacramento, and while the financial loss, through the destruction of several barrels of oil, was nominal, the possibilities for a general conflagration were enormous.

The fire was discovered by Leszer, a fireman at the gas works, and he gave the alarm. Two employees of the supply department rushed to the fire with two chemical fire extinguishers.

The lessons taught in this case were: the necessity for an immediate alarm; familiarity with fire-equipment stations; prompt and intelligent action,—all going to prove the statistical statement that ninety per cent. of all fires are discovered in their incipiency.

R. J. Cantrell, Property Agent.

# Sunshine

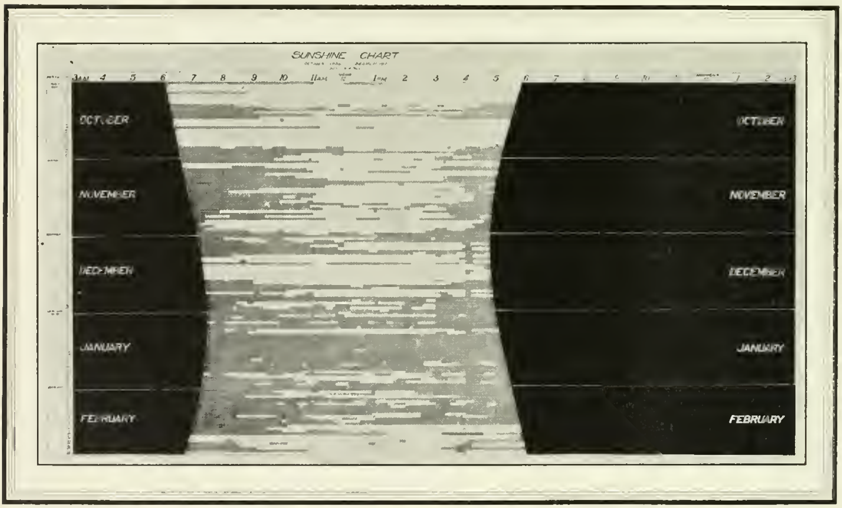
By E. C. JONES, Chief Engineer Gas Department.

E. C. Jones

**Gas as an illuminant** is a competitor of sunshine. But sunshine is free, and no other form of lighting can even approximate it in brightness. When the sun is not shining the amount of gas or electricity used for artificial lighting naturally increases. But this enforced use of a daytime substitute for free sunshine is not always given proper consideration when comparison is made between lighting bills of different months or different seasons.

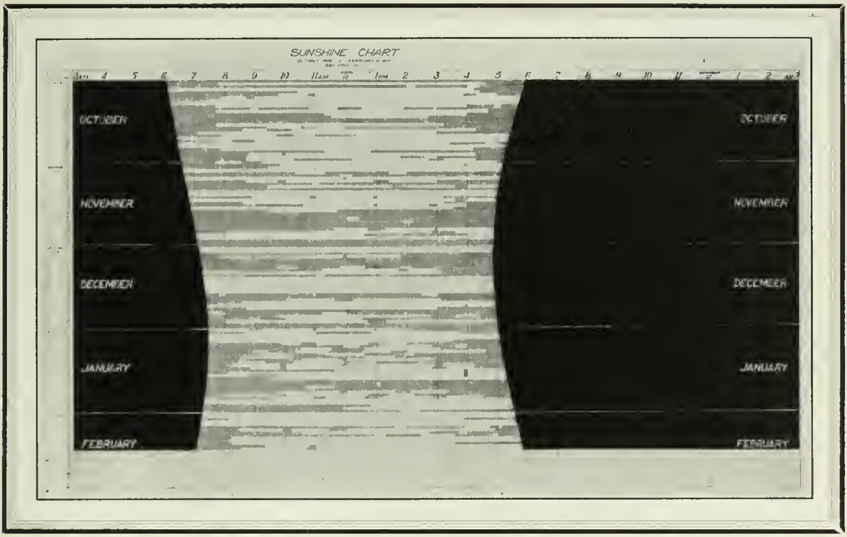
Few people know that the United States Weather Bureau keeps an exact record of every moment of sunshine during the year. Up in the Merchants' Exchange Building in San Francisco Professor McAdie supervises the operation of delicate instruments which tell when the sun is shining and when it is obscured. Through his kindness it was possible to prepare the two accompanying charts illustrating the hours of actual sunshine in San Francisco during the periods from October, 1908, to March, 1909, and from October, 1909, to February 15th, 1910. The black portions of the charts indicate the actual night, and the inner edges of these black parts indicate the exact moment of sunrise and sunset.

In preparing this graphic story of the sunshine of a San Francisco winter the twilight was not taken into consideration. The time between actual sunrise and sunset is shown between the solid black, or night, sections, the daylight period being shortest in December. Each narrow horizontal division across the chart represents a day, and the white sections in these layers show the periods of actual sunshine. The darker sections cover




**Showing San Francisco's Sunshine Hours During the Winter of 1908–1909**

The black is the nighttime. The lighter section is the daytime, from sunrise to sunset, and its dark patches are the cloudy periods of no sunshine. Note how much less sunshine there was in January, 1909, than in January, 1910. Dark days more gas and electricity are used for lighting.




**Showing San Francisco's Sunshine Hours During the Winter of 1909–1910**

Each twenty-four-hour day is traced from left to right across the chart, beginning at 3 a. m. From the hour of sunrise to the hour of sunset every period of cloudiness and no sunshine is shown in grayish black. The hours are given along the top.

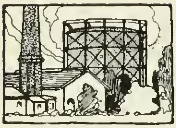
the hours of the day when the sun was obscured.

It might seem reasonable to assume that the hours of actual sunshine in a given month would tally with those of the same month in another year. But these charts show that such an assumption will not hold good. In January, 1909, the total time of possible sunshine was 305.7 hours, but the actual sunshine was only 54.8 hours. So San Francisco really had sunshine only 17.92 per cent. of the time during those January days. In January, 1910, the period of possible sunshine was also 305.7 hours, while the actual sunshine was 158.2 hours. So this January San Francisco had sunshine 51.75 per cent. of the time. From the 1st to the 10th of January, 1910, there was actually as much sunshine in San Francisco as during the whole month of January, 1909. This would account for the excessive use of artificial illuminants during the month of January, 1909, above the amount used during the month of January, 1910.

On a postal card to the manager at Oakland:

Gas Co. Sirs:—I think the Meter full in water. Because the Gas is breathing now strong now weak, as if wounded Soldier was at point of death in battlefield. Please inspect it at your convenience. Yours truly, S. Aoki.
March 2d.

"Damage Claims—A Modern View," published in the December number of this magazine, by John P. Coghlan, manager of the company's claims department, was reprinted in its entirety in the January number of "Public Service," a Chicago magazine.



# MEN OF THE COMPANY

## FRANK A. LEACH (JUNIOR)

### Or a Printer's Devil Who Became Manager of the Gas and Electric Needs of 300,000 People

WHAT makes a "junior"? Is it a part of a man's name? or merely a temporary appendix? Is it his for life? or only during the lifetime of the "senior"?

A young man came to San Francisco in the pioneer mining days and put out a sign as a broker. It read "John Perry, Jr." It continued to read just like that for nearly sixty years, though its owner had got well on toward ninety. Query: Was he still a "junior"?

When you see a "cullud pussun" with a name like George Washington Brown or Thomas Jefferson Jones or Abraham Lincoln Smith, you do n't infer lineal descent: merely parents' admiration for a great character. But when you see a Jr. after a man's name you think of immediate kin, usually a father; and you harvest the past to cull some connection.

In this case, Who was Frank A. Leach (the elder)? Let 's get him first, and see about Frank the Second and his claims to individuality apart from being the son of his father.

Back in the rush of '49 two men came to California. Of course there were about 100,000 others. But these two were named Leach and Powell. They did n't know each other. Each had left his wife and small children in the east. Leach got well established in Sacramento as a wagon-maker, and then, in the early fifties, went back and brought his family out from Cayuga County, New York, by way of the Isthmus of Panama. Powell, who was the first naval constructor at the Mare Island Navy Yard, also brought his family out from Philadelphia, likewise by way of the isthmus.

Just before the outbreak of the Civil War the Leach family moved from Sacramento to Napa, which was a geographical point closer to Mare Island and the Powell family. Still the Leaches and the Powells were strangers, though not many miles apart.

The little Leach boy that had come across the isthmus grew to be eighteen. Right then he did something of note. He founded the Napa "Register." Five years later, when twenty-three, he moved over to Vallejo, right across the narrow little channel from Mare Island, and founded the Vallejo "Chronicle." This young editor and newspaper founder then met the Powell girl who had crossed the isthmus as a baby; she had by then grown to attractive young womanhood. So, Frank A. Leach (senior) and Mary Louise Powell were married. The Leach family from New York and the Powell family from Pennsylvania thus became connected through the fates that had turned two men in '49 to seek their fortunes in California.

Frank A. Leach, while conducting the Vallejo "Chronicle," also founded the Benicia "New Era", and then the Suisun "Solano Republican." Meanwhile Frank A. Leach (junior) had arrived to augment Vallejo's population, followed in orderly sequence by three brothers.

When Frank the Second was sixteen the family moved to Oakland. The father, who had already founded four well-known California newspapers, then bought the Oakland "Enquirer", and immediately converted it from a comparatively obscure little bi-weekly publication to an important daily newspaper.

Three years after the "Enquirer" became an Oakland daily Frank the Second was graduated from the Oakland High School. He was then nineteen, and had founded nothing but scholastic convolutions in the gray matter within a fairly well-shaped head. Then he started in earnest to dirty his hands and get practical knowledge of the printing and publishing game. From the time he was nineteen till he was twenty-seven he worked in the "Enquirer" office, going gradually through all the stages from printer's devil to assistant business manager, and including a thorough working knowledge of type-sticking and kicking off a job press. He learned the trades of the practical printer, the pressman, the linotypeman, the photo-engraver, and the bookbinder.

Frank A. Leach, Jr.

About the middle of that period, to be exact, when he was twenty-four, he did n't go and ask a young woman to change her name to Leach; not Frank the Second. He had been attracted to one who had started life with that name, and after meeting Frank she was evidently determined not to change her name. It was easy: No monograms had to be altered. Miss Margaret Helen need no longer be a Miss. In fact there would be one Miss less in the families but still a gain in Mrs., though no gain in Leaches. All this having been satisfactorily elucidated in a Frank way (it took time, of course, and many private calls), these two unrelated people, as here now duly related, were married. There had been no loss or gain by the union. But wait a few years. There came some gains. Score two additions: little Margaret Elizabeth Leach and Frank Powell Leach, children of Mr. and Mrs. Frank the Second.

Meanwhile things had happened in the Leach business sphere. In 1897 Frank A. Leach (the elder) had been appointed director of the United States Mint at San Francisco, the largest coinage works in the world. Think of it: a newspaper man began making a lot of real money! The following year he sold the Oakland "Enquirer", and, after making millions of dollars in San Francisco (at the mint), he resigned to accept the presidential appointment of director of all the mints and assay offices in the United States. He made millions and millions of dollars during two years more and resigned, with a record for money-making never equaled by any other newspaper editor of Napa, Vallejo, Benicia, Suisun, Oakland, or any other city you may care to mention!

But the sale of the "Enquirer", when Frank the Second was twenty-eight and married, sidetracked a whole assortment of that young man's professional printing prospects. For several years the "Enquirer" publishing concern had been doing practically all of the printing for the Oakland Gas Light and Heat Company and also the printing of the proceedings of the Pacific Coast Gas Association. Frank the Second, with a typographical and editing eye, had been reading these proceedings with interest; also, it happened he had been personally much attracted to electricity and chemistry while in the high school.

The gas company decided it wanted him. He started as "the last man in"; was a roustabout, doing miscellaneous stunts for six months; then served for three years "on the counter", taking orders, taking in cash, receiving "kicks", giving information, and meeting the company's consumers face to face. He was then transferred to the electric department as its first clerk, to organize its work and reduce it to a system. He served there a year, and, during the next two years, was promoted to purchasing agent and to auditor. While auditor he was practically acting as manager at Oakland.

Then, in August of 1904, when John A. Britton found his own official duties so numerous at the San Francisco office that he had to forego his former daily visits to the Oakland office, Frank A. Leach, Jr., was appointed manager of the Oakland district and of the Berkeley district.

Official titles mean little or much, according to what you know of the requirements of the position. Frank A. Leach, Jr., is manager of the Oakland Gas Light and Heat Company and of the Berkeley Electric Lighting Company. But that does not mean much either, unless you happen to know that these two companies, as subsidiary concerns of the Pacific Gas and Electric Company, supply gas, electricity, and power to Oakland, a city of 230,000 people, and to Berkeley, a city of 41,000 people; gas to Alameda, a city of 30,000; gas, electricity, and power to Emeryville, a town of 2,000; to Piedmont, a community of 2,000; and to Albany, a town of 500 people; and that this present aggregate of more than 300,000 population was only half so large five years ago; that Leach has under him a force of between 500 and 600 employees; that because of this quick growth of these communities the office building in Oakland has been doubled in height by the addition of two stories, the gas-making capacity of the Oakland works has been tremendously increased, several miles of underground conduits have been laid in Oakland's business streets to eliminate all poles and overhead electric wires, and the regular business of the territory has been complicated by the details of this general work of expansion and development.

In addition to supervising the regular business of that immensely populous area, Frank A. Leach, Jr., has found time during the past four years to be one of the founders of the Oakland Chamber of Commerce and to serve last year as its president, to be on its board of directors for the past four years, and to be chairman now of its publicity committee that is spending thousands of dollars in eastern advertising of Oakland. He is also an active member of the Berkeley Chamber of Commerce, of the Merchants Exchange of Oakland, of the Athenian Club of Oakland, vice-president of the Nile Club of Oakland, a member of an Oakland lodge of Masons, a trustee of the Oakland Y. M. C. A., and vice-president of the Pacific Coast Gas Association.

Thus at thirty-eight (he 'll be thirty-nine October 1st) he may be said to qualify in his own right as an individual who has achieved and is not dependent for public identification solely upon the fact that he is the son of Frank A. Leach, former director of United States mints. His three younger brothers have also done somewhat to stand for themselves: Abe P. Leach, for eight years prosecuting attorney for Alameda County, is an

Oakland lawyer; Edwin R. Leach, after taking a degree from the college of mining engineering at the University of California, is melter and refiner at the San Francisco mint; and Harry E. Leach is a young Oakland lawyer.

Personally Frank Aleamon Leach, Jr., (do n't mispronounce that Roman middle name and call it "A Lemon") is like his father, of medium height and wirey of build. He gives the impression of being alert, full of business, and ready of speech, and, among the thousands of men in this great company, his handwriting is noticeable for its clearness, fluency, and neatness. He has never traveled far by land or sea, nor does he journey into dreamland during business or recreation hours hand in hand with Lady Nicotine.

In ancient Rome he might have been Francus Leachus, the younger; in ultra-fashionable eastern society lists, Mr. F. Aleamon Leach, 2d; and in France, M. Francois Leach, fils. But even in Oakland, "the Athens of the Pacific," it would be taking a chance to write him down Frank Leach, fils, lest many, unfamiliar with French, might ask, "Fills what? and why?"

A. R.

# Electric Transmission Troubles

By C. F. ADAMS, Engineer of Electric Construction.

C. F. Adams

**Industrial application** of electricity marks the most notable physical advance of all history. Twenty centuries ago the message "Peace on earth, good-will toward man" started a moral impulse that is still a compelling force. No individual, society, or invention has quickened the mind, advanced the general welfare, and hastened the coming of "peace and good-will" as has the application of electricity to the uses of every day.

The transmission of speech and signals has blotted out space and time. The transmission of energy has lightened the labors and multiplied the constructive capacity and comforts of the individual. A brief half-century will almost cover the entire progress of the "electric age." A quarter-century will almost cover the electric transmission of energy and the commercial use of the electric light. Read the literature of twenty-five years ago and see how little the founders of the art appreciated its possibilities. Then industries were located along streams capable of power development. The mill and the village represented the manufacturing interest.

But electric-power transmission has carried the energy of the waterfall to the city. The single power-station has replaced a thousand small engines. Now power can be delivered at any point where an electric motor can be located. The enormous growth of the city is the direct result. The next few years will see the application of modern power to the farm, and a restoration of interest in agriculture.

The purpose of this article is not to forecast the future, but to inquire as to some of the causes that tend to limit electric service. What are our ordinary "electric troubles"? and why do they exist?

In the transmission of electricity we have advanced from the small central station, with its maximum range of a few miles, to systems, operating under single control, serving a territory larger than a commonwealth. In transmitting voltages we have progressed by stages from 1,000 volts to 130,000 volts, and the final limit is reached only when losses through the air from line to line render operating costs prohibitive. The advances in the art of transmitting electric energy have been accomplished by careful study of "the weak point," and by the selection of the best method and material as determined by service trial.

The entire problem of transmission is to confine electric current to a selected channel; to keep it from escaping from the wire.

The sole tendency of an electric current is to return to the point at which it was generated. Insulation of numberless forms has been developed to confine this force to useful paths. Practically all the "troubles" of the art are those due to some defect in insulation.

In the work of power-transmission the troubles confronting the engineer may be examined in their normal order as those relating to generating apparatus, to motors, to transformers, and to transmission lines.

The modern dynamo well exemplifies the law of the survival of the fittest. It is the result of evolution and selection. From small and crude designs generators have evolved into a form of machine which is practically standard. The high velocity of steam has been utilized to great advantage in the simple high-speed turbine, with its special design of dynamo. In hydro-electric plants practically no new designs of dynamo have appeared in the past five years. The high efficiency, strong construction, and durable insulation of the modern dynamo make it one of the most dependable of machines.

There is so small a limit of possible improvement in the efficiency of the modern dynamo that further progress in its construction is questionable. The "troubles" are generally due to heat, to vibration, and to moisture. The insulation enclosing an armature coil consists mainly of a vegetable fabric, impregnated with an insulating varnish or compound. The useful life of an insulation material is limited to its flexibility. High temperature reduces its physical strength, and renders it brittle. Long-continued heat lessens its dielectric strength, and gradually reduces it to carbon.

An electric conductor imbedded in an armature slot is subject to heavy mechanical strains. A current-carrying conductor (be it copper bar or wire) is alternately repelled and attracted by the powerful magnetic field which, swiftly revolving in front of it, produces electric energy in the copper. Unless this conductor is firmly secured in its slot there will be vibration which, in time, will pulverize the insulation about the copper and result in current-leakage and damage. This pulverizing of the insulating material is greatly hastened where the edges of the grooves are not true and smooth on the side walls and the bottom of the armature slot.

Where an armature coil consists of a number of flat copper bars wound into several turns the individual bars tend to repel each other. The vibration resulting from this repelling force destroys the insulation between the turns, and the copper itself is crystalized and fractured. Another form of "trouble" experienced in the mutiple-turn coil is the unequal expansion of the conductor; the centre turns of the copper, having less radiation, will expand most, and will crowd the other coil turns to a dangerous degree.

For these and for other reasons the most stable form of electric generator is the one having the fewest armature turns. Two conductors to the slot is the preferred type, and these conductors should be of cable or strand if the armature is of the open-slot type. Where the armature insulation becomes worn and the copper conductor comes in contact with the iron, the damage done depends on the extent to which the machine is "short-circuited."

*(To be continued.)*

# The Electric Service of the Peninsular Towns

By LEE H. NEWBERT, Manager Redwood District.

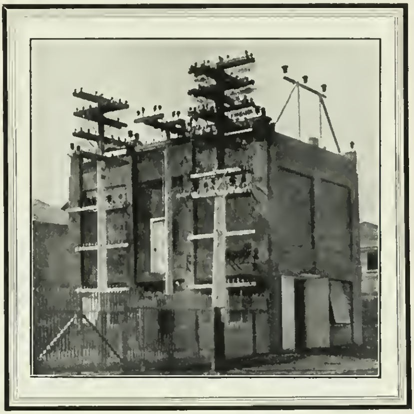
Lee H. Newbert

**For business reasons** the vast territory served by the Pacific Gas and Electric Company is cut up into more than twenty districts. These districts are roughly somewhat larger than California counties, and, like them, they vary in shape and area according to the lay of the land and the density of the population.

The railroad route about the southerly arm of San Francisco bay roughly outlines a wish-bone. The joint of the wish-bone is the city of San Jose, down beyond the reach of the waters; the lobe at the end of one arm is the city of Oakland; and the lobe at the end of the other arm is the city of San Francisco. Along the peninsular arm, from the limits of San Francisco to the limits of San Jose, there is a valley and foothill stretch of territory about forty miles long and about five miles wide, gently sloping eastward toward the bay. Midway of this great surburban strip of live-oak country is Redwood, so called because half a century ago it was the centre of a redwood lumber district, one old tree of which remains in the giant "Palo Alto," near Stanford University. And Redwood is the headquarters of the Redwood, or peninsular, district of the Pacific Gas and Electric Company's system. This Redwood district includes just a dozen communities: Belmont, with 600 people; Burlingame, with 5,000; Easton, with 500; Mayfield, with 1,500; Menlo Park, with 1,500; Milbrae, with 300; Mountain View, with 2,500; Palo Alto, with 6,000; Redwood, with 3,500; San Carlos, with 150; San Mateo, with 7,000; Stanford University, with 2,000; and Sunnyvale, with 2,000,—total, 32,500 people.

All the peninsular communities as far down as and including Palo Alto are supplied with gas manufactured at the Pacific Gas and Electric Company's great oil-gas plant, located in Visitacion Valley and known as Martin Station. A huge main more than twenty miles in length carries the gas supply to these communities.

But this article is chiefly concerned with the electric supply and how it is distributed. The great high-tension power-lines from the mighty hydro-electric plants up in the Sierras come down through the interior valleys and stretch high across Carquinez Straits. A southern branch extends through to Mission San Jose, and then goes on to San Jose and way down to Davenport and the city of Santa Cruz. From Mission San Jose a branch of this high-tension system comes up round the bay, through Redwood, and on into San Francisco. The pole-line, with its big

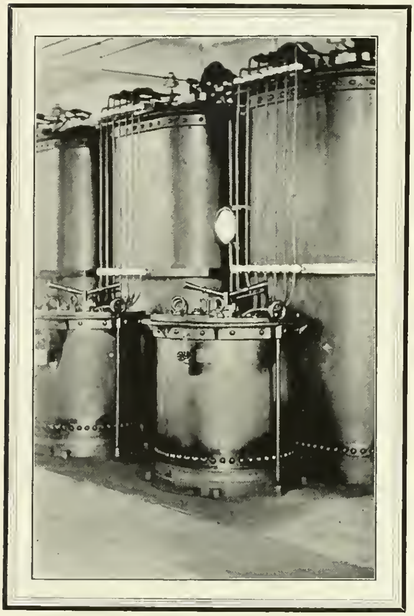


**The Station at Redwood**

Showing the high-tension lines entering the building (on left) and leaving from the roof (on the right); the 11,000-volt circuit leaving the building (just to the right of the pole outside the fence); the 4,000-volt distributing circuit leaving the building (on the extreme left); the Baum paralleling switch (on the first pole inside the fence), which allows the Mountain View station to carry the peninsular load when it is necessary for the Redwood station to shut down; and (over the street door) the telephone wires entering and leaving the building.

insulators, is a familiar sight across the marsh-lands.

At Redwood there is an electric station. It serves two functions: it is the distributing station for supplying the electric needs of the northern part of the peninsular district, and it is an important high-tension switching station. The second floor of the concrete building is devoted exclusively to high-tension wiring and switching. That long marsh-land pole-line carries two 60,000-volt lines from Mission San Jose round into San Francisco, and those two lines pass through the Redwood station, where the switching arrangement is such that either of the two lines coming into or going out of the station can be taken out of service temporarily to permit repairs or work on them without shutting off the current along the entire double line. The different high-voltage switches making this safety plan possible are located in separate concrete compartments, the construction of which, like that of the entire building, is intended to reduce fire risk to the smallest possible factor.



The 500-kilowatt, high-tension transformers and two of the hand regulators. (Redwood Station)

When the Pacific Gas and Electric Company came into possession, about eight years ago, of the gas and electric properties of the peninsula the substation at Redwood consisted of a wooden-frame building, covered with corrugated iron. It was twenty feet square and twenty-four feet high. For equipment that building had simply four, 200-kilowatt, high-tension transformers (one being a spare held in reserve) and three high-tension, Stanley air-switches. The 6,000-volt secondaries were carried overhead to another frame and corrugated-iron structure housing a steam auxiliary plant and a secondary switchboard, which was a combination of marble, wood, open fuses, and air-break switches.

By 1906 business along the peninsula had so increased that the present two-story concrete station building at Redwood was ordered erected. It is twenty-six by thirty-six feet, and stands twenty-eight feet high. The high-tension oil- and disconnecting-switches located in the enclosed concrete compartments on the upper floor are operated from the lower floor by means of levers. And on the lower floor are the high-tension transformers, the switch-boards, the regulators, and other apparatus.

