Missouri State Board of Agriculture.

Compliments of

Geo. B. Ellis,

Secretary.

W. R. WILKINSON,
St. Louis, Mo.
President State Board of Agriculture.

34TH ANNUAL REPORT

OF THE

MISSOURI

STATE BOARD OF AGRICULTURE

FOR THE

YEAR 1901.

JEFFERSON CITY, MO.:
TRIBUNE PRINTING COMPANY STATE PRINTERS AND BINDERS.
1902.

LETTER OF TRANSMITTAL.

STATE BOARD OF AGRICULTURE,
OFFICE OF SECRETARY,
COLUMBIA, MO., February 27, 1902.

TO HON. A. M. DOCKERY, Governor of Missouri:

Sir—In compliance with the law I have the honor to transmit herewith a report of the work of the State Board of Agriculture for the year 1902.

Very respectfully,
GEO. B. ELLIS, Secretary.

CITY OF JEFFERSON, Feb. 11, 1902.

To the Commissioners of Public Printing:

I require for use of my office Fifty-five Hundred copies of the Thirty-fourth Annual Report of the State Board of Agriculture—all bound in cloth—which I desire as per accompanying sample.

Respectfully,
GEO. B. ELLIS, Secretary.

Approved:
SAM B. COOK, Secretary of State,
ALBERT O. ALLEN, State Auditor,
R. P. WILLIAMS, State Treasurer.

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For Swine Breeders' Association.......................F. H. Schooler, Rockport.
For State Board of Agriculture..........................Geo. B. Ellis, Columbia.
For Improved Live Stock Breeders' Association.....T. F. B. Sotham, Chillicothe.
For State Poultry Association.......................Dr. J. T. Dewey, Keytesville.
For State Sheep Breeders' Association..............L. E. Shattuck, Stanberry.
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For State Grange.......................................C. O. Raine, Monticello.

ANNUAL MEETING.

OFFICE OF THE SECRETARY,
COLUMBIA, MISSOURI, December 17, 1901.

The Missouri State Board of Agriculture convened in regular session in the Secretary's office, called to order by the President, W. R. Wilkinson. The call of the roll by the Secretary showed the following members present: W. T. Carrington, H. J. Waters, Chas. F. Afflick, Alex Maitland, H. F. Hand, N. H. Gentry, Wm. C. Howell, J. A. Potts, Chas. L. Boisselier, W. R. Wilkinson, F. J. Hess, J. J. McNatt and A. T. Nelson.

The following members were absent: Gov. A. M. Dockery, S. H. Prather, W. L. Bryant, N. J. Colman and C. M. O'Connell.

Minutes of call meeting held in Sedalia, September 12th, 1901, read and approved. Minutes of last annual meeting approved as printed in Annual Report.

Report of Secretary read, and after discussing the suggestions contained therein, the report was adopted and ordered printed in the Annual Report.

REPORT OF SECRETARY.

Gentlemen of the Board of Agriculture:

According to a time honored custom and in the fulfillment of my official duty, I present to you the following report of the work of this office for the past year:

This year's work is now a part of the history of the State and must be judged by what it has accomplished. Many changes have been made in the membership of the board during the past year and while we regret to lose the counsel and assistance of the old members, some of whom had served the people of the State for many years, we most cordially welcome to the membership of our body, those who have been appointed to take their places.

Death of Hon. A. Nelson.—It is my painful duty to report to you the death of one of your honored members, Hon. A. Nelson of Lebanon, Laclede county, Missouri, who died on Sunday, November 10th, 1901. He had been appointed by the Governor only a short time before his death, and had the pleasure of meeting with you only one time, that at the called meeting in Sedalia, September 12th. He was present at the Institute meeting held in Lebanon only a few days before his departure and took a great interest in the meeting. Had Mr. Nelson lived, he would have been a valuable member of the board. He was a successful farmer and fruit grower, a good business man, a leading spirit in all public enterprises in his county and had been a member and officer in the Missouri State Horticultural Society for a number of years.

MONTHLY BULLETIN.

The work of the officers of the Board of Agriculture could not accomplish much unless in some way it is put in form to reach the farmers of the State. The publication of the work done by the board through the annual report has been practiced since the first organization in 1867. For several years past a number of bulletins have been printed containing crop reports and a great deal of other valuable information. The bulletin is perhaps the best means of reaching the people with the results of the work of this office, as it can be sent out at a time when the information is wanted. In order to get the benefit of reduced postage, I decided, after conferring with your Executive Committee, to publish a regular monthly edition under the title of the Missouri State Board of Agriculture Monthly Bulletin, and have it admitted to the United States mail as second class matter. The amount saved in postage and the amount saved by securing a reduction in the price paid for printing, enables us to send out about twice the amount of printed matter for the same money. The increasing demand for this publication is sufficient evidence of the appreciation the farmers of the State have for it and I am sure it is filling a useful purpose.

More than three and a quarter million pages of printed matter have been prepared and sent out the past twelve months, more than eight thousand letters have been written pertaining to the current business and in answer to hundreds of inquiries received, asking for information on numerous subjects, several thousand blank inquiries have been prepared and sent out, collected again and the information contained on condition of crops and live stock compiled and published. These bulletins have given information on the following subjects: Condition of crops and live stock, dairying, quarantine

N. H. GENTRY,
Sedalia, Mo.
President Missouri State Fair.

regulations, agriculture in rural schools, tuberculosis of cattle, cattle feeding experiments, the feeding problem or the relative value of different feeds, and many other subjects.

CO-OPERATION WITH OTHER DEPARTMENTS.

There has been a very hearty co-operation between the Department of Education through Superintendent W. T. Carrington and his assistants, Dean H. J. Waters and other members of the Faculty of the Agricultural College and the officers of the Board of Agriculture. This is as it should be, for all employees of the State are servants of the people, and should work together for the common good. Many farmers have co-operated in the work by acting as crop correspondents without any compensation, and without this co-operation of the farmers themselves, our crop reports would be of little value, last, but by no means least, of all the agencies that have assisted in our work, are the newspapers of the State. The great city daily and weekly papers, many of the county papers and all of the agricultural journals of the State have given their co-operation by publishing our crop reports, interviews and information from our bulletins, thus reaching thousands of farmers and rendering a most valuable service.

CROP AND LIVE STOCK REVIEW, 1901.

Perhaps the worst drouth in the history of Missouri has prevailed in nearly every county in the State the past season. The farmers of the State have entailed a loss on crops and live stock of more than one hundred millions of dollars and yet in the face of this great disaster there is no lagging nor sorrowing over "spilled milk," but they are buoyant with hope and bending every energy to recover the loss as soon as Providence again smiles upon them. There is yet a bright side to the situation, and in the future many will no doubt be able to look back to the year 1901 as the beginning of better methods in farming, more systematic rotation of crops, of breeding better live stock, of boring deep wells instead of depending on shallow ponds, of the more general growing of drouth resisting and soil renovating crops, the building of silos and the saving of the entire fodder crop.

The season was rather unfavorable from the opening, the winter having been mild and the early spring very wet put the ground in poor condition for a crop. The following is a summary of crop yields and conditions for the year:

Corn.—The planting was considerably later than usual only about one-fifth of the crop planted May 1st, and only 90 per cent planted June 1st. The cool weather also retarded germination; and was favorable to cut worms, wire worms, corn lice and moles, which did considerable damage. The cool weather continued until the middle of June, and being very dry after April 18th, the corn made slow growth. The condition on June 1st was 77, on July 1st 68, and the high temperature, withering winds and lack of moisture for July, cut the condition to 21 on August 1st, the lowest of the season.

The showers that fell the last few days of July and early in August made considerable improvement in late corn, but on most of the early corn the hot winds of July had killed the tassel before pollination took place and the improvement was in the fodder only, which matured in fairly good condition, and was harvested to a greater extent than ever before. The final estimate made up in November showed an average yield for the State of 9.9 bushels per acre, which very closely agrees with the Government Report made up at the same time and from an entirely different set of correspondents, the Government estimate being 10 bushels per acre. This indicates a total yield for the State of 61,667,000 bushels. The quality, however, is very inferior on account of being worm eaten, light and much rotten corn, the average quality given is 45. This would bring the total yield down to a feeding value of only 27,750,000 bushels. A comparison of yields and acreage for the State and by sections since 1894 is given in the following table:

CORN.

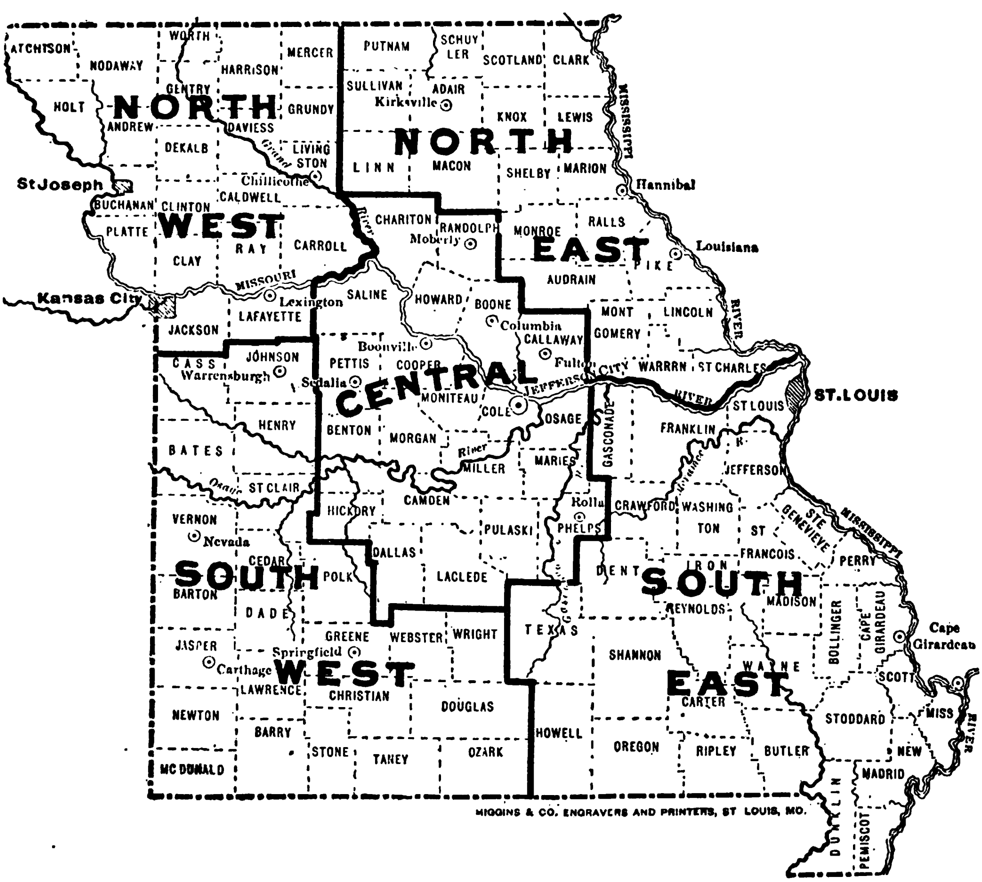
Year.	Acreage.	Yield per acre.	Total yield.	Av. farm price Dec. 1st.
1894	6,099,000	23	140,227,000	*.40
1895	6,577,000	38	249,926,000	*.20
1896	6,250,000	32	200,000,000	*.20
1897	6,700,000	25	167,500,000	*.24
1898	6,425,000	30	192,750,000	*.27
1899	6,330,000	30	189,900,000	*.30
1900	6,413,000	30	192,390,000	*.32
1901	6,229,000	9.9	61,667,000	†.62

*U. S. Year Book. †November Bulletin.

The following table shows the total acreage, average yield, and total production of corn by sections for 1900 and 1901:

Section.	Acres.	Bushels per acre.	Total production.
Northeast, 1900	926,000	30	27,780,000
Northeast, 1901	935,000	11	10,285,000
Northwest, 1900	1,937,000	33	63,921,000
Northwest, 1901	1,956,000	15	29,380,000
Central, 1900	1,053,000	30	31,590,000
Central, 1901	949,000	7	6,603,000
Southwest, 1900	1,677,000	28	46,956,000
Southwest, 1901	1,626,000	6	9,756,000
Southeast, 1900	820,000	28	22,960,000
Southeast, 1901	763,000	8	6,104,000

NOTE.—A slight error appeared in November Bulletin. Corrected in this table.



MAP OF STATE SHOWING SECTIONS FOR CROP REPORTS.

Wheat.—The estimated acreage sown in 1900 for the harvest of 1901 was 1,040,000, being an increase of 4 per cent over the previous year. The plant generally wintered well and practically all the crop sown was harvested. The cool, dry weather the latter part of April and in May, which was so unfavorable to corn, proved advantageous to wheat. Some sections reported damage by Hessian fly, and a few fields in Greene and Jasper counties were almost destroyed by plant lice. The wheat filled exceedingly well and ripened almost perfectly, and was put into the bin in first class condition. The quality for the whole crop is placed at 98, and a great many samples are reported testing as high as 64 pounds per sealed bushel.

Table showing the acreage, yield per acre, total yield and average farm price for wheat 1894-1901, inclusive:

Acreage.	Yield per acre.	Total yield.	Av. farm price Dec. 1st.
1,539,000	15	23,085,000	.43
1,550,000	11	17,050,000	.51
1,271,000	10	12,710,000	.70
940,000	10	9,400,000	.85
1,034,000	12	12,408,000	.59
900,000	9	8,100,000	.62
1,000,000	16	16,000,000	.63
1,040,000	16	16,640,000	.66

The above table shows the yield for the crop to be 16 bushels per acre, exactly the average yield for 1900, and a total yield for the State of 16,640,000. There is a wide difference between the acreage estimate of this office and that of the United States Government, the Government estimate being 1,500,000 or 500,000 greater than the State estimate. The surplus shipments reported by the Labor Commissioner for 1900 places the shipments of wheat, not including the three large cities of St. Louis, Kansas City and St. Joseph, at 11,809,022 bushels. If we account for what is kept for seed, consumed on the farm for bread and feed, and what is sold to the local mills, we believe the estimate made by the State is considerably below the actual production. This discrepancy in the estimates, if the census report soon to me announced confirms, has probably been made in part at least by the correspondents not taking the proper basis for estimates in the years 1898 and 1900, each of which followed a year in which the amount harvested was much below the amount sown.

The acreage sown this year for the harvest of 1902 has been largely increased, the estimate for the State compared with that of the previous year is 154 per cent. The greatest increase is in the Southwest section, where the acreage is 199.

The average condition of the plant November 1st, this year, was 91 compared with 96 for 1900. In some counties it was too dry to properly prepare the ground, and a few correspondents report some of it dying for lack of moisture, but generally the crop is in good condition, as shown by the figures in the table on page 15.

Oats.—The unfavorable weather during March and up to April 18th, the time of the last general rain and snow fall in the State, caused a decrease in the acreage, compared with the previous year of 19 per cent, making the acreage 810,000. The average condition on May 1st was only 81 per cent, some correspondents putting it as low as 20 per cent. Only about 24 per cent of the crop sown was threshed, the remainder being pastured or put up for hay. The average yield per acre on the acerage threshed is 13.9 bushels, making a total yield of only 2,898,000 bushels, compared with 30,000,000 bushels for 1900. The quality of the grain is placed at 61 per cent.