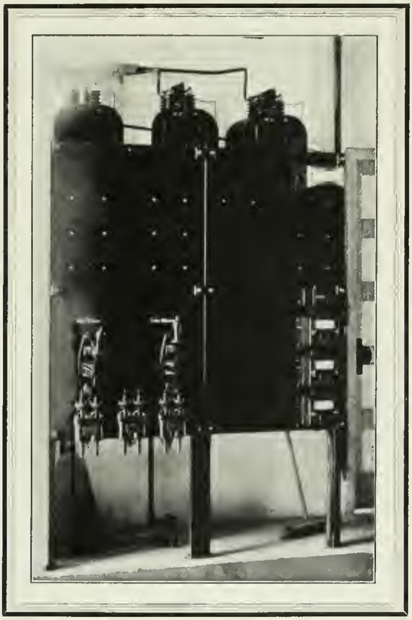
There are three, 500-kilowatt transformers. They reduce the main-line current to 11,000 volts for transmission northward to San Mateo and other towns and southward to Palo Alto, Mountain View, and Sunnyvale; and to 4,000 volts for local distribution in Redwood and the vicinity. There are also three, 100-kilowatt transformers to supply Redwood's local service. These smaller transformers are fed from the 11,000-volt lines coming from the high-tension transformers. The connection is such that if anything should happen to the Redwood station these smaller transformers for Redwood's local service could be instantly supplied through the 11,000-volt line from the Mountain View station. The 11,000-volt circuits are three-phase, and the local distributing circuits are three-phase, four-wire, 4,000-volt.

Ordinarily the current all comes from the hydro-electric plants in the distant Sierras through either of the two, three-phase, 60,000-volt lines, which extend on to San Francisco. But if something should happen along the hydro-electric power-line there is an emergency switching arrangement by which current may be turned on from the company's great steam-generated electric plant situated out beyond the Union Iron Works in San Francisco, or from the company's steam-generated electric plant at San Jose. So the peninsular towns can not be deprived of electricity except through some rare combination of accidents putting several mountain and two city plants temporarily out of commission.

The growth of peninsular population following the San Francisco fire was very rapid, and early in 1907 it became evident that the existing electric system of the United Gas and Electric Company (a subsidiary company of the Pacific Gas and Electric Company) would have to be completely reconstructed in order to meet the increased demand for light and power service. Briefly described, the system to be replaced consisted of a main high-tension substation at Redwood, with two-phase, 6,000-volt lines extending southward fourteen miles to Sunnyvale and northward eight miles to San Mateo. At San Mateo two, 100-kilowatt transformers were employed to reduce the pressure to 2,200 volts for distribution to San Mateo and Burlingame.

After a thorough study of conditions it was determined, notwithstanding the existing high price of materials, to rebuild in such a manner as to give not only a greatly improved service but also to meet requirements for some time into the future. Subsequent development in the peninsular towns has demonstrated that the decision was a wise one, as the electric load taken today exceeds that of 1906 by one hundred per cent.

The new peninsular system as laid out by the engineering department called for an additional high-tension station to be located at Mountain View, eleven miles south of the existing station at Redwood. The Mountain View station was to be fed from the high-tension line then in course of construction and now supplying Davenport and Santa Cruz. There was to be a secondary substation at Palo Alto and an enlargement of the secondary substation at San Mateo. These stations were to be connected by a three-phase, 11,000-volt tie line, with current supply from either Redwood or Mountain View.



The 11,000-volt Switchboard (oil switches are in concrete compartments at the left). (Redwood Station)

As a result of the work, which was completed in the summer of 1908, the system consists today of the high-tension station at Mountain View, which, under regular operating conditions, supplies service to Mountain

View and Sunnyvale and to the Palo Alto substation; and of the high-tension station at Redwood, which supplies Redwood and the San Mateo substation. The switching arrangement is such that, when circumstances

Two of the three 100-kilowatt transformers that supply the local service. (Redwood Station)

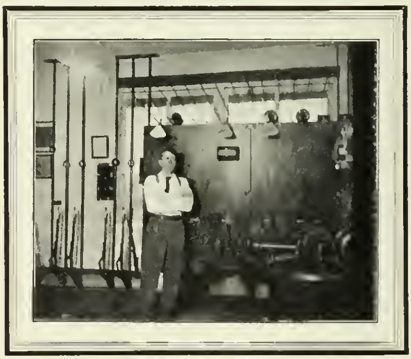
require, either the high-tension station at Redwood or the one at Mountain View can supply the entire peninsular district.

The Mountain View station contains three, 500-kilowatt, oil-insulated, water-cooled, single-phase transformers, star-connected for 60,000 to 11,000 and 4,000 volts; three, 100-kilowatt, single-phase, oil-insulated, air-cooled transformers; and the necessary switchboard and control apparatus. The high-tension oil-switches, like those at Redwood, are located on the second floor. The disconnecting switches are pole-type, and are located on suitable structures outside. Voltage regulation is by hand, with two sets of regulators, one on the secondaries of the high-tension transformers and the other on the secondaries of the low-tension, or 4,000-volt, transformers.

Service to Sunnyvale, three miles south of Mountain View, is through a three-phase, four-wire, 11,000-volt line. Mountain View service is three-phase, four-wire, and is regularly supplied from the 4,000-volt transformers. When necessary, this service may be supplied from the 4,000-volt taps of the high-tension transformers. Service transformers have voltages of 2,400 to 220 or 110.

The Palo Alto substation is supplied through a three-phase, four-wire line. Service transformers are connected to supply consumers along the seven-mile line between Mountain View and Palo Alto. The Palo Alto substation contains three, 250-kilowatt, oil-insulated, single-phase transformers, 11,000 to 2,400 volts; and the necessary switchboard, control apparatus, and instruments. Voltage regulation is by means of two, single-phase, automatic, induction regulators so connected as to maintain a maximum voltage during the peak of the load. The secondary circuits are: Stanford University, Peninsular Railway, Palo Alto single-phase (for commercial district), Palo Alto poly-phase (for residence service), power, Menlo three-phase.

An 11,000-volt, three-phase, No. 4-copper, three-wire circuit extends from the Redwood station to the Palo Alto substation, four miles south, where it can be joined to the 11,000-volt line from the Mountain View



The 4,000-volt distributing switchboard, the oil switches being mounted on the left. At the left are the high-tension levers. (Redwood Station)

station, when operating conditions require. Another 11,000-volt, three-phase, No. 4-copper, three-wire circuit extends from Redwood north eight miles to the San Mateo substation.

The local circuits from Redwood station are: Redwood lighting (single-phase, 4,000 volts), Redwood power (three-phase, four-wire, 4,000 volts), San Carlos and Belmont (three-phase, four-wire, 4,000 volts), Fair Oaks (single-phase, 4,000 volts), street lights.

The San Mateo substation contains three, single-phase, 300-kilowatt, oil-insulated, air-cooled transformers, 11,000 to 2,400 volts, together with the necessary switchboard and control apparatus. Voltage regulation is by means of two, single-phase, automatic, induction regulators. The secondary circuits are: San Mateo single-phase (2,400-volt for commercial district lighting), San Mateo poly-phase (for residence district), Homestead poly-phase, water works poly-phase, Peninsular Hotel poly-phase, Burlingame poly-phase, San Mateo street lights, Burlingame street lights.

In addition to the regular telephone service a private telephone line connects the stations at Redwood, Mountain View, San Mateo, and Palo Alto.

All switching on the 11,000-volt line is directed by the Redwood station.

The current supply to both high-tension stations is through duplicate lines from the Sierra power houses or (through the same lines) from the steam plants at San Francisco and San Jose. With the aid of the 11,000-volt tie line in case of accident at either high-tension station interruptions in service are doubly provided against, and the rare occasions when they do occur they last but a few moments.

After months of operation it can be said that the peninsular system has been tried and not found wanting.

Where thirty tons of "Hitch" fish from Clear Lake, in Lake County, were stranded up Kelsey Creek May, 1900, because the stream sank rapidly and cut off their return to the lake

(Photo furnished by J. W. Hall, Stockton)

# Six New Appointments in the Company

WHILE February marked the dual retirement from the Pacific Gas and Electric Company of F. V. T. Lee as assistant general manager and of J. H. Wise as civil and hydraulic engineer, it also witnessed six new appointments near the heads of various departments. Here is the gist of the changes:

The "Placer County District" was created by consolidating the old Placer and Auburn districts of the South Yuba Water Company, which embraces in its scope several hundred miles of aqueducts, scores of reservoirs and mountain lakes, and considerable stretches of flumes, comprising the system that supplies water for domestic and irrigating purposes to many communities of the Sierra slopes and several thousand acres of foothill orchards tributary to Newcastle as a fruit-shipping centre. Herbert M. Cooper, former superintendent of the Placer division of this great water system, was made manager of the new district. He was born and brought up in Nevada County, his father having owned and operated the Cooper sawmill and lumber camp that still stands as a relic near the present site of this company's Deer Creek power plant. The younger Cooper was himself an experienced lumber cruiser and sawmill operator, and in 1907 he was foreman of the Tiger Creek sawmill. W. R. Arthur, who had been for some time manager of the Auburn water district, was made assistant manager of the combined district. The headquarters will be at Auburn.

The recently created "new-business department" has for its managerial head F. E. Cronise. He is a native of Woodland, California, and is something above six feet. After attending the grammar school in San Francisco and graduating from the high school at Fairfield in Solano County, he returned to San Francisco and served for three years as a bookkeeper with the Wells-Fargo express company, then three years as a passenger agent for the Southern Pacific, then one year as city passenger agent for the Rock Island Railroad, then a year at field and office work for the Hotaling Estate Company in forwarding its California Railway enterprise, and then half a year as a counter clerk in the main office of the San Francisco Gas and Electric Company, supplemented by several months of special work in the office of the treasurer and comptroller of the Pacific Gas and Electric Company.

The new "publicity department," having to do with the company's publicity, its newspaper and other advertising, and the supervision of this magazine, has as its manager Archie Rice, a native of Hueneme, California, a graduate of the high school at Santa Barbara and of Stanford University in the first class to complete the four-year course there, along with P. M. Downing, A. H. Burnett, and Walter Hyde, who occupy well-known positions in the company. For some twenty years Rice has been principally identified with journalism and magazine writing. He began at nine as a paper carrier on horseback, and before entering college rode cattle, was a school teacher, and a steamship freight clerk, and after college was reporter, special writer, interviewer, business manager, editor, supposed authority on all branches of amateur athletics, and had some minor experience prior to the San Francisco earthquake as an insurance agent and during the fire as a policeman. He thinks he is a pedestrian and a long-distance swimmer, but his thinking so does n't prove any thing.

With the retirement of J. H. Wise as civil and hydraulic engineer, Harry C. Vensano of Wise's department was promoted to the position of civil engineer. A native of San Francisco, a graduate of the University of California in 1903, and with this company for the past three years, Vensano has practically developed into the position, although nature did not exactly plan him to fill Wise's shoes, for James is a six-footer while Vensano, no matter how great may be his engineering achievements, will always have to look up to "Jimmy" Wise!

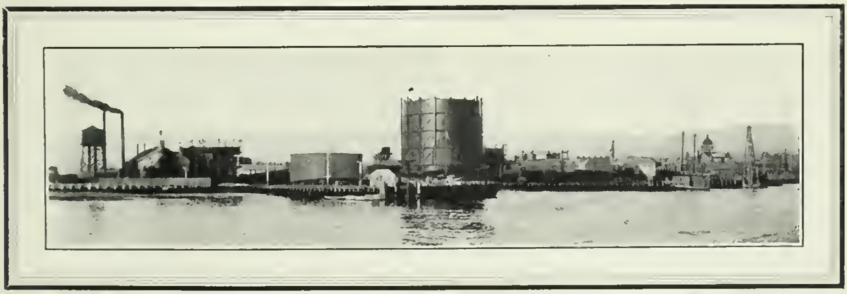
James H. Wise, who resigned to take up private practice, has been retained in the employ of the Pacific Gas and Electric Company as its consulting hydraulic engineer.

George C. Holberton has been appointed general manager of the San Francisco Gas and Electric Company, and will also act as assistant to the local president—John A. Britton, the general manager of the Pacific Gas and Electric Company.

## Gas Men to Convene at Los Angeles

LOS ANGELES, which is said to have 305,000 people (with 300,000 of them real estate agents and the others advertising agents) is to be invaded three days running next September by delegates to the eighteenth annual convention of the Pacific Coast Gas Association, which has some three hundred members, many of whom may be yearning to go into that southland to be handed an orange or a lemon or a transfer. The president of the association this year is a Los Angeles man; W. B. Cline; hence the desire in his town to greet the gas men coming from afar. Just what form the entertainment is to take is not divulged, but the president has on his staff of organized hosts the Los Angeles Gas and Electric Company, the Pacific Light and Power Company, and the Southern California Edison Company, which looks like some hospitality and sight-seeing for Tuesday, Wednesday, and Thursday, the 20th, the 21st, and the 22d of September.


The Pacific Gas and Electric Company, in addition to having a good many members in the association (at five dollars a year), also has three of the officers: Frank A. Leach of Oakland being vice-president; John A. Britton of San Francisco, secretary and treasurer; and Harry Bostwick of San Francisco, assistant secretary and treasurer.



**Oakland's Gas Works from the Waterfront**

This plant, known as Station B of the Pacific Gas and Electric Company, supplies all the gas used in Oakland, Berkeley, and Alameda. The new 2,000,000-cubic-foot gas holder is shown in the middle of the picture.

# Electric Pumping for Street Sprinkling

By FRANK A. LEACH, JR., Manager Oakland District.

Frank A. Leach, Jr.

**Oakland has developed** a system of ten electric pumping plants for supplying salt-water for further use in its street-sprinkling service.

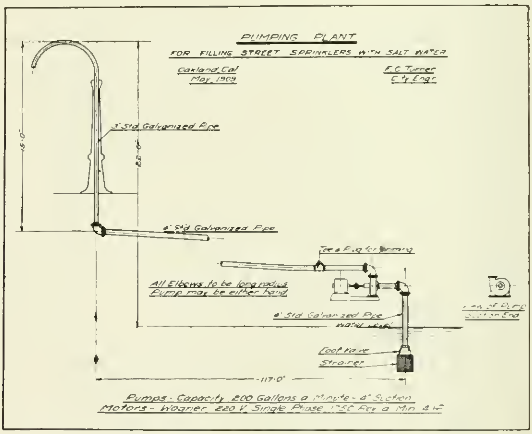
Aside from the very large saving in expense to the city, the use of salt-water has many advantages over fresh water for the purpose of laying the dust. This is especially evident where there is moist atmosphere, such as exists about San Francisco bay. The deposit of salt upon the sprinkled streets is soon sufficient to gather moisture during foggy nights, and thus make it unnecessary to sprinkle the streets every day. Salt also prevents the growth of weeds. The only objection is that the salt-water more readily causes rust on the exposed metal of the wheels of vehicles.

The outfits herein described are those used by the city of Oakland, but they could be adopted by any other fog-frequented city near tidewater. The figures show at what a very low cost 800 gallons of water can be placed in the cart ready for delivery. The appliances described could be fitted to tank wagons and used to pump water from wells on county roads where secondary distribution is available.

In a test made by P. F. Browne of Oakland an 800-gallon sprinkling cart was filled in 3 minutes 47 seconds, or at the rate of 210 gallons a minute, the water being raised an equivalent of thirty-six feet, with the expenditure of 4.94 horsepower hours.

The specifications of the Board of Public Works of the City of Oakland required the following qualifications from those bidding on the construction of any of the four latest salt-water pumping plants:

The pumps shall be of the centrifugal type, with cast-iron castings and runners, and having shafts fitted for salt-water; they shall be direct connected with flexible couplings to motors, and mounted on cast-iron baseplates arranged for pump and motor. When new, the pumps shall produce in useful work an efficiency of at least 40 per cent. of the power delivered on the pump-shaft; and after six months' use the efficiency shall not be less than 40 per cent. The pumps shall be designed so as to operate without the use of throttling devices in the pipes because of changes of head due to the tide. They shall each have a capacity of 200 gallons of salt-water a minute, under the conditions shown on the accompanying plan. The suction shall be fitted with a flange to suit the suction opening, and shall be tapped for four-inch standard pipe.




The motors shall be not less than four-horsepower. They shall be single-phase, 220-volt, alternating current, and arranged to start on full current with full load; and the full-load speed shall be 1,750 revolutions a minute.

The city shall install the plants in accordance with the accompanying plans, and the tests after completion must show each plant delivering continuously not less than 200 gallons of salt-water a minute without overloading the motors at any stage of the tide.

## Swam a River to Save a Pole-Line

DURING the general California storm of December 9th, 1909, the 60,000-volt power-line across the Yuba river was threatened with destruction. One of the double-constructed poles carrying the wires for this enormous voltage is shown in the background of the accompanying illustration. That particular pole was about to be washed out by the high water. There was no way of getting men and material over to it.

Then it was that H. A. Kirkpatrick, foreman for the Pacific Gas and Electric Company's Yuba-river district, himself volunteered to swim across the big, turbid river, wallowing along bankful with its unusual flood. As he swam across he dragged along after him a steel cable, which he succeeded in fastening high in a tree on the opposite side. The other end of the cable was then drawn taut and made fast to a rock pile in the dredger district. He then constructed a "Dutchman" to travel along the cable, and by that means transferred workmen and materials to the threatened pole. The relief arrived there none too soon. A few minutes more and the pole could not have maintained its position; the wires would have been broken by the drag on the pole. The picture shows H. A. Kirkpatrick sitting on the "Dutchman" in transit. The photograph was sent by C. E. Young, superintendent of the Marysville power division.

# PERSONALS

Edward S. Jones, superintendent of the gas works at Sacramento, is a son of E. C. Jones.

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Charles W. McKillip, manager of the Sacramento district, is one of the supervisors of Sacramento County.

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Hite A. Grove, an operator at Station A in San Francisco, is the father of a six-pound baby girl, little Miss Grove having made her initial call March 5th.

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A. F. Hockenbeamer, treasurer and comptroller of the Pacific Gas and Electric Company, was, at the recent annual election of the directorate, made vice-president to succeed John S. Drum, the personnel of the other positions remaining unchanged.

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Early in February Herman Weber, the company's manager at Petaluma, saved the lives of a quarter of a million chickens! An accident had happened to the gas main that brings the local supply from Santa Rosa, and if the gas were turned off pending repairs all the great incubators in the poultry metropolis of the world would go cold. Weber stepped to the telephone and in the name of tens of thousands of old hens to be, defied Manager Thomas Petch at Santa Rosa to turn off the gas. Hence, "Herman the hens' hero!"

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Arthur B. Saunders of the Martin Station gas works, who got into the magazine's personals as "Sanderson, Stanford '05," writes by way of correction thuswise: "Having been there since the car-strike and being the only Stanford man on the job, it looks as though I am it, though your informant has added a 'son' to my name, which is more than has happened to my family. Apropos of sons: Maurice Hixon of Martin Station has a community interest with Mrs. H. in a bouncing son four months old, who seems to have bounced out of sight of the newsgatherer."

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Lee H. Newbert, manager of the Redwood district, is this year's president of the board of trade of San Mateo County. The Redwood Elks, over whom Newbert now presides, gave a minstrel show February 7th and 8th, and Newbert had his picture in the paper in black-face caricature and labeled "The sterling interlocutor who gives a heart-throb with every bleat." The column article goes on to declare: "He [Newbert] is at the present time well charged with laughing-gas and carries a jar of cold-cream to use on his face to keep it from cracking, laughing at the jokes now tied up in his system." Another of the troupe was to "swallow a whole doughnut hole!"

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R. R. Colgate, now of 111 Broadway, New York, and the Knickerbocker Club, despite the warning of those who knew him that it would be useless to request his picture for the magazine, sent this as part of his reply: "Your letter was forwarded to my residence at Sharon, Connecticut, and I at once sent you the desired photograph. I have a great aversion to publicity. This is the first time my picture has ever appeared in public. As the power house was named after me and as I was the first president of the California Gas and Electric Corporation and worked so many years for its inception I feel differently toward this company, and could not refuse the request you made. I wish you would send me a copy of the article as I should like to read over old times."

# Pacific Gas and Electric Magazine

Vol. I | Contents for April | No. 11



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# Pacific Gas and Electric Magazine

VOL. I APRIL, 1910 No. 11

## History of Napa and Its Gas Business

By E. C. JONES, Chief Engineer Gas Department.


E. C. Jones

**Napa,** nestling in her inland valley, at the head of navigation on the Napa River, forty-six miles from San Francisco, is one of the most beautiful residence towns of California. It is a community of 7,500 people, and the seat of Napa County, which embraces a territory of eight hundred square miles.

Here is a city of homes surrounded by lawns and flowers; possessing all the charm of New England's country towns, with their beautiful shade trees, combined with California's delightful climate and all its gifts.

There are no waste lands about Napa. The town merges insensibly into orchards and farms and a beautiful and prosperous country side.

Napa derived its name from the Indian word *Nappo*, used by the Pomo tribe to convey the idea of numbers—a collection, a group of dwellings.

The valley was originally occupied by the Pomo Indians, whose descendants, still famous among aboriginal basket-makers, are now found in Lake County and some other northern districts of California. The path of these Indians, as they retreated further and further northward before the white settlers, is marked along the way by names that are traceable exclusively to the vocabulary of the Pomo tribe.

Pomo legends of the old days when the tribe dwelt in the Napa Valley mention the large quantities of fish in the waters there, and particularly the hordes of salmon that annually ascended the Napa River. This abundant supply of their favorite article of food caused the Pomo Indians to congregate about the present site of Napa in a fishing village or settlement, or *Nappo*.

In 1829 Kit Carson, the famous hunter, visited California on a hunting expedition. In describing the Indian population he said that many of the interior tribes were continually at war, while those living near the coast were comparatively orderly and peaceful. The indolence and indifference of the coast Indians he ascribed to the mildness of the climate and the ease with which they could obtain a living.

In 1830 there were about 3,000 Indians within the boundaries of what is now Napa County.

The first grant by the Mexican government of land in what is now known as Napa County was made to George C. Yount, who was the first white man to settle in the valley. His grant comprised two square leagues situated in the heart of the valley east of the present site of Yountville, and was given to him by Nicholas Gutierrez March 23d, 1836. After the American occupation of California it was confirmed to him by the

A characteristic landscape near Napa—vineyards, orchards, wooded foothills, and surrounding mountains

United States board of land commissioners February 8th, 1853, and by the United States court in 1855.

The Entre Napa Rancho, where the city of Napa now stands, was ceded to Nicolas Higuerra by Manuel Chico May 9th, 1836. This grant and Yount's were the beginning of white settlements in Napa Valley.

George C. Yount was an American and arrived in California in February of 1831. He was accompanied by a young man named Guy F. Flynn, who acted as guide and afterward became a settler in the county. It seems to be a fact that Flynn visited the Napa Valley as early as 1825, and obtained the knowledge of the country that enabled him to act as a guide to Yount. Flynn revisited the valley, located there permanently, and in 1872 he died in a little old house among the Indians near Napa.

Yount did hunting and trapping until 1836, when he built the first log house erected in California by an American. It was eighteen feet square, with an upper story twenty-two feet square in which were portholes for the purpose of defending himself against the Indians. After obtaining from the Mexican government his grant of land, which was known as the Caymus Rancho, he became a permanent resident of the valley, remaining until his death, October 5th, 1865.

Among the early settlers who followed Yount was Nicolas Higuerra, who settled on the banks of Napa Creek. There he built a wicker house, plastered with mud on the outside and covered with a thatch of tule reeds. Two of Higuerra's daughters afterward married into the Berryessa family of the valley in Napa County which bears that family's name.

Bartlett Vines had come across the plains with Yount, and in 1844 he went to Napa on board Captain Sutter's schooner "Sacramento." He was Yount's son-in-law. To the Vines family came the first white child born in Napa County, and, it is claimed, the first American child born in California.

As early as 1841 John Rose and John C. Vines built a schooner at Napa and launched it at a point just above the present stone bridge on First Street. It was not much larger than a whale boat. In 1849 they built a barge which was used as a trading boat in all the bay inlets.

One of the curiosities of the olden days in Napa was the first carriage, the property of General Vallejo. It had been at one time the state carriage of the Duke of Wellington. General Vallejo purchased it in London in 1833, and brought it to California shortly afterward. The driver of the carriage rode on one of the horses.

The first board of supervisors of Napa County convened December 7th, 1856.

The fertility of the land and the splendid climate of the valley tempted the early settlers to experiment with semi-tropical plants.

In 1861 William Baldridge tried to raise cotton in the Napa Valley, but with no success. His experiments proved that the soil was much better adapted to the growing of grapes than to cotton. To Baldridge belongs the credit of planting, from seed sent him in 1845, the black locust trees that are seen along the coast highways of California.

In 1864 a crop of tobacco was planted near Napa by George N. Cornwall and John Cornwall, with much success.

The first railroad into Napa was completed from Soscol January 10th, 1865. The rolling stock consisted of two cars and

Napa County Is Noted for Its Stone Bridges

The Old Gas Plant at Napa, built in 1888

a pony engine. The track entered Napa by the way of Main Street, and was laid along that street to Third Street. The first train passed over the track the 11th of July, 1865.

The original boundaries of Napa County also included all of the territory now known as Lake County until 1861, when Lake County was created.

The first mention of Napa in any newspaper was in an article in the "Californian" in 1848, which stated that the ship "Malek Adhel" had passed up the Napa River and "found plenty of water to a point below the Embarcadero de Napa."

Early in May in 1848 the first building in the town was erected. This, probably by the merest accident, happened to be a saloon eighteen feet by twenty-four feet in dimensions. The historian tells us that the saloon formed a nucleus about which the present city has grown. The lumber for this building was sawed at Bale and Kiburn's mill, two miles above St. Helena.

The site of the town of Napa was surveyed and laid out in the spring of 1848 by Nathan Coombs. The original limits of the town included only the land lying between Brown Street and the river and extended six hundred yards from Napa Creek to the steamboat landing. The town was originally divided into upper and lower sections, Napa Alta and Napa Abajo. The Alta section, consisting of more than one hundred acres, was known as Thompson's Addition. The Embarcadero, or landing, was at the head of navigation, and the ford just above it determined the location of the town. That was before the erection of the beautiful bridges, which have added so much to the attractiveness of the Napa Valley.

During the year 1848 John Truebody mowed almost the entire town-site, which was covered with a rank growth of wild oats. He sold the hay to the government. The discovery of gold in that year almost depopulated Napa, as it did other towns in California.

The first bridge across Napa Creek was built in 1849, near the line of Brown Street. It was a timber bridge, and the two wooden stringers, each sixty feet long, cost $100 each, which gives an idea of the high price of materials at that time.

Very little United States coin was in circulation then, and even as late as 1856 the medium of exchange was gold dust, foreign coin, or a substitute for coin issued by the assay office of Kellogg and Humbert in San Francisco. These were gold pieces of $5, $10, $20, and $50, were of weight and fineness equal to the United States government standard, and were readily accepted as legal tender. No change was used smaller than a "bit," having a value of twelve and one-half cents. The price of everything, including labor and all classes of material, was enormous. Money was the only thing that was plentiful.

In 1854 the town of Napa had a population of about four hundred, and there were in all about forty buildings. As late as 1856 very little effort had been made to improve the streets or the highways, and both were almost impassible during the rainy season. There were only two places on Main Street where a person on foot could cross. Crossings were made with bundles of straw thrown into the mud until the bottom was found. This is in sharp contrast with the excellent roads for which this county is now noted, some of the best automobile drives in California being in Napa County. All the roads are sprinkled in the summer-time.

It is said of the first newspaper published in Napa, the 4th day of July, 1856, and known as the "Reporter", that it was "a tri-weekly"; that is, they published it one week and tried for another week to get it out again.

Napa was the tenth city in California to introduce gas for illumination. In 1867 William Smith and E. E. Chalmers were granted a franchise but did not operate under it. They conveyed their rights to James H.

The Gas Works at Napa

A picturesque old mill, near St. Helena, Napa County

Goodman, James Freeborn, and William W. Beggs, who incorporated "The Napa City Gas Light Company" with a capital stock of $80,000, May 25th, 1867. Beggs was at that time the chief engineer of the San Francisco gas company. The gas works was located on a lot sixty feet by one hundred and twenty feet on Fifth Street, between Main and Brown Streets. The brick building was a counterpart, as to size and general design, of the Oakland gas works of that time, also designed by Beggs. The office, condensing and purifying room, and retort house were all under one roof.

A 7,000-cubic-foot gas holder was constructed in a redwood tank, and there were two benches of iron retorts, one retort in each bench capable of carbonizing 2,000 pounds of coal at a charge. Oak wood and the coke made from the coal were used to heat the benches. The coal used for making gas was Scotch and Australian cannels, costing from $20 to $30 a ton. It was freighted by schooner from San Francisco at a cost of $2.50 a ton, with $1 drayage added. At that time all coal sold in San Francisco for reshipment had to be sacked, and the cost of gunny bags, filled and sewed, was added to the expense of the coal. The yield of gas the pound from this coal was four to four and one-half cubic feet.

The condenser was of the ordinary return tubular type, made of tin, as was also the centre seal of the purifiers. They were furnished by Morris Dobrzensky, who was the first manufacturer of gas meters on the Pacific coast. There were two redwood purifying boxes four feet by five feet by three feet, with wooden trays. Dry lime, costing $2.25 a barrel, was used as a purifying material.

All the pipe at the works beyond the condenser was of galvanized sheet iron, with soldered joints, and it was made and erected by Napa tinsmiths.

Gas was first turned on in Napa and the town lighted September 1st, 1867. Henry Adams, formerly with the gas company at Sacramento, and later superintendent of the gas works at Oakland, was the first superintendent at Napa.

Public Library presented to Napa by George E. Goodman, formerly president of the gas company

The original price of gas was $7.50 a thousand cubic feet, and there were sixty-five consumers. The county paid for thirty-three street lights at the rate of $9 a month. These street lights were used only when there was no moonlight.

The first street mains laid in Napa were mostly condemned boiler tubes two and one-half inches in diameter, in six-foot lengths, and joined together by cast-iron sleeves with lead joints.

In April of 1869 Adams resigned as superintendent to accept a similar position at the gas works in Stockton, and he was succeeded at Napa by T. R. Parker. At that time James H. Goodman, James Freeborn, and Captain Harry Parker were the directors of the Napa gas company, and Richard Dudding was secretary.

During that year, 1869, prosperity, long held back by the civil war, returned, and Napa felt its good effects. The income tax was abolished, and even the gas business in Napa shared in the good times. The price of gas was reduced to $6 a thousand.

Under T. R. Parker's efficient management many improvements in the making of coal-gas were introduced, including large clay retorts, each capable of carbonizing three hundred to four hundred pounds of coal. The purifying house was remodeled, and the street-main system was thoroughly renovated and enlarged. The rates on street gas-lamps were also reduced to $6 a month each.

It was about that time that bituminous coals for gas-making were brought from Vancouver and Australia to take the place of the more expensive cannel coals which had previously been used.

These cheaper coals were Nanaimo from Vancouver and Greta and Wallsend from Australia. The gas made from them was enriched with Anvil Creek cannel, or shale, from Australia. Coke in those days sold at $20 a ton, and tar at ten cents a gallon.

These improvements increased the earning capacity of the company so that dividends were declared at the rate of 15 per cent. on the actual investment. Also the company voluntarily reduced the price of gas to $5 a thousand, and the rate on the ninety street lamps to $4.50 each a month.

The 13th of August in 1888 the directors of the company decided to erect a new gas works. John Fullagar, formerly superintendent of the gas works at Cincinnati, Ohio, was employed to construct it. The company was disincorporated, and then re-incorporated under the name of the Napa Gas Light and Heating Company. The articles of incorporation were dated November 20th, 1888. The first board of directors of this new company consisted of George E. Goodman, Theodore R. Parker, E. S. Churchill, Isabella Parker, and James Freeborn. H. P. Goodman was secretary, and John Fullagar was superintendent. The new gas works was erected on the site of the present works and included a 20,000-cubic-foot gas-holder and

Theodore Roosevelt Parker

a complete six-inch coal-gas works, with Hicks settings of clay retorts. The price of gas was again reduced, and made $4 a thousand, and the street-lamp rate was reduced to $3.50 for every night and all-night service.

In 1889 Fullagar resigned the superintendency to take charge of the gas works at San Jose. This brings the Napa gas works down to the time the writer took up his residence in California.

Coming in 1889 from the east, where the highest types of coal-gas benches were in use and where there was a rivalry among differ-

The Water Tower in Napa

ent plants to obtain the best results, it was a pleasurable shock to me, upon visiting the little coal-gas works in Napa under the able management of T. R. Parker, to find the retort house equipped with the most modern type of full-depth regenerative benches, containing five retorts, each capable of carbonizing a ton of coal in five hours, and giving an average yield of 11,000 cubic feet for each ton of coal. Such results were better than were then obtained in some of the best eastern gas works. In looking about for the reason for such results I found it in the skill and ingenuity of T. R. Parker. He had applied his own improvements to the best knowledge then obtaining in the east, and his gas plant there at Napa surpassed in results attained all the other coal-gas works in California. Coupled with mechanical excellence was the highest degree of cleanliness possible in a gas works. About the buildings the grounds were laid out in gardens of roses and cannas, and round the gas-holder tank were beds of calla lillies, while at the back of the garden were trellises completely embowered with purple wistaria. Everywhere, inside and outside the works, was evident the touch of Parker's knowledge and good taste.

In 1893, at the organization of the Pacific Coast Gas Association, T. R. Parker was one of the charter members. To his enthusiastic good work much of the first and continued success of the association is due. He immediately took charge of the "Wrinkle Department," and the splendid results of his conscientious work are a matter of record in the proceedings of the association. In 1897 T. R. Parker was elected president of the Pacific Coast Gas Association, and he performed the duties of the office with credit to himself and profit to the organization.

Then came electricity as a rival of gas. In November of 1899 Dr. Thomas Addison, coast manager of the General Electric Company, and John L. Howard purchased the old steam electric plant in Napa from the General Electric Company and the Napa gas works from the George E. Goodman bank people.

O. E. Clark was then appointed manager of the combined enterprises, with T. R. Parker as superintendent of the gas works.

During all those years T. R. Parker had also managed the interests of the Napa City Water Company, as its superintendent. When the city was small he was able to attend to both the water and gas works, but with the growth of Napa and the consequent increase in the use of water he decided to devote his attention entirely to the interests of the Napa City Water Company. One of the accompanying illustrations shows the water tower at Napa, which he designed. It stands as a sort of landmark, and as a reminder of what the long influence of T. R. Parker has meant to that city beautiful.

At the time of the consolidation in 1899 George E. Goodman, who had been associated with the Napa gas interests from the beginning, severed his connection with the business.

An illustration accompanying this article shows the beautiful library building that George E. Goodman presented to Napa, with the proviso that it should always be used "as a library and a resting place for the country people during their trips to town."

The Napa gas works was operated by the new owners until the winter of 1902. Then the company was purchased by the California Central Gas and Electric Company, and O. E. Clark was retained as manager of the new concern. Since then the Napa Gas Light and Heating Company has become one of the subsidiary companies of the Pacific Gas and Electric Company.

As fuel-oil became plentiful in California, and the new method of making gas from petroleum was rapidly superseding the use of coal, the gas works at Napa was equipped with a complete oil-water-gas plant, with a capacity of 5,000 cubic feet an hour. A 20,000-cubic-foot relief holder was added to the plant, as well as a 500-barrel tank for the storage of oil. At the time the works was taken over by the California Gas and Electric Corporation the daily output of gas was from 12,000 to 15,000 cubic feet. At the present time, in 1910, the output is 45,000 cubic feet a day. During the period since the introduction of fuel-oil the distributing system of pipes has increased from six and one-half miles to twelve and one-quarter, or nearly double.

AUTHOR'S NOTE—The writer, in preparing this article, has drawn freely from a historical sketch entitled "Auld Lang Syne," as well as from the "History of Napa County," by Captain Wallace.

## Nine Counter-men Had to Run

EVERY week day the counter-men of the San Francisco Gas and Electric Company stand patiently and take the public's kicks. But Sunday is different; they are not in "The House of Courtesy" that day. April 10th, when a lot of noisy fellows from the company's auditing department tried to beat some quiet counter-men out in Golden Gate Park the counter-men would n't stand for it, and they did n't stand—they ran; and they ran all the way home; yea, verily, till the auditing alliance stopped pursuing and, scanning the score, agreed that "Counter-men 21, Auditing 9" was correct.

And so another baseball bubble burst, and eighteen envious emulators of Joseph D. Butler sighed "What 's the use?" and returned to Obscurity to spend their declining years in the same town with Gus White.

Incidentally there were two home runs by Barrhold, sensational base-sliding by "Dutch" Bowman, a living haberdashery and furnishing goods advertisement by the immaculately attired and gloved Harry White, and some short-stop stabbing of low balls by Johnny Cute Ham.

The gladiators glared at each other thusly:

| AUDITING-ERS | | COUNTER-MEN |
|---|---|---|
| Barrhold | pitcher | Egan |
| Lilly | catcher | Judge |
| Butler, C. | first base | Brearty |
| Kenny | second base | Talcott |
| Hood | third base | Travers |
| Hefferman | short-stop | Cunningham, J. |
| Murray, E. | right-field | Dixon |
| White, H. | left-field | Dragcevich |
| Murray, W. | centre-field | Bowman |

# Four Prize-Winners

## And Twenty-three Others Who Supplied the Company With Ideas on "How To Get New Consumers"

THE prize contest is ended. It developed twenty-seven competitors and an aggregate of half a hundred different ideas or suggestions as to "How to Get New Consumers."

Very simply and plainly the conditions for competition were these: any employee of the company eligible, matter to be submitted not later than March 31st, writing on only one side of the paper, and no more than 400 words.

Those exceeding the 400-word limit were necessarily disqualified as competitors for the cash prizes.

The first prize of $20 was awarded to W. R. Morgan, superintendent of gas distribution in San Francisco.

The next three prizes of $10 each were awarded to P. C. Wickersham, bookkeeper at the Oakland office; M. J. Kelly, employed at the Potrero gas works, San Francisco; Oscar M. Hager, employed at the gas works in Oakland. The gas men seem to have been possessed of more business-getting schemes than the electric men.

San Francisco furnished eight competitors, Oakland five, Berkeley two, Sacramento two, Ocean View, Mountain View, San Jose, Alameda, Santa Rosa, Marysville, Chico, and Grass Valley one each, and the De Sabla and Electra power plants one each. About eight persons out of every thousand in the employ of the company helped supply it with these business-getting ideas, and while there are cash prizes for but four, there are cordial thanks for the co-operation of all who thus helped the company and are here listed as—

### Those Who Contributed

| EMPLOYEE | POSITION AND ADDRESS | WORDS | IDEAS |
|---|---|---|---|
| H. G. Schath | Meter Shop, San Francisco | 74 | 5 |
| S. Burns-Macdonald | Pressureman, Alameda | 93 | 2 |
| C. W. McKillip | District Manager, Sacramento | 143 | 4 |
| T. W. Hawley | Oakland | 222 | 4 |
| F. A. Schliemann | Camp One, De Sabla | 238 | 2 |
| J. E. Calvert | Foreman, Grass Valley | 251 | 3 |
| H. B. Heryford | District Manager, Chico | 261 | 6 |
| J. F. Fugazzi | Oakland | 286 | 8 |
| Theo. H. Smith | Collector, Oakland | 348 | 1 |
| P. C. Wickersham | Oakland | 355 | 15 |
| Mrs. M. E. Walsh | San Jose | 356 | 8 |
| T. E. Fogalsang | Station A, San Francisco | 357 | 1 |
| W. E. Kennedy | Transformer Room, San Francisco | 369 | 9 |
| C. E. Young | Division Superintendent, Marysville | 375 | 6 |
| John Clements | Field Agent, Berkeley | 392 | 6 |
| W. R. Morgan | Supt. Gas Distribution, San Francisco | 394 | 26 |
| M. J. Kelly | Ocean View | 398 | 13 |
| Geo. Stroh | Office, San Francisco | 400 | 9 |
| Will T. Jones | Accountant, Electra | 400 | 5 |
| Oscar M. Hager | Compressor Station, Oakland | 400 | 13 |
| John Sydney Judge | Office, San Francisco | 400 | 4 |
| A. P. Parratt | Chief Clerk, Berkeley | 484 | 12 |
| A. D. Kimball | Operator, Mountain View | 499 | 3 |
| H. Shields | Collector, San Francisco | 515 | 12 |
| Joseph T. McEvoy | Service Man, San Francisco | 591 | 5 |
| W. T. Gehan | Clerk, Sacramento | 702 | 7 |
| Mrs. Lelia A. Bohall | Demonstrator, Santa Rosa | 703 | 9 |
| *D. E. Kepplemann | Office, San Francisco | 260 | 11 |

*Received April 5th.

## The First Prize-Winner

W. R. Morgan

DIVIDE THE CITY into districts, assigning to each as agent a man who is well acquainted, and thoroughly competent to "saturate" his district. In a settlement of foreigners appoint a native. At frequent intervals the agent should make a house-to-house canvass, and keep in close touch with the people in his district; he should distribute literature, follow up prospects, take service and appliance orders, and report to the complaint department all cases of dissatisfaction.

By good service, liberal treatment, extensive advertising, and arguments of skillful salesmen, supported by the statements of consumers, bring home to every non-consumer the cleanliness, economy, convenience, reliability, and other advantages of up-to-date methods of heating, lighting, and cooking. Employ Chinamen to teach Chinese cooks to use gas ranges.

Agents and salesmen should study the consumer's needs and educate him up to the advantages of appliances. A list should be prepared of the most logical and convincing reasons why the various appliances are used, a copy placed in the hands of every non-consumer, and the matter followed up by enthusiastic salesmen. Arrange with appliance men to make installations "on trial," say for thirty days, and to sell appliances on easy terms.

The company should make an attractive and conspicuous display of appliances, new burners, *et cetera*, in its business office, with attendants on duty to explain each particular advantage to visitors, and to offer free trial installations to those who are interested. Aim to place a gas range, a room heater, a water heater, and inverted gas mantles in the home of each consumer.

If there be a rival company, duplicate its system; meet all its concessions.

Act promptly on complaints; make a searching investigation of each repeated complaint. Employ competent men to make regular rounds of large consumers and keep installations in good order.

Exercise extreme vigilance in discovering and blocking attempts of rival company to win away consumers. Plan and carry on a systematic campaign to win over rival company's consumers; discover causes of preference for rival company, and bring to bear every legitimate influence to induce a change. Be ready to supply any building in the competitive district the instant an order is signed.

Make every effort to satisfy present consumers. Do n't wait for complaints; anticipate them, and remove the cause. Do n't wait for new consumers; GO AFTER THEM STRONG.

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Later the other prize papers will be published, together with a summary of all the effective ideas. The contest was judged by the managers of the new-business and publicity departments.

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George de Long, at one time a glee club man and tennis champion at Stanford University and later a Bohemian Club entertainer and amateur society actor, is one of the corps of field agents engaged by the new-business department of the company.

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George W. Merrill, superintendent of the Pacific Gas and Electric Company's street-car system in Sacramento, a trolley service with thirty-four miles of track, and Miss Alice Muttersbach were married at the Muttersbach residence in Colusa March 16th, and moved to their new bungalow in Twenty-eighth Street, Sacramento. The bride is a young woman of practical business experience. After graduating from the Colusa schools, where she was a favorite, she became secretary of the Colusa Improvement Club, then secretary of the Valley Federation of Improvement Clubs, then deputy county treasurer during the administration of T. O. Arens and part of the administration of R. E. Blevins, then associated with the C. F. Foster mercantile concern at Corning, and for the past seven years was stenographer and bookkeeper at Sacramento for the Thompson-Diggs Company.

# Usefulness of a Photo Department

By JOSEPH P. BALOUN, Head of the Draughting Department.

Joseph P. Baloun

**Way down deep** in the basement of the tall six-story office building of the Pacific Gas and Electric Company, at 445 Sutter street, San Francisco, is a small section set apart for photographic reproduction work. It carries two name plates on the door: "Keep Out," "Photo Dept."

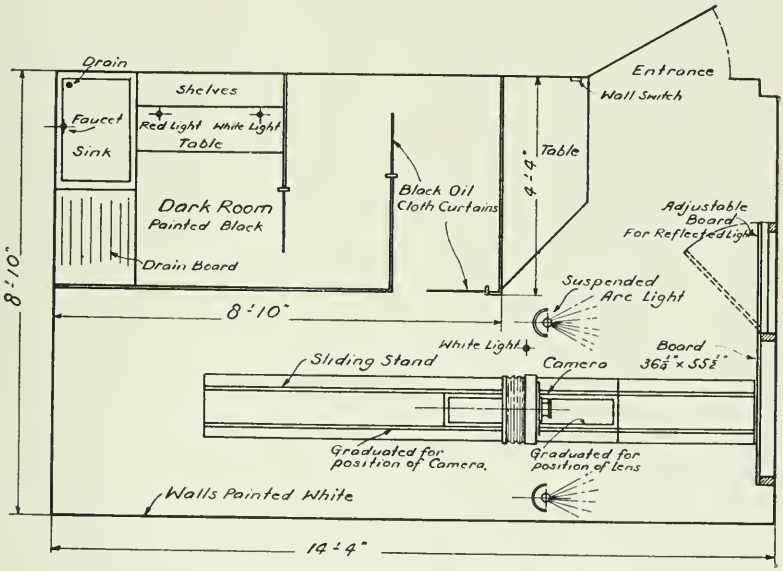
In that very lowly position the highest grade work of its kind is executed, principally for the various departments represented on the crowded and busy floors overhead; for if any office-building in San Francisco be a bee-hive of industry it is this "House of Courtesy." It is here that the company's engineering, commercial, legal, accounting, and administrative departments are so admirably distributed and interconnected throughout a building specially designed for public-service needs and demands.

When the author of this article was given the humble and yet necessary task of designing the "photo shop," as the boys call it, he was told to make it as large as necessary but also to keep it as small as possible. For, on account of the very rapid increase of business and the large sales of gas and electricity for power and lighting, basement space would be a more and more valuable adjunct to a crowded building. In fact, additional stories may have to be added to keep the concentration of business under one roof, and to meet the requirements of a dozen different departments.

The photo department was suggested as a necessity to the general organization. But would it be available in helping to produce a revenue in the company's earning capacity? Every one knows that the costs of amateur protography far exceed the sale of pictures to friends. So it was predicted that a photo department would be a quicksand for the stockholders' dividends. But it has most quickly and convincingly proven both economical and practical. Large maps, drawings, sketches, documents, or other printed matter can be photographed in a short space of time. They can be reproduced with infallible correctness to the original or smaller dimensions. Information and data are thereby reduced in bulk to a size convenient for filing in reference records and loose-leaf pocket, or "dope", books. Large, original sections, measuring five feet across, can be photographically reproduced for mounting on a card eleven by fourteen inches, or smaller to any suggested scale or degree down to a postal-card size. Thus a variety of reductions can be made to suit the needs of the different departments. But a minimum number of these special sizes has been found preferable. It helps in filing the original plates and films and also in reducing the labor in setting the camera frame and lens in position.

The draughting department at the present time has six so-called standard-size sheets for its drawings. If these sizes were brought to a common reduction of nine inches on a letter-size sheet eight and a half by eleven inches the cost of operating the camera would be materially increased over that of some one constant reduction.

It has become possible, on account of the uniformity of the majority of the drawings and from their nature and character, to set the camera on previously determined markings on the tracks, or guides, of the camera frame. These positions represent settings for different sizes of sheets to be photographed. Since considerable care was exercised in the primary test and indelible marking of these various needed positions the setting of the camera for a given piece of work has become purely mechanical. Thus much time is saved, which ordinarily is spent with a cloth over the ground glass and in a constant juggling of the camera slide to secure the proper ratio of reduction of image. Even on very special sizes of drawings or documents positions can be readily interpolated. The adjustment of the bellows with its lens movement is so carefully arranged and set with its indelible markings that it corresponds to it has a dark room, with a sink, running water, shelves, *et cetera*, and white and ruby lights with separate switches. The dark room is as black as the proverbial ace of spades, due to its labyrinth passage arrangement, with zig-zag partitions, the walls, floor, and ceiling of which are painted a dull black. Besides this precaution against outside light, the intervening passages are hung with black oilcloth painted black also on the under side.




Plan of Photo Room

that particular size measured in its original setting and to no other. An operator can readily set the carriage frame and lens position for a given size drawing and for a given reduction without looking at his ground glass or testing or checking in any way, for he knows that he will get the desired result by carefully following the marks and their full meaning as minutely indicated for his guidance.

The photo room is only fourteen feet four inches long by eight feet ten inches wide, and

As all the lighting is artificial two open-type arc lamps are suspended from the ceiling. These lamps are each of six and a half amperes capacity and are on the 110-volt, direct-current service; each lamp is also controlled by a separate switch.

The camera is mounted on a specially rigid frame with guides for facilitating its ready movement backward and forward, as indicated in the accompanying sketch.

Not only drawings but actual details of machinery have been mounted in front of the camera in the regular way and exposed to the arc lights with excellent results on the negative.

Although the new photo department has but one employee, and he under the author's supervision, it has the secret pride of doing more than "all it is worth," and that both quickly and willingly.

## Daring Work in the Line of Duty

ACROSS the Straits of Carquinez, at the head of San Francisco bay, four huge high-voltage electric cables are suspended from hilltop to hilltop 4,000 feet. At the lowest point of the sag of the stranded-steel wires they are still two hundred and six feet above the surface of the water and safely high above the tallest masts of passing ships.

D. A. Kammerer

On the Benicia side, the hill is one hundred and forty feet above the bay, and on the top of it is a mammoth steel skeleton tower two hundred and twenty-five feet high, holding the electric-power cables three hundred and sixty feet above the level of the waters.