Table showing total acreage, yield per acre, total yield and average farm price of oats for the years 1894 to 1900, inclusive:

Year.	Acreage.	Yield per acre.	Total yield.	Av. farm price Dec. 1st.
1894	1,116,700	25	28,000,000	.29
1895	1,140,000	30	34,200,000	.18
1896	1,140,000	19	21,660,000	.17
1897	1,037,000	25	26,000,000	.19
1898	923,400	18	16,621,000	.23
1899	767,000	27	20,709,000	.24
1900	1,000,000	30	30,000,000	.23

Hay.—The hay crop for Missouri is second only to the corn crop in value, the crop of 1900 was estimated at nearly $20,000,000. The drouth of this year cut the pastures short and many farmers were compelled to turn on the meadows. Only 63 per cent of the timothy meadows were cut for hay with an average yield of .84 tons per acre. Clover yielded slightly better, one ton per acre. The total yield for the State is estimated at 1,242,000 tons, which at the average farm value, November 1st, of $11.80 per ton, gives a total value of $14,556,000.

Table showing total acreage, yield per acre, total yield and average farm price of timothy hay for the years 1894 to 1901, inclusive:

Year.	Acreage.	Yield per acre.	Total yield	Av. farm price Dec. 1st.
1894	2,620,650	.9 tons	2,358,000	$7.82
1895	2,360,000	1.27 "	3,000,000	6.80
1896	2,360,000	1.5 "	3,540,000	4.85
1897	2,360,000	1.28 "	3,021,000	6.15
1898	2,360,000	1.6 "	3,776,000	5.80
1899	2,360,000	1.5 "	3,540,000	6.25
1900	2,218,000	1.3 "	2,884,000	6.95
1901	2,218,000	.84 "	1,242,000	11.80

Fruits.—We do not attempt to gather detailed information of the fruit crops, as we do not wish to encroach upon the State Horticultural Department. A crop review for the State, however, is not complete without mention of this very important and growing branch of agriculture in this State.

The prospect early in the season was excellent for all kinds of fruit. The canker worm appeared in several counties in large numbers in May, completely defoliating thousands of trees. Aside from this there was less damage to the fruit crop from insects and fungous diseases perhaps than for several years past. The strawberry crop, while not large, was of good quality, and the growers generally report making good profits. The withering July sun dried the blackberries on the vines, killed many of the young orchard trees, and seemed bent on cooking the fruit on the trees. The intelligent orchardist, however, did not lose hope, but gave greater attention to cultivating his trees, and thinning and otherwise looking after his orchard with the result that in many instances his profits were larger at the end of the season than ever before. The yield was about 50 per cent of a full crop, but on account of the scarcity in other states it sold for a very high price and brought a great deal of money into the State. Many farmers have made good money off their orchards this year, some of them receiving $100 to $200 per acre for their apple crop in the orchard.

Live Stock.—The worst feature following the drouth is a general decrease in the number of all kinds of stock in the State. The greatest source of revenue for the Missouri farmer is the live stock. Our reports show a decrease in the number of horses of 13 per cent; of cattle, including all classes, a decrease of 30 per cent; of fattening cattle, 70 per cent decrease; hogs, all classes, 36 per cent decrease; fattening hogs, 58 per cent decrease; sheep showing a decrease of 21 per cent.

The loss on cattle will take some time to regain, but if our reports are correct on hogs, showing a loss of all classes of only 36 per cent, while the loss on the number in fattening pens is 58 per cent, it is apparent that a great many hogs have been kept for breeding purposes, and with normal crops next year, the loss in number of hogs may soon be regained.

Condition of Live Stock.—Our reports show a decrease in number of cases of hog cholera, only a very few correspondents reporting any diseases at all among the hogs. In quite a number of counties aphthous fever, or sore mouth, among the cattle has been reported and the following diseases show an increase over 1900: Corn stalk disease in both cattle and horses, black leg and lump jaw in cattle, and rabies or hydrophobia in dogs.

Forage Crops.—A large acreage of forage crops, including sorghum, Kaffir corn, millet, cow peas, rape and other crops was sown in July and August with the hope of producing feed to take the stock through the winter. While the yield was very good in many places, a great deal of that sown did not mature any crop at all.

Other Crops.—The yield of other crops grown in the State and the average farm price is shown in the following table:

SUMMARY OF CROP REPORT FOR 1901 FROM NOVEMBER BULLETIN.

Summary of Crop Reports.	State......	Northeast Section....	Northwest Section...	Central Section....	Southwest Section....	Southeast Section....
Wheat, condition of plant, Nov. 1st................	91	83	100	90	95	86
Wheat, acreage sown compared with 1900...	154	192	142	125	199	114
Wheat, amount of crop in farmers' hands Nov. 1st.	48	38	43	56	50	55
Wheat, quality of grain..........................	98	96	100	95	98	99
Corn, quality of new crop..........................	45	54	55	40	38	38
Corn, amount of old crop on hand..................	10	12	8	9	10	11
Oats, quality of grain.............................	61	78	71	48	55	55
Average crop yields for 1901:						
Wheat, bushels..................................	16	16	20	14	14	14
Corn, bushels	9.9	11	15	7	6	8
Oats, bushels....................................	13.9	16	20	9.3	11	13
Rye, bushels.....................................	13	15	17	12	9	11
Flax, bushels....................................	2.7	4	2.7	1	2.7	3
Clover seed, bushels.............................	1.7	2.3	2	.8	1.9	1.3
Timothy seed, bushels............................	2.2	2.2	3	1.8	2	2
Irish potatoes, bushels..........................	17.4	19	18	11.9	16	22
Sorghum syrup, gallons...........................	41	43	57	14	49	42
Timothy hay, tons................................	.84	.9	1.3	.57	.64	.8
Clover hay, tons.................................	1	1.2	1.3	.82	.9	.9
Cotton, bales of 500 pounds each.................	.39	....	....	....	.29	.5
Average price on farm, Nov. 1:						
Corn, price per bushel...........................	.62	.55	.54	.67	.63	.72
Wheat, price per bushel..........................	.66	.68	.66	.66	.65	.66
Oats, price per bushel	.39	.37	.34	.45	.38	.42
Rye, price per bushel............................	.70	.62	.60	.77	.74	.77
Flax, price per bushel...........................	1.31	1.25	1.30	1.42	1.26	....
Clover seed, price per bushel....................	6.51	7	6	5.50	6.87	7.20
Timothy seed, price per bushel...................	3.07	2.60	2.60	3.70	3.15	3.30
Irish potatoes, price per bushel.................	1.07	1	.98	1.14	1.05	1.20
Cow peas, price per bushel.......................	1.48	2	....	1	1.42	1.50
Timothy hay, per ton.............................	11.80	9	9.55	13.84	11.62	15
Clover hay, per ton..............................	10.66	8	8.27	13.15	11.15	12.72
Wheat straw, per ton.............................	5	4	3.41	6.21	5	6.40
Wool, per pound..................................	.17	.17	.15	.17	.19	.18

LIVE STOCK SANITARY SERVICE.

The importance of a well regulated department having in charge the live stock sanitary regulations of the State, is second to no other work done by the State in behalf of the breeders of live stock. The total value of all the live stock in the State is not less than $250,000-000. The actual assessed valuation of the cattle, horses, mules, hogs, sheep and other live stock for the year 1900, as shown by the Auditor's books, was nearly $62,000,000. The live stock alone, saying nothing about other investments necessary in carrying on the business, pays into the State Treasury annually, in round numbers, the sum of $155,000 and to the counties approximately $500,000 more, making a total revenue derived from this source of $655,000. It is then a profitable investment for the State to foster the live stock industry to the extent of providing for and enforcing the best sanitary service possible.

Can the best service be provided with the amount of money now appropriated for this work? Without hesitating, I answer it can not. There are new lines of work demanding your attention and must be provided for if the live stock interests receive the protection its importance will justify. The loss in this State annually caused by hog cholera, black leg, corn stalk disease, contagious abortion, calf cholera, and other less dangerous diseases, such as scabies, actinomycosis, aphthous fever, etc., cannot be actually estimated without more reliable data than what we have, but it will reach hundreds of thousands and perhaps millions of dollars. That a competent force of veterinarians should be employed to make the most careful study of these plagues and the best means of preventing their spread, and perhaps entirely stamping them out, I think will not be disputed. The State Veterinarian in his report will show that his time is now all taken up, and hence if this work is thoroughly done, increased help necessitating larger appropriations must be had. Some other states with one-fourth to one-half the number and value of live stock that Missouri has, spend more than twice the amount of our appropriation for their veterinary service. The present annual appropriation for this work does not exceed one-sixteenth of a cent. per head of the live stock in the State. I offer these suggestions that you may make your plans for the future, and ask of the next Legislature the necessary funds to carry them out. Your authority is given to you and the means provided by the Legislature, and it is your duty to be governed thereby unless perhaps some extraordinary conditions were to threaten more than ordinanry losses. The appropriation made for the veterinary service for the year 1901 and 1902 was $16,200 or $8,100 per year. The expenditures for this year are $8,886.46, which is $786.46 in excess of the appropriation. The expenses this year, however, are $764.92 less than that of 1900.

CATTLE QUARANTINE.

The cattle quarantine regulations adopted by the Executive Committee and promulgated by the Governor's proclamation on February 14th have been published, and are not materially different from the regulations of 1900.

The annual meeting on December 19th ordered that the inspection season should be for the months of November, December, January, February and March of each year. The Bureau of Animal Industry, Order No. 80, dated December 10th, 1900, only provided for inspection during November and December. This order was subsequently amended so as to admit cattle upon inspection from the two northern tiers of counties in Arkansas, up to April 1st.

These conflictions cause a great deal of confusion among the cattle men, and no doubt to some extent bring the regulations into disfavor. It seems to me the proper thing to do is to authorize the admission of cattle into this State upon Federal inspection and require the State Inspectors to guard the line and thoroughly stamp out the infection of our own territory. It has been contended that a dual inspection gave double protection against the admission of infested cattle. The State Inspectors stationed at the stock yards of St. Louis, Kansas City and St. Joseph are also agents of the United States Department of Agriculture, and just how a dual inspection of cattle made by one individual at the same time offers any protection is difficult to perceive.

To get an expression from the Bureau of Animal Industry on this subject, the following letter was addressed to the Chief of the Bureau, Dr. D. E. Salmon:

Columbia, Missouri, November 21st, 1901.

Dr. D. E. Salmon, Bureau of Animal Industry, Washington, D. C.:

My Dear Sir—It is now only a very short time until the annual meeting of our Board when the quarantine regulations for next year will be considered. I have been thinking for sometime of writing to you and suggesting that I think it would be a good idea if the United States Department would take charge of all the inspection of cattle coming into this State and for the Missouri Inspectors to try to control the infection in our State and assist the United States Inspectors in preventing violations of the United States quarantine regulations. I cannot see any need for both the State and the United States seeking to do the same thing. Under our present dual regulations it is necessary for the cattle men to have inspection by both the United States and the State. Under the plan that I suggest there will be no confliction of dates as to time for the season of inspection.

If you are pleased with this suggestion, please let me know, for I want to call the attention of our Board to this matter when they meet; but unless it meets with your approval I cannot hope to suggest any recommendation to the Board.

Yours truly,

GEO. B. ELLIS, Secretary.

The following reply was received:

United States Department of Agriculture,
Bureau of Animal Industry, Washington, D. C., Nov. 27, 1901.

Hon. Geo. B. Ellis, Secretary Missouri State Board of Agriculture,
Columbia, Missouri:

My Dear Sir—Replying to your letter of the 21st instant, I heartily agree with the plan mentioned in your letter, and will do everything I can to carry it out successfully. I believe it would be more satisfactory to have the Federal inspectors make the inspection of cattle coming into your State from below the quarantine line, and for your inspectors to assist in preventing violations of our quarantine regulations. This would simplify matters for the shippers of stock and I think would give better service than the plan which has been followed in the past of a dual inspection.

Very truly yours,

D. E. Salmon, Chief of Bureau.

If this suggestion meets your approval and the inspection of cattle coming into Missouri is turned over to the Bureau of Animal Industry it will save to this office a considerable sum that can be used to advantage by the Veterinary Department.

If competent veterinarians could be employed as live stock inspectors for the southern part of the State, they could in addition to their work as inspectors do much of the veterinary work for that territory, thus making a further saving of expenses, without in any way interfering with the efficiency of the work.

The Governor's proclamation rescinding the tuberculosis regulations and the one promulgating the regulations concerning scabies in sheep have both been published and require no further comment.

For further information concerning the veterinary work I refer you to the following report of the State Veterinarian which has been made by Dr. D. F. Luckey:

REPORT OF STATE VETERINARIAN.

To the Honorable Board of Agriculture:

Gentlemen—In additon to the regular quarterly reports which are required by section 10556, Revised Statutes of 1899, to be made by the State Veterinarian to the Secretary of the Board of Agriculture, I wish to make the following explanation of my work during the past year, and the plans I have in view for the future.

As is required by section 10546, Revised Statutes of 1899, all petitions asking for the State Veterinarian to investigate outbreaks of contagious diseases have been answered by myself or my deputies.

By an understanding which was had with the Board at the beginning of my term, letters from regularly graduated veterinarians over the State, giving notice of a contagious disease, have been construed as "sufficient evidence" of the existence of a contagious disease, and the Secretary has ordered investigations according therewith by myself or my deputies. In order to control scab among sheep a system has been arranged with the United States Bureau of Animal Industry Inspectors at the public stock yards by which the Secretary of this Board is notified of the receipt from any point in this State of any lot of sheep affected with scab. These notices embrace such facts in connection with the shipment as the shipper's name, address, the station from which the shipment was made, name of the railroad making the shipment, the number of the affected sheep, and other points which would seem to be of value to us in investigating the outbreak. On receipt of such notices it has been the policy of the Secretary of the Board to have the outbreak promptly controlled. In the control of sheep scab it has been my policy to place the shipping pens under quarantine until they have been disinfected, and to quarantine the sheep until they have been permanently cured. The Bureau of Animal Industry Inspectors at the public stock yards in this State have been authorized by the Governor's proclamation of April 19th, 1901, to hold in quarantine any sheep that are affected with scab until they are permanently cured, and no scabby sheep are allowed to be shipped to any point in this State. By this system we are controlling the spread of scab and getting it eradicated at a satisfactory rate.

A table, printed on another page of the Annual Report, shows all the work done by the Veterinary Department in controlling contagious diseases, together with the expenses incurred.

The extra traffic in mules and horses, during the past two years, as result of the war demand and largely higher prices has made the spread of glanders and other diseases of horses much more probable. Extensive outbreaks of Anthrax or Charbon among all kinds of stock in Mississippi, Louisiana and other southern states and in Illinois in the vicinity of Chicago has caused no small amount of anxiety concerning the stock of this State. This disease amounted to a veritable plague in parts of the southern states and almost depleted many plantations of their stock. In spite of all possible care on the part of the sanitary authorities of the various states this disease spread until vaccine firms were unable to prepare Anthrax vaccine as fast as it was needed to protect exposed stock.

There is also renewed activity in the traffic in dairy cattle. The impetus given the dairy industry by an act of the recent Legislature establishing the Chair of Dairy Husbandry in the University, and providing for a dairy building in connection with the Agricultural College will doubtless result in the establishment of new herds and the improvement and building up of old ones. The consequent addition of new blood to the herds and the interchange of dairy cattle will have a tendency to spread and increase their diseases. With even the very insignificant interest in dairying heretofore to cause any traffic in dairy cattle, tuberculosis has gained a slight foothold and contagious abortion is entirely too common for the best interest of the dairymen.

Yet the owners of live stock all over the State have cause for congratulation in that all stock are comparatively free from contagious diseases. Compared with the vast traffic in horses and mules the outbreaks of glanders have been very few, and they have all been promptly controlled. Anthrax did not gain a foothold in this State at all. There is reason to think that there are only a few herds of cattle in this State affected with tuberculosis and contagious abortion alone threatens to spread to an alarming extent.