The 6th of January two men climbed up to the very top of the steel ladder to take photographs. One of them, in drawing back to include his companion in the picture, accidentally touched one of those 60,000-volt wires. He dropped, as from the top of a twenty-story building to the sidewalk, dead! The electric arc that flashed to his body had also set fire to the wooden cross-arms holding the insulators. That was at 11:30 o'clock. Extra linemen were rushed from both sides of the bay. They came and looked up at the fire, and they hesitated. At 1:45 o'clock the company's engineer of electrical operation and maintenance started from San Francisco on a special tugboat with some San Francisco linemen. They arrived a few minutes before 4 o'clock. The fire was still burning.

McCann, a daredevil little San Francisco lineman, now working at Los Angeles, gazed aloft, stripped off his coat, took a wet sack and a fire extinguisher, and started up the long, steep ladder, instantly followed by D. A. Kammerer, another San Francisco lineman, and the score of linemen and electricians who had hesitated stood and watched these two. Up, up they went and, through a shower of falling cinders and released bolts, finally came to the top. In a few seconds more they had beaten out or smothered the little lines of flaming timbers. And the fire was all out at 4:02 o'clock, a great anxiety safely ended, and electric service to the bay cities not interrupted for even a minute.

# Reeling Up a Line by Its Own Power

By WALLACE H. FOSTER, Manager Marin County District.

Wallace H. Foster

**To reel up** many miles of copper wire by electric power secured from the line itself may possibly be a new method of removing a distributing system. At any rate, Walter A. Pennell, line superintendent of the Pacific Gas and Electric Company's Marin district, used this means during December, 1909, of doing practical work at a financial saving over the usual method.

There was a little more than thirteen miles of No. 1 O, hard-drawn copper wire to be gathered in between Schutzen Park and the Alto substation. This three-phase line followed the county road about half the distance, and the rest of the way went over high hills, with numerous sharp turns and steep pitches. The roads were bad from the rains, and the hillsides were soft and difficult because of the wet.

Owing to the inflexible character of the wire and the difficulties of the country traversed it was estimated that an expenditure of $500 would be necessary to accomplish the work.

Pennell finally decided to use a 30-horsepower, three-phase, electric hoist mounted on a truck and supplied with current from the live end of the line that was being removed. The wire was cut at a convenient point, and the dead side was untied from the insulators and dropped to the ground in the usual manner. At abrupt corners or on steep pitches the wire to be pulled was led through ordinary telephone messenger blocks to prevent friction. The dead end of the wire was made fast to the drum of the hoist and was wound upon it till the capacity of the drum was reached. Reels, mounted on trestles to permit them to revolve easily by means of an endless rope driven by one of the "nigger heads" on the hoist, were provided so that the wire on a full drum could be transferred to a reel with very little labor. As soon as the drum was thus emptied it was started upon the work of pulling in and winding up more wire.

The team used for hauling the truck and electric hoist was also employed in conveying the full reels to the point of shipment.

A considerable part of the labor cost was expended in setting up and unshipping the hoist. On a larger job this item would be relatively less by the mile, so that the cost for each mile of wire removed could be brought below the $34 average that resulted from the following items:

| | |
|---|---|
| Length of wire removed, miles... | 13.2 |
| Longest single pull, feet........ | 5,250 |
| Maximum reeled in one day, feet. | 25,200 |
| Total number employed, men.... | 16 |
| Cost of labor on the work....... | $377.42 |
| Cost of teaming ............... | 53.50 |
| Cost of sundries ............... | 17.88 |
| Total cost | $448.80 |

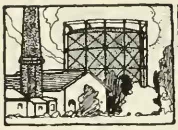
## Not an Ordinary Letter

It came from a man who had moved to Oakland and it read:

Dear Sir: Your kind letter of 11—30 at hand. While I regret I caused you again to remind me of the bal. of one dollar due the company, I will say that I really had let it slip my mind, having many other things to attend to. We buried father Nov. 22, so that and other things were, I guess, part of the cause. However, I wish to thank you for your kindness when we were in the city and also your endurance with us in waiting for the money long past due. I am pleased to be able to settle the bal. You will find enclosed a one-dollar bill.

Why will a woman persist in carrying her umbrella with the sharp end projecting backward from under her arm?

Ah! She wants to catch somebody's eye.



# MEN OF THE COMPANY

## FRANK HASTINGS VARNEY

### Who Solves the Steam-Engineering Problems of Three Great Steam-driven Electric Plants

BEFORE the big fire San Francisco and also many of the rural sections of California held standing acres of advertising billboards, each labeled at the top

VARNEY & GREEN.

Then the four-mile firing line moved steadily forward for three days and nights and drove an army of refugees into the outlying residence districts. Curbstone kitchens suddenly became the only permissible places for cooking. Fuel was scarce. Some one took an ax to a billboard. The suggestion spread faster than a prairie fire. By morning hardly one of those unburned Varney & Green boards remained in San Francisco. They had been converted into fuel-hoards or improvised shacks or windbreaks for street kitchens.

So earthquake and darkness and fire effaced a business title and made it "one with Ninevah and Tyre"!

Was it our Mr. Varney who thus went by the board? No, not so sad as that. Our Mr. Varney is merely a cousin of the late Mr. Bill Board Varney. But our Mr. Varney has a new residence of his own high on the top of Russian Hill, and it is on Green street. This goes to show that you really can 't keep the Varneys down, though you use an ax. For, behold! even the old title still persists in San Francisco, only slightly amended to read, like a vaudeville team,

*Frank*—VARNEY & GREEN—*Street.*

Nearly thirty-eight years ago, long before San Jose had become the prune metropolis of the world, some one may have looked up from a morning paper there and said, "Ah, ha! I see the Varneys have a son. Born the 15th of September. Let 's see. That brings him into the world equipped with certain characteristics, unless his will-power or environment change them. He should grow up to be very orderly and methodical, generous, solicitious about other people's affairs, able to keep his own and other's secrets, good at planning and designing, devoted to his family, possessed of most accurate intellectual discrimination, capable of quick recovery from defeat or disaster, having an accurate sense of feeling and touch, not readily nourished by food unless surrounded by cheerful and unirritating conditions, reach above medium height, be well formed, and have an oval face. But the faults of these kids born between August 22d and September 23d are: tendencies to be militant and dominant, to value money too highly for itself, to be careless about their diet, and to seek medicine and doctors too often, though unusually free from real ailiments. The most agreeable business or social affinities for this youngster should be the people born between September 23d and October 23d and between November 22d and December 21st."

Not being a politician and perhaps dissenting from these outside analyses of his personal possibilities, Frank Varney quit San Jose as the Dissenters quit England; and when he quit he took his parents along with him over into Nevada and established them at Virginia City. There the Varneys dwelt five years, or until Frank was seven years of age. Then, with an eye on the future, he brought his parents down to the city by the Golden Gate, and so the Varneys became residents of San Francisco.

Frank entered the edifices of education. To put it more simply, he went to the Mission Grammar School and then to the Horace Mann Grammar School. Thus he came to the age of fourteen, and was big for his years, and some strong. So he quit school and tackled work. From the time he was fourteen till he was twenty he was a grocery-store clerk in San Francisco (six months), drove a San Francisco milk wagon twice a day from 2 till 8 every morning and from 2 till 7 every afternoon (one year), was an engineer on a threshing-machine at Halfmoon Bay, an engineer in a sawmill at Los Gatos, and was several other things that meant work and wages.

Frank H. Varney

At twenty he returned to San Francisco and was fireman and engineer for a wholesale coffee and spice house six months. Then he went back to Los Gatos and put in six months at farming, haying, plowing, and again studying the milky way, this time coaxing the lacteal fluid from the contented cud-chewing cow.

Again he returned to San Francisco, and entered the employ of the James H. Donohue Railroad as a shipping-clerk on the Washington-Street pier. He evolved to recording clerk and to way-bill clerk, and thus rounded out one year as a railroad man. Then at the age of twenty-two he started as engineer for the Harbor Light and Power Company, and put in fifteen months being "the whole thing but the president" for a small electric plant that supplied about a hundred arc lights. This concern was absorbed by the Edison Company, and Frank Varney stayed with the business, simply being transferred to the company's proposed new station in Stevenson Street. He did construction work at that Stevenson-Street plant till it was completed in 1895, and then he was twenty - three. Still with the Edison company, he bethought him that now was the time to get a little more systematic schooling, so he began taking the long-distance courses of the American School of Correspondence, and when he was twenty-four he received a graduating diploma. He continued at the Stevenson-Street plant, advancing from operator to watch foreman and to station foreman; and then, in 1898, when the San Francisco Gas and Electric Company bought that plant, he was made chief electrician in charge of three local steam-driven electric plants—Station A, next to Station C, in Stevenson Street, employing twenty-two men and generating 1,000 kilowatts; Station B, in Townsend Street, between Second and Third, employing forty men and having forty arc machines with 3,300 engine horsepower; and Station C, in

Stevenson Street, employing seventy-two men and generating 2,200 kilowatts. About 1900, when George Thompson quit as chief engineer, Frank Varney, then twenty-seven, was made superintendent and given control of both the steam and electric stations and also the distributing system. A little later, when the San Francisco Gas and Electric Company bought out the Independent company, Varney was made superintendent of stations, and in addition to the generating stations A, B, and C there were put on his list seven substations: (1) at Fern Avenue, near Polk; (2) at Eleventh and Minna; (3) at Pacific and Stockton; (4) at Eighth and Mission; (5) at Third and Mission; (6) at Sacramento and Montgomery; and (7) at Hyde, near McAllister.

Then came the great fire in 1906 and swept all the substations and those three generating stations off the map. Three sidewalk shacks were hurriedly erected as temporary substations, supplied from a bigger Station A, near the Union Iron Works, and old Station C in Stevenson Street was rehabilitated for a substation, from which to radiate reduced-voltage lines.

In the spring of 1907 Frank Varney was made engineer of steam operation and maintenance of the Pacific Gas and Electric Company, and his duties confined to the engineering problems of the huge steam-driven electric plant in San Francisco called Station A; the great oil-gas works in Visitacion Valley, known as Martin Station; the big, steam-driven, electric plant in Oakland; and the steam-driven, electric plant in San Jose.

Frank Varney is the father of young Frank Varney, aged seven months; and he is a Mason, a Shriner, and a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the Pacific Coast Gas Association; an elder brother of "Jack" Varney, who is superintendent of all the company's electric substations in San Francisco; and he is the son of Vermont parents who came to California about 1860 by way of the Isthmus of Panama and located in the "Garden City," thus giving Frank, their first-born, somewhat of a sentimental advantage should any one think it necessary to raise the question, Which child is the flower of the family?

A. R.

## Big New Gas Holders

THE company will soon start the construction of another big storage tank at its gas works in the Potrero district of San Francisco, out toward the Union Iron Works. This tank will be approximately 200 feet high and 150 feet in diameter, and it will hold 5,000,000 cubic feet of gas. It will loom up nearly the size of the Hotel St. Francis, and will be the largest gas tank west of the Rockies, excepting only a tank of similar size in Los Angeles, which cost $300,000 to build. From this new gas receiver will be extended eight miles of big, steel, gas main, sweeping round through the residence districts to give them a direct supply, instead of having them depend upon the mains that reach from the works into the downtown business districts first. The new main will terminate in the company's 2,000,000-cubic-foot gas holder at North Beach, near the foot of Van Ness Avenue, about the same size as the company's big one at the Oakland waterfront.

At Vallejo the company has just completed a big, new gas tank to hold about 151,000 cubic feet of gas, or about three times the capacity of the regular tank at that plant. In testing this new Vallejo tank, 676,000 gallons of water were pumped into it, which suggests something of its capacity.

# "The Hollyhock"

## Or Being a Bride in a California Logging Camp

By J. W. HALL, Manager Stockton Water District.

J. W. Hall

**It was a warm afternoon** in August. The logging camp in the clearing lay basking in the sun. Great, protruding, flat-top stumps and trodden bare ground marked the confines of the settlement. The park-like forest hugged it closely all about with a stockade of towering trees. A bright green carpet of "mountain misery" clothed the slopes and hillsides, and on it the tall pines cast their intermingling shadows in fantastic patterns. Streaks of red dust, traversing the green, marked the roads and trails that diverged from the camp and lost themselves in the depths of the woodland.

The glistening tracks of the logging railroad, leading up from the cañon below, turned into the little valley, stretched across its length, made a long curve round its upper end, turned back, and, with a rapidly ascending grade, went out again and upward and onward along the heavily timbered slopes of the Sierras.

Near the centre of the railroad curve, on its outside contour, at the head of the valley, stood the station building and warehouses of the lumber camp. And scattered about in reckless disregard of the points of the compass or of uniformity with one another were the shacks and dwellings of the community. Slab Creek, a noisy torrent of ice-cold water, ran down under one of the trestles. A little way below was the bull barn and the sawmill, and farther up the track were the round-house and the blacksmith shop and other buildings of the company. On the rails near the trestle stood a little Baldwin locomotive, awaiting the return of Billy the engineer. Billy was busily engaged on some errand preparatory to the next trip down to the Point. In the cab sat Dolly, resplendent in glad garments, preening herself in the prospect of a ride down the cañon. Her spotlessly clean shirtwaist displayed upon it two sheaves of wheat and the legend "Drifted Snow Flour". The healthful color of her cheeks rivalled the bloom of the azalia.

Across Slab Creek could be heard the clink, clink, clink of Nick the blacksmith working at his forge, making new or repairing old logging equipment.

The shimmering heat was rising in languid waves from the roadbed. The needles in the tops of the pines stirred slowly at the touch of a passing breeze. The air was fragrant with the delicious odors of the forest.

In the roomy office of the station building sat the operator, busy over his accounts. Suddenly he raised his head and listened intently; then ejaculated in an undertone, "train coming, flat wheel", and resumed attention to his desk. A faint throbbing, like the distant beating of partridge wings, had reached his ear-drum. In a few minutes he again listened; then commented, "running pretty fast, do n't sound right." Soon the echo that at first had seemed only one of the subdued noises of the forest became louder and more insistent. The cars or train or whatever it was must be rounding some open point. Then all was hushed again as though they had gone into the depths of a cañon. The sounds grew nearer. The echoes spoke more and more

EDITORIAL NOTE—The author of this article long ago lived the life of the California logging camps, one of which he here so picturesquely portrays; and specific interest in the subject today is increased because the Pacific Gas and Electric Company now owns and operates two logging camps and sawmills to supply its miles of mountain flumes with lumber for the annual repairs.

harshly. The squealing of the car wheels on the distant curves increased in intensity, and a few minutes later settled into a steady shrill.

The occupant of the station stretched himself lazily, left his desk, and came to the door. He looked up the track, uneasily noted that whatever train it was there was something unusual about it, something going wrong. Finally, at the fartherest visible point of the track, he made out two cars loaded with railroad iron. They were running alone and running away. They had broken loose from the construction train further up the mountain.

Necks were craned out of doors and windows in camp. Startled voices yelled, "What 's up?" The speeding cars disappeared for a moment on the sloping hillside. Then they burst with a roar round the last point, and bore down on the camp with the speed of a racing auto and the noise of a hurricane.

One of two things would happen! The cars would shoot off on the curve and crash into the buildings, or they would stay on the track and drive like an iron-clad into the standing locomotive and wreck it.

Dolly sat in the cab like one paralyzed, unable to move or escape. Billy bounded toward her. He saw the danger, raced for the locomotive. He would move it off down the track. In his excitement he forgot on which side he had placed the safety chuck-block, and ran round to the wrong side. He then rushed back to the other side, wrenched out the block, sprang into the cab, and opened the throttle, but too late!

The runaway cars, now coming with terrific speed, raced across the two high trestles. Nick the blacksmith had heard the tumult above the sound of his anvil. He looked up; saw them coming. Without a moment's hesitation he sprang out of the door and ran across the tracks in the face of the flying train and grasped the bar of a derailing switch. He wrenched once, twice, and then, with a last herculean effort, threw open the switch. The flying train sped by him, plowed along up the opposite bank, and wrecked itself amongst the stumps of a previous season's cut.

There was a general gasp of relief as the cars left the track. Nick, with his hand still on the bar of the switch, glanced once at the pile of wreckage, then round at the blanched faces of the onlookers, spat reflectively, and sauntered leisurely back to his forge. And the incident was closed.

In the solitude of the great woods the small things of life become important. Still there is nothing small in the woods. The horizon is wide. Operations are undertaken on a large scale. The occupations, much out of doors, are wholesome, conducive to exuberant health. And with bounding health there is a zest in the very details of each day's existence.

The furor over the runaway cars had scarcely subsided when the logging community was again all excitement. Sandy Bruce had been away from camp on one of his periodical visits to Hangtown. And when Billy returned from his run down the track to the Point he brought the news that Sandy was coming back with a side-partner!

Logging Jacks do not often marry. But no one ventured openly to question the propriety of Sandy's action.

Sandy's wife had ridden in with him on the stage down Break-Neck Cañon; had been hauled across the river on cables and up the long tramway to the Point. Then, seated on a bale of hay on a logging truck, she had compassed the ten or twelve miles inland by rail to the camp without getting much mussed up.

She was clad in an apple-green dress of modern make; her shoes were trim; she wore gloves; and on her head was a very large sunbonnet of bright crimson. One of the boys who first saw her at the store exclaimed in open-mouthed astonishment to another, "Holy Macinaw! look at the hollyhock." A moment later, as she turned her gaunt, but finely-cut features and clear gray eyes in his direction, he made mental allowances. But the name was out; she was "The Hollyhock" after that.

Sandy paid small attention to any one's opinion. She was promptly installed in his little shack. That same night she was honored with the customary charivari, with its medley of mock music. Sandy was a popular man, so the charivari was made a red-hot welcome.

"The Gimlet," who led the orchestra on such occasions, appeared waving the stars and stripes, for sometimes the receptions were precipitous, and a man needed all the protection he could invoke. "The Gimlet" rode on a camp burro, with a rusty scythe over his shoulder in lieu of a sword, and he was accompanied by the balance of the camp, with horns, tin cans, and other nerve-racking noise-makers. The demonstration was prolonged and boisterous. Sandy and his wife took the compliment in good part. Sandy would probably have felt slighted had the ceremony been omitted. After the first "number" he led "The Hollyhock" out by the hand and clumsily said, "Boys, this yers my wife." The band saluted. Sandy then "set 'em up," and thus the house was warmed.

The next day Sandy went to work as a brakeman on a logging train. On one of the first trips a truck went off on a trestle, and Sandy fell off the train and landed on his head in the gulch. They brought him home much dazed, and summoned a physician. When, some hours later, the doctor arrived he looked Sandy over and 'lowed he had a pretty bad crack on the nut, but that his head was so hard it could n't be broken, and that he would be O. K. in a few days. He left a prescription to be mixed with a quart of whisky—dose one swallow every hour,—and turned Sandy over to the greatly-perturbed "Hollyhock" and to Scotty, a close friend.

From the moment of the accident Sandy had been much dazed, but at short intervals, perhaps a hundred times that day, he would rally and ask, "Scotty, how far did I fall?" Scotty would patiently reply in a pleasant drawl, " 'bout twelve feet, Sandy." Then Sandy would put his hand to his head and ejaculate, "the hell!" and again relapse into a semi-stupor, only to recover in a little while and enquire again, "How far did I fall, Scotty?" Scotty would reiterate, " 'bout twelve feet." "The Hollyhock" nursed Sandy tenderly, and his condition improved slowly all that day.

The next day, which was Saturday, two other logging Jacks returned to camp from Hangtown. The wives of these two men dwelt over there. They had acquired the Salvation-Army habit, and during this latest visit of their husbands it seems they had inveigled their mates into the army.

Now, those two men had been considered incorrigibles. Furthermore, anything so out of place as the reformation of a logging Jack had never been considered amongst the social possibilities. The conversion of such men was sufficient news to startle the nerves of any ordinary logging community. The thing looked impossible! A logging Jack and religion do not amalgamate.

A logging Jack thinks he can out-work, out-fight, out-swear, out-drink, and out-last anything that ever wore boots. From the nature of his wholesome life in the woods he is hardier, huskier, and broader than any other class of workmen, and he never does things by halves.

Now Bill and Harry having temporarily back-slid into the Salvation Army, due to the energetic solicitations of their wives, in good faith and enthusiastically, wished to reform the whole camp right away. They unflinchingly spoke of their salvation. They announced that the next day, being Sunday, they would hold a meeting in the round-house and relate their experiences. All were cordially invited to attend.

Nobody needed urging. Even "The Hollyhock" and Scotty left Sandy at home and went to see the fun, "The Hollyhock" in thankful earnestness and Scotty with mental reservations.

"Slippery Jim," who was at the bottom of most of the mischief in the camp and who labored faithfully to relieve its monotony, had been round and passed the word to the boys to secure some small iron washers at the shop on their way to the meeting.

The assemblage came to order. Harry and Bill were good talkers and earnest. Each in turn gave a forceful account of his regeneration, and called upon all the others to join in with them. Bill stated in simple words that they all knew what a dissipated wreck he had formerly been, and recalled the many fights that had come off between Harry and himself; but now the hatchet was buried, and they were like two brothers, "as David and Joe Nathon," as he pronounced it. Unfortunately for Bill's peace of mind they called him Joe Nathon for many days thereafter.

"Slippery Jim" arose in his seat and gravely endorsed the religious reform. He proposed that a small collection be taken as evidence of their good will, to help the cause along. To give things a start he immediately proceeded to pass round a small box that he had provided for the occasion. Contributions were generously showered into it. "Slippery" walked up to the front and dumped the collection upon the table. A pile of iron washers, with a solitary silver quarter gleaming amongst them!

Bill and Harry looked at it, then at each other. With one accord they sprang upon "Slippery." The fight was fast and furious while it lasted, but the odds were too great. Bill and Harry were soon obliged to succumb to the combined resistance of the congregation. The meeting was adjourned, amid the laughter and joshing of the loggers.

"The Hollyhock" hurried breathlessly home, and burst into the house with, "Oh Sandy, it was a dreadful fight! You should have seen Bill hit 'Slippery.' "

Sandy stirred slightly and inquired, "How far did he fall?" And Scotty, who came in at that moment, responded in his usual drawl, " 'bout twelve feet, Sandy." Sandy's hand went up to his head and he said, "the hell!"

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## Digger Pine Near Yuba River

This freak landmark, growing alongside the trail between the Colgate and Yuba

electric-power plants, was probably tied in a knot years ago by a miner or hunter. Some day it will amaze tourists.

**Pacific Gas and Electric Magazine**

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## EDITORIAL

**Save Something; Buy Land**

Some men and nearly all women can not get life-insurance. Most men, through personal selfishness, evade it. Many are favorably impressed by accident-insurance, and practically all people favor fire-insurance.

All forms of insurance mean small regular deposits against a future need. Insurance is a kind of compulsory savings account, based on the hope that if loss come these small deposits will suddenly repair part or all of the damage.

In the Pacific Gas and Electric Company there are approximately 3,500 employees. Whether or not they believe in any of the standard forms of insurance is immaterial.

The thing is this: They are all now earning money. Many of them are probably saving little or nothing, for that is the great easy-going way that has ever been characteristic of the generous, free-spending Californian.

In France, following the Napoleonic wars, taxes became so high that all the people had to save scientifically to live and pay the government's demands. As a result of that enforced experience the French people today, only half as numerous as we Americans and confined to a territory about the size of California, are the money-lenders of the world.

In Japan, since the Russian war, the people are practically paying half their wages to remove the nation's debt, and that experience in enforced thrift will make the Japanese the future bankers of the orient.

In our own country and the world over the members of the Salvation Army give one-tenth their regular earnings to the cause.

This all goes to show that people can save when they have to, and that they may save something on their own account if they will. What is needed is a specified incentive, a good, sensible little investment to receive and increase the value of the gradual savings.

Everywhere in California there are still good investments, in a city lot or a few country arces for a future home. The land can be bought with a very small initial payment, followed by modest monthly installments. And such opportunity is right now within the financial reach of every person who is earning a little money. It is a form of insurance against the higher prices, higher rents, and home needs that are certain to develop as the years pass.

When you own a well-chosen little piece of land you have a property that can not be destroyed and will never decrease in value.

In a few years you can get it finally paid for. Many a man has said with regret, "I remember when I could have bought all that land for a hundred dollars."

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## Subscription Price Increased

Beginning with the May number of this magazine the subscription price to persons not employed by the company will be $1.50 a year. Employees will continue to receive the magazine free. Subscriptions already entered or those received prior to May 1st will, of course, be at the old rate of fifty cents a year. All employees who may wish to put their friends or relatives on the subscription list will have the opportunity at the fifty-cent rate if their prepaid subscriptions be received before May 1st. It 's cheaper than writing twelve monthly letters, and easier and more entertaining. But act quickly if you see it that way.

# Forty-four Years a Company's Home

THE accompanying picture shows the old office building of the San Francisco Gas Light Company. It faced on First Street, with one end on Natoma Street, and was the headquarters of the company from 1853 till April 1st, 1897, when the move was made to the new building that stood on Post Street, above Powell, until the fire of April, 1906, destroyed it and the old structure here illustrated.

As originally constructed in 1853 this old brick building was only about half the size here shown, the section of four windows along the right-hand front having been added in 1873, two years after the original San Francisco Gas Company changed its name to the San Francisco Gas Light Company.

In the near corner downstairs, the room lighted by two windows on each street, was the cashier's office. There during many years Thomas J. Slevin served as cashier. He was a man of a studious bent, particularly interested in all history and bibliography pertaining to California.

The Old Office Building at First and Natoma Streets

At the right of the door, on along the remainder of the front of the building, was the large room occupied by the bookkeepers and collectors. The one-story wing at the extreme left of the main building formed the office of the president and the secretary from 1853, when Beverley Sanders was president, down to 1897, when Joseph B. Crockett was the chief.

On the second floor the three end and two front windows at the near corner opened into the office of E. C. Jones, in the days when he was only assistant engineer of the company. The next front window to the right lighted the office of the bill clerks. And the next six windows opened upon an assembly hall that extended through to the back of the building. In that assembly hall were held the meetings of the stockholders and there, too, was formed the Pacific Coast Gas Association, at a meeting held July 11th, 1893. The association also held its annual sessions there in 1895 and 1896.

The little two-story building off to the right was the original office of the company's chief engineer, in the days when Joseph Beggs and William Beggs and Joseph B. Crockett were the engineers. Upstairs was the draughting room, where, it is said, Peter Martin started to learn to be a draughtsman because his uncle Peter Donahue thought the young man might take gas as a profession. Later that little building served as an office for the sale of coke and tar.

## The Southernmost Lamp Post

Way down at the other end of the world, where modern community civilization has come its nearest to the south pole, there is a

little town in New Zealand called Invercargill. This picture shows the southernmost gas lamp in that town, the southernmost church, and the southernmost bus as a means of street transportation.

J. O. Tobey, formerly assistant superintendent of the San Jose power division, has been made superintendent of the Sacramento power division, which has been reduced in size by transferring from it to the Nevada-County division the Deer Creek and Alta power houses.

Goodness! Where do all the pins go?

Never could tell; all I 've ever seen seemed to be headed one way and pointed the other.

## A Trolley Train to Carry Gold

The North Star mine in Nevada County, California, is a property that has already produced $30,000,000 in gold. It has incline shafts down mcre than 5,000 feet on the ledge; has underground passageways aggregating about twenty-five miles, and on the surface of the earth it covers several hundred acres of land. The mine regularly em-

ploys about 350 men. All its motive power is furnished by the Pacific Gas and Electric Company. This illustration shows a tiny trolley train used on the surface to carry gold ore from different shafts to the mill. This little motor car was designed by George Scarfe, the Pacific Gas and Electric Company's electrical superintendent in that section. Note the very narrow gauge of the track, and the double trolley.

# To Improve the Telephone's Usefulness

TELEPHONING is the only kind of communication a good many people have with certain other people. Such are the conditions brought about by the time-saving devices of modern business methods. The telephone-talk is often the means of making or losing a friend for a large concern that has thousands of customers to serve. The promptness of response, the tone of the voice, the courtesy displayed or lacking are all little things that count, and, in the aggregate, with tens of thousands of customers, they make for popularity or public resentment.

It 's good to work for a company that 's popular; it 's unpleasant to be occasionally reminded —"That 's one of the meanest, worst-hated corporations in the country."

Prompt, fair, courteous treatment all along the line from every employee is the human force that produces popularity for a company; and when all are working toward that end the mechanical parts of the system get a sort of reflex impulse that helps make things run smoothly. Railroads are abused, but the passenger agents of the railroad companies as a class are chosen because of their cheerful personality and their natural courteous demeanor in the face of irritating conditions. There may be grouches in every railroad's official family, but they are not the big passenger agents.

The purpose of this article is to indicate along what lines the best results may be attained in the regular use of the hundreds of miles of private telephone system owned by the Pacific Gas and Electric Company and the San Francisco Gas and Electric Company in conjunction with the well-known local and long-distance service system of the commercial telephone companies.

Nearly all the Pacific Gas and Electric Company's tens of thousands of customers use the telephone in transmitting requests for service, repairs, and general information. That 's why this company aims to have the best telephonic service in California, and to keep it accurate, prompt, and courteous. Every employee who has occasion to talk with an outsider by telephone is regarded as a personal representative of the company. He helps make or mar the company's reputation for courtesy and promptness.

One thing that always irritates the average person is the knowledge that he must wait and keep waiting and asking when he knows that another who happens to be a personal acquaintance of some one in authority can reach headquarters and get quick results. And he 's right in resenting such favoritism.

Here are some suggestions covering the telephone situation. Read them, follow them in your business, and the public effect will gradually become evident, and every local condition applying to the company will be made a little pleasanter. A business lifetime consists of a great aggregate of pleasant incidents and a great aggregate of irritating things; and whichever way the balance goes more decidedly the man is marked in time upon his features by the prevelance of sunshine or shadow, and into one class or the other most men go before they are fifty.

Let us remove as many of the little irritants as possible, and get for ourselves and the company the maximum of sunshine and its honest good-nature.

### PROMPTNESS

When the telephone rings, answer it promptly; when an employee is away from his desk and his telephone bell rings, the nearest employee should answer it at once. Telephone etiquette begins with a prompt response.

### HOW TO ANSWER

The lack of an explicit and uniform method of answering telephonic calls is responsible for much waste of time. Such responses as "Hello" and "What is it, please?" should be avoided. "Hello" is meaningless; "What is it?" is courteous but inefficient, and only results in prolonging the conversation, as the person making the call is usually obliged to enquire the name. It is not practicable to formulate phrases that will satisfy every condition, but the following responses may be generally employed:—

(1) Where an employee answers the call, and his personal identity is not of special importance, the name of the department or office should be given, as, for example,—"Contract Department," "Treasurer's Office," "Repair Department."

(2) Where the employee, in a sense, answers for the department, and at the same time has direct dealings with the public, and the line on which he answers is more or less individual, he should give the name of his department, followed by his own name, thus:—"Commercial Department, Mr. Walton."

(3) Where the line is individual, and is not used by the public to any extent, the name only should be given in responding, as —"Mr. Downing," "Mr. Varney." This should also apply in all cases where a call has been answered by one person, while the request has been made for another. Where this condition is known, the person happening to answer should give his own name.

(4) Employees taking calls over lines located in the private offices of officials, or departmental heads, should answer as follow—"Mr. Barrett's office," "Mr. Love's office." Where a name is given in answering a call, it is more dignified and courteous to preface the name with "Mr." or "Miss," as the case may be.

(5) Endeavor to obtain, as early in the conversation as possible, the customer's name, address, and telephone number. Failure to do so results frequently in considerable delay and annoyance to the customer, as it is not at all an uncommon occurrence for a custimer to hang up his receiver abruptly before remembering to supply this necessary information, or he may be inadvertently cut off before he is through talking.

### BREVITY

It order to be brief, it is not necessary to be brusque; the sharp, peremptory tone employed by so many people when using the telephone can not be too severely condemned. To be brief it is only necessary to be business-like and concise. In using the telephone, remember that unnecessary conversation ties up a trunk line to the detriment of some other department. If the requisite data be not at hand, do not ask the customer to hold the line, but obtain his telephone number, and call him up as soon as you have secured the desired information.

### COURTESY

Courtesy is the outward expression of breeding and character. Its practice is founded upon the Golden Rule of doing unto others as you would they should do unto you. In very few industries is the need of courtesy more imperative than in the business of manufacturing and supplying gas and electric light and power. To the layman this business is peculiarly technical and mysterious. He does not comprehend its complicated processes, and he resents its apparent mystery. In dealing with this type of man, who can not understand why his service is not connected within twenty-four hours after signing an application, or why he should have to obtain city inspection, our employees have daily opportunities for showing the quality of their courtesy. It is necessary for them to remember that the customer is unacquainted with many conditions with which they are thoroughly familiar, and in imparting this knowledge to the consumer, they should do so without any assumption of superiority or any display of impatience. The favorable impression made upon a customer who takes up his telephone to register a vigorous complaint, and who finds a courteous employee at the other end of the wire, quick to understand his difficulties and eager to remedy them, can not be over-estimated. From being one of its severest critics, the customer becomes one of the company's best friends; he is usually gratified to recognize the courtesy with which he has been treated, and does not hesitate to advertise it amongst his friends. True courtesy pays because—

(1) It makes friends for the company, as well as for the employee.

(2) Its practice is conducive to greater dignity and self-respect.

(3) It eliminates friction, and lubricates the machinery of business.

(4) It refutes the traditional attitude, popularity ascribed to public-service corporations, of being callously indifferent to the interests of their patrons.

### PROMISES

Only authorized employees should make definite promises as to the completion of work at a given date, and these employees should at once make a record of such promises, and hold themselves personally responsible for the fulfillment. If it subsequently develop that the work can not be completed as agreed, the employee should call up the customer prior to the date promised, and make whatever explanation is frank and proper.

PERSONAL USE OF TELEPHONES

The company does not desire unduly to restrict its employees in the necessary personal use of its telephones; but it should be understood that the abuse of this privilege, or the indulgence in frivolous or unnecessary conversation over the telephone, will not be permitted. The various exchanges of the commercial telephone companies and the chief operator of this company's own switchboard are instructed to report any abuses of this nature which come to their attention.

SWITCHING

Our customers are often referred to the wrong department, owing to the indefinite nature of their requests, and in this manner they are frequently subjected to the annoyance of being switched from one department to another, before they are finally able to tell their story to the right man. The resultant impression made upon the customer is extremely unfavorable. So this practice should be avoided as far as possible. If it be necessary to transfer the person calling to another department, the operator on our switchboard should be signalled and asked to secure the desired connection. Whenever it is practicable, our employees are requested to take down the customer's message, and see that it is forwarded to the proper department for attention; they should also offer to make a note of any messages intended for an employee who is absent, and see that such messages are delivered. Employees should keep posted as to the classification of our business and should know the respective departments to which various applicants should be assigned.

SIGNALING

After a call has been received by the telephone, and it is desired to signal our operator, care should be taken to flash slowly, as the signal lamps on the switchboard will not light up if the receiver hook be jiggled up and down rapidly. If, on an original call, or on a flash signal, the operator do not respond within a reasonable time, the matter should be at once reported over another telephone to the chief operator, who will thus have an opportunity to ascertain if the corersponding signal lamp on the switchboard is burned out.

TELEPHONIC PEAKS

The principal peaks, or busiest periods, on our switchboards occur between the hours of 9 and 10:30 a. m., and from 3:30 to 5 p. m. In addition to these regular peaks, there is also a heavy traffic on the switchboard at times of abnormal darkness during the day, or following any severe storms, or any serious break-downs on our lines. Employees are requested to pay due regard to these conditions, and to avoid using the telephone during these busy periods except in the necessary discharge of their duties.

TELEPHONE TROUBLES

In order to maintain our telephone system at its highest efficiency, the coöperation of all our employees is very essential. Whenever any trouble is experienced on any of our lines, or any complaints are received from our customers regarding telephonic service, they should be promptly transmitted to R. J. Cantrell, property agent, who is responsible for the operation of our telephone system.

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## A Snowplow on Colgate Flume

This flume is eight miles long, clings to the mountain side hundreds of feet above the depths of the Yuba-River cañon, carries an enormous flood of swift-rushing water to drive

the wheels at the great Colgate power plant, and has only two boards, laid side by side along the crossbeams over its treacherous flow, as a path for the workmen. In the chill winds of January up in the Sierras they are out operating that plow to scoop clear the walking boards so that the lumber dollies can be trundled along with timber for the ever-necessary repairs.

# Electric Transmission Troubles

By C. F. ADAMS, Engineer of Electric Construction.

PART II

C. F. Adams

**In a generator** or motor every foot of armature conductor affected by the magnetism of the field adds to the total electromotive force of the machine. A single multiple-turn coil may have an induced voltage of from 50 to 500 volts, according to the number of the coil turns, the length of the "active" conductor, the strength of the magnetic field, and the speed of the machine.

Where the short circuit occurs in a single coil the voltage affected may be so low that an arc will not be formed. Under such conditions the short-circuited turns will heat rapidly, char the insulation, and result in damage to the individual coil, and possibly involve other coils if not promptly detected and replaced.

When a short circuit affects voltages higher than 20 volts an arc generally occurs, fusing the copper and sometimes melting out the armature-iron itself.

It was once the privilege of the writer to inspect and rebuild a 500-kilowatt, engine-type alternator that was allowed to run on a short-circuited bus bar for a whole hour under full steam. Not a foot of wire was left in the armature. Every coil melted, warped out of shape, and was torn out of the machine by the revolving element. This giant "pin-wheel" was a gorgeous spectacle while it lasted. Steam was finally shut off. But the drunken engineer who had abandoned the plant never reported for further duty.

During that period of negligence the armature-iron was not burned or appreciably damaged. The single field bobbin (Stanley-type) was warped and sprung by the heat of the blazing armature. The machine was repaired, and after about thirty days was again in use and as good as ever.

Armature troubles are somewhat affected by the type of winding; the manner of connecting coils, whether "delta" or "star"; and also by the potentials existing between adjacent coils. The operator should know his apparatus in every detail; know the voltage a coil and a coil turn; know the high potential points; be able to trace out each phase group of coils. Such knowledge will tend to guard against trouble and prevent failures.

Another class of dynamo troubles are those due to the failure of the insulation of the field coils. The intensity of the electric current is not great, ranging only from 60 to 120 volts; so the liability to puncture is slight. But, because of the weight and speed of the field coils themselves, heavy mechanical strains are imposed on the insulation and cause it to fail. Consider a possible case. In an eighteen-pole machine, suppose a short circuit occurs that will affect six coils. A part of the current will be diverted from these coils, and they will thus be weakened as magnets. Each magnet or pole may have exerted a mechanical stress of 1,000 pounds on the armature iron. If the six magnets are weakened only ten per cent. this would reduce their mechanical pull by 600 pounds, and the rotor would be out of mechanical balance to that amount. At a speed of 400 revolutions a minute this would possibly wreck the machine before it could be shut down. An accident of this nature is positively the most dangerous thing that can happen to the revolving field-coil-type of generators.

In the Stanley, inductor-type generator this danger is eliminated, as all the magnetic poles are equally affected by any change in the field winding. Field circuits should be as carefully watched and tested as the armature windings. In synchronous motors or in generators that may "fall out of step" there is a possibility in the field windings of an induced voltage many times the normal operating voltage, even rising to 3,000 or 4,000 volts in large machines. Later failure of insulation may result from such troubles.

Another annoying class of troubles is due to improperly clamped armature laminations. Two similarly charged free poles tend to repel each other. As the sheet-steel armature metal is magnetized by the field magnets it has a tendency to expand. This is due to the repulsion. Any loose laminations are put into violent vibration. Crystalization results. The armature pole, or "tooth," is broken off and drawn into the field. Damage of this nature is chargeable to poor design and inferior workmanship.

There is one destructive agent in all power houses and electric stations that is the cause of endless trouble and of rapid deterioration —Dirt. It chokes up the ventilating ducts in the armature-iron, spreads a heat-insulating film over the machine windings, collects free oil or moisture, and gradually rots out the insulation of the machine. Trouble from dirt is most aggravated where constant duty is imposed and where the surrounding atmosphere is dust-laden.

*(To be continued.)*

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Palmer D. Russell, a switchboard operator at Martin Station, and Miss Martha De Voni were married at San Rafael March 22d. They will reside in San Francisco.

---

F. V. T. Lee, former assistant general manager of the company, will have departed for Europe the end of April, accompanied by his family, for a two-years' residence abroad.

**A San Francisco Crew of Linemen that Rush to the Scene of Trouble in Fire-engine Style**

Left to right (on wagon)—J. Ewald (driver), J. Gannon, George Ellings, R. Corbett (helper), George Parker.

Left to right (on ground)—D. Cameron (foreman), W. Schaeffer, M. Calvin, Gus Fletcher, A. Matthews.

# PERSONALS

Ed Case, an employee of the Pacific Gas and Electric Company at Sausalito, a deer-hunter and motor-boat enthusiast, has gone east for a six-months' visit with relatives.

---

George Scarfe, manager of the company's Nevada-County water district and superintendent of the Nevada power house and its power lines in Nevada and Sierra Counties, has had his electrical jurisdiction extended to include the company's Deer Creek power house and its Alta power house, along with their power lines and substations in Placer County.

---

Paul R. Shipley, superintendent of electrical work for the company's street-car system in Sacramento, has just completed a big job at Bakersfield, using the company's rail-bonding car down there to weld together with a copper wire bond rails of the Bakersfield Power Transit and Light Company and rails of the Santa Fe railroad, doing all the work under an electric heat of 5,000 degrees.

---

Paul M. Downing, engineer in charge of the maintainence and operation of the company's eleven hydro-electric plants, its hundred substations, and its hundreds of miles of power lines, is to read the leading paper before the convention of the American Institute of Electrical Engineers to be held in San Francisco the 5th, 6th, and 7th of May. This meeting will make a specialty of transmission problems and will be called a transmission congress. Downing's subject is "The Developed High-Tension Network of a General Power System." The institute has 6,000 members, and the secretary of the California section and its 263 members is S. J. Lisberger, another of the ocmpany's engineers.

John J. McManus, an assistant to George C. Holberton, general manager of the San Francisco Gas and Electric Company, is a member of the state legislature, representing the Thirty-seventh Assembly District.

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W. J. McLean, former chief accountant, and L. P. Pryor, a former accountant of the company, went out into the Santa Cruz mountains the middle of April and took the limit of fifty trout each out of Big Creek, and, to prove it, presented some beauties to their old friends in the San Francisco office.

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Clem A. Copeland, who came into the company late in March as an electrical engineer in the department of hydro-electric operation and maintenance, has had an interesting engineering career. He graduated from Stanford University fourteen years ago. His first year out of college he was electrical engineer for the great Copper Queen Mining Company at Bisbee, Arizona, then employing more than 1,000 men; the next year and a half he was in electrical work at Los Angeles for the Los Angeles Railway and the Edison Electric Company; the next two years and a half he was acting professor of electrical engineering at Stanford University, following the retirement of the late Professor F. A. C. Perrine; the next four years he was superintendent of distribution in Los Angeles of what is now called the Southern California Edison Company, which produces 45,000 electrical horsepower from mountain-water and city-steam plants; for the next four years he was in independent electrical and mechanical engineering, with headquarters in Los Angeles; and the past year he was doing electrical engineering work for the Pacific Electric Railway Company, with its 600 miles of trolley lines radiating from Los Angeles.

# PACIFIC GAS AND ELECTRIC COMPANY

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North Tower........C. D. Clark
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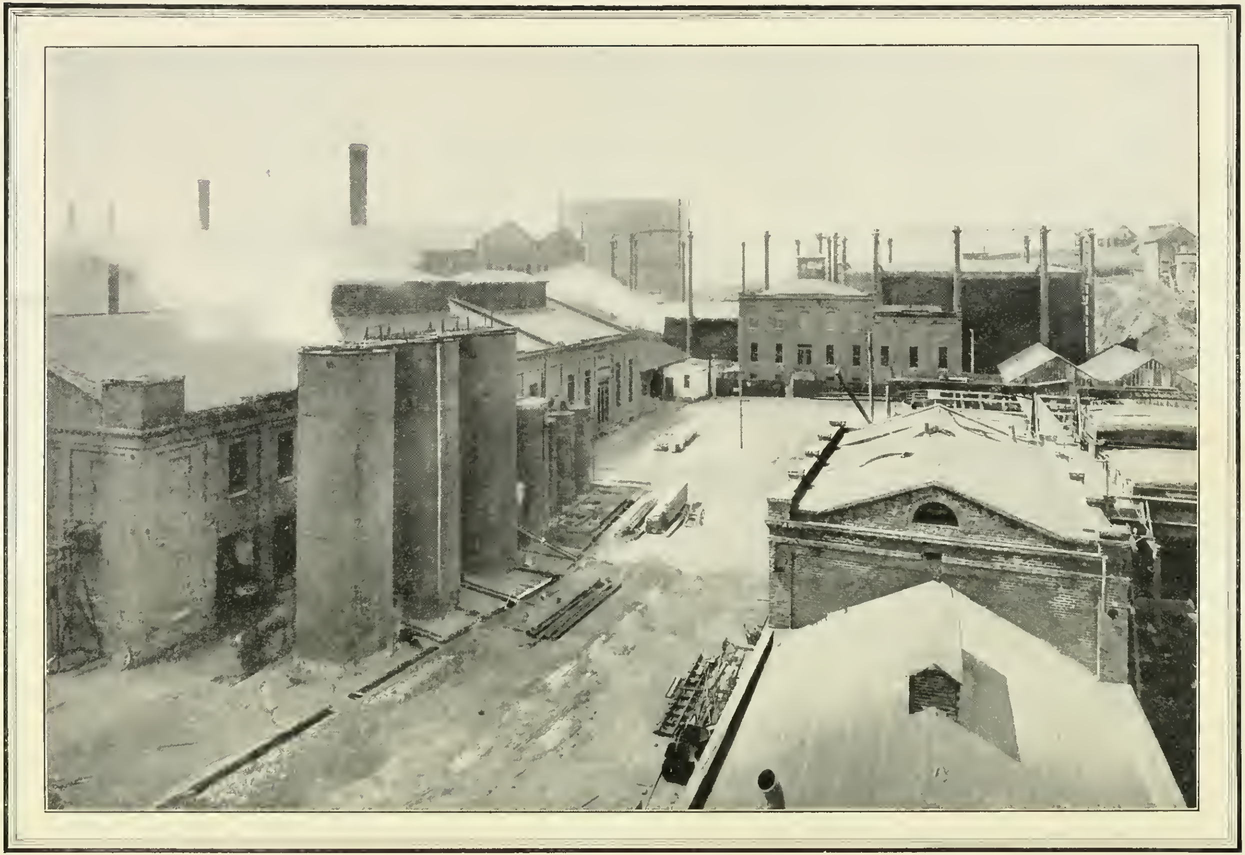


WHERE SAN FRANCISCO'S GAS IS MADE—THE POTRERO WORKS, THE LARGEST ON THE PACIFIC COAST

Here are employed 160 men, and every day from 1,500 to 3,000 berrels of fuel-oil are converted into gas

# Pacific Gas and Electric Magazine

VOL. I — MAY, 1910 — No. 12

## Distributing Gas In San Francisco

By W. R. MORGAN, Superintendent of Gas Distribution.

W. R. Morgan

**The distributing system** of San Francisco's gas service is the result of nearly sixty years' growth. It represents the efforts of eight companies that flourished during periods of varying length.

Here they are:

1852—San Francisco Gas Company.
1862—The Citizens Gas Company.
1870—The City Gas Company.
1871—The Metropolitan Gas Company.
1872—The Central Gas Company.
1883—The Pacific Gas Improvement Co.
1898—The Equitable Gas Company.
1901—The Independent Gas and Power Co.

The seven later companies were absorbed by the original San Francisco Gas Company, now known as the San Francisco Gas and Electric Company, which has inherited from them some three hundred miles of street mains. Each system has contributed its advantages and defects; its services, valves, drips, and leaks. A complete plan of the mains would be practically a street map of the city. Nearly every house is reached by the services, and every gas street-lamp is supplied from the mains.

In localities where gas consumption is greatest two mains are used, one in each side of the street. This double arrangement affords advantages that can not be secured when only a single main is available. It permits shorter service pipes, greater storage capacity, a lighter drag at peak hours, and insurance of uninterrupted service, as either main will suffice temporarily should a stoppage or serious break occur in the other.

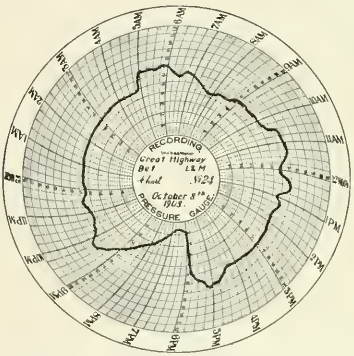
Regarded as a field for gas distribution San Francisco is approximately square, with boundary lines conforming closely to the cardinal points of the compass. The area to be supplied is six miles square or thirty-six square miles. Elevations range as high as four hundred and fifty feet above sea level, and the nature of the soil varies from alluvial deposits and sand to a fairly hard granite.

Gas is supplied from Potrero Station, located on the bay shore at about the middle of the easterly boundary. From this station the two principal trunk lines (twenty-four-inch and thirty-inch) extend westerly and northerly a distance of four and a half miles to North Beach Station on the northerly boundary line of the city.

The Richmond district has presented a serious problem. Until 1906 it was a sparsely settled area provided with but two-inch and four-inch mains. It is three miles from North Beach Station and six miles from Potrero Station. Dead ends were the rule, and services were small, mostly one-inch.

Shortly after the fire the population of the Richmond district was increased fully four fold by an influx of people who had been burned out. Every vacant house was filled, and many new houses and stores were quickly built.

The combination of small mains, long distance, and sudden increase of consumption developed a deplorable "no gas" condition. A four-inch, auxiliary, high-pressure line from North Beach Station furnished the principal supply, although with a fourteen- by sixteen-by twelve-inch compressor it was difficult to keep a pressure at the station of twenty pounds to the square inch.