The sanitary authorities of this State are fortunate in being in a position to control most of the contagious diseases by preventing their introduction anew, and their spread from the limited areas where they now exist. Laws and regulations for the prompt suppression of outbreaks of contagious diseases and their eradication and plans carefully laid to prevent their future introduction from other states will result in keeping our stock healthy. If our present opportunities are not neglected, we can, with small expense, prevent the increase of the disease as has been the history in many of the older states as the different lines of live stock production advanced. While in some of the older states appropriations aggregating hundreds of thousands of dollars must be expended in order to give the live stock a respectable reputation as to health, we will need to spend but a few thousand yearly to prevent the accumulation of disease. A rough estimate would show that the $40,000 expended semi-annually in Pennsylvania to control tuberculosis would be enough to pay the market value of all the tuberculous cattle in Missouri.

TEXAS FEVER.

The Texas fever infection in this State is in such a shape that it requires special mention. In 1899 Texas fever infection existed in seven counties in this State. Ever since then efforts have been made to control and eradicate it, and year by year the infested areas have become more limited. At the beginning of this year it was made a part of the imperative duties of the cattle inspectors to locate and place in quarantine all infested cattle and pastures and report each quarantine to the Secretary of the Board. During the year only nineteen cases of infection of farms in the whole State have been reported. While the introduction of Texas fever from the southern states is equally as probable as ever, the infection within the State is of little importance, and can be controlled in the future with small expense. Through correspondence the Chief of the United States Bureau of Animal Industry and the Secretary of Agriculture have indicated that the Federal authorities are willing to take the sole responsibility of preventing the introduction of Texas fever into this State from without and to provide for the inspection of southern cattle which heretofore has been done mostly at the expense of this State. If the matter is left in the hands of the Federal authorities, besides relieving this State of an unnecessary expense the inspection of southern cattle will be simplified to such an extent as to greatly benefit the cattle industry. I advise that the Board consider this matter thoroughly, and, if the plan seems practicable, that it be adopted as soon as is possible without upsetting present arrangements too much.

In addition to the control work done during the past year this Department has promptly answered all correspondence from stockholders and given them all possible information concerning the diseases of their stock. As has been the custom in the past the August Crop Bulletin this year was used as a means of giving stockmen of the State such veterinary information as their correspondence and the observation of the State Veterinarian indicated that they most needed. Another part, and probably the most important of all, was the attendance at the Farmers' Institutes daily for over ten weeks, where lectures were given by way of explaining the nature of contagious diseases and the method by which they could be prevented. It seems to me that the ordinary run of diseases can be controlled in the future by the same methods that have been used in the past. This office will continue through correspondence, the August Crop Bulletin and the Farmers' Institute to disseminate knowledge pertaining to the diseases of live stock. As these labors consume my whole time I have no opportunity left for the investigation of any special disease. I suggest that it will be a matter of economy to the Board to arrange for more of the control work to be done by deputies, giving the State Veterinarian an opportunity to investigate in detail outbreaks of diseases that are not well understood. At the present time the so called "corn stalk disease" is causing such extensive losses that the matter deserves careful attention. Contagious abortion among cattle should receive special attention during the coming year, and no pains should be spared to get its damaging nature thoroughly understood by the breeders and dairymen of the State. They should be aroused to the importance of the prompt control of this disease. An attempt to do the control work will make it impossible for me to give these matters the proper amount of attention.

TUBERCULOSIS.

No special work in connection with tuberculosis is intended during the coming year. This disease is fairly well understood now, and tuberculin is an agent of undoubted reliability for its diagnosis. The work in connection with it will probably be limited to an effort to get the whole subject properly understood by breeders and dairymen, that any undue prejudice in their minds against the tuberculin test may be removed. It is hoped that they may be interested in getting such legislation as will be absolutely necessary for successful work in this line, and that, at the proper time, they will co-operate in enforcing regulations by which tuberculosis may be eradicated from our herds and its further introduction prevented. I do not believe the present law of this State in regard to tuberculosis is adequate. There is no effective plan for eradicating it consistent with the present law that can be followed without working an injustice to the owners of cattle which happen to be tuberculous. It is doubtful whether the law authorizes the State Veterinarian to go into herds and make the tuberculin test without being solicited to do so by their owners. But if he does make an examination and cattle are found to be tuberculous the law only authorizes the cattle to be held in quarantine. The loss of their use to their owner would be complete. No manner of reimbursement for his loss is provided by law. The injustice to the owner of the cattle is apparent. This course would stir up so much resentment that the prejudice would make it impossible to ever accomplish anything. I think it is best to let the whole matter rest until the law can be revised so that the eradication of tuberculosis within the State can be attempted at the same time that regulations are put in force for preventing its introduction from other states. In the meantime I want to get the breeders and dairymen in line in this matter and get up a plan for the control of tuberculosis that will meet with their general favor. In regard to the law I suggest that it ought to be changed so as to provide that any cattleman could have his herd tested whenever he desired, and that if it became necessary to destroy any diseased cattle he would be reimbursed according to the present practice in connection with glandered horses. I state this as a general plan, the details of which may be arranged at the proper time.

I submit this report that the members of the Board may call attention to any mistakes of the past and offer suggestions for the future.

Very respectfully,
D. F. LUCKEY.

FARMERS' INSTITUTES.

The great benefit to the farmers and to the whole State resulting from a well organized system of Farmers' Institutes is now recognized by every intelligent citizen. The largely increased attendance at the meetings and the intense interest in the numerous subjects discussed show that the farmers of Missouri are abreast of the times in this important work. The value of the work done this year is shown in the endorsements now on file in this office from many of the most progressive farmers of the State, and also from the fact that a large majority of the places where meetings were held have already asked for a meeting next year. Quite a number of places have perfected permanent organizations with a view of holding monthly meetings.

The following letter, among many others, received in this office will give some idea of the manner of conducting a local Farmers' Club in a way to be of practical benefit to the community:

Lebanon, Missouri, February 8, 1902.

Geo. B. Ellis, Esq., Columbia, Missouri:

Dear Sir—I take pleasure in informing you that we are getting along very well with our farmers' meetings. We hold a meeting the first Saturday in every month. We have leased a hall with the room adjoining, that we expect to use for a library. We throw this hall open for the accommodation of farmers. These rooms are in the center of the business part of our city. We would consider it a great favor if you would assist us in getting up our library, and such reading matter as would benefit or interest our farmers.

Very respectfully,
PHIL DONNELLY.

The work of organizing local institute societies for the purpose of holding frequent meetings and encouraging regular reading courses for the members should, I think, be given the hearty co-operation of this Board. Your board is organized on a non-partisan basis, and this is undoubtedly in the best interests of our farmers. The only question asked concerning any man employed for institute work was, "Is he thoroughly qualified to give instruction in his line of work?"

In the work this year we have had the earnest co-operation of the State Superintendent, the Faculty of the Agricultural College, the Director of the South Missouri Fruit Experiment Station, and each of the three State Normal schools.

Meetings were held at one hundred and twenty different places, and the aggregate attendance would amount to many thousand people, many of whom have expressed themselves as being well pleased with the meetings and having received great benefit therefrom.

A DROUTH YEAR INSTITUTE EXHIBIT—PUTNAM COUNTY.

At a number of places the farmers brought their wives and the wives brought well filled baskets of provisions, and two days were spent in earnest institute work. In a great many places a fine display of grain, fruits, vegetables and grasses were placed on exhibition, showing what Missouri can do in a year of drouth.

A strong force of lecturers was employed, and the subjects discussed covered a wide range of subjects.

H. J. Waters, Dean Agricultural College, Columbia, Missouri, subjects: What Kinds of Feeds Should be Bought this Winter? Clover and Cow Peas as Soil Renovators. The Work of the Agricultural College and Experimental Station.

Dr. D. F. Luckey, State Veterinarian, subjects: The Prevention of Contagious Diseases Among Live Stock. Vaccines and Vaccination of Live Stock. Diseases of Poultry. Tuberculosis. The Horse's Foot. How to Judge a Horse. The Horse's Teeth.

Dr. J. W. Connaway, Veterinarian to the Experiment Station, subjects: The Southern Cattle Market. Immunizing Cattle Against Texas Fever.

Hon. W. T. Carrington, State Superintendent of Schools, subjects: Nature Study Leading Up to the Study of Agriculture in the Rural Schools. Unification of the Work in All of the Public Schools of the State.

Mr. H. A. Gass, Editor Missouri School Journal and Prof. L. J. Hall, Chief Clerk Department of Public Schools, attended a number of meetings and rendered valuable assistance.

W. A. Hoover, Professor of Agriculture, Warrensburg Normal, subject: Nature Study and Agriculture.

Hon. John R. Kirk, President Kirksville Normal, subject: Industrial Education.

R. W. Clothier, Professor of Agriculture, Cape Girardeau Normal, subjects: Soil Improvement. Agriculture in Rural Schools.

C. H. Eckles, Professor of Dairy Husbandry Agricultural College, Columbia, Missouri, subjects: The Selection, Feeding and Care of the Dairy Herd. Profits in Dairying.

C. L. Willoughby, Instructor in Dairying, Agricultural College, Columbia, Missouri, subjects: Butter Making on the Farm. The Farm Separator.

F. B. Mumford, Professor of Agriculture, Agricultural College, Columbia, Missouri, subjects: Some Fundamental Problems in Profitable Stock Feeding. Animal Form as Related to Profitable Food Consumption.

T. I. Mairs, Assistant in Agriculture, Columbia, Missouri, subjects: Comparative Draft of High and Low Wheeled Wagons. The Value of Clover and Cow Pea-Crops.

J. M. Stedman, Entomologist Experiment Station, Columbia, Missouri, subject: Insect Pests of the Farm and Orchard, and How to Combat Them.

C. D. Lyon, Higginsport, Ohio, subjects: Improving and Keeping up the Fertility of the Soil. Legumes as Soil Improvers. Tobacco Growing. Farm Workshop. Poultry Yard and Garden.

G. W. Waters, Canton, Missouri, subjects: Soil Building. Lessons of the Drouth. Profitable Pig Feeding. The Farmers and the World's Fair of 1903.

W. L. Howard, Assistant in Horticulture, Agricultural College, Columbia, Missouri, subjects: Commercial Orchards for Southeast Missiouri. Diseases of Fruits and Their Treatment. Budding and Grafting.

John T. Stinson, Director South Missouri Fruit Experiment Station, Mountain Grove, Missouri, subjects: Spraying. Insects and Remedies.

E. W. Robinson, LaBelle, Missouri, subjects: Thoroughbred Hogs. Prevention of Hog Cholera.

Hon. N. F. Murray, President State Horticultural Society, Oregon, Missouri, subjects: Commercial Orchards. Farm Orchards.

G. W. Williams, Humansville, Missouri, subjects: Scientific Bee Keeping. Growing Small Fruits. Alfalfa.

INDUSTRIAL MEETING.

The fifth annual meeting of the different State Industrial Associations was held in Chillicothe, December 10th to 13th. A most excellent program was carried out and the information given in the lectures and discussions will, when printed, make a valuable addition to any farmer's library. At the suggestion of your Secretary a general Executive Board, consisting of one member from each Association was created to have the general management of the meeting. The feeling generally prevailed in favor of organizing one grand convention of farmers, to be participated in by every State Association interested in the improvement of any branch of Agriculture. The Tenth Annual Exhibit of the State Poultry Association held at the same time was the largest held for several years, and demonstrated to some extent the growing importance of this industry.

The most important thing to do to make a complete success of these meetings in the future is a better system of organization for some of the associations participating. Each association should not only have its regularly elected officers, but it should also have some plan of a fixed membership.

The resolution adopted by the Road Improvement Association declaring in favor of an appropriation to be made by the Legislature to the Board of Agriculture for the purpose of doing some object lesson road building in different parts of the State, is an important step toward the improvement of our roads, and I think should receive the support of the people.

The next meeting will be held in Springfield, Missouri, beginning January 6th, 1903.

WORLD'S FAIR 1903.

The people of Missouri are awake to the importance of the Louisiana Purchase Exposition which will be the first great International Exposition held within the borders of the State. The farmers of Missouri have met the farmers of other parts of the world in all the great expositions in the past twenty years, and have taken a larger number of prizes on the combined products of live stock, grains and fruits than any other State in the Union. Now, in this Exposition held on our own soil, we must be ready not only to win our share of the premiums for producing the best, but we should show to the people of the world that Missouri produces a greater variety of products than any other country of equal area on the globe.

The Board of Agriculture has already, by resolution adopted at the Sedalia meeting, tendered its assistance in any way that may be required. This Board, while not specially commissioned to do any of this work, should as one of the departments of the State Government proceed at once to perfect plans for co-operating with the Missouri World's Fair Commission for producing, collecting and preparing the Agricultural exhibit.

This Exposition will go down in history as one of the great mile stones of the world's history, showing the achievements of the century of greatest progress in the past, and marking the beginning of a new century of still greater development than has heretofore been thought possible.

ANTI-BUTTERINE LAW.

The enforcement of the Anti-Butterine Law is placed in charge of the State Board of Agriculture, and an appropriation is made by the Legislature for that purpose. Two inspectors have been employed all the time, and for a part of the time a third inspector, who have given their whole time to the enforcement of the law. The large profits made by selling oleo for butter afford an incentive for dishonest men to take chances in violating the law. Under the present law, if the officers of the law would do their sworn duty, the illegal sale of oleo could be suppressed in a very short time. But when the prosecuting attorneys refuse to file the cases that have ample and positive evidence for conviction, and when judges on the bench will make frivolous and the most ridiculous and arbitrary rulings in order to shield the violators it can be seen what a difficult task it is to thoroughly enforce the law. However, the constant presence of the inspectors and an occasional conviction with a fine of $50 and costs, and the fear of being arraigned in court as a criminal, no doubt curtail the fraudulent sale of oleo to a very great extent.

With the protection of this law withdrawn, there is no doubt that the dairy industry of this State would be almost entirely ruined. The development of the dairy business in Missouri will add millions of dollars to her resources, and that without injury to any other industry. From the practical working of this law for six years we should be able to determine its defects and point out some improvement. The greatest difficulty in the enforcement of the law has been: First, an indifferent public sentiment in the towns and cities where the oleo is sold and consumed; second, the neglect of duty by judges and prosecuting attorneys who are influenced by the indifferent public sentiment on the one hand and the power of wealthy corporations and their agents engaged in the manufacture and sale of the counterfeit article, on the other hand.

No one will object to the sale of oleomargarine if it is honestly sold upon its merits as oleomargarine. The law, then, should seek to confine the sale to its legitimate channel.

I believe that an inspection law requiring that all substitutes for butter manufactured or sold in this State should be inspected, and every package sold stamped with a stamp provided by the State through an agent of the Board of Agriculture would confine the sale of oleomargarine to the proper channel. The principle is not new, but has been successfully tried in other lines of business. This inspection law requiring every package to be stamped will protect the consumers, will protect the dairymen from dishonest competition, and produce a sufficient revenue to properly enforce the law.

OLEOMARGARINE INSPECTION IN ST. LOUIS.

For a statement of conditions concerning the enforcement of the present law I refer you to the following reports of the Inspectors:

St. Louis, Mo., December 16, 1901.