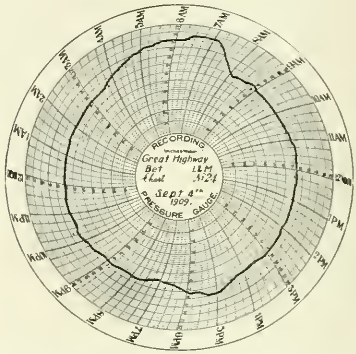

Showing the low and irregular pressure in the Ocean Beach district in 1908, before the improvements were made.

In 1909 the situation was relieved by the extension of a twelve-inch, low-pressure main for a distance of two miles through Point Lobos Avenue, the principal thoroughfare, with direct connection to a twenty-inch feeding line. All laterals were connected, thousands of feet of two-inch main replaced with four- and six-inch, and many dead ends eliminated.

A new sixteen- by seventeen- by twenty-inch compressor was installed. And now during peak hours a pressure of thirty pounds is maintained at North Beach Station. Two Chapman-Fulton district governors are located at suitable points and set to keep a pressure of not less than five inches in the distributing system.

The service now is very satisfactory, and complaints have dropped to normal. Some accompanying charts show pressure conditions both before and after improvements were made in Richmond and also at the extreme southerly end of a main extending along the ocean beach.

The Sunset district is supplied by means of a low-pressure system, which is boosted at peak hours by high-pressure from a two-inch main extended from the high-pressure line in the Richmond district. This main also extends southerly to the newly built settlement of Parkside, which is the only exclusively high-pressure district in San Francisco; about seventy-five houses are supplied by means of half-inch services, No. 1 Equitable governors, and ordinary five-light meters. The Parkside installation gives less trouble, and the district is the source of fewer complaints than any other of equal area in the city.




Showing fairly uniform pressure in the Ocean Beach district in 1909, after the improvements in street mains.

Service pipes to houses in San Francisco vary in diameter from one-inch up. Nothing less than one-and-one-quarter-inch pipe has been installed during the past ten years, although thousands of smaller services, relics of former times, are still in use.

Present practice favors generosity in regard to sizes. The constantly increasing use of gas appliances demands one-and-one-half-inch and two-inch pipe in houses which formerly could be supplied by means of one-inch and one-and-one-quarter-inch.

An accompanying chart shows the effect recorded when there was a water-heater using gas, in addition to the customary burners for illumination.

It has been found advisable in many such cases to install separate service pipes to supply heaters which require a rapid flow of gas. When lights and heaters are supplied from a single service, the irregular demands of the heaters cause quick variations of pressure and flickering lights unless the service pipe be extravagantly large.

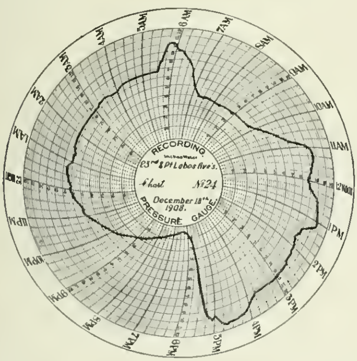
During the last few years particular attention has been devoted to the matter of meter locations. It is required that in every new building a suitable place shall be provided for gas meters in the part of the building near the street and not higher than the ground floor, where light and ventilation are good, where the meters may be reached easily by statement-takers, where they are accessible in case of fire, and whither the service pipe can be run without elbows, bends, or traps.

About two hundred old service pipes are now being overhauled each month, and larger pipe installed, bends and drips removed, and meters reset in accordance with the conditions just mentioned.

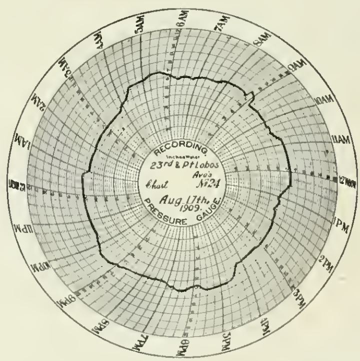
Under average conditions the life of a meter is six years. If kept in commission for a longer period it is liable to become inaccurate and leaky or to break down altogether. After six years' use the leather diaphrams are generally dry and hard, the oil having evaporated, and the meter becomes "slow" (not registering enough) or possibly fails to register at all.

To simplify the regular changing of meters they are painted a different color each year. Those set during the year 1904 were painted green; in 1905, blue; 1906, red; 1907, yellow; 1908, dark lead; and 1909, cream color. This year all green meters are being taken to the shop for a general overhauling.

The subject of complaints is the liveliest storm centre in all the affairs between a gas company and the general public. This is a remarkable condition in view of the fact that the desires of the complainant and the interests of the company are identical.




Showing varying pressure in the Richmond district in 1908.

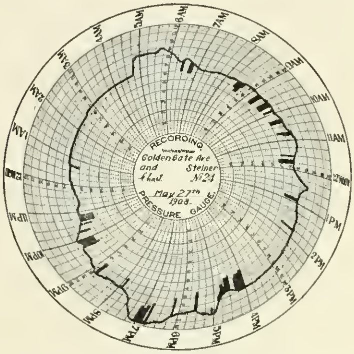



Showing pressure in the Richmond district in 1909, after the improvement in street mains.

However far apart the principals may be regarding rates or whatever differences of opinion may exist between them concerning the veracity of a meter or the equity of a bill, they surely meet on common ground when it comes to the complaint question.

Nine times out of ten the consumer wants more gas and ten times out of ten the company is eager to accommodate him. The only difficulty hinges upon the ability of the company to furnish a satisfactory supply quickly enough.

A consumer with a complaint is generally saturated with the idea that he is not getting a proper return for his money. He fails to consider that for a small monthly payment he




This tells a domestic story. It shows the sudden lessening in existing gas pressure every time an instantaneous water-heater was used. The black patches show the exact periods when some one was getting hot water. This disturbance of pressure was due to the installation of a water-heater on a small service pipe intended originally only to supply a few lights.

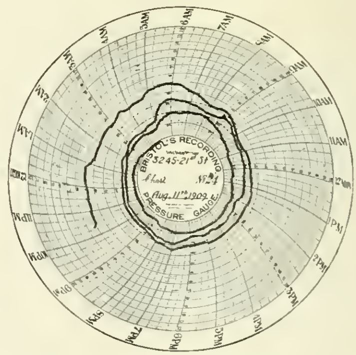
enjoys the use of an investment running into millions of dollars, of a plant that is the result of study and experiments extending over a period of more than one hundred years, of an organization that is almost military in its discipline and efficiency, the whole end and aim of which is to give him continuous service.

It is impossible for the company to prevent occasional stoppages. The number of complaints at the most is very small compared with the number of services, seldom amounting to one per cent. a day.

At the particular instant a "no gas" wail reaches the office probably not a single pump man is available. It is not practical to keep men lined up waiting for complaints; still they offer the best possible opportunity to make either a friend or an enemy. At such times delay means dissatisfaction to the consumer, with a big by-product of prejudice against the company.

In order to get quick action in these cases, it has been arranged that a few of the "trouble men" shall telephone to the office for orders while on their rounds, the calls being timed so that one is received about every hour. Thus it is possible to have a complaint investigated and the cause removed within thirty minutes after the message has been received at the company's office.

Ninety per cent. of complaints are on account of poor pressure, caused by napthaline in the service pipes or the meter connections. A little gasoline blown through the service with a force pump is sufficient ordinarily to clear the pipe. Particularly stubborn cases require that the service pipe shall be overhauled and thoroughly cleared by mechanical means. Some months ago a six-inch service pipe supplying a San Francisco cannery became badly choked, and it was cleared by disconnecting at the main and blowing the




This shows diminishing pressure due to the formation of napthalene in the pipe. Starting at about 10:20 p. m. it grew gradually less, till three days and a half later, the gas was choked off altogether about 5 a. m.

pipe out with steam by means of a hose connected to the boiler.

Climatic conditions in San Francisco are particularly favorable for the rapid formation of napthaline in service pipes and meters that are exposed to the air. From May until October the forenoons are usually warm and clear, followed by a cool sea breeze and banks of fog in the afternoon. The change of temperature is sufficient to affect exposed services and start an avalanch of complaints of poor pressure.

An accompanying chart presents a graphic illustration of the formation of napthaline in a service pipe. Between 6 and 10 a. m. the pressure was reduced three inches; conditions became steadily worse until gas was practically shut off forty-eight hours later. Instances have occurred in which only ten hours elapsed between the commencement of such trouble and the final stoppage.

In the congested district of San Francisco street conditions below the surface are somewhat discouraging. From curb to curb to a depth of from six to ten feet the space is filled with iron, brick, and concrete structures. The street railroad right-of-way covers eighteen feet. Into the remaining space are packed telephone, telegraph, electric light and power conduits, with manholes up to ten feet square; gas and water mains and services, with valves and drips; sewers and manholes, catch-basins, and laterals; an occasional steam line; and numerous abandoned pits formerly used in connection with cable railways.

At some crossings the city is building water cisterns thirty-four feet in diameter, and the gas company has been politely advised by the city engineer to remove its mains from the cistern areas.

If by any possible chance a cross is found with an outlet plugged some foreign company hastens to fit a reinforced concrete manhole neatly and snugly up against the plug. There is at least one consolation derived by the gas company in such a case. It is sure the plug will not blow out.

During the last half century fewer changes have been made in the distributing system than in any other part of a gas company's plant.

The construction of the works, the material used, and the methods of manufacture have all undergone radical changes; even office methods have been revolutionized. Although gas is made from a new material (fuel-oil), by a new process, and consumed in burners embodying newly discovered principles, the means used for delivery have remained practically the same for a period of fifty years.

Plans have been prepared for the installation of a sixteen-inch high-pressure main from Potrero Station to North Beach Station, designed to carry gas under a pressure of forty pounds to the square inch.

Five district governors are to be located at points from which the Mission, Sunset, Richmond, Western Addition, and business districts can each be furnished with a supply far in excess of present demands, and this without adding to or materially altering the existing low-pressure system.

The plan is to change the catenary curve of a long chain to practically a horizontal line by means of equidistant supports between the abutments. When this has been accomplished "peaks" will lose their terrors, and the increase of gas consumption in San Francisco will be anticipated for fully fifty years to come.

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A Vanderbilt University professor has discovered a new gas,—it takes millions of pounds of ordinary air to make a pint of it,—and this gas, strangely affected by electricity, is the property that produces the heretofore mysterious Aurora Borealis, or northern lights.

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It arrived at the San Francisco office, reading just like this:

GAS COMPANY. We received your notice stating which we are not aware.

We had a deposit of $5.00 in your office where we paid our bill of $4.40 where I can show my resite we give you notice to come up read the meeter and that was all and we never burned any gas after that because we left the City as the meetei was read which we paid you $4.40 again which we have the resite for and don't want to be bathered any more. Respectfully yours, I. Neuman.

# The Growth of the Placer Water System

## Vast Hillside Orchards Resulting from Hydro-Developments and Mountain Power Plants

By W. R. ARTHUR, Assistant Manager Placer County Water District.

W. R. Arthur.

**Can you imagine** a freight train of fifteen or seventeen refrigerator cars loaded full of fresh California fruit? Can you picture to yourself the thousands of boxes of luscious things packed solid in that long procession? Can you see it finally spread out on exhibition—acres of opened boxes of sun-kissed spheres of delicious juiciness,—peaches, grapes, oranges?

Let that first train go. It 's on its way across the continent to the distant eastern markets. Tomorrow there 'll be another like it, and the next day another, and so on for many days, all through the fruit-picking season. Can you see them dotted clear across the map of the United States, hurrying east?

Where did they start from?

The eastern boundary-line of California is abruptly bent near the middle, forming an angle somewhere out in the clear waters of lofty Lake Tahoe. Along about there where the state has a kink in its bank the first transcontinental railroad bears heavily down with its ceaseless traffic that hurries both ways over glistening rails from ocean to ocean.

Follow that railroad over the Sierras and see things as you come down the western slopes. Here, on each side of the track, note these evergreen ridges; over there those hidden defiles, carrying the snow-water from the lofty summits. All this domain beneath a hazy bluish atmosphere above a vast expanse of pines belongs to the story. Along down there observe those balder slopes patched with orderly rows of fruit trees. All this country from Auburn down to Loomis and beyond is the district that produces that fruit. The timbered ridges and rolling evergreen vistas up behind are a part of the scheme. Through that vast solitude of primeval forest wind the ditches and canals that tap rivers up in the mountains and draw upon many lakes to bring down an abundance of the purest water to irrigate some fifteen thousand acres of these foothill orchards. Look; they seem tilted so they 'll get all the western sun.

Do you get the location? Now let 's come to the water system that in the past fifteen years has grown and developed as the orchards have spread from a few hundred acres to thousands, with other thousands in ultimate prospect.

From boyhood I have lived in that country, and I have seen that great water system develop from the original ditches built by the early gold miners in 1850, '51, and '52.

The miners had the Bear River ditch and Auburn Water and Mining Company's fifty-mile canal, which started from Bear River, just below the mouth of Greenhorn Creek, ran to Auburn and on to a point near Newcastle, with several smaller distributing channels taking water thence for mining purposes and to all the mining camps within range of a gravity flow.

In those early mining days they also had the Gold Hill ditch, which tapped Bear River a little below the mouth of Wooley Creek and carried water down to Ohio Ranch and Sailor Ravine, and then branched off with water for Doty's Flat, Doty's Ravine, Gold Hill, Virginia, Fox's Flat, Denton's Ravine, Gray's Diggings, Markham's Ravine, New Town, Dry Creek, Whiskey Diggings, Camp Far West, and other historic mining camps of the old times.

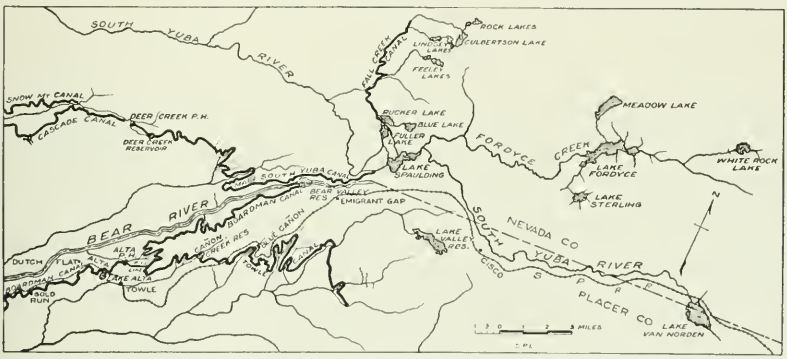
Gold Hill was the place where Philip D. Armour was a pioneer. He made a good deal of money at mining there and with merchandise. After he returned to the middle western states he founded the great Armour packing industry, and his name survives as a world-wide commercial asset.

In those old days gold was found among the grass roots in nearly all the small ravines of the western section of Placer County. It was a placer-miner's country, and that 's why convenient water courses were created to help wash the gold, and why the county was so significantly named.

Even among the 3,500 employees of the Pacific Gas and Electric Company comparatively few men yet comprehend the ramifications and incidental developments resulting from the harnessing of rivers high in the mountains, with the creation of electric power, the encouraged growth of communities and industries down the long lines of electric distribution or along the onflowing canals, the waters of which, after being made to shoot their energy from great heights against impulse wheels, are led quietly on to be domestic and horticultural benefits of immense magnitude. Each hydro-electric power plant means a mountain water system, each water system means a resulting irrigating system further down, and both of them mean increased commercial advantages for the districts they traverse.

The Pacific Gas and Electric Company owns eleven hydro-electric power plants, all inter-connected by power-lines so that they may cooperate to insure a service which one

LOCATION OF STORAGE LAKES AND UPPER CANALS OF SOUTH YUBA SYSTEM




FIGURES FROM THE MAP

| LAKE. | ACRES. | CAPACITY (CUBIC FEET). |
|---|---|---|
| Blue Lake | 63 | 49,000,000 |
| Bear Valley (reservoir) | 60 | 14,000,000 |
| Culbertson Lake | 67 | 30,000.000 |
| Feeley Lakes | 67 | 37,000,000 |
| Fuller Lake | 67.5 | 40,000,000 |
| Lake Fordyce | 510 | 875,000,000 |
| Lake Spaulding | 215.5 | 254,900,000 |
| Lake Sterling | 104 | 71,800,000 |
| Lake Valley Lakes | 260 | 230,000,000 |
| Lake Van Norden | 390 | 230,000,000 |
| Lindsey Lakes | 49.3 | 13,300.000 |
| Meadow Lake | 249 | 200,000,000 |
| Rock Lakes | 23.9 | 10,300,000 |
| Rucker Lake | 63 | 22,600,000 |
| White Rock Lake | 90 | 180,000,000 |
| Totals | 2,279.2 | 2,257,900,000 |

DITCH FLOW EACH SECOND

| CANAL. | CUBIC FEET. | MINER'S INCHES. |
|---|---|---|
| Main South Yuba | 200 | 8,000 |
| Boardman | 75 | 3,000 |

Building the core of the dam for Lake Arthur

plant alone might not always be able to maintain uninterruptedly. And with these eleven mountain power plants and three big city steam-driven plants it already supplies electric energy to one hundred and fifty-eight California communities and to three-score of commercial industries. It furnishes electricity in twenty-five counties to two-thirds of the population of the state of California. And with its eighteen gas plants it supplies gas to thirty-seven cities. With its three water systems it supplies water to seventeen communities and irrigation to the thousands of acres of orchards in that hillside country already mentioned. To maintain its canals and miles of power flumes it owns and operates two mountain lumber camps to produce its own great supply of repair lumber. It employs gangs of patrolmen who prevent and fight forest fires, because there are hundreds of miles of pole-lines and about 650 miles of aqueducts to be protected and nearly forty mountain lakes and artificial reservoirs to be guarded against the blight of denuded hillsides and blackened drainage areas. It is a great system of conservation, preservation, and development of latent power to be turned over for the benefit of mankind singly and in masses in the mines, in the agricultural valleys, and in the great cities, even as far as two hundred miles from its mountain power plants, which in the aggregate have a generating capacity of 66,980 kilowatts, or about 89,760 horsepower.

But let us get back to that Placer water system, which is part of the great enterprise. The ownership of those earliest mining ditches changed from time to time. I can remember when the system supplying that whole western part of Placer County was owned by George W. Reamer. He and his family knew me from my school days. Mrs. Reamer was my Sunday-school teacher; her daughter and two sons were my playmates until, in 1868, I was old enough to go to work to support myself.

Reamer sold, April 19th, 1875, his system of ditches, including the Bear River ditch and the Auburn Water and Mining Company's canal, to Frederick Birdsall, who also acquired the Gold Hill ditch system and the American River Water and Mining Company's ditch, which tapped the American River about a mile and a half southeastward of Auburn.

Birdsall sold his American River ditch property separately in March of 1887 to C. W. Clark and others of Sacramento.

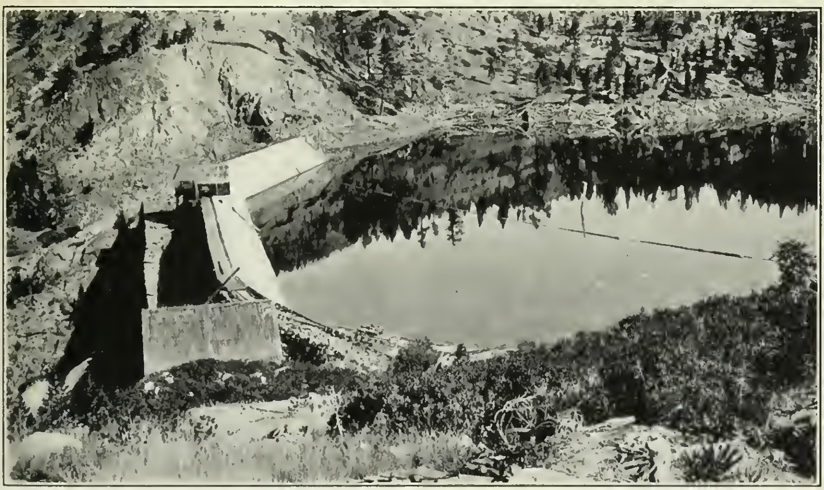
In the course of years the paying placer diggings had been pretty well cleaned up, but much water was being used for operating hydraulic mines, where placering was done on a mammoth scale, producing torrents of outflowing muddy water. Birdsall's water system kept up a fairly good flow all summer through the aid of storage-reservoir supplies turned into Bear River from some of the hydraulic mines in the vicinity of Dutch Flat, Little York, You Bet, and Red Dog.

Over in neighboring Nevada County the South Yuba Water Company was operating a similar water system of mining canals. Both systems were doing business by supplying water for domestic purposes and to gradually developing orchards.

But when Judge Sawyer's famous decision put a stop to hydraulic mining because of the great deposits of mud produced in the lower river channels, Birdsall found his system suddenly deprived of that summer help from the flow of storage waters that the hydraulic miners had been turning into Bear River. So he had to buy water from the South Yuba system to carry his customers through July, August, September, and October when the natural flow in Bear River was very low.

Both the South Yuba and Birdsall's water systems were deprived of their hydraulic customers, and Birdsall saw little profit in buying water from the other system to keep his customers supplied. So (May 26th, 1890) Birdsall sold out his system to the South Yuba Water Company. And in 1891 the South Yuba Company began a general development of the combined irrigating systems.

Even back in the years when placer mining



Lake Theodore, showing dam

Lake Alta in Placer County, near Towle

was waning some of the miners had begun to turn their attention to planting fruit trees and patches of vegetables and berries. They found a ready and profitable market in the nearby mining camps. It became evident that with water most of that upland country would grow fruit and vegetables to perfection. Gradually the land-owners started clearing off the brush and planting orchards. It was this natural development of horticulture that conveniently came to prolong the life of the old mining ditch.

When the South Yuba company took hold of the combined systems and in 1891 began further developments it made a new ditch from Gold Run to Clipper Gap, following the ridge between Bear River and the north fork of the American River, and made a branch canal from Clipper Gap to the Wilson place just above Newcastle.

The ditches tap the rivers, but to keep up the ditch-flow during the dry season, when the orchards want the water, there are numerous storage lakes, some natural, others man-made, and they are supplied either from natural catchment and small streams or from the ditches themselves when river water is plentiful. Then when the river-flow subsides, or when a canal breaks, or a flume collapses, any one or several of the lakes can suddenly be drawn upon to maintain the normal flow.

On the Auburn ditch there is Lake Theodore, and on the Fiddler Green ditch there is Lake Arthur (named for your humble servant). Further down, for the smaller ditches, there is a reserve reservoir in Clover Valley for the Antelope ditch, one at Cook's Ridge for the Caperton ditch, and one in Orr Creek for the Gold Hill ditch. Then there is the Mammoth reservoir east of Loomis to regulate the ditch-flow to Roseville and the westerly lands; and there is the Muldoon reservoir at the end of the Greeley ditch; and the Banvard reservoir at the end of the Banvard ditch.

High above all these reserve supplies, way up in the mountains, in the cañons and between the ridges along the south and middle forks of the Yuba River, the Pacific Gas and Electric Company has twenty-three larger lakes and reservoirs, having a combined storage equivalent to 48,700 acre-feet, or a body of water more than a mile square and fifty feet deep, supplied from a high mountain

Pipe-line and elevated flume near Gold Run

catchment area equal to a territory sixteen miles long and ten miles wide.

The Towle system is a later addition to the great South Yuba combination. It con-

A bit of the South Yuba canal

sists of several hundred acres of land in Lake Valley, where there is a storage capacity capable of producing for twenty-four hours a steady flow of about 110,000 miner's inches of water into a ditch that extends twenty-one miles to convey the water from Valley Lake to Lake Alta and then on to Dutch Flat, with several laterals to old mining camps.

During the past two years important developments have been made. A tunnel six hundred and forty-five feet long was bored through a ridge at the outskirts of the city of Auburn to make a short-cut saving 3,200 feet of ditch distance through a region where the nature of the soil caused great quantities of water to be lost by percolation. The leakage produced too much moisture for the land below that got the free soaking. A new rock and concrete dam was constructed in Bear River to divert water into the Gold Hill ditch, and about two miles and a half of new ditches and flumes were extended from this dam. Lake Arthur was built on the old Bear River ditch. A new rock and concrete dam was constructed in Bear River, near Colfax, to divert water into the old Bear River-Auburn ditch. A thirty-inch pipe-line crossing Blue Cut was replaced with a new one thirty-six inches in diameter; and the twenty-four-inch Applegate pipe-line was replaced with a new one having a diameter of thirty inches. A twenty-two-inch pipe-line has been placed alongside of the thirty-inch Baker pipe-line. And a water system has been installed for the town of Colfax.

The company has about two hundred and sixty-five miles of ditches, pipe-lines, and flumes to deliver its water to the fruit districts of Placer County, whence all those refrigerator carloads of fruit go east. And thirty men are kept constantly patrolling these particular irrigation lines, every man with a ten-mile beat to cover each day.

So much has the whole water service been improved in the last few years that nowdays very little complaint is ever heard from the orchardists whose fruit, pre-cooled in plants operated by the company's electricity, goes into those long trains that load at the towns of Loomis, Penryn, Newcastle, and Auburn, all of which get electric light and power and water from the company's service.

The orchard-irrigating period is from May 1st to October 1st, and a flow of one miner's inch of water (one-fortieth of a cubic foot a second) will irrigate from five to ten acres of land, the average being about seven acres. But when the orchard acreage runs up into the thousands it takes a whole lot of water and careful planning to keep it coming steadily through hundreds of miles of aqueducts winding through forests, along ridges, and gradually down the foothill slopes.

## Some New Users of Electricity

The Columbia Steel Company of Portland is to establish a large branch plant near Antioch in Contra Costa County, to be completed this summer, to take electric energy from the Pacific Gas and Electric Company, and eventually to use about 1,000 electrical horsepower.

The Spring Construction Company that used daily to bombard Berkeley with the noise of its big quarry blasting on the hillside northeastward of the university campus, having been compelled to desist from the heavy cannonading, has opened a new quarry on Cerrito Creek, north of Berkeley, to make macadam. Again it will use electric energy supplied by the Pacific Gas and Electric Company.

The Ben Franklin, one of the famous mines of the Grass Valley district on the mother lode, has installed electric service and quit the steadily thinning ranks of California quartz mines operated by water-power or steam.

All the Southern Pacific Company's passenger stations from Burlingame to San Jose are now lighted by electricity supplied by the Pacific Gas and Electric Company.

How the use of electric automobiles is increasing is exemplified in the fact that the Pacific Gas and Electric Company has been engaged to supply one concern having restoring stations at San Francisco, Mayfield, San Jose, Oakland, and Berkeley.

Stanley V. Walton,
Manager Commercial Department.

# The Making of Lake Arthur

By JIM MARTIN, Superintendent of Construction.

Jim Martin

**On the western slope** of the Sierras, up in Placer County, California, a location was selected 1,500 feet above sea-level for an artificial lake that should serve as a reserve reservoir for the great South Yuba Water System.

The lake was created to have a water surface area of eight acres and an average depth of twenty-five feet. This was accomplished by the clearing of ground and the construction of a great dam forty-five feet high and three hundred feet long and the spending of about $40,000 upon the work. The purpose of this article is to explain how it was done.

Lake Arthur was named for W. R. Arthur, assistant manager of the Placer water district and, for the past fifteen years, an employee of the South Yuba Water Company. The lake is three-fourths of a mile southwestward of the railroad town of Clipper Gap, just below which the body of water is visible from passing trains. The county road from Auburn to Colfax skirts the west side of the lake.

The construction of the dam alone took just five days less than two months in 1909,—from May 28th till July 23d. There were some days when as many as one hundred and nineteen men and seventy-six horses were at work; and at different times there were used on the job three plows, twelve four-horse fresno-scrapers, six two-horse fresno-scrapers, fourteen wheel-scrapers, ten dump-wagons, one roller, one road grader, one harrow, and two road wagons for chores. Such was the force needed to complete a work of that mag-

Lake Arthur, looking toward the dam. County Road is at right.

nitude. The dam itself required the hauling into position of 28,972 cubic yards of loose earth to form a final compact embankment of approximately 21,000 cubic yards of material.

A mountain canal winds from Bear River for miles gradually down the slopes, supplying water for domestic purposes to various communities, and all the way from Clipper Gap

Lake Arthur Dam in the Making

along down to the town of Lincoln irrigating large tracts of fruit land. For forty miles that canal meanders through the forest and along the ridges before it gets down to Clipper Gap, and in coming that far and traversing the additional miles to Auburn and Colfax and Lincoln much water is lost by evaporation during the summer season, the very time when a goodly flow is particularly needed.

That this canal flow might be reinforced by a reserve supply of water, maintained at full head despite any climatic handicaps or mountain mishaps—such was the reason for the creation of Lake Arthur, right on the route of the canal, where the lake could conveniently be drawn upon whenever extra water might be needed. Lake Arthur has a capacity of six million cubic feet of water.

The work camp was established March 15th, and it was abandoned August 10th, and about September 1st the lake was first filled to its capacity with water from the canal. But before the water was turned in all trees and brush within the reservoir site were cut off close to the ground and all rubbish and perishable matter were removed.

During the work period, in addition to the construction of the actual dam, much other labor had to be performed. A private road was constructed 1,300 feet in length, and 2,400 feet, or nearly half a mile, of road was built for the county.

The first work preparatory to the actual construction of the dam was the removal of the surface soil and all loose and porous materials. In doing this, great care was taken so that the dam might rest on a firm bedrock foundation. All bottom irregularities were cut into V-shape channels, the better to retain the firmly tamped-in materials. One large pot-hole was developed near the dam centre, but it was filled in with solid rock, given a drain-pipe outlet, and covered with a twelve-inch layer of concrete well connected all round the rim of the hole to the solid bedrock.

The outlet pipe for taking water from the lake is thirty inches in diameter, and it has a gate at the down-stream end. This pipe is encased in concrete. The up-stream and down-stream ends of the pipe rest on solid bedrock, and the centre, where the bedrock is low, is supported on masonry blocks. In placing the concrete great care was taken to have it soft and well worked round this pipe.

The dam has a gradual slope on two sides like the roof of a house; it is eight feet thick at the top and down at the bottom it has a thickness of one hundred and sixty-eight feet. The entire inner face of the dam is protected by a close paving or covering of rock rip-rap work. The rocks were laid by hand, so the surface is uniform and comparatively smooth.

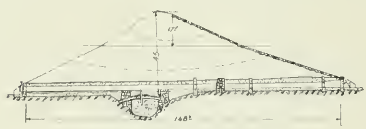
A spillway is cut round one end of the dam clear through the solid rock formation, leaving a twelve-foot wall of native rock between the spillway and the end of the dam. This spillway is twenty-five feet wide, and the bottom of it is four feet lower than the inner edge of the crest of the dam. From the crest of the dam on the up-stream face a painted gauge-board slopes down to the bottom, and upon it are plainly marked the figures indicating the depth wherever the surface of the water reaches.

After the location for the base of the dam had been scraped down to bedrock and a rough groove made as a sort of cradle for the outlet pipe and its surrounding coat of cement then several short cement walls were made crosswise of the length of the pipe. The ends of these walls were roughly dovetailed into the bedrock, which was left rough or blasted rough to make a better anchorage for the cement. The board forms were removed from these cross walls while the cement was still soft, so that the cement surfaces could be roughened. Then earth was puddled and tamped solidly down next to the cement walls. All this was done as an extra precaution to prevent the formation of seepage channels developing along the route of the outlet pipe.

The main part of the dam was then gradually constructed of earth dumped on in rows which were leveled down to ten-inch layers. The earth was secured from sidehill pits along the banks of the proposed lake area, always at a height above the actual developing surface of the dam, so that the delivery could be made by a down-hill haul. As the earth was scooped out of the sidehills it was dumped from scrapers onto temporary wooden shelves so placed that the dump wagons could drive under them and receive loads through an opening in the floor of the shelf. As the dam grew in height the earth was taken from higher up the banks, and the shelves were also moved up, always keeping the earth-loading stage high enough to permit a down-grade haul to the dam. Thus thousands of cubic yards of earth were hauled down and dumped on the growing dam. First the earth was distributed in a ten-inch layer clear across the dam from bank to bank but only half the width of the dam; then the other half-width was given a similar layer. Later in the course of the construction the plan was changed to spreading a layer the full width of the dam but only half the length from bank to bank, and then spreading the other half.

While the work was going on repeated samples were taken of the character of the earth to be used, and these samples were tested in original and in dried condition to determine the character of the substance and its weight. As the dam grew in height test pits were dug down through the mass itself so that it might be seen whether or not the layers were forming strata or were amalgamating into a uniformly solid substance without the evidence of possible future fissures or crevices through which water might force its way and develop a break. Every test showed results satisfactory to the hydraulic engineer, James H. Wise.

As the dam was being made its top surface was kept hollowed out trough-shape from bank to bank so that it was lower along the medial line than along the up-stream edge and the down-stream edge. This hollowed-out form was maintained by keeping the difference between the middle depression and the outer edges one-eighth of the height remaining to be built to the ultimate top of the dam. That is, when the dam had twenty-four feet yet unbuilt the depression would be three feet deep; eight feet to rise, and the depression would be only one foot deep.



SECTION OF LAKE ARTHUR DAM

Note the treatment of the pot-hole, the little concrete cross walls along the outlet pipe, and the rock surfacing on the up-stream slope.

There was a water tank on the hillside thirty feet above the final crest of the dam, and from that water tank ran a two-and-a-half-inch pipe which was suspended on uprights from bank to bank midway of the growing dam and kept high enough above it to permit the wagons to pass under. From this pipe-line was obtained the water for regularly sprinkling the layers of earth. Near the outlet pipe the earth was firmly tamped down by hand, but everywhere else the tamping was done by a large horse-drawn revolving cylinder bristling with tampers.

While half a layer was receiving its dump-loads of earth the other half was being rolled.

As the earth was rolled and tamped any brushy matter or woody stuff was cast aside; smaller stones were rolled to the up-stream edge of the dam to be used for the rip-rap surfacing there; and larger rocks were rolled to the down-stream corners of the dam to be used in making a finishing wall in the angle to prevent future guttering out by storm waters gulleying down at the outer ends of the dam. These rock surfacings gave the dam a neater and better finished appearance and added to its strength.

When the dam was completed a row of posts was set all along the crest from bank to bank, and additional posts were set in the solid bank at each end of the dam. Then the tops of all these posts were sawed to an exact common level. This was done so that at any time in the future it could be seen at a glance how much the dam as a whole or how much and where any part of it had settled, despite all the careful tamping and wetting and constant care in its making.

## White Hands Won

The men who have to dirty their hands in the gas business and those that do not have to tested their comparative prowess in the national game. The Gas Workers' Union has gone against the neatly uniformed San Francisco Gas and Electric team. It all happened Sunday, May 8th, on the St. Ignatius College grounds in San Francisco. The score was 2 to 1, with the office-boys on the smiling end. About two hundred spectators watched the fast match, and what they paid will go half toward buying uniforms for the gas workers and half as a donation toward the new Gas Elco Club. Feeney played a remarkable game at short. Mensing made a slashing single to right in the last half of the ninth inning when the score was 1-1 and three men on bases, and clinched the game for "the pen-pushers," as the "huskies" styled the clean-hand crowd. The teams will meet again later in the season, as they are evidently very evenly matched, and the "huskies" want satisfaction.

## The Nearest Light to Daylight

Sunlight is really a uniform blending of the seven primary colors. This is shown by passing a ray of sunlight through a glass prism. No one color predominates. Delicately tinted fabrics when seen in daylight show all their real tints and shades.

Electric light, apparently of a brilliant whiteness, really verges much toward the violet, while gas-light tends toward the other end of the spectrum, with its reds and yellows.

An Englishman, Herbert E. Ives, has recently made an elaborate presentation of the relative whiteness of the different kinds of illuminants compared with ordinary daylight. In other words, he has reduced to a percentage basis the degree of daylight whiteness in different lights. The result proves which lights come the nearest to showing colors in their true tones without neutralizing some of the shades. His analysis shows that gas-light produced with a Welsbach mantle comes the nearest of all the artificial lights to a reproduction of the conditions of ordinary daylight, which, merely as a standard, he calls 100.

| LIGHT. | WHITENESS. |
|---|---|
| Mercury arc | 00.0 |
| Glow lamp (4.85 watts the candle) | 19.3 |
| Glow lamp (3.75 watts the candle) | 21.2 |
| Glow lamp metallized (3.1 watts the candle) | 24.6 |
| Tantalum lamp (2.6 watts the candle) | 26.3 |
| Tungsten lamp (1.56 watts the candle) | 33.2 |
| Acetylene | 42.0 |
| Welsbach mantle (3/4 per cent. cerium) | 50.5 |
| Average daylight | 100.0 |

# Gold Mining by Electric Dredging

## A Great California Industry Taking Power from Mountains and Gold from Rivers

By T. E. FOGALSANG, Electrical Superintendent, Station A, San Francisco.

T. E. Fogalsang

**Nothing better** illustrates the modern concentration of energy, man's desire to crowd all he can into his allotted span of life, than the gold dredgers now used along various streams in the northern part of California.

The Forty-niners toiled by the thousands, shoveling gravel, scooping water with a dipper, working a crude rocker, doing everything by hand and in a primitive way, while washing the gravel and earth to get the ultimate results of nuggets, flakes, or fine grains of gold, the superior weight of which always lodged it safely at the bottom of the receptacle. But today one big floating machine run by electricity and operated by a crew of half a dozen men does the work of a thousand laborers, and does it better, because the dredge gouges deep below the water level and brings up in its huge chain-connected series of scoops everything down into the very bedrock itself and lands it in the great boat for washing and gold-recovery on a big scale.

The Feather River near Oroville, the American River above Sacramento, the Yuba River above Marysville, and Butte Creek above Chico all have their gold dredgers quietly nosing deep in midchannel or penetrating to some distance inland overhauling the alluvial soil and piling up dumpings of cobbles to mark for all future time where man's greed for gold changed productive land into sterile areas of bleaching round stones from which every vestige of soil has been dissolved and washed away in a scientifically thorough modern method of placer mining.

A gold dredger is really a big flat-boat equipped with machinery for operating two sets of endless chains, one carrying the digging

A typical gold dredger at work; the digging end at the right buckets and the other the great belt for spilling the cobbles far astern. It also has centrifugal pumps for pouring torrents of water over the dumpings of rock and earth that contain the hidden particles of the precious metal.

One large dredger cost $125,000 to build and equip. Some cost $90,000. But all imply investment of capital beyond the means

Gold dredger working in a river channel

of any ordinary individual. It takes companies to go into this kind of mining, and when they do they get options on large tracts of dredgable land or buy it outright, often paying hundreds of dollars an acre.

If the ground worked over is fairly good it is not uncommon for a dredger to take out $30,000 a month. And for monthly expenses, well, here are some data from an actual thirty-day run of a dredger in the Oroville district: labor—one dredge master at $150, three wenchmen (at $103 each) $310, three oilers (at $75 each) $225, two shoremen (at $60 each) $120; electric power—$1,000; supplies—$210; interest on investment, depreciation in equipment, and costs of repairs—$1,800: total—$3,815. That indicates something of the profit, when the digging brings $30,000 in gold.

Placer mining is the easiest and most primitive form of gold hunting. It consists in dissolving away the surface earth, picking out the stones, and letting the gold settle during the process. It is the kind of mining that appeals to the poor man. It takes neither elaborate equipment nor personal ingenuity. Anybody can do it. Hundreds of scattered individuals are still at it in California. And at one place up on the Yuba River there is a white man, whose Indian mate is quite blind, but the man, with an eye to the almighty dollar, regularly leads his sightless squaw out to the rocker and she faithfully jiggles it and pours on the water while he puts in an occasional shovelful of gravel.

Oroville, as the name suggests, was a goldminers' town. There in the stirring times of '49 and the early fifties an array of redshirted men burrowed along the edges of the Feather River. Then came thousands of Chinese coolies to tackle the diggings because what was left was too expensive work at the prevailing prices of commodities for a white man to get back a profit. The coolies, living on next to nothing in rice and tea, took out thousands and tens of thousands of dollars that went back to the Flowery Kingdom. Then the Chinese quit, but not till after a pestilence had killed off hundreds of them and not till they had washed off and picked over all the best cobble area down to the water level.

In the course of half a century silt and turbid streams at high-water periods made a rich soil over some of those old placer cobble heaps, and willows had begun to grow here and there.

Then the gold dredger was perfected. The Oroville district was the pioneer in the dredging business. Huge flat-boats were built on dry land, then surrounded with an earth embankment, and a ditch constructed to run river water into the small basin and float the boat, with its digging machinery. With water to float it and a supply to furnish washings for the dredged-up material a boat slowly plowed its way along through acres adjacent to the river and piled up in its wake winrows of cobbles.

Other boats started right along the river itself. Power was brought to them from electric lines. It was nice, clean mining; no delving in the dirt, no stifling labor down in the bowels of the earth blasting out gold-streaked quartz veins.

Every day the owner could heat the gold amalgam and separate the attracting quicksilver and see how much real gold he had got. The climate was fine, the surroundings healthful and delightful. Stately oaks and sycamores and trailing wild grape vines made picnic bowers along the river bank, and orange and olive groves were nearby.

The mining near Oroville became so good that all the old Chinese territory was worked over, the old Chinese cemetery was purchased, moved, and mined. Even fine orange groves were sacrificed to the yellower riches hidden below the roots of the trees. Money—yes; but what a devastation of good land that through all time would support future generations.

There are other dredger districts in California, some further north, in Shasta and Siskiyou Counties, and in other parts of the state. Gold dredgers are being used with great success in Alaska, where the digging season is limited because of the frozen soil. But the four districts originally mentioned are of special interest for the readers of this magazine because the electric energy they use is largely supplied by the Pacific Gas and Electric Company from its great hydro-electric plants located higher up on the streams that are being mined.

On the American River, along below Folsom, hundreds of acres are great, piled-up, corrugated ridges of cobbles glaring in the sun, solid masses uniformly spread out far and wide and more than a dozen feet higher than was the original surface of the earth. A monster rock-crushing plant is located there patiently devouring that limitless pile, smashing the cobbles up to bits. And trains of railroad cars come and load and bear it away to make roadbed ballast or street and highway macadam. After many years this process may remove the desolate heaps of stones and restore that part of the American River to what nature first designed in making California beautiful.

The gold dredger is only a primitive miner on a giant scale. Where the Forty-niner used a shovel the dredger uses either a huge double scoop or a large number of single scoops that travel along one after another and gouge deep down and get a mass of dripping stuff from the depths. Where the manual miner of early days in California used a rocker the dredger has a great revolving "grizzly", and where the miner poured on water from a dipper the dredger uses centrifugal pumps to pour torrents of water upon the rapidly succeeding dumpings from the scooping buckets. Where the old miner had little riffles or wooden cleats down along a sloping trough to catch the gold particles the dredger has quicksilver in riffles to amalgamate with every settling particle of gold and hold it fast. And where the miner of old used to furnish all the energy by mighty effort of hand and arm the dredger does it all with the silent power of the subtle electric current

Plant of the Natoma Rock-crushing Company, near Folsom, where the tailings from gold dredgers are made into ballast for railroads and streets coming in through a protected wire to operate the scoops, to work the pumps, to carry off the tailings, and to light the whole place, because the dredger works along day and night.

Electric motors on the larger dredgers represent as much as four hundred and fifty horsepower; on the smaller ones one hundred and sixty. A dredger has aboard from five to seven three-phase motors, which are running all the time, except during repairs to the machinery.

Electric energy is delivered to the dredger district at 4,000 volts, and then it is reduced by a transformer to a potential of four hundred and forty volts for use on the boat. In the pilot-house, to be handy for the wench operator, there is a switchboard, with a switch and fuse blocks for each motor and also for the lighting circuits. Two of the motors are variable speed with controllers. The others are provided with auto-starters.

Double rubber-covered wire is used throughout the installation, except at the grids, and there asbestos-covered wire is used. The rubber-covered wire is supported by single-wire porcelain cleats. The outside lighting is done by means of incandescent clusters with reflectors.

In a district where there are several such boats one electrician can easily look out for six dredgers. His work concerns all the electrical repairs and the changing of the pole-line and the feed cable each time a boat has reached the limit of its dredgable area.

# Mapping Gas-Main Routes

By AUSTIN J. RIX, Assistant, Gas Engineering Department.


Austin J. Rix

**A complete record** of a gas company's distribution system is a very valuable asset. It should be kept up to date and reduced to a system. In smaller companies or in the districts of large corporations difficulty often arises in keeping these records, as no one man is employed for that particular purpose. In many instances such records are left to the distribution foreman or the service man, and sometimes to one of the office force.

Maps and block-books are generally used, but it has been found that maps are not very practical. Size is often an objection. Wall space is not always available, and constant exposure causes maps to fade and become illegible. A well designed block-book of large proportions, say thirty-six by forty-two inches, and drawn to a fifty- or one-hundred-foot scale, is the best form and the most valuable.

In plotting down mains use ink of various colors, letting black represent cast-iron pipe and red wrought-iron. Where casing or tubing is to be shown, use red, and show the line broken, as a dash and two dots. This will apply in all cases where a low-pressure system is used.

Where high- and medium-pressure mains, say eighty pounds and 100 pounds the square inch, are to be shown, use green ink to represent the high-pressure, and blue to show the medium, making the lines solid when wrought-iron is used and broken lines for tubing or casing. The mains should be stamped as to their size, with small rubber figures in proper colors.

If a twelve-inch cast-iron main extends for three blocks on the north side of the street it should be shown on the north side, and drawn in black, and the number 12 on each end. It is not best to show too many numbers. Depth of pipe and distance from property line can be readily shown by small figures and arrows.

As to services, different conventions may be used. The simplest and most effective is to draw a service from the main to the property line or just beyond, according to length, placing the number of the service tag at the end. By so doing it will make it easy to obtain a ready reference at any time. Service tags should give the consumer's name, street number, size of service, length, and exact location from property lines.

The location of drips is a great source of trouble. Their records can not be too complete. They should be numbered consecutively, and a list filed in the front of the block-book with their exact location from property lines or from some well-defined landmark. Trees and public-service poles are very indefinite, as they are subject to removal most any time. In addition to this record the drips should be indicated on the main by the use of a small black circle. Then, in case of trouble, a glance at the chart will locate many difficulties. Manholes, stopcocks, and regulators should also be designated by some convention, such as various colored circles or large dots.

In addition to the forementioned chart record it is well to have hanging handy in the office a small map with the mains plotted in. This map could use the same system of marks, and in one corner a small key, or index, would explain the meanings.

As block-books do not afford much space for any quantity of data, it is advisable to have in addition a separate record of the large mains and feeders. These books should be very much smaller, on the style of field or transit books. But in them should be carried out a more elaborate scheme, noting all fittings and their exact location and depth, taking account of all water, sewer, and gas pipes, conduits, and other services crossing over the main. All these things should be drawn to scale, and various discriminating colors should be used.

Last but not least, whenever a new main is discovered, as often happens, careful note should be made of it, and its size, depth, distance from the curb-line, and general condition should be inscribed on the map record to keep it up to date.

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## Sounds

I have heard the mountain-lion
In the distance scream and cry on
As a challenge to all lurking in the wild and brushy land.
And the sly coyote's calling
In the night has been appalling
As he signaled to the scattered pack to come and take a hand.

I have heard the sad turtle dove
A-moaning to his mate of love
As he sat content beside her on a high commanding limb.
And oft I've heard the passing breeze
Whispering softly through the trees
That stand as stately sentinels along the forest rim.

I have also heard some humans swear
And seen them disarrange their hair
While trying hard to demonstrate their right to make complaint.
And I have wondered which was worse
The lion's roar, or irate curse
Of the gas-consumer whose ire will brook no more restraint.

Yet some voices are sweeter
Than the breath of a meter!
Such flavor of garlic and cheese,
Diffused by a cough and a sneeze!
Whatever their language—it's strong.
But always the gas-man is wrong!

Leigh R. Quigley,
Book-keeping Department.

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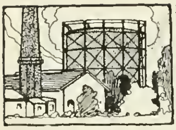
W. C. J. Finely, formerly superintendent of the Pacific Gas and Electric Company's Sacramento division, has returned to work in the department of electrical construction, where his field of operations will be considerably larger.



# MEN OF THE COMPANY

## DAVID HOWARD FOOTE

### Who Came West to Avoid Hay-fever, and Succeeded

RIGHT at the start it may not sound well to say he was driven out of the east. But he was, and it happened to be hay-fever that made him move.

Showed lack of nerve by that feverish retreat toward the land of the setting sun? Sh! In Philadelphia he once took a job that had unnerved the man before him, and then he continued at the work five years. And later, out in the mountains of Colorado, he took another job that had become too exciting for his immediate predecessor, who quit after five armed bandits held up the place. Hay-fever is not a nerve disease.

But to start at the beginning. His father was Dr. George Champlin Foote, a native of Utica, New York, whose mother was of the Champlin family from which Lake Champlain got its name. First the father was an Episcopal minister, but he switched from the spiritual to the physical ministry, and up to the time of his death was a physician in Philadelphia. His wife was Anna Mary Murray of the Philadelphia and Quaker branch of the Murray family that at one time owned the Murray Hill tract in the centre of New York city.

Such were the family and religious settings for a great event that preceded the breaking out of the Civil War. The 27th of February of 1861 a child was born in Philadelphia. He entered the Foote family, which, with his advent, was changed from a pair to three Footes, and little David made the yard. Tradition does not say that he started in as yard-master, even in his own backyard. But why raise a question? His parents raised a Foote.

Of course there were other babies in Philadelphia, even in those days, and people in that city of brotherly love were also giving an occasional tired thought to the war. So David grew up without entering a lion's den or getting any newspaper publicity; he attended a private school until he was ten. Then the family went over to Moorestown, New Jersey, with the boy and entered him in Githens Academy, where he remained till he was fifteen.

Then came the centennial exposition at Philadelphia, and David celebrated the event by starting to work. His grandfather Murray had long been a public-weigher, an office which still obtains in Philadelphia, and David started under his grandfather's instruction, weighing great sales of goods transferred from producer to manufacturer and attesting the accuracy of the scale record. After one year's apprenticeship he was made a public-weigher. At the great warehouses he worked with two assisting gangs of negroes, putting the stuff on or taking it off one or the other of a pair of great scales. He went on in this way making a weigh of but not making away with goods till he was nineteen.