To the State Board of Agriculture:

Gentlemen—I assumed the duties as an inspector of the Missouri State Board of Agriculture for the prosecution of the violators of the law against the illegal sale of oleomargarine on the 1st day of April, 1901, and I desire to make a report of the work that has been done in that direction since that time:

In the St. Louis Court of Criminal Correction the following cases have been disposed of, viz.:

State of Missouri vs. Geo. Goener et al.; acquittal.
State of Missouri vs. E. Gerelman; conviction.
State of Missouri vs. Otto Kohrs; conviction.
State of Missouri vs. Louis Honig; acquittal.
State of Missouri vs. Henry Borrenpohl; conviction.
State of Missouri vs. Chas. Adler; conviction.
State of Missouri vs. John Becker, Jr.; conviction.
State of Missouri vs. Ben. Miller; conviction.
State of Missouri vs. John Dennis et al.; conviction.
State of Missouri vs. Jacob Maurer; conviction.
State of Missouri vs. Frank Hertel; conviction.
State of Missouri vs. George Goener; conviction.
State of Missouri vs. Henry Bockstruck; conviction.

The prosecution in the above cases resulted in a conviction in all cases with the exception of two. Three of the above defendants had been prosecuted and convicted before for the illegal sale of imitation butter, hence the above prosecution was for a second offense in each of the three cases, viz.: J. Maurer, F. Hertel and Henry Bockstruck, the punishment for a second offense being not less than \$250.00 and not more than \$500. We secured a conviction of \$250 in the case of the State vs. J. Maurer, the first and the only conviction for a second offense ever obtained in Missouri under the law against the sale of oleomargarine. After the above conviction, at the sole suggestion of Judge Clark, which we took to be in the nature of a mild command, the remaining second offense cases were disposed of at a fine of \$50 and costs of court.

On the 19th day of June of this year the law permitting a civil suit to be brought before a justice of the peace of the district where the violation occurred went into effect, and since that time the following cases have been brought in the justice court, viz.:

State of Missouri vs. F. F. Harrision.
State of Missouri vs. Chas. D. Kelting.
State of Missouri vs. B. H. Surkamp.
State of Missouri vs. F. D. Mundinger.
State of Missouri vs. H. Bohn Grocery Company.
State of Missouri vs. H. W. Heuman.
State of Missouri vs. John B. O'Connor.
State of Missouri vs. C. Kuhlmann.
State of Missouri vs. C. Kuhlmann.
State of Missouri vs. Zurheide Bros.
State of Missouri vs. Wm. Loewnau.
State of Missouri vs. B. Surkamp.
State of Missouri vs. F. H. Heehs.
State of Missouri vs. L. F. Meyerhoff.
State of Missouri vs. Stocker Bros. Grocer Company.
State of Missouri vs. Henry W. Meyer.
State of Missouri vs. John C. Duemler.
State of Missouri vs. Schrieber Bros.
State of Missouri vs. Thomas McCormack.
State of Missouri vs. Aug. F. Reller & Son.

All of the above cases have not been disposed of. Twelve of them remain to be tried. The rest have been disposed of. A verdict in favor of the State was obtained in four of the cases. No appeal by the defendant was taken. The judgments were paid. The State lost three cases before a jury in the justice court, and an appeal was taken in each of them. Mr. R. D. Ellis, the attorney, informs me the three appealed cases will not come up for trial in the circuit court till the latter part of January or first part of February, 1902. If the State obtains a favorable verdict in these cases, the sale of oleomargarine will rapidly diminish. There will be no doubt, then, of the validity of the new law, and not much difficulty of securing a conviction for all violations.

While there are more wholesalers there are not so many retailers, as there were this time last year. Some of the retailers have agreed to sell only uncolored goods, among them being Louis Meinecke, 1017 N. Vandeventer Ave., and the Graffman Dairy Company at 2020 and 1700 Franklin Ave. Both of these are very large dealers. On the whole, the prospects for a diminished sale of oleomargarine are very much brighter. As soon as the law allowing civil suits to be brought in the justice court has been declared constitutional, all we have to do to stop the sale of oleo in such large quantities is to make a vigorous prosecution for all violations of the law.

Very respectfully,

JNO. H. WILKINSON.

OLEOMARGARINE INSPECTION IN KANSAS CITY.

When the present Inspector was appointed last May, he found that fifty-three licenses had been issued during the year. That oleomargarine was being sold in many places for genuine butter, and no attempt was being made to even comply with the Federal law in putting the required label "Oleomargarine, etc.," upon the retail packages. Two months, perhaps, were spent interviewing the violators of the oleomargarine law with the result that many abandoned the oleomargarine business entirely.

The criminal court docket being crowded, Prosecutor Hadley has advised that the oleomargarine cases be filed in the several justice courts, with the hope that justice might be had there without having to take the criminal court's time with these prosecutions. Of seven cases filed in the justice court, four have been tried and lost, two others dismissed by the State, and one is still pending. In every instance but one, defendants take a change of venue, barring every justice in the city, but one particular justice, in whose court the State has never won an oleomargarine case. It is our hope that when the case now pending in the justice court is finally disposed of that we will have sufficiently demonstrated to the prosecutor that justice in these cases cannot be had in the justice courts. The late law provides for a civil action against violators of the oleomargarine law. Under this act six cases are now pending in the circuit court and two in the justice court. These civil actions in the justice court are appealable to the circuit court. One case was taken where the Federal law was being violated. Defendant in this case quit the business, plead guilty to the charge and was fined by the court.

The results of this work show that the better class of dealers have ceased to handle oleomargarine in violation of the law. That all of the dealers are now complying with the Federal law, labeling the retail packages. We further find that the number of retail licenses in Kansas City have decreased. That convictions are easily obtained before an impartial court or jury. The butter dealers say that the market is now in better shape than it has been in a number of years.

Respectfully submitted,

FRANK YEOMAN, Inspector.

The Auditing Committee, appointed by the President to examine the books of the Secretary and Treasurer, made the following report:

REPORT OF AUDITING COMMITTEE.

We, the undersigned committee authorized to examine vouchers in the hands of the Secretary and warrants paid and returned by the Treasurer and compare these with the financial statement, after a careful examination, submit the following report: The books in the Secretary's and Treasurer's office were found to correspond and vouchers approved by the Executive Committee were exhibited covering all expeditures reported in the financial statement. We find the following balances in the hands of our treasurer to the credit of the several funds:

Monthly Crop Report Fund	$106 12
Expense of Members' Fund	449 27
Office Expense Fund	136 34
State Veterinary Fund	377 30
Butterine Fund	286 66
Farmers' Institute Fund	691 37

The money appropriated has been expended so as to meet all requirements. No deficit is charged to any of the funds. All of which is respectfully submitted.

F. J. HESS,
W. C. HOWELL,
ARTHUR T. NELSON.

Report unanimously adopted.

Recess taken until 7:30 p. m.

December 17th, 7:30 p. m.

Board called to order by President.

Committee appointed to examine and report upon the work of the Agricultural and Mechanical College and Experiment Station, submitted the following report:

REPORT OF AGRICULTURAL COLLEGE COMMITTEE.

We, your committee to whom was assigned the duty of examining into the affairs of the College of Agriculture and Mechanic Arts, including the Experiment Station, as provided by law, beg leave to submit the following report:

We find the College of Agriculture and Mechanic Arts to consist of:

(a) School of Agriculture.
(b) Experiment Station.
(c) School of Mechanic Arts.
(d) School of Engineering.
(e) School of Architecture.

We find the School of Agriculture to consist of the following departments:

(1) Agriculture, with two professors, one instructor and two student assistants, having 160 students.
(2) Horticulture, with one professor, two non-resident lecturers, having 130 students.
(3) Entomology, with one professor and one student assistant, having 38 students.
(4) Veterinary Medicine, with one professor and one student assistant, having 35 students.
(5) Dairying, with one professor and one instructor. Being a recently organized department, the courses will not open until the first of January, 1902.
(6) Agricultural Chemistry, with one professor and one instructor, having about 40 students.
(7) Domestic Economy, with one professor, having 16 students. This department was organized last year.
(8) Botany, with one professor, having 82 students.
(9) Commercial, with one instructor, having 82 students.

Experiment Station work is divided into Agriculture, Horticulture, Entomology, Veterinary Science, Dairying, and Agricultural Chemistry, and at least half of the time of the officers for these departments enumerated above is devoted to investigations along these lines.

We find the School of Mechanic Arts to consist of:

(1) Shop-work, including carpentry, blacksmithing, wood-turning, pattern making, machine design and machine shop, with one instructor, and three student assistants, having 237 students.

(2) Drawing, including mechanical, agricultural, machine design, with one professor and one student assistant, having 160 students.

We find the School of Engineering to consist of the following departments:

(1) Civil Engineering, with one professor, one instructor and two student assistants, having 69 students.

(2) Electric Engineering, with one professor, having 48 students.

(3) Mechanical Engineering, with one professor, having 30 students.

The number of students enumerated here is taken from last year's catalogue. We could not determine the enrollment in all of the departments this year, owing to the fact that some of the courses are offered in the second semester only.

A SUMMARY OF THE RECEIPTS AND EXPENDITURES OF THE COLLEGE OF AGRICULTURE AND MECHANIC ARTS FOR 1901.

We herewith submit a statement of the receipts and expenditures of the fund of the College of Agriculture and Mechanic Arts, exclusive of the Experiment Station, together with the apportionment of these funds between the College and University:

INCOME.

From Morrill Fund—U. S. Appropriation—after deducting one-fourth which goes to Rolla	$17,578 00
Land Grant Endowment, after deducting one-fourth which goes to Rolla	13,120 50
Incidental fees from students	750 00
	$31,448 50

EXPENDITURES.

Salaries of Technical Men.

	Paid out of College of Agr. fund	Paid out of Experiment Sta. fund.
Dean	$1,250 00	$1,250 00
Professor of Agriculture	2,200 00	
Two student assistants	160 00	
One assistant in agriculture to Exp. Station	....	720 00
Horticulture—Professor	1,100 00	1,100 00
Assistant to Station	....	600 00
Non-resident lecturers	400 00	
Entomology—Professor	1,100 00	1,100 00
Student assistant	....	200 00
Agr. Chemistry	1,100 00	1,100 00
Assistant Chemist to Station	....	900 00
Veterinary Science	1,100 00	1,100 00
Student assistant	....	300 00
Drawing	1,350 00	
Mechanical Engineering	2,000 00	
Civil Engineering (2)	3,100 00	
Electrical Engineering	2,000 00	
Shop Work (4)	1,100 00	
Commercial Work	800 00	
Stenographer	300 00	300 00
Household Economics	1,300 00	
Botany	1,200 00	
Dairying	300 00	
	$21,860 00	$8,670 00

Salaries of Non-technical Men.

	Total Cost of Dep't to University.	Amt. paid by College of Agriculture.
English	$6,000 00	$1,250 00
Mathematics	4,100 00	1,250 00
Geology and Mineralogy	2,150 00	125 00
Physics	4,150 00	1,000 00
Biology	3,200 00	500 00
General Chemistry	5,400 00	1,000 00
Economics and History	5,200 00	125 00
Bacteriology	2,200 00	
Pedagogy	2,000 00	
Physiology	2,200 00	
Totals	$36,600 00	$5,250.00

	Whole University.	A. and M. College.
Current expenses, such as heating, repairs to buildings, campus, insurance, printing, advertising, etc., etc	$40,000 00	$7,000 00
Fund set aside for equipment of Agriculture College		1,100 00
		$8,100 00
Grand total of expenditures of A. and M. College		$35,210 00
Total receipts		31,448 50
Overdraft on University fund		$3,761 50

From the above it is seen that the fixed income of the College of Agriculture and Mechanic Arts is insufficient to maintain all of its departments as at present organized.

IMPROVEMENTS DURING THE YEAR.

We find that the following improvements in the material equipment of the College are now being made through the liberality of the 41st General Assembly:

1. A building for instruction and scientific investigation in dairying, and a building for work in veterinary science and live stock judging. These two buildings are being erected on the College Farm, of stone, at a cost of $40,000.

2. A building for horticulture and entomology on the Horticultural grounds, of stone, to cost, with the equipments, $40,000.

3. An engineering laboratory to be built on the campus, to cost, with the equipment, $40,000.

The 41st General Assembly appropriated $5,000 for the establishment of a department of dairying, $3,500 for enlargement of the experimental work of the College, and $1,200 for student labor. None of these appropriations have been included in the foregoing financial exhibit, for the reason that only a small proportion of these moneys has been expended up to this time.

In addition to the foregoing statement of receipts and expenditures of the College of Agriculture, the Experiment Station receives an annual appropriation of $15,000 from the United States Government, which is expended in investigations in stock feeding, farm crops, soil fertility, the control of animal diseases, fruit and vegetable growing, spraying against fungous diseases and insect pests, etc., the results of which are published in quarterly bulletins and distributed to the farmers of the State.

We find the Agricultural Farm and Horticultural Grounds in excellent condition; the Agricultural, Engineering and Mechanic Arts Buildings well arranged and equipped for their several purposes. So far as we are able to determine, the work in all departments is in efficient hands. The fact that three of its graduates have been recently called to fill important positions in the Argicultural Colleges of Kentucky, Pennsylvania and Georgia, is an indication of the high standing of this institution.

We cannot in too strong terms endorse the action of the college in offering the short terms in Agriculture, Horticulture and Dairying for the benefit of farmers and farmers' boys, who cannot take the long course, and also for offering in the Summer School instruction in Agriculture and Horticulture to the teachers of the State. We believe that it can be made still more helpful by providing one instructor for each of several Summer Schools to be organized in different sections of the State, and by preparing and publishing free to the 12,000 rural teachers of the State a monthly nature study bulletin.

We believe that the interests of agriculture and horticulture in the State, and of the Agricultural College, will be best subserved when the teachers of the State are prepared to do efficient work in nature study in rural schools. Hence we insist that it is the duty of the Agricultural College to take advantage of every means of helping the teachers to better prepare themselves for this work, and thereby secure the co-operation of all of the public school interests of the State, for the reason that the professors of the Agricultural College are certainly the best equipped people in the State to do the work in these summer schools and in preparing the above mentioned bulletins. The cost of such bulletins would not be great, since the work could be done without extra cost, except for printing and distribution. To this end we recommend that a committee of three members of this Board be appointed to present the matters of summer schools and nature study bulletin to the Board of Curators.

One of the most important departments of such an institution is bacteriology, as it is related to the animal industry, dairying and plant life, and, as we find no such department connected with it, we hope that the Board of Curators will take steps to establish such a department at the earliest moment possible. Very respectfully submitted,

W. T. CARRINGTON,
W. C. HOWELL,
A. T. NELSON,
Committee

After discussion by W. T. Carrington and H. J. Waters, the report was unanimously adopted.

Mr. Carrington moved that a committee of three be appointed to draft cattle quarantine regulations. Motion carried. President appointed on the committee Geo. B. Ellis, H. J. Waters and Dr. D. F. Luckey.

ELECTION OF OFFICERS.

The following officers were elected to serve the Board for the ensuing year:

President, W. R. Wilkinson, St. Louis.
Vice-President, F. J. Hess, Charleston.
Secretary, Geo. B. Ellis, Appleton City.
Assistant Secretary, Miss S. B. Willis, Columbia.
Treasurer, H. H. Banks, Columbia.

EXECUTIVE COMMITTEE.

W. R. Wilkinson, St. Louis.
F. J. Hess, Charleston.
H. J. Waters, Columbia.
W. L. Bryant, Independence.
Wm. C. Howell. Ulman.

On motion of Mr. Carrington, the Board took recess to permit a meeting of the State fair directory.

Board called to order by the President after recess of one hour.

Committee appointed to draft cattle quarantine regulations submitted the following report:

REPORT OF COMMITTEE ON CATTLE QUARANTINE REGULATIONS.

That the cattle industry of the State may be more fully protected against southern or splenetic fever, we do hereby declare the following quarantine line and regulations, which shall be enforced from and after the date hereof, unless changed by the order of the State Board of Agriculture.

All that country lying south of or below the following described line shall be considered infected territory, and cattle from said country shall not be brought into Missouri only upon the condition and under the regulations herein provided:*

* * * * * *

First—Cattle from the above described infected territory shall not be transferred on foot into or through the State of Missouri, nor kept, grazed or watered on public ranges, unfenced land, State lands, highways, or within the corporate limits of any town or city within the State except as hereinafter provided.

Second—All cars carrying cattle that have been brought from the above described territory into or through the State of Missouri, shall bear a placard setting forth plainly in large letters that said car contains southern cattle, and each way-bill of each shipment shall have a note upon its face with a similar statement. And when said cattle shall be unloaded at any point in this State for any purpose whatsoever, the places occupied by the animals shall be considered infectious grounds, subject to quarantine, and shall be immediately set apart by the owners or lessees of the property for the accommodation of southern cattle, and no other cattle shall be admitted thereto.

Third—All the stock yards which shall keep or receive southern cattle for trade or transit within Missouri shall provide for use a sufficient number of pens, to be used exclusively for the accommodation of cattle coming from within the territory above described. Such pens shall be marked or designated by reasonably large signs, conspicuously posted, and bearing in plain and large letters the words "Southern Cattle Pens."

Fourth—Cattle brought by boat from infected districts or all cattle on board boats that are carrying infected cattle shall be unloaded only at such points in this State as are provided with southern cattle pens sufficient for their reception, and the unloading and transferring from the landing to the stock yards must be under the instructions and regulations provided by an inspector of this department.

Fifth—The cars and boats used to transport such animals, the chutes, alleyways, and the pens used during transportation and at points of destination, shall be disinfected in the following manner:

(a) Remove all litter and manure. This litter and manure may be disinfected by mixing it with lime or saturating it with a five per cent solution of 100 per cent carbolic acid or if not disinfected it may be stored where no other cattle can come in contact with it.

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*NOTE—The line adopted and described is the same as the United States quarrantine line. which traverses the southern border of Missouri.

(b) Wash the cars and the feeding and watering troughs with water until clean.

(c) Saturate the entire interior surface of the car, and the fencing, troughs and chutes of the pens with a mixture made of 1½ pounds of lime and one quarter pound of 100 per cent of straw-colored carbolic acid to each gallon of water; or a solution made by dissolving 4 ounces of choloride of lime to each gallon of water may be used; or disinfect the cars with a jet of steam under a pressure of not less than 50 pounds to the square inch.

Sixth—It having been demonstrated beyond further controversy that the southern cattle tick (Boophilus bovis) is a means of disseminating southern or splenetic fever, it is ordered that all cattle infested with these ticks without regard to the territory whence they originated, and cars and boats used for transporting them, shall be subject to all the rules and regulations herein provided governing the movement of southern cattle.

Seventh—Southern cattle, if upon examination by a live stock inspector of this State or by a duly authorized agent of the Bureau of Animal Industry of the United States Department of Agriculture are found free of Texas fever infection and not infested with Texas ticks (Boophilus bovis) may be admitted to this State as natives during the months of November, December, January, February and March of each year, or during such time as is provided by the Federal quarantine regulations for the admission of southern cattle. Provided, first that such cattle be rounded up and placed in an enclosure where the examination can be thorough and sufficient; second, that no examination shall be made and no permit shall be issued for such cattle until they are ready for immediate shipment or movement into the State; third, the cattle after the examination must not be driven through nor unloaded from cars in infected territory, and cars used for shipping must be free from infection.

Eight—The townships of Lowell, Garden and Spring Valley in Cherokee county, Kansas, shall be considered infectious territory, and cattle originating therein may be admitted to this State as natives only upon permits issued by a live stock inspector of this State or by the live stock sanitary authorities of Kansas.

Ninth—The State Veterinarian and all deputy veterinarians and all live stock inspectors in the employ of this department are charged with the enforcement of these regulations and are hereby empowered to quarantine all cattle brought into this State in violation thereof and to remove from the native to the southern division of any stock yard in this State any such cattle or others that may be infested with Texas ticks or capable of spreading infection to native cattle.

The Executive Committee of the State Board of Agriculture is hereby authorized to make any changes in the above quarantine line and in the quarantine regulations herein described that may hereafter become necessary to fully protect the cattle interests of Missouri.

Note—These regulations are adopted by authority of Section 10551, Revised Statutes of Missouri, 1899, which provides a penalty for violation of a fine of not less than $1,000, nor more than $10,000 for each and every offense, to be recovered in any county into or through which such stock is brought.

Sheriffs and constables in Missouri are hereby directed to enforce these regulations and to arrest any and all parties who may be guilty of violation thereof.

Respectfully submitted.

GEO. B. ELLIS,
H. J. WATERS,
D. F. LUCKEY,
Committee.

On motion of Mr. Maitland, the regulations as reported by the committee were unanimously adopted.

The President appointed the following committee to draft suitable resolutions on the death of Hon. A. Nelson, member of the Board.

Prof. W. T. Carrington.
H. F. Hand.
Dean H. J. Waters.

On motion, the President appointed the following committee to draft resolutions in regard to pure food legislation:

W. T. Carrington.
John W. Hill.
H. F. Hand.

The Board took a recess until 8 a. m., Wednesday.

Wednesday, Dec. 17th, 8 a. m.

Board called to order by the President. Committee on death of A. Nelson submitted the following report, which was unanimously adopted:

REPORT OF COMMITTEE ON RESOLUTIONS.

Whereas, It has pleased our Heavenly Father to remove from among us one of our number, the Hon. A. Nelson of Lebanon, one of the most earnest horticulturists of the State, a man thoroughly devoted to his duties as member of the Board of Agriculture, and to the State's material development; therefore, be it

Resolved, That we hereby express our sincere condolence to his family and regret that Providence in His wisdom has seen fit to deprive us of his counsel and assistance, and further recommend that a copy of this resolution be sent to his family and also spread upon the records of this Board.

W. T. CARRINGTON,
H. F. HAND,
H. J. WATERS,
Committee.

The Committee on Pure Food Legislation made the following report, which was unanimously adopted:

REPORT OF COMMITTEE ON PURE FOOD LEGISLATION.

Whereas, there are now pending in Congress certain bills, the objects of which are to prevent the sale of fraudulent imitations of butter; therefore, be it

Resolved, That the Missouri State Board of Agriculture convened in annual session, does hereby declare that it is opposed to the manufacture and sale of imitations of pure food in any form whatsoever, and requests our Senators and members of Congress to use all legitimate means to secure the passage of a law by Congress, similar to what is known as "The Grout Bill," and that our Secretary be instructed to furnish a copy of this resolution to each Senator and Representative in Congress from Missouri, and to the press of the State. Respectfully submitted,

J. W. HILL,
H. F. HAND,
W. T. CARRINGTON,
Committee.

On motion of W. T. Carrington, a committee was appointed to present to the Board of Curators the suggestions contained in the report of Agricultural College Committee, that the Board of Curators set aside $500 to pay for printing a Nature Study Bulletin to be edited by the Faculty of the College of Agriculture.

The President appointed W. T. Carrington and Geo. B. Ellis on the committee.

There being no further business, the meeting adjourned.

GEO. B. ELLIS,
Secretary.

W. R. WILKERSON,
President.

SECRETARY'S FINANCIAL STATEMENT.

DISTRIBUTION OF ANNUAL REPORT FUND.

Date.	No. War.	Name.	Dr.	Cr.
1901.				
Apr. 3..	....	To Requisition	$150 00	
Sept. 12..	106	By American Express Co		$51 27
Sept. 12..	107	By E. F. Ammerman		98 73
			$150 00	$150 00

MONTHLY CROP REPORT FUND.

Date.	No. War.	Name.	Dr.	Cr.
1901.				
Jan. 1..	....	To Balance	$169 73	
Apr. 3..	....	To Requisition	100 00	
Apr. 3..	218	By S. H. Elkins		$21 00
Apr. 3..	219	By Missouri Statesman		4 50
Apr. 3..	220	By S. H. Elkins		25 00
May 1..	....	To Requisition	100 00	
May 1..	221	By E. W. Stephens		123 10
May 1..	222	By W. E. Harshe		3.10
June 5..	....	To Requisition	100 00	
June 5..	223	By Missouri Statesman		9 50
June 5..	224	By S. H. Elkins		64 80
June 5..	225	By American Roll Paper Co		6 00
July 3..	226	By S. H. Elkins		12 00
July 3..	227	By Missouri Statesman		69 80
Aug. 7..	....	To Requisition	100 00	
Aug. 7..	228	By S. H. Elkins		15 44
Aug. 7..	229	By Missouri Statesman		80 45
Aug. 7..	230	By A. B. Dick Co		16 00
Sept. 12..	....	To Requisition	100 00	
Sept. 12..	231	By S. H. Elkins		13 00
Sept. 12..	232	By Missouri Statesman		4 50
Sept. 12..	233	By S. H. Elkins		20 00
Oct. 5..	....	To Requisition	100 00	
Oct. 5..	234	By Smith-Premier Typewriter Co		1 50
Oct. 5..	235	By S. H. Elkins		4 05
Oct. 5..	236	By Missouri Statesman		53 50
Oct. 5..	237	By S. H. Elkins		42 40
Oct. 5..	238	By S. H Elkins		18 20
Nov. 6..	....	To Requisition	100 00	
Nov. 6..	239	By Missouri Statesman		60 50
Nov. 6..	240	By F. O. Sawyer, Paper Co		21 77
Nov. 6..	241	By J. Manz Engraving Co		3 45
Dec. 3..	242	By S. H. Elkins		3 65
Dec. 3..	243	By Missouri Statesman		66 40
Dec. 3..	....	By Balance		106 12
			$869 73	$869 73

EXPENSE OF MEMBERS' FUND.

Date.	No. War.	Name.	Dr.	Cr.
1901.				
Jan. 1..	....	To Balance..........	$415 32	
Jan. 1..	410	By Geo. B. Ellis..........	....	$4 00
Jan. 1..	411	By W. R. Wilkinson..........	....	11 70
Jan. 1..	412	By D. A. Ely..........	....	10 50
Jan. 1..	413	By C. P. Cook..........	....	25 10
Feb. 6..	414	By W. R. Wilkinson..........	....	10 85
Feb. 6..	415	By H. J. Waters..........	....	6 80
Feb. 6..	416	By D. A. Ely..........	....	16 00
Feb. 6..	417	By F. L. Luthy..........	....	15 00
Feb. 6..	418	By T. B. North..........	....	8 00
Feb. 6..	419	By Geo. B. Ellis..........	....	19 50
Feb. 6..	420	By C. P. Cook..........	....	22 50
Mch. 6..	421	By C. P. Cook..........	....	27 45
Mch. 6..	422	By J. W. Hill..........	....	18 00
Mch. 6..	423	By W. R. Wilkinson..........	....	12 00
Mch. 6..	424	By H. J. Waters..........	....	8 10
Mch. 6..	425	By Geo. B. Ellis..........	....	5 50
Apr. 3..	426	By D. A. Ely..........	....	11 00
Apr. 3..	427	By W. R. Wilkinson..........	....	11 20
May 1..	428	By D. A. Ely..........	....	11 00
May 1..	429	By F. J. Hess..........	....	26 80
May 1..	430	By W. R. Wilkinson..........	....	11 20
June 5..	....	To Requisition..........	100 00	
June 5..	431	By D. A. Ely..........	....	21 05
Aug. 7..	432	By H. J. Waters..........	....	14 95
Aug. 7..	433	By Geo. B. Ellis..........	....	10 00
Aug. 7..	434	By W. R. Wilkinson..........	....	6 25
Aug. 7..	435	By D. A. Ely..........	....	15 10
Sept. 12..	....	To Requisition..........	200 00	
Sept. 12..	436	By W. T. Carrington..........	....	6 60
Sept. 12..	437	By W. R. Wilkinson..........	....	8 80
Sept. 12..	438	By Chas. L. Boisselier..........	....	12 65
Sept. 12..	439	By J. J. McNatt..........	....	9 95
Sept. 12..	440	By W. L. Bryant..........	....	7 10
Sept. 12..	441	By A. Nelson..........	....	18 20
Sept. 12..	442	By C. M. O'Connell..........	....	15 20
Sept. 12..	443	By W. C. Howell..........	....	8 85
Sept. 12..	444	By Geo. B. Ellis..........	....	15 35
Sept. 12..	445	By H. F. Hand..........	....	5 50
Sept. 12..	446	By H. J. Waters..........	....	5 45
Sept. 12..	447	By D. A. Ely..........	....	29 30
Oct. 5..	448	By Geo. B. Ellis..........	....	10 70
Oct. 5..	449	By F. J. Hess..........	....	16 90
Nov. 6..	....	To Requisition..........	300 00	
Nov. 6..	450	By F. J. Hess..........	....	16 20
Nov. 6..	451	By H. J. Waters..........	....	12 50
Nov. 6..	452	By Geo. B. Ellis..........	....	7 25
Dec. 3..	....	By Balance..........	....	449 27
			$1,015 32	$1,015 32

OFFICE EXPENSE FUND.

Date.	No. War.	Name.	Dr.	Cr.
1901.				
Jan. 1..	....	To Balance	$71 22	
Jan. 1..	365	By Lelia B. Willis		$10 00
Jan. 1..	366	By Sam Berry		15 00
Jan. 1..	367	By W. E. Harshe		1 75
Feb. 6..	368	By S. P. Howell		8 70
Feb. 6..	369	By Sam Berry		9 45
Feb. 6..	370	By Lelia B. Willis		10 00
Mch. 6..	371	By S. P. Howell		16 11
Apr. 3..	....	To Requisition	100 00	
May 1..	....	Requisition	100 00	
May 1..	372	By Snowdon Willis		30 00
May 1..	373	By S. P. Howell		30 90
June 5..	374	By Snowdon Willis		10 00
June 5..	375	By S. P. Howell		15 15
June 5..	376	By S. H. Elkins		10 90
June 5..	377	By Columbia Telephone Co		6 00
June 5..	378	By W. E. Harshe		2 50
July 3..	....	To Requisition	100 00	
July 3..	379	By S. P. Howell		15 75
July 3..	380	By Columbia Gasworks		3 30
July 3..	381	By Snowdon Willis		10 00
July 3..	382	By Wyckoff, Seamens & Benedict		3 42
Aug. 7..	383	By Columbia Telephone Co		6 35
Aug. 7..	384	By W. E. Harshe		1 25
Aug. 7..	385	By Snowdon Willis		10 00
Aug. 7..	386	By S. P. Howell		16 05
Aug. 7..	387	By J. W. Strawn		15 60
Aug. 7..	388	By S. H. Elkins		15 00
Sept. 12..	....	To Requisition	100 00	
Sept. 12..	389	By W. E. Harshe		5 40
Sept. 12..	390	By S. P. Howell		15 40
Sept. 12..	391	By Snowdon Willis		10 00
Sept. 12..	392	By O. C. Newman & Co		4 10
Sept. 12..	393	By S. H. Elkins		30 00
Oct. 5..	394	By S. P. Howell		15 90
Oct. 5..	395	By Snowdon Willis		10 00
Nov. 6..	....	To Requisition	100 00	
Nov. 6..	396	By S. P. Howell		17 00
Nov. 6..	397	By Snowdon Willis		10 00
Nov. 6..	398	By A. B. Dick Co		4 25
Nov. 6..	399	By S. H. Elkins		2 40
Nov. 6..	400	By Columbia Telephone Co		7 05
Nov. 6..	401	By W. E. Harshe		5 10
Dec. 3..	402	By Snowdon Willis		10 00
Dec. 3..	403	By S. P. Howell		15 10
Dec. 3..	....	By Balance		136 34
			$571 22	$571 22

STATE VETERINARY FUND.