Then he entered the employ of the Frogmoor Cotton Mills of Philadelphia as accountant and time-keeper in a mill where about two hundred men, women, and girls were employed in spinning cotton yarns for cloth and soft-twisted yarns for stockings. The mill had its own dye-vats for coloring the sock yarns, which shows that even in those days there was something more than Quaker gray in the city of yawns. Till he was twenty-one David Foote spent his days in the three-story brick mill while the women and girls spun yarns.

But one tires of yarns, and David accepted a position as head bookkeeper for Lawrence Johnson and Company of Philadelphia, importers and exporters, and put in two years there. The concern did a business of about a million dollars a month. It imported sugar from Cuba, crude rubber from Brazil, sulphur from Italy, and exported to Brazil agricultural implements and to Cuba and Germany barrel staves and heads from its own mills out in Wisconsin. And there was a good deal of bookkeeping for a young man, with very little time then for yarns or yawns.

David Howard Foote

So he came to the age of twenty-three, and every summer had hay-fever! Some told him to go west for a change, if he had enough change for the move. Just then the Philadelphia Mining and Smelting Company asked him to take charge of its offices out at Ketchum, Idaho, as manager and cashier. He accepted with (hay) feverish alacrity. He spent about a year at the smelter in Ketchum, and as no hay or any other vegetation will grow within miles of a smelter he had no hay-fever. The smelter had a four-cupola furnace, and employed about a hundred men working in three shifts. It bought ore from the mines and shipped the bullion to Salt Lake. The mines petered out, the smelter ceased to fume, Foote pieced out his stay by working in the recorder's office, and then acted on the hint of an Indian who grunted, "Ketchum train."

He arrived in Chippewa Falls, Wisconsin, at that time a town of 10,000 people and the site of the largest lumber mill in the world. He was twenty-four, and the first thing he did was to become Chippewa's assistant postmaster. Thus he spent a year. Then the Lumbermen's National Bank was started, and he was made cashier. He handled the lumbermen's money two years. Canada was near, but the cashier remained on the American side.

Along came an offer from Philadelphia to return and be assistant treasurer of the Union Trust Company, a million-dollar concern. He went, and was assistant treasurer for four years. The bank was selling between four and five million dollars' worth of Kansas and Nebraska farm lands on which mortgages had been foreclosed. The farmers were discouraged, and the new buyers fell heir to bad seasons. The discouragements and trials of the bank's investing clients so worried the bank's treasurer that he resigned, broken in health and a good deal of a nervous wreck. Foote was then made secretary and treasurer, and he held the job for five years more, making many trips to Kansas and Nebraska to temper the trials of those who were struggling with cultivation and climate.

The west had got on Foote again harder than the hay-fever that was again charging him compound interest. He picked out Denver as a nice high place where the living would perhaps be too high for hay-fever. He was thirty-six when he moved, but the real Denver did n't somehow foot up as it had to Foote a thousand miles away. While he was still peeking at Pike's Peak and the top of the continent a band of five typical western desperadoes rode into the mountain town of Meeker and held up its bank in broad daylight. The townsmen rushed to cover, but quickly came out and covered the bandits with rifles. The shooting was good, for the coroner found five bandits lying in wait for him—all dead. The bank cashier felt a bit nervous after that experience and sent in his resignation, intimating that he longed to be a meeker man though not a Meeker citizen. A Denver bank suggested the Meeker job to Foote, and he went over and did a year's time being bank cashier in that fearless community of half a thousand people supplying a rich cattle country within a radius of a hundred miles.

Then a former Philadelphia friend down in Tucson, Arizona, wrote him to come. So he went and took a position as cashier of a foundry that made a specialty of mining machinery, heavy hardware, galvanized tanks, and the installing of cyanide plants. One year in Arizona was enough.

At thirty-nine he finally started for California, which is waiting nearly an ordinary lifetime to get into God's country! He arrived in San Francisco with a letter from a Tucson bank to E. R. Lilienthal of the Anglo-Californian Bank, who introduced him to Jim Taylor, now traveling auditor for the Pacific Gas and Electric Company, and Taylor introduced him to Robert Oxnard, and Oxnard made him assistant manager, office manager, and buyer for the great beet-sugar factory at Oxnard in Ventura County, employing hundreds of men during the beet "campaign", consuming 2,000 barrels of fuel-oil a day, keeping five hundred wagons hauling beets, and having a daily capacity of two thousand tons of beets convertable into more than two hundred tons of white sugar.

A year later he returned to San Francisco. The California Gas and Electric Corporation was then being organized, and through the acquaintanceship of R. M. Hotaling and C. W. Conlisk he entered the service of the corporation as its first cashier and assistant secretary. He promptly installed the methods and system of accounts still in use by the company. In 1906 the concern grew by additions and became styled the Pacific Gas and Electric Company. In July of 1907 Foote was elected secretary of the Pacific Gas and Electric Company with the implied duties of cashier, and he still holds the position.

Soft snap? Nothing to do but see that a stenographer gets a correct record of the directors' meetings? Not exactly. The Pacific Gas and Electric Company is an amalgamation of about forty different companies of central California, and while many have completely lost their original identity the entity of others is still preserved in separate official records of stock and finances and apportionments. This applies to such companies as the San Francisco Gas and Electric, Bay Counties Power, Yuba Electric Power, Nevada County Electric Power, Valley Counties Power, Standard Electric of California, United Gas and Electric, Oakland Gas Light and Heat, Berkeley Electric Lighting, Sacramento Electric Gas and Railway, Central California Electric, California Central Gas and Electric, Blue Lakes Water, Stockton Water, South Yuba Water, and Central California Electric. The secretary, with a force of seven men, keeps the records of all these companies (except the San Francisco), pays out all the payroll checks and drafts for thousands of employees, receives and receipts for all the money collections of the general company and the subordinate concerns, attends the directors' meetings and keeps the records, and then attests every contract authorized by the directors, and there are several thousand contracts a year. He also keeps a record of all the stocks and bonds and their transfer to different owners, and as cashier virtually has charge of all the funds of the company, subject to the calls of the treasurer. And unless D. H. Foote had had exceptional banking and financial experience and a genial temperament the secretary's job might make him think very wistfully of Oxnard and its beet-sugar factory, or Tucson and its foundry, or Meeker and its bank bandits, or Keetchum and its smelter, or Chippewa Falls and its postoffice, or even of the effete east with its banking, its importing, its yarn-spinning, and its weighing—all flavored fitfully with hay-fever. But no, he fills the position smilingly in San Francisco and sleeps in Alameda. A. R.

# Electric Meter-Test Methods

By OTTO A. KNOPP, Meter-Testing Department, Oakland.

Otto A. Knopp

**Two principle methods** are commonly used for testing watt-hour meters. In the oldest method, still the most reliable and accurate, the correctness of the meter is determined in this manner: A certain watt-load on the meter is measured for alternating current with an indicating wattmeter; for direct current, with volt and ammeter. By means of a stop-watch the meter being tested is timed, and the watt-load on the meter is calculated by the formula

$$\text{Watts} = \frac{K \times \text{Rev.} \times 3{,}600}{\text{Time in seconds}}.$$

From the calculated meter watts and the standard watts, as measured by the indicating instruments, the error of the meter is determined as to its percentage fast or slow.

By the other common method of testing the meter in doubt is simply compared with an accurate meter of the same type. This test meter is portable, so that it can be carried to different places. It is called a master meter, or rotating standard. This method of meter-testing reduces the work of calculation and eliminates the use of the stop-watch. Therefore for commercial work it has supplanted the method previously mentioned.

The author was one of the first to advocate this simpler second method, but he early recognized its disadvantages.

When using this simpler method, testing with the rotating standard, a factor of uncertainty exists because, if anything should be wrong with the standard meter, it is impossible to notice any retarding effect in its speed. Therefore, if a serious difference be discovered between the rotating standard and the doubtful meter the question arises, Which meter is really wrong. The rotating standard, being packed round all day, undoubtedly has many chances to get out of order. Another disadvantage in this method of testing is the necessity of carrying along some device for loading the meter, as there is not always an opportunity to load the meter with the consumer's load. This loading device, added to the standard meter itself, makes up a weight too great to be handled by one man.

In an effort to find some method of testing which has none of the uncertainties here mentioned and could be applied by one man, the writer used the principle embodied in a test method employed in the test rooms of manufacturing companies, where large numbers of new meters have to be tested.

The principle of this method consists in applying a predetermined load to each of a large number of meters of the same type and size. A clock gives signals at certain intervals, during which the meters, if correct, are supposed to have made a certain number of revolutions. If more revolutions are made, or less, by any meter, then that meter is either slowed down or speeded up until it is correct.

But this method is not applicable to the ordinary testing work of electric-lighting companies. It is only a stationary method, useful in testing a large number of meters of the same type and size at one time and one place.

**Electric Meter Testers; Arc-Lamp Repairers, and Shopmen of the Oakland District**

Top row (left to right—C. J. Loose, George Wagner, B. A. Rathjen, J. O. Conger; middle row—E. P. Mann, A. Eliason, W. G. Schmidt, O. A. Knopp, O. A. Schumann, C. F. Fellmer, W. B. Lisher; bottom row—O. A. Meitzker, U. S. Maybee.

By modifying and adapting this method to the needs of the electric-lighting companies, a very convenient, accurate, and quick testing method has been developed in Oakland. This modified method is used for outside and inside testing on both alternating and direct current meters. A predetermined measured load is applied to the meter that is to be tested. This load is made of such a magnitude as to cause the meter, if correct, to complete a certain number of revolutions in a given time. This time interval is chosen as the one-hundredth part of an hour, and is indicated by a special stop-watch. This stop-watch has a hand that completes one revolution in one-hundredth of an hour, and the face of the watch is divided up into one hundred parts. Therefore, when the meter is timed with the chosen load and it takes more or less than one-hundredth of an hour while registering the standard load, the watch will show at a glance the exact percentage of fast or slow, as the dial is divided into one hundred equal segments. If the meter is right the load should run it through one complete revolution in one-hundredth of an hour.

If the watch completes 1.04 revolution instead of 1.00 the correction factor of the meter in test is 1.04. That is, for every dollar of that man's electric bill he should have been charged $1.04. In other words, the meter is approximately 4 per cent. slow. If the watch completes .96 revolution, instead of 1.00, the correction factor of the meter in test is .96. That is, for every dollar that consumer was charged he should have been charged only $.96. In other words his meter is approximately 4 per cent. fast.

The simple rule for applying this test method is: A load (100xK) in watts, applied to the meter will cause a correct meter (with a calibrating or disc constant K) to complete one revolution in one revolution of the watch, which is one-hundredth of an hour. Because (100 x K) watts x 1/100 hour=K watt-hours. But K watt-hours is what one revolution of the disc represents. If we apply four, five, or ten times the load, we get four, five, or ten revolutions in the same time interval of one-hundredth of an hour.

In order to apply these different loads accurately and steadily over a period of one-hundredth of an hour, different appliances have been developed to meet the requirements of the electric-lighting companies for testing the alternating-current and the direct-current meter on the consumer's premises. Also, for shop-testing of alternating-current and direct-current meters. But a description of these appliances is another story.

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## EDITORIAL

**The Strength to Forbear**

Of all the kinds of wild animals that lived upon this earth tens of thousands of years ago, possibly only the rhinocerous has survived down through the ages. Other mammoth forms have disappeared. They have been replaced by new creatures that have evolved to present types.

The rhinocerous is full of fight. Huge, able to see but dimly with its little pig eyes, it relies upon its keen sense of smell. When it scents a strange animal it charges, intent on killing. That is the spirit that animated the world's first creatures.

Evolution has ever been toward less fighting when there is not adequate cause. But even yet among animals in their wild state life is constant warfare, fear, attack; the stronger and fiercer preying upon the smaller and less defensible. Those not equipped to fight survive only because of their constant alertness or superior speed.

As the necessity to fight for life is removed animals become tamer, gentler. The horse, the cow, the dog are evolved types of meaner creatures. But they have been made man's friend and helper, because man through generations has found it to his advantage to protect these creatures from their one-time natural foes.

Some animals still display that primal fierceness. The little wild-cat is untamable, snarling, a caged fury. The mighty lion and the creeping tiger can be subdued by a trainer's course of great physical cruelty and pain, but the instinct to kill is always there smouldering, dangerous.

Man in the beginning was a crude fighting animal. He had to fight or be killed. Animals threatened him; so did other men. Gradually as weaker or smaller tribes were killed off and neighborhood animals exterminated more peaceful conditions came, more friendly relations man with man. And having less fighting to do, man turned his time to better things.

That ancient fight spirit is not all gone. The rattlesnake strike, the wild-cat fury, is with us yet in some individuals. The man who is "mad in a minute" if some one inadvertantly jostle him in a crowded car or tread upon his toe has some of that world-old instinct surviving strong in his cosmos.

Forbearance is a mark of human development, of brain strength come to replace brute fury. To be strong and yet not fly to anger and the infliction of bodily injury—that is a measure of intelligent fortitude. Not to strike, when it were easier to do so, often requires a superior kind of courage. It implies quiet reason as distinguished from wrathful, quick revenge. That was the Christ spirit, and that was the spirit of Abraham Lincoln during the constant anxieties of the Civil War.

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When a request was made in the January number for coöperation among the employees in helping to restore the magazine's depleted collection of reserve back numbers, several persons shrugged their shoulders. Who would heed? It was useless even to ask! Was it? The response was both cordial and prompt. Every month's supply but June and October had been exhausted. Those who could spare copies sent them in till the reserve stood thus: June, 32; July, 14; August, 12; September, 28; October, 169; November, 40; December, 22; January, 49. To each of those whose kindly thoughtfulness made this possible, thanks are here expressed.

# The Mosquito That Causes Malaria

By ARCHIE RICE, Manager Publicity Department.

Archie Rice

**Malaria** comes only from the bite of a mosquito. There are many kinds of mosquitoes in the world, but so far science has been able to discover but two species that produce disease in human beings.

One kind of mosquito is absolutely and solely responsible for yellow-fever. The other dangerous kind is the one that inoculates you with malaria, gives you the recurring chills and fever that make you languid and in time considerably enervated and constitutionally weakened after annually repeated attacks.

From long habit, with thousands of other people, you may have believed that malaria is in the climate, or in the water you drink. Old settlers will always tell you that. And old settlers are tenacious in what they know; " 'cause nobody can 't tell them nothin' ."

This little article is not written for argument. It is not printed to display scientific research or to work off technical terms that you can 't understand. It is put in here for whatever help it may be to this magazine's readers and their associates, many of whom live in or go into parts of California where results show that there are mosquitoes of the malaria-giving kind. Nearly every section of the habitable globe has some of these malaria mosquitoes.

What you should know is how to tell the dangerous kind. Just as you should know how to tell the deadly rattle-snake from the harmless gopher-snake. So some pictures of mosquito wings are here presented, on a greatly enlarged scale, to make identification easy.

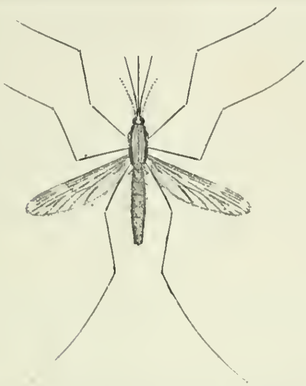
Remember this: The malaria mosquito is the only kind of a mosquito that has spots on its wings. They look like spots, but under the magnifying glass they are really close little groups of tiny branches on the vein-like markings of the wings. Squint your eyes as you look at the enlarged spotted wings here illustrated and you 'll get the effect that you will recognize when you catch a real malaria mosquito.

In the Sacramento valley I know country doctors who have long told their patients to boil the drinking water and thus avoid malaria. And there was a wise well-borer in Red Bluff who advised going down to a depth of more than one hundred and fifty feet "to get below the malaria water."

The state of New Jersey has been so bothered by mosquitoes that its seaside resorts were threatened with financial extinction. A few years ago its legislature appropriated $10,000 to investigate mosquitoes, and experts were put to work. I sent to the secretary of state and got that New Jersey report, a closely printed volume of nearly 500 pages. Then I had several long talks with Dr. Rupert Blue, the government's special authority on the suppression of epidemics. He is the man that waged the campaign that stamped yellow-fever out of New Orleans. Now every little street urchin in New Orleans knows at sight the yellow-fever mosquito, and helps exterminate it. It was Dr. Blue who tackled the job of ridding San Francisco of bubonic plague by exterminating the rats, because rats are subject to bubonic plague, and those rats that get it die, and then their fleas hop on to another rat or a human being and inoculate with the plague germ. But bubonic plague is not nearly so deadly as some other diseases if known and properly treated. Many children's diseases are passed along by flies and by ordinary fleas from child to cat or dog and to another child. Most of the diseases formerly called contagious are now called communicable, because familiar insects pass them along.

It is very interesting, but you may not care for it. So we will get back to mosquitoes.

All kinds of mosquitoes breed wherever and only where there are small puddles,



Just an ordinary mosquito magnified many times

ditches, or receptacles holding water that is left undisturbed by wind or current or unfrequented by fish for at least ten days. They can hatch out by the million in an old bucket. They do not breed in shrubbery or lawns, and the castor bean bush does not keep mosquitoes away.

Mosquitoes begin arriving in May. But there are no definite mosquito rules, because there are so many varieties, with different habits. As a general thing the mosquito lives from several weeks to six months, and the malaria kind hides through the winter in cellars or such places, acting very dopey. The female mosquito squats on a still bit of water and lays between fifty and seventy-five eggs, sometimes singly, but usually all clinging together in a sort of little raft. The eggs are tiny, elliptical, black-looking things. In two days they hatch downward and become tiny wrigglers that spend the next week or ten days head down and tail up, the tip just protruding above the surface of the water, as the nose is in one fork of the tail. If the water be riffled by wind or disturbed the poor little things can 't breathe, and they die. If crude petroleum gets on to the surface of the water it forms a layer that cuts off the wriggler's chance for air. But barring these accidents you can raise mosquitoes without any care or expense. The wriggler turns within ten days into a tiny sort of pollywog, mostly head, and lives a marine life anywhere from one day to three days. Then it floats on the surface and hatches up out of its transparent shell. The shell opens to form a dear little boat! In a minute the occupant awakes, stretches into legs and wings, gets them dry, and, before you know it, flies away a full-fledged mosquito ready for business.

Now consider this, and feel flattered: It is only the lady mosquito that ever bites you. The male mosquito has a bill too dull for any skin-game, and his life is short. Poor fellow!

Before a lady mosquito is five minutes old she is ready for a flirtation with any man. Some kinds sing to you first. The yellow-fever lady sings and sings a long while in your room before she comes quietly and bites

Showing the tell-tale spotted wings by which you can always recognize the malaria mosquito—two of the three varieties

you on the neck. Then there are some kinds that lure you with no music, but they get there just the same.

The reason the mosquito bite hurts is this: When the lady taps your epedermis to test for real blue blood in your veins she always finds it too rich for her. So she injects a tiny drop of acrid, poisonous fluid to thin the blood so she can draw it up through her dainty little test-tube. If you let her alone she will draw out most of the stinging matter with the blood sample, but if you slap her on the wrist or frighten her away she will leave it there just to rebuke your rudeness to a perfect lady.

Then it will smart. But do n't scratch it. Rub on some ammonia, or the juice of an onion, if you happen to have one in your purse. Experts say these two remedies are the best for that irritating effect. No ordinary lady mosquito will make you ill. She has a bitter tongue, yes; but consider her sex.

If you happen to notice that the lady mosquito who is favoring you with her attentions has those tell-tale spots, slap her quick, and then take a very small quantity of quinine twice a day for the next three days; but not the regular country doctor's dose that makes your ears ring and your eyes water.

No yellow-fever mosquito can give you yellow-fever unless she has acquired it by first biting some yellow-fever patient. And no spotted-wing mosquito (there are three variations, each with its own particular number of spots) can give you malaria unless she has first bitten some person that got the recipe from some other mosquito lady.

In mosquito society the ladies with the spotted reputation are called *Anopholes* to distinguish them from all the other kinds of mosquitoes. But when mosquitoes bite you you may go right on calling them by the same old names.

If you would attract the attention of lady mosquitoes wear dark-colored clothes. They prefer to settle on a black coat, just as fleas jump delightedly at sight of a skirt that is white.

If you keep fine-mesh screens in your windows and doors, that will help a lot. The spotted-wing mosquitoes insist upon coming into a house, and they bite harder than nearly any other kind. But if there is no tiny pool of standing water within a hundred yards of your dwelling you will have to go out and call on one of the spotted ladies in the evening, because they never wander further than that from their original pools.

Mosquitoes usually hunt blood only in the evening. Doctors who know say it is no risk at all to go into a yellow-fever district or to visit yellow-fever patients, provided you enter the town and depart before nightfall. And why are negroes usually immune from yellow-fever? Well, the lady mosquito does not care for perfume.

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Charles N. Chittenden, electrician in charge of the Pacific Gas and Electric Company's sub-station at St. Helena, and Miss Jessie Rice of St. Helena were married in San Francisco April 14th.

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Arthur S. Cummings, when he resigned last month to go east, was presented by his fellow employees in the Santa Rosa division with a handsome suit-case and given to understand that he would be missed.

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In the territory embraced by Arizona, California, Nevada, Oregon, Washington, Idaho, British Columbia, and the Hawaiian Islands all the water-driven and steam-driven electrical installations combined are now regularly producing 920,936 kilowatts, or 1,151,174 electrical horsepower, and there are plans under way for the development of 382,600 additional horsepower. In this same western area the annual production of gas is 15,075,985,907 cubic feet, of which 13,799,985,970 cubic feet is made from fuel-oil and 1,236,000,000 from coal, while 40,000,000 cubic feet is obtained as natural gas from wells. The combined gas and electric and electric car business of the area mentioned represents a capitalization of $731,507,452, of which more than $504,700,000 has actually been paid in. The electric railways in this area operate 5,694 cars on a total of 3,463 miles of track. The longest transmission line is 351.95 miles.

# Cost of Running an Automobile

HERE is some automobile experience based on absolute figures. This information comes from one of the district managers of the Pacific Gas and Electric Company. It gives a very good idea of what it really costs to have a machine.

This is an exact record of where the money went in keeping up a twenty-horse-power machine for a period of exactly one year following its purchase new.

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|---|---|
| Number of miles traveled | 12,543 |
| Tire expense | $300.12 |
| Gasoline | 135.75 |
| Oil | 35.05 |
| Repairs and sundry expense | 326.66 |
| Total cost for year | $797.58 |
| Average expense a mile | 6.35 cents |
| Monthly average–1,045 miles for | $66.47 |
| Daily average ..–34⅓ miles for | $ 2.20 |

These figures merely cover operation costs. They do not include interest loss on the money invested in the machine or the proportion of that cost to be charged as depreciation in its value, the lifetime of an automobile being anywhere from one to a dozen years, according to the care with which it is handled and kept in condition. Nor do these figures include the wages of a chauffeur at anywhere from $75 to $125 a month, the assumption being that a man runs his own machine.

Now as to lifetime and depreciation. A conservative general estimate is this: A machine lasts an average of five years. During those five years it depreciates the first year say 10 per cent. of its cost, the second year 10 per cent., the third year 20 per cent., the fourth year 20 per cent., and the fifth year 40 per cent. Among big business concerns it is the practice to charge automobile depreciation off at the rate of 30 per cent. a year, allowing the average lifetime of usefulness and up-to-dateness as a little more than three years.

Taking the average cost of a twenty-horse-power automobile as $1,800, then the interest charged the first year, at 6 per cent., would be $108, and the depreciation, at 10 per cent., $180, or a loss of $288 the first year. The second year the loss charge would be the same—$288; the third year it would be $468; the fourth year the same, or $468; and the fifth and last year, $828.

Without a chauffeur, and assuming the same average mileage as this machine made in its first year as a new machine, the real total costs would be something like this: first year about $90 a month; second year about $90 a month; third year about $105 a month; fourth year about $105 a month; and fifth and last year about $135 a month. Then the machine would be used up. But during the later years the repair cost would probably increase proportionately and add an indeterminate amount, ranging possibly from $5 to $25 a month. These figures suppose the automobile good for a total of a little more than 60,000 miles, which is going some, or about 1,000 miles a month at an average of about $100.50 a month or about 10 cents a mile. Much depends on the roads, on the man, and on the care the machine gets.

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From Will T. Jones, Electra:

Every body likes the magazine. I think it is improving all the time.

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From a letter by Ray D. Lillibridge, 100 Broadway, New York, to F. V. T. Lee:

I beg to take occasion to congratulate whoever is responsible for the origin and make-up of the Pacific Gas and Electric Magazine upon its extremely artistic and otherwise attractive appearance.

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Each month's issue of this magazine, on the regular run of 3,500 copies for the employees, costs approximately $320, made up of the following items: paper $120, typesetting $90, printing $45, halftones $45, binding $20. Each copy actually costs, exclusive of delivery and editing, nine cents to produce.

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