Date.	No. War.	Name.	Dr.	Cr.
1900.				
Dec. 18..	....	To Balance	$1,163 76	
Dec. 19..	1122	By H. H. Banks		$32 94
Dec. 19..	1123	By C. M. O'Connell		25 80
Dec. 19..	1124	By Eugene Rhoades		25 00
Dec. 19..	1125	By L. F. Luthy		9 10
Dec. 19..	1126	By W. R. Wilkinson		16 15
Dec. 19..	1127	By George B. Ellis		11 50
Dec. 19..	1128	By N. J. Colman		6 00
Dec. 19..	1129	By O. P. Cook		27 54
Dec. 19..	1130	By Alex Maitland		7 50
Dec. 19..	1131	By N. H. Gentry		4 10
Dec. 19..	1132	By W. T. Carrington		4 60
Dec. 19..	1133	By John W. Hill		15 00
Dec. 19..	1134	By F. J. Hess		25 40
Dec. 19..	1135	By T. B. North		18 45
Dec. 19..	1136	By J. A. Potts		6 50
Dec. 19..	1137	By D. A. Ely		14 00
1901.				
Jan. 1..	1138	By John Forbes		25 00
Jan. 1..	1139	By Geo. H. Boughner		25 00
Jan. 1..	1140	By Joseph Bruser		25 00
Jan. 1..	1141	By M. L. Blackwell		50 00
Jan. 1..	1142	By D. F. Luckey		217 30
Jan. 1..	1143	By Jesse Robards		125 05
Jan. 1..	1144	By G. G. Henry		120 25
Jan. 1..	1145	By Ira Fenimore		104 43
Jan. 1..	1146	By J. A. Eylar-Smith Premier Typewriter Co		47 75
Feb. 6..	1147	By M. L. Blackwell		50 00
Mch. 6..	1148	By Columbia Telephone Co		6 00
Mch. 6..	1149	By E. F. Ammerman		15 46
Mch. 6..	1150	By D. F. Luckey		75 00
Mch. 6..	1151	By M. L. Blackwell		3 44
Apr. 3..	....	To Requisition	3,000 00	
Apr. 3..	1152	By W. E. Harshe		2 25
Apr. 3..	1153	By S. H. Elkins		20 00
May 1..	....	To Requisition	1,000 00	
May 1..	1154	By M. L. Blackwell		150 00
May 1..	1155	By John Forbes		100 00
May 1..	1156	By G. H Boughner		75 00
May 1..	1157	By Joseph Bruser		75 00
May 1..	1158	By G. G. Henry		253 65
May 1..	1159	By E. M. Hendy		79 02
May 1..	1160	By R. B. Love		24 50
May 1..	1161	By D. F. Luckey		870 75
May 1..	1162	By B. F. Milstead		231 49
May 1..	1163	By I. O. Fenimore		309 15
May 1..	1164	By Jesse Robards		505 08
May 1..	1165	By E. F. Ammerman		5 76
May 1..	1166	By Andrew Brown		75 00
June 5..	....	To Requisition	500 00	
June 5..	1167	By George H. Boughner		50 00
June 5..	1168	By Joseph Bruser		50 00
June 5..	1169	By S. H. Elkins		3 07
June 5..	1170	By M. L. Blackwell		50 00
June 5..	1171	By Andrew Brown		104 85
June 5..	1172	By G. G. Henry		10 00
June 5..	1173	By B. F. Milstead		114 40
June 5..	1174	By D. F. Luckey		160 70
June 5..	1175	By E. M. Hendy		41 85
June 5..	1176	By Jesse Bobards		108 00
June 5..	1177	By John Forbes		25 00
July 3..	....	To Requisition	1,000 00	
July 3..	1178	By D. F. Luckey		208 77
July 3..	1179	By E. Brainerd		24 85
July 3..	1180	By Andrew Brown		98 25
July 3..	1181	By Jesse Robards		110 00
July 3..	1182	By E. W. Stephens		58 50
July 3..	1183	By E. M. Hendy		19 15
July 3..	1184	By G. H. Boughner		25 00
July 3..	1185	By John Forbes		25 00
July 3..	1186	By B. F. Milstead		112 00
July 3..	1187	By M. L. Blackwell		50 00
July 3..	1188	By Joseph Bruser		25 00
Aug. 7..	....	To Requisition	500 00	
Aug. 7..	1189	By M. L. Blackwell		50 00
Aug. 7..	1190	By E. F. Ammerman		8 18
Aug. 7..	1191	By Geo. H. Boughner		25 00
Aug. 7..	1192	By John Forbes		25 00
Aug. 7..	1193	By Joseph Bruser		25 00
Aug. 7..	1194	By D. F. Luckey		257 86

STATE VETERINARY FUND—Continued.

Date.	No. War.	Name.	Dr.	Cr.
1900.				
Aug. 7..	1195	By B. F. Milstead		$118 27
Aug. 7..	1196	By Andrew Brown		103 00
Aug. 7..	1197	By R. B. Love		33 22
Aug. 7..	1198	By S. H. Elkins		20 00
Sept. 12..	....	To Requisition	1,000 00	
Sept. 12..	1199	By M. L. Blackwell		50 00
Sept. 12..	1200	By S. H. Elkins		28 84
Sept. 12..	1201	By S. H. Elkins		5 00
Sept. 12..	1202	By Missouri Statesman		56 00
Sept. 12..	1203	By E. Brainerd		13 49
Sept. 12..	1204	By E. W. Stephens		11 25
Sept. 12..	1205	By B. F. Milstead		112 65
Sept. 12..	1206	By Jesse Robards		111 25
Sept. 12..	1207	By Jesse Robards		111 35
Sept. 12..	1208	By G. H. Boughner		25 00
Sept. 12..	1209	By John Forbes		25 00
Sept. 12..	1210	By Joseph Bruser		25 00
Sept. 12..	1211	By D. F. Luckey		260 32
Sept. 12..	1212	By E. F. Ammerman		5 34
Sept. 12..	1213	By American Express Co		49 46
Oct. 5..	....	To Requisition	300 00	
Oct. 5..	1214	By E. F. Ammerman		9 43
Oct. 5..	1215	By John Forbes		25 00
Oct. 5..	1216	By Joseph Bruser		25 00
Oct. 5..	1217	By G. H. Boughner		25 00
Oct. 5..	1218	By B. F. Milstead		112 29
Oct. 5..	1219	By Jesse Robards		124 00
Oct. 5.	1220	By R. B. Love		41 05
Oct. 5..	1221	By D. F. Luckey		200 84
Oct. 5..	1222	By M. L. Blackwell		50 00
Oct. 5..	1223	By E. M. Hendy		15 80
Nov. 6..	....	To Requisition	500 00	
Nov. 6..	1224	By M. L. Blackwell		50 00
Nov. 6..	1225	By John Forbes		25 00
Nov. 6..	1226	By Geo. H. Boughner		25 00
Nov. 6..	1227	By Joseph Bruser		25 00
Nov. 6..	1228	By D. F. Luckey		150 00
Nov. 6..	1229	By E. F. Ammerman		12 00
Nov. 6..	1230	By American Express Co		14 55
Nov. 6..	1231	By Jesse Robards		122 50
Nov. 6..	1232	By B. F. Milstead		114 70
Dec. 3..	....	To Requisition	300 00	
Dec. 3..	1233	By Geo. H. Boughner		25 00
Dec. 3..	1234	By Joseph Bruser		25 00
Dec. 3..	1235	By John Forbes		25 00
Dec. 3..	1236	By M. L. Blackwell		50 00
Dec. 3..	1237	By S. B. Cook		3 70
Dec. 3..	1238	By E. M. Hendy		14 35
Dec. 3..	1239	By F. W. O'Brien		22 46
Dec. 3..	1240	By R. B. Love		92 19
Dec. 3..	1241	By E. Brainerd		19 79
Dec. 3..	1242	By E. M. Hendy		35 20
Dec. 3..	1243	By B. F. Milstead		105 50
Dec. 3..	1244	By D. F. Luckey		59 45
Dec. 3..	1245	By E. F. Ammerman		21 12
Dec. 3..	1246	By D. F. Luckey		150 00
Dec. 3..	1247	Ry Jesse Robards		124 75
Dec. 3..	....	By Balance		377 30
			$9,263 76	$9,263 76

BUTTERINE FUND.

Date.	No. War.	Name.	Dr.	Cr.
1901.				
Jan. 1..	....	To Balance	$1,073 68	
Jan. 1..	290	By H. H. Banks		$9 92
Jan. 1..	291	By J. R. Rippey		50 00
Jan. 1..	292	By Carl G. Hinrichs		35 00
Jan. 1..	293	By Thomas Davies		52 00
Jan. 1..	294	By L. F. Luthy		42 50
Jan. 1..	295	By R. L. Wright		44 30
Jan. 1..	296	By F. M. Slutz		11 85
Jan. 1..	297	By ——Hackley		4 00
Jan. 1..	298	By R. D. Ellis		80 00
Feb. 6..	299	By L. F. Luthy		43 05
Feb. 6..	300	By R. L. Wright		44 45
Feb. 6..	301	By J. W. Carter		30 00
Feb. 6..	302	By Olney Burrus		2 00
Feb. 6..	303	By Geo. B. Ellis		50 00
Feb. 6..	304	By Thos Davies		52 30
Mch. 6..	305	By L. F. Luthy		62 75
Mch. 6..	306	By R. L. Wright		42 50
Mch. 6..	307	By Thos. Davies		48 00
Mch. 6..	308	By H. C. Arnold		1 50
Mch. 6..	309	By Geo. B. Ellis		50 00
Apr. 3..	....	To Requisition	500 00	
Apr. 3..	310	By J. W. Carter		25 00
Apr. 3..	311	By R. L. Wright		42 50
Apr. 3..	312	By Thos. Davies		52 45
Apr. 3..	313	By L. F. Luthy		37 40
Apr. 3..	314	By Geo. B. Ellis		50 00
May 1..	315	By R. D. Ellis		60 00
May 1..	316	By Carl G. Hinrichs		15 00
May 1..	317	By J. W. Carter		50 00
May 1..	318	By Thos Davies		53 50
May 1..	319	By Mrs. Lutie Ward		5 00
May 1..	320	By C. G. Miller		1 00
May 1..	321	By R. L. Wright		55 00
May 1..	322	By F. M. Slutz		5 00
May 1..	323	By John H. Wilkinson		54 95
May 1..	324	By Geo. B. Ellis		8 00
June 5..	325	By Frank Yeoman		42 00
June 5..	326	By Geo. B. Ellis		4 75
June 5..	327	By John H. Wilkinson		54 00
July 3..	....	To Requisition	500 00	
July 3..	328	By Missouri Statesman		4 00
July 3..	329	By Frank Yoeman		50 00
July 3..	330	By C. A. McCrum		1 20
July 3..	331	By John L. Stringley		3 00
July 3..	332	By Carl G. Hinrichs		60 00
July 3..	333	By R. L. Wright		59 00
July 3..	334	By R. D. Ellis		80 00
July 3..	335	By John H. Wilkinson		57 10
Aug. 7..	....	To Requisition	200 00	
Aug. 7..	336	By Frank Yeoman		54 25
Aug. 7..	337	By C. A. McCrum		8 00
Aug. 7..	338	By J. W. Carter		50 00
Aug. 7..	339	By Carl G. Hinrichs		30 00
Aug. 7..	340	By John Wilkinson		63 75
Aug. 7..	341	By R. L. Wright		6 00
Sept. 12..	....	To Requisition	200 00	
Sept. 12..	342	By Carl G. Hinrichs		15 00
Sept. 12..	343	By J. W. Carter		25 00
Sept. 12..	344	By C. A. McCrum		6 00
Sept. 12..	345	By Frank Yeoman		58 10
Sept. 12..	346	By R. D. Ellis		9 45
Sept. 12..	347	By John H. Wilkinson		54 00
Oct. 5..	348	By Carl G. Hinrichs		25 00
Oct. 5..	349	By John H. Wilkinson		60 65
Oct. 5..	350	By R. D. Ellis		30 00
Oct. 5..	351	By Frank Yeoman		60 35
Oct. 5..	352	By Carl E. Kimpton		6 00
Oct. 5..	353	By Wm. E. Smith		1 05
Nov. 6..	....	To Requisition	500 00	
Nov. 6..	354	By Frank Yeoman		59 25
Nov. 6..	355	By R. D. Ellis		170 00
Nov. 6..	356	By John H. Wilkinson		59 20
Nov. 6..	357	By Jas. W. Bibb		5 00
Dec. 3..	358	By Carl G. Hinrichs		25 00
Dec. 3..	359	By Frank Yeoman		52 00
Dec. 3..	360	By John H. Wilkinson		61 45
Dec. 3..	361	By Clara Herzel		6 55
Dec. 3..	....	By Balance		286 66
			$2,973 68	$2,973 68

FARMERS' INSTITUTE FUND.

Date.	No. War.	Name.	Dr.	Cr.
1901.				
Jan. 1..	....	To Balance	$855 22	
Jan. 1..	439	By A. S. Prather		$85 76
Jan. 1..	440	By G. W. Waters		100 00
Jan. 1..	441	By C. O. Raine		50 00
Jan. 1..	442	By H. H. Banks		7 14
Jan. 1..	443	By S. H. Elkins		2 00
Jan. 1..	444	By S. H. Elkins		30 00
Feb. 6..	445	By G. W. Waters		81 10
Feb. 6..	446	By Missouri Statesman		16 00
Feb. 6..	447	By S. H. Elkins		15 00
Feb. 6..	448	By W. E. Harshe		10 63
Feb. 6..	449	By Jas. Root		20 00
Mch. 6..	450	By S. H. Elkins		7 00
Mch. 6..	451	By Woodward & Tierman		22 50
Mch. 6..	452	By E. F. Ammerman		6 08
Mch. 6..	453	By G. W. Waters		50 00
Mch. 6..	454	By R. R. Skipper		25 00
Mch. 6..	455	By J. O. Erwin		25 00
Mch. 6..	456	By R. L. Harbaugh		15 00
Mch. 6..	457	By J. M. Ballenger		15 00
April 3..	....	To Requisition	300 00	
April 3..	458	By G. W. Waters		100 00
May 1..	....	To Requisition	200 00	
May 1..	459	By E. F. Ammerman		6 54
May 1..	460	By American Express Co		5 11
May 1..	460½	By E. W. Stephens		288 00
May 1..	461	By Geo. B. Ellis		50 00
June 5..	....	To Requisition	200 00	
June 5..	462	By Geo. B. Ellis		50 00
June 5..	463	By J. Manz Engraving Co		5 43
July 3..	464	By Geo. B. Ellis		50 00
Aug. 7..	465	By J. Manz Engraving Co		4 41
Aug. 7..	466	By Geo. B. Ellis		50 00
Aug. 7..	467	By Missouri Statesman		3 50
Aug. 7..	468	By S. H. Elkins		20 00
Sept. 12..	....	To Requisition	1,000 00	
Sept. 12..	469	By Geo. B. Ellis		50 00
Sept. 12..	470	By G. W. Waters		176 70
Sept. 12..	471	By Geo. B. Ellis		1,000 00
Oct. 5..	....	To Requisition	2,000 00	
Oct. 5..	472	By S. H. Elkins		15 00
Oct. 5..	473	By Missouri Statesman		23 50
Oct. 5..	474	By Geo. B. Ellis		50 00
Oct. 5..	475	By Geo. B. Ellis		1,500 00
Nov. 6..	....	To Requisition	300 00	
Nov. 6..	476	By Geo. B. Ellis		50 00
Nov. 6..	477	By Missouri Statesman		23 50
Dec. 3..	478	By Geo. B. Ellis		50 00
Dec. 3..	479	By Missouri Statesman		9 00
Dec. 3..	....	By Balance		691 37
			$4,855 22	$4,855 22

SECRETARY'S ACCOUNT.

Date.	Name.	Dr.	Cr.
1901.			
Sept. 12...	To Warrant No. 471 on Farmers' Institute Fund	$1,000 00	
Sept. 21...	By C. H. Eckles		$40 00
Sept. 26...	By Geo. W. Waters		50 00
Sept. 26. .	By C. D. Lyons		50 00
Sept. 26...	By N. F. Murray		50 00
Oct. 4...	By Geo. W. Waters		50 00
Oct. 4...	By G. W. Waters		50 00
Oct. 4...	By D. F. Luckey		100 00
Oct. 5...	To Warrant No. 475 on Farmers' Institute Fund	1,500 00	
Oct. 5...	By L. H. Rice		6 75
Oct. 8...	By S. H. Elkins		5 00
Oct. 9...	By N. F. Murray		50 00
Oct. 9...	By C. D. Lyon		50 00
Oct. 11...	By S. H. Elkins		5 00
Oct. 14...	By L. H. Rice		6 75
Oct. 15...	By S. H. Elkins		5 00
Oct. 16...	By F. B. Mumford		52 67
Oct. 17...	By E. W. Robinson		50 00
Oct. 19...	By T. I. Mairs		35 00
Oct. 21...	By C. D. Lyon		25 00
Oct. 25...	By G. B. Ellis		5 50
Oct. 26...	By Geo. W. Waters		100 00
Oct. 28...	By J. M. Stedman		64 64
Oct. 30...	By C. D. Lyon		50 00
Oct. 31...	By C. H. Eckles		30 00
Oct. 31...	By T. I. Mairs		40 00
Oct. 31...	By N. F. Murry		145 29
Oct. 31...	By E. W. Robinson		48 37
Nov. 1...	By G. W. Waters		50 00
Nov. 9...	By C. D. Lyon		50 00
Nov. 11...	By Geo. W. Williams		152 28
Nov. 11...	By C. D. Lyon		92 20
Nov. 13...	By C. L. Willobughby		15 00
Nov. 14...	By Reliable Poultry Co		16 00
Nov. 14...	By C. L. Willoughby		3 75
Nov. 20...	By G. W. Waters		50 00
Nov. 21...	By T. I Mairs		50 00
Nov. 23...	By C. H. Eckles		30 00
Nov. 26...	By W. L. Howard		40 00
Nov. 27...	By H. J. Waters		40 62
Nov. 29...	By C. H. Hancock		11 70
Nov. 29...	By E. M. Magruder		3 00
Nov. 30...	By J. N. Price		11 70
Nov. 30...	By J. M. Douglas		11 70
Dec. 3...	By S. H. Elkins		3 00
Dec. 3...	To Refund by Burlington Railroad	36 32	
Dec. 3...	By D. F. Luckey		103 38
Dec. 3...	By R. W. Clothier		26 68
Dec. 4...	By G. W. Waters		150 99
Dec. 7...	By W. L. Howard		26 84
Dec. 12...	By C. W. Nuss		100 00
Dec. 13...	By G. W. Waters		25 00
Dec. 13...	By Alex Maitland		10 00
Dec. 13...	By J. W. Hill		11 65
Dec. 16...	By Snowdon Willis		12 05
Dec. 16...	By Minnie Lee Blackwell		12 55
Dec. 17...	By Balance		261 26
		$2,536 32	$2,536 32

SUMMARY OF FINANCIAL STATEMENT.

Distribution of Annual Report Fund.

		Dr.	Cr.
1901.			
April 1	To appropriation	$300 00	
	By vouchers paid		$150 00
Dec. 3	By balance with State Treasurer		150 00
		$300 00	$300 00

Monthly Crop Report Fund.

		Dr.	Cr.
1901.			
Jan. 1	To balance	$169 73	
April 1	To appropriation	1,500 00	
	By vouchers paid		$763 61
Dec. 3	By balance with our Treasurer		106 12
Dec. 3	By balance with State Treasurer		800 00
		$1,669 73	$1,669 73

Expense of Members Fund.

		Dr.	Cr.
1901.			
Jan. 1	To balance	$415 32	
April 1	To appropriation	1,200 00	
	By vouchers paid		$566 05
Dec. 3	By balance with our Treasurer		449 27
Dec. 3	By balance with State Treasurer		600 00
		$1,615 32	$1,615 32

Farmers' Institute Fund.

		Dr.	Cr.
1901.			
Jan. 1	To balance	$855 22	
April 1	To appropriation	8,000 00	
	By vouchers paid		$4,163 85
Dec. 3	By balance with our Treasurer		691 37
Dec. 3	By balance with State Treasurer		4,000 00
		$8,855 22	$8,855 22

Office Expense Fund.

		Dr.	Cr.
1901.			
Jan. 1	To balance	$71 22	
April 1	To appropriation	1,000 00	
	By vouchers paid		$434 88
Dec. 3	By balance with our Treasurer		136 34
Dec. 3	By balance with State Treasurer		500 00
		$1,071 22	$1,071 22

State Veterinary Fund.

		Dr.	Cr.
1900.			
Dec. 18	To balance	$1,163 76	
1901.			
Apr. 1	To appropriation	16,200 00	
	By vouchers paid		$8,886 46
Dec. 3	By balance with our Treasurer		377 30
Dec. 3.	By balance with State Treasurer		8,100 00
		$17,363 76	$17,363 76

Butterine Fund.

		Dr.	Cr.
1901.			
Jan. 1	To balance	$1,073 68	
Apr. 1	To appropriation	4,000 00	
	By vouchers paid		$2,687 02
Dec. 3	By balance with our Treasurer		286 66
Dec. 3	By balance with State Treasurer		2,100 00
		$5,073 68	$5,073 68

TREASURER'S REPORT.

To the State Board of Agriculture:

Distribution of Annunl Report Fund.

Date.		Dr.	Cr.
1901.			
Apr. 3....	To State warrant..........	$150 00	
	By vouchers paid and returned..........	....	$150 00
		$150 00	$150 00

Monthly Crop Report Fund.

Date.		Dr.	Cr.
1901.			
Jan. 1....	To balance..........	$169 73	
Apr. 3....	To State warrant..........	100 00	
May 1....	" "	100 00	
June 5....	" "	100 00	
Aug. 7....	" "	100 00	
Sept. 12....	" "	100 00	
Oct. 5....	" "	100 00	
Nov. 6....	" "	100 00	
	By vouchers paid and returned..........	....	$763 61
Dec. 3....	By balance..........	....	106 12
		$869 73	$869 73

Expense of Members' Fund.

Date.		Dr.	Cr.
1901.			
Jan. 1....	To balance..........	$415 32	
June 5....	To State warrant..........	100 00	
Sept. 12...	" "	200 00	
Nov. 6....	" "	300 00	
	By vouchers paid and returned..........	....	$566 05
Dec. 3....	By balance..........	....	449 27
		$1,015 32	$1,015 32

Office Expense Fund.

Date.		Dr.	Cr.
1901.			
Jan. 1....	To balance..........	$71 22	
Apr. 3....	To State warrant..........	100 00	
May 1....	" "	100 00	
July 3....	" "	100 00	
Sept. 12....	" "	100 00	
Nov. 6....	" "	100 00	
	By vouchers paid and returned..........	....	$434 88
Dec. 3....	By balance..........	....	136 34
		$571 22	$571 22

State Veterinary Fund,

		Dr.	Cr.
1900.			
Dec. 18....	To balance..........	$1,163 76	
1901.			
Apr. 3....	To State warrant..........	3,000 00	
May 1....	" "	1,000 00	
June 5....	" "	500 00	
July 3....	" "	1,000 00	
Aug. 7....	" "	500 00	
Sept. 12....	" "	1,000 00	
Oct. 5....	" "	300 00	
Nov. 6....	" "	500 00	
Dec. 3....	" "	300 00	
	By vouchers paid and returned..........	....	$8,886 46
Dec. 3....	By balance..........	....	377 30
		$9,263 76	$9,263 76

Butterine Fund.

		Dr.	Cr.
1901.			
Jan. 1....	To balance..........	$1,073 68	
Apr. 3....	To State warrant..........	500 00	
July 3....	" "	500 00	
Aug. 7....	" "	200 00	
Sept. 12....	" "	200 00	
Nov. 6....	" "	500 00	
	By vouchers paid and returned..........	....	$2,687 02
Dec. 3....	By balance..........	....	286 66
		$2,973 68	2,973 68

Farmers' Institute Fund.

		Dr.	Cr.
1901.			
Jan. 1....	To balance..........	$855 22	
Apr. 3....	To State warrant..........	300 00	
May 1....	" "	200 00	
June 5....	" "	200 00	
Sept. 12....	" "	1,000 00	
Oct. 5....	" "	2,000 00	
Nov. 6....	" "	300 00	
	By vouchers paid and returned..........	....	$4,163 85
Dec. 3....	By balance..........	....	691 37
		$4,855 22	$4,855 22

All of which is respectfully submitted,

H. H. BANKS, Treasurer.

The More Important Insects Injurious to Wheat In Missouri.

BY

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THE CHINCH BUG.

Blissus leucopterus, Say.

INTRODUCTION.

The chinch bug is perhaps the most destructive insect affecting the wheat plant, although the Hessian fly in some years is a close second. While the Hessian fly is confined in its ravages almost entirely to the wheat plant, the chinch bug is broader in its selection of food, and infests nearly all the members of the grass family. This includes, of course, the wheat and other grains, and the corn, et al. While it will feed when forced to, on account of the scarcity of other varieties, upon practically all members of the grass family, yet it has its preferences, and seems to prefer, other things being equal, such cultivated grasses as Hungarian grass, Panicum crus-galli, millet, Setaria glauca, blue grass, wheat, corn, sorghum, broom corn, Bermuda grass and rab grass. It will thus be seen that the insect will live and multiply upon various grasses in regions where there is very little or no wheat or corn. In the State of Missouri, the insect does its vast amount of damage by attacking the wheat and the corn plants.

DISTRIBUTION.

The distribution of the chinch bug in North America is confined very largely to that portion east of the Rocky Mountain region, extending from the Great Lakes to the Gulf of Mexico. The insect is found west of the Rocky Mountains in only isolated places. By observing the map of North America, shown in figure 1, one can see at a glance the known areas of the chinch bug infestation. It should not be understood, however, that the chinch bug does an unusual amount of damage throughout this entire area. As a matter of fact, its region

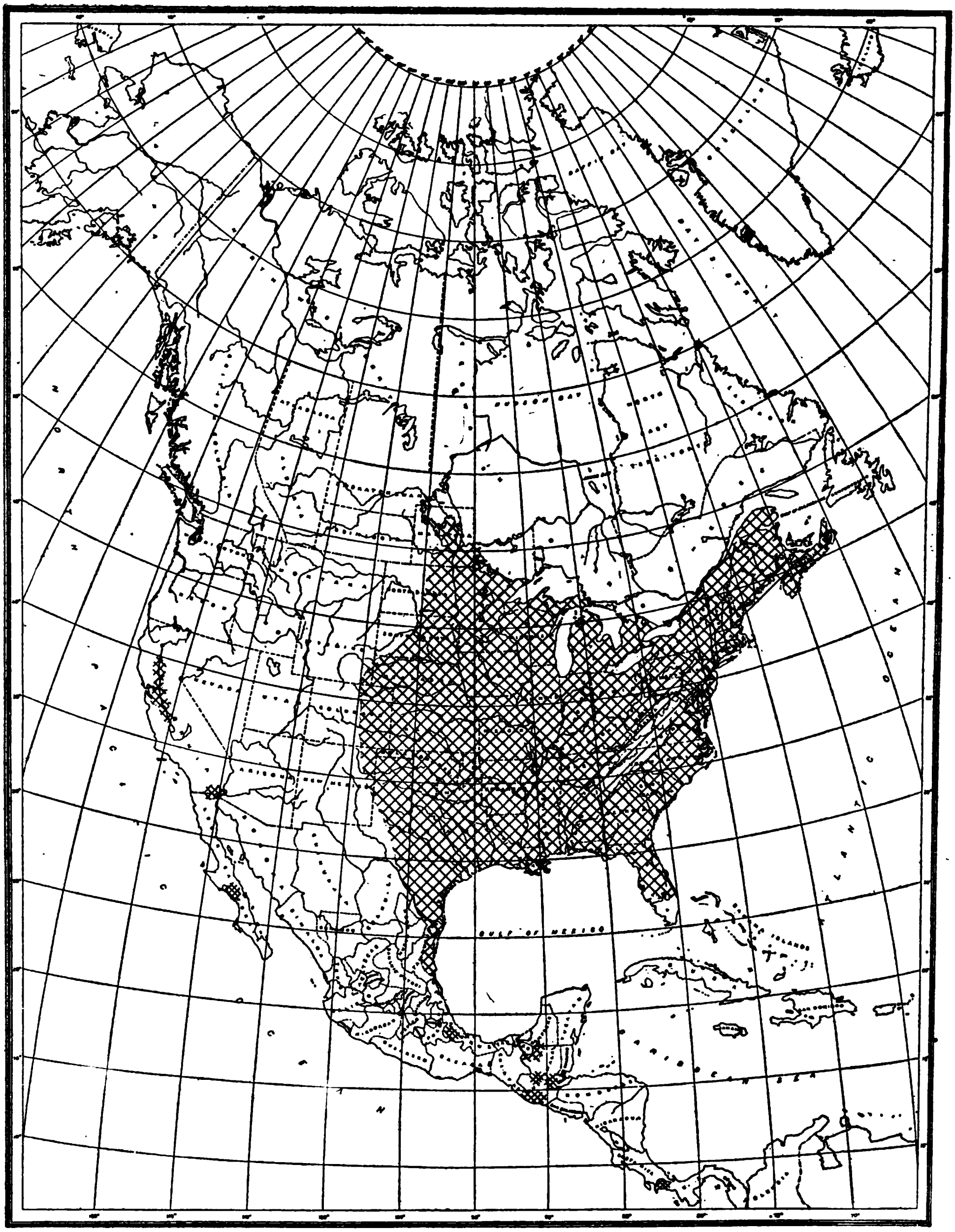

FIG. 1.—Map of North America showing areas infested by Chinch Bug. (From Webster, U. S. Dept. Agric.)

of greatest destructiveness is confined to the following states: Ohio, Indiana, Illinois, Minnesota, Iowa, Missouri, Nebraska, Kansas, Oklahoma, Indian Territory, Virginia, North Carolina and South Carolina. Of these twelve states, Ohio, Indiana, Illinois, Iowa, Missouri, Kansas, Nebraska, Minnesota and Indian Territory are by far the greatest sufferers. A glance at the map of the United States, shown in figure 2, will give you an excellent idea of the area of greatest destructiveness. In the states just mentioned we expect a great annual loss from the ravages of the chinch bug; but like many other injurious insects, the chinch bugs have their ups and downs, and will, as a rule, increase in number, and destructiveness for two or three years before they reach their highest ambitions in this direction, and then they will suddenly drop down to comparatively normal numbers again, and then gradually increase until the height is again attained. They behave very much like spasmodic waves passing over the country.

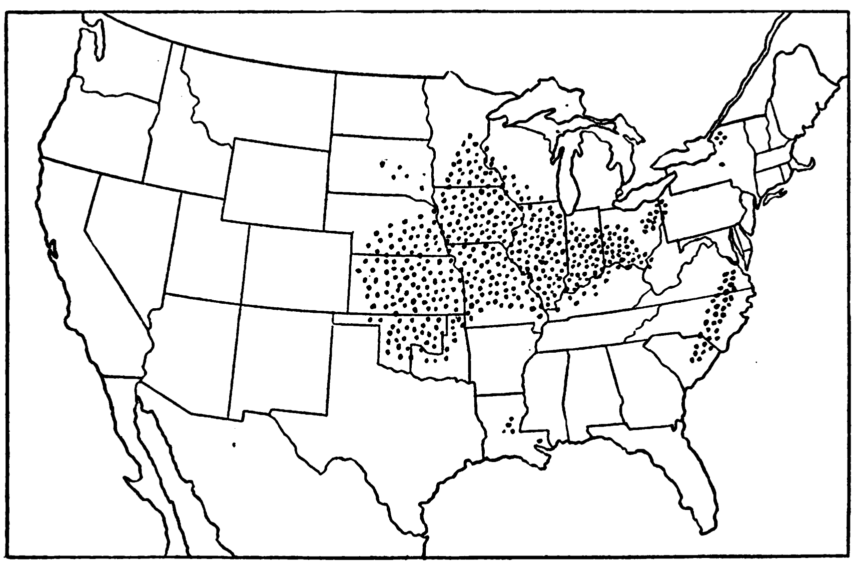

FIG. 2.—Map showing areas in the United States over which the Chinch Bug occurs in most destructive numbers. (From Webster, U. S. Dept. Agric.)

While the chinch bug has been with us for a great many years, in all too numerous quantities every year, yet in some years, as for instance 1871, the chinch bugs have been unusually numerous and destructive. It was carefully computed by Dr. LeBaron, then State entomologist of Illinois, that the loss in the single year 1871, in only seven states, by the ravages of the chinch bug was $30,000,000. Those seven states were Iowa, Missouri, Illinois, Kansas, Nebraska, Wisconsin and Indiana. In the year 1874 the chinch bug was again unusually destructive, and in Missouri alone, Dr. C. V. Riley, then State Entomologist of Missouri, computed the loss in this one State by the ravages of this one insect during that single year at $19,000,000, and stated that for the seven states I have above mentioned the loss for that one year might safely be estimated at $60,000,000. The loss in the United States for that one year has been estimated at upwards of $100,000,000. While these estimates are undoubtedly correct, they are enormous, and cover the ravages of but this single insect during one single season. If we take into account the aggregate losses from year to year, one could hardly realize that insects could cause so much damage.

THE DIFFERENT STAGES OF THE CHINCH BUG.

The chinch bug is so well known to most farmers in Missouri that it hardly seems necessary to give any detailed description of it, although the false chinch bug is very frequently mistaken for it. A short description of the different stages of the insect, however, may not be out of place, since the insects differ in their coloring to such an extent between the young and adult stages.

The *eggs* of the chinch bug are very small, and are deposited in masses, each female depositing upwards of five hundred eggs. The eggs, however, are not all deposited in one mass, but may be scattered in several masses; and are placed, as a rule, just under the surface of the ground near or upon the roots or the base of the stems of the grass or the wheat plant, as the case may be. The eggs, while large for an insect the size of the chinch bug, are really very small, measuring only three one-hundredths of an inch in length. See figure 3, *a, b,* which represents two eggs greatly enlarged. When in masses, such eggs appear of a whitish translucent color when first deposited, but later become amber colored, and just before they are ready to hatch, have a decided reddish hue, due to the fact that the young insect shows through the egg envelope.

While most farmers have not observed the eggs of the chinch bug, it is really a very simple matter. If they will pull up clumps or bunches of grass and carefully pull the dirt away from the roots, they will find the little masses of eggs tucked away just under the little clumps of dirt about the base of the plant. Occasionally the eggs are deposited on the stem or between the stem and a leaf, above the ground, or between the earth and stem of the plant, rarely on the leaves or further up the plant. See figure 4, *g,* which represents the masses of eggs about the roots of a wheat plant, and also some masses on the lower leaf. The females take from two to four weeks to deposit their eggs. The eggs hatch in about two weeks, but vary considerably according to the weather. In some instances they may hatch in ten days, and in other cases they may take three weeks. From the time the egg hatches until the adult stage is reached, requires about forty days. Hence you can readily see that from the time the first eggs are deposited until the first adults of this brood appear, would require practically two months.

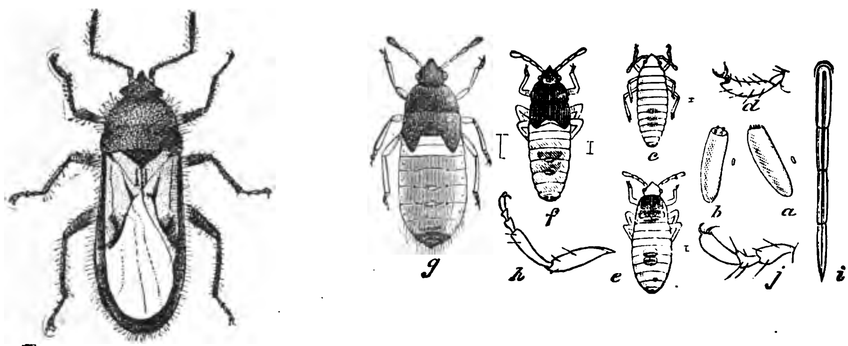

FIG. 3.—Chinch Bug, *Blissus leucopterus*, showing different stages in its development: *a*, *b*, eggs; *c*, newly hatched bug; *d*, its tarsus; *e*, bug after first molt; *f*, same after second molt; *g*, same after third molt; at the left an adult which is the result of the fourth molt, much more magnified; *h*, enlarged leg of adult bug; *i*, probosis or beak enlarged; *j*, tarsus of same still more enlarged. The lines at the sides of each bug represent its natural size. (From Webster and Riley, U. S. Dept. Agric.)

The *young* chinch bugs when they are first hatched look very little like the adult. They are very small, of a pale yellow color, and with an orange spot on the back of three abdominal segments. See figure 3, *c*, and figure 4, *b*. In form these newly hatched bugs are not unlike the adult, but of course, they have no wings whatever. As soon as hatched, they lose no time in seeking a place in which to insert their beaks through the tissues of the plant and suck the sap. After a time they have grown in size so that their skin becomes too small for them; it then splits open along the back and the creature crawls out, leaving its first skin behind. This is known as the first molt. The insect now appears quite decidedly red, or vermilion, with a pale band across the middle of the body. See figure 3, *e*, and figure 4, *c*. After feeding for sometime, the larva again becomes too large for its old coat, and it again splits open along the back and the creature crawls out, leaving its cast skin behind a second time. The insect now has a dusky head and thorax, while the abdomen is of a duller red, with the pale band still distinct. See figure 3, *f*, and figure 4, *d*. The future wing pads now become apparent. After feeding and growing for a time, this young chinch bug again sheds its skin. This is the third molt; and this stage of the young bug, which is its fourth stage since leaving the egg, is sometimes spoken of as the

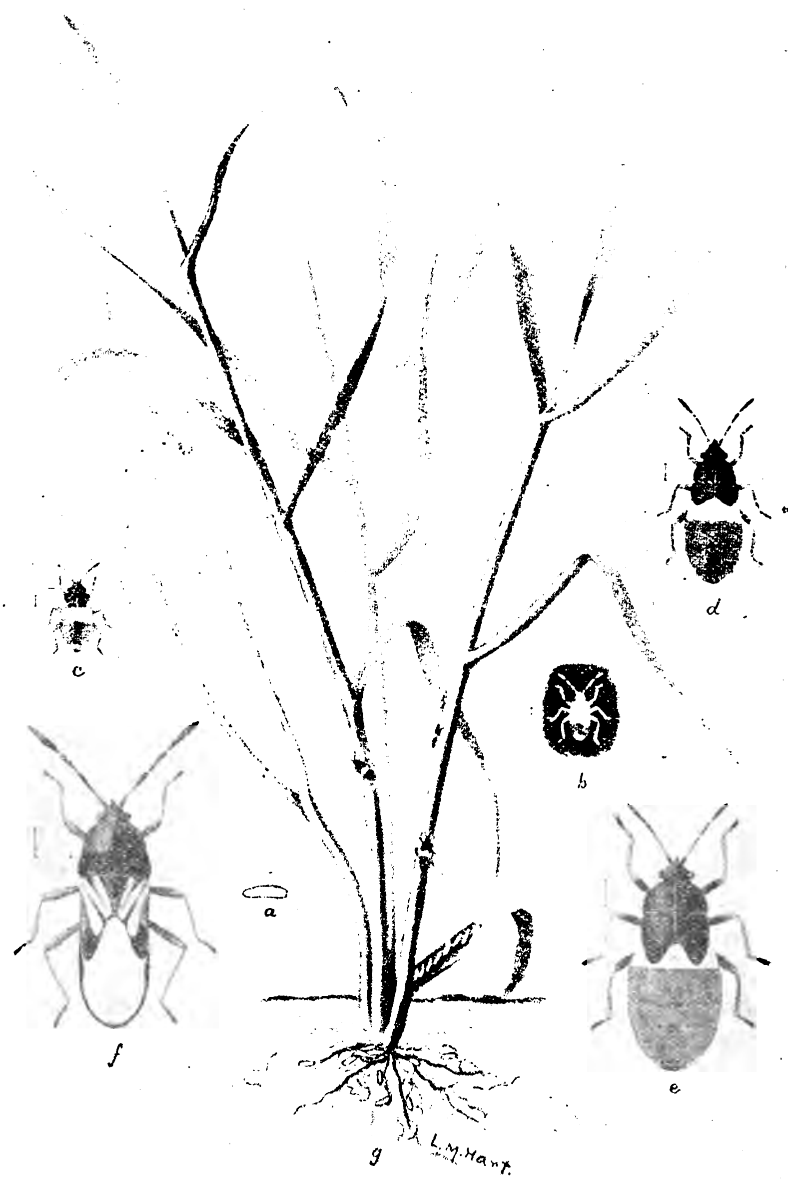

FIG. 4.—Chinch Bug, *Blissus leucopterus*, and wheat plant. On the stems are three bugs natural size; *a*, an egg greatly enlarged; *g*, egg masses on roots and on lower leaf; *b*, *c*, *d*, *e*, young chinch bugs after succeeding molts; *f*, adult chinch bug. A molt occurs between each stage. The hair lines indicate the natural size of each stage. (After Lugger.)

pupa stage, since it is next to the adult stage. But in reality, there is nc true pupa in this case, because these insects develop by means of an incomplete metamorphosis, and, therefore, these younger stages should all be known as nymphs. See figure 3, *g*, and figure 4, *e*. This so-called pupa has a brownish black head and thorax, and the little wing pads that made their appearance in the previous stage are now larger. The adbomen is dingy gray in color with a dark horny spot at the tip. When this insect has reached its proper size, the skin again splits open along its back, and the adult insect comes forth. See figure 3, bug at left, and figure 4, *f*.

This *adult* insect has, as a rule, well developed wings extending practically the length of the body, but in some instances the wings seem to be aborted, so that they are not fit for use as organs of flight. By observing a great many adult chinch bugs, one can find various stages, from the adults with very short and useless wings to the adults with long, normal wings, that are of service as organs of flight. The adults are about three-twentieths of an inch in length, and the body is of a black color with a very fine grayish down. This down can be readily seen under a magnifying glass, but is not visible to the ordinary naked eye. The wings and the wing covers are white, and the wing covers have two irregular black lines and a black spot near the margin. By referring to figures 3 and 4, one can obtain a fairly good idea of the general shape and comparative size of the different stages of chinch bugs, from the time they hatch, up through the various stages that I have just described to the adult bug. While the figures show simply the comparative or relative size and the general markings, they do not show the color, which differs so greatly between the adult and the younger stages. Figure 3, bug at left, shows an adult with normal wings, while figure 5, shows three adults with the aborted wings of different lengths, the one to the left showing an adult with very small aborted wings, and the one to the right showing an adult with wings nearly the normal size. Of course all of these figures show the insects greatly enlarged.

HOW AND WHERE THE CHINCH BUGS SPEND THE WINTER.

Chinch bugs always hibernate in the adult condition during the winter. While there are possibly no exceptions to this rule, at least in Missouri, yet it is a fact that by the time the chinch bugs are forced to seek winter quarters, some of them are not quite full grown or adult insects. It appears that those chinch bugs that seek winter quarters before they have reached the adult condition fail for some reason to live through the winter. While this may not lessen the number of chinch bugs to any appreciable extent, it nevertheless is a fortunate circumstance. Late in the fall, when the proper food plants have become more or less dried and cooler weather is approaching, the chinch bugs begin to migrate and scatter, leaving the plants or the fields in which they have been feeding, and crawl about or fly, as the case may be, in search of suitable places in which to pass the winter. This migration usually occurs in Missouri at the time most people call "Indian Summer." The great bulk of chinch bugs have by this time reached the adult condition, and have fully developed wings by means of which they can fly from place to place and scatter about the neighborhood. But it is a very common sight to see those chinch bugs that are perfectly able to fly crawling about, occasionally in large numbers, even in the villages, showing that they have come from the neighboring country, probably by flight. Very frequently they occur in villages at this time of year in such immense numbers as to attract a great deal of attention from the village people, who do not understand the invasion or the name of the insect. Chinch bugs are very apt to leave in great numbers the fields that they have infested during the summer, especially if these fields do not contain a sufficient amount of grass and weeds or shocks of corn, and seek such places as the edge of timber, Osage orange hedges, wind breaks, places where there are plenty of rubbish as along fences, among stone piles or wood piles, hay and straw stacks, and places where there are great masses of rank growth of grass and weeds, especially in the corners of rail fences. The insects crawl under such rubbish, especially under leaves and under matted grass, and will collect in these places in vast numbers. They seek especially the above places that are on high, well drained ground, and seem to prefer sandy or rocky soil to mucky. They shun to a great extent the low places that are liable to be flooded or become excessively damp.

During the winter, these insects remain in a dormant condition in these sheltered, protected and more or less dry places, and may be readily found during the winter in great numbers by the ordinary farmer, if he will take the trouble to turn over the rubbish near the ground in the places I have mentioned. These insects, however, will become more or less active and sometimes crawl about during the warm days that occur at frequent intervals during our winters here in Missouri. No amount of cold seems to affect the insects whatever, at least 30° below zero has no terror for them, that temperature having been reached in Missouri. In some of the northern states they have been known to withstand 40° below zero without any apparent inconvenience. They seem to stand continuous cold weather much better than they can the rapid changes in temperature, from extreme cold to comparative warm spring like weather and then suddenly turning cold again, as usually happens during our Missouri winters. Those immature chinch bugs that go into winter quarters probably perish from the alternate cold and warm weather as well as from dampness. It appears that the immature insects especially cannot endure any great amount of moisture. They seem to have an instinct that teaches them to seek dry places, and the shocks of corn that are so common in this State, afford the very best places for these insects to collect in the fall and hibernate during the winter. It is no uncommon thing to see thousands of these chinch bugs under a single shock.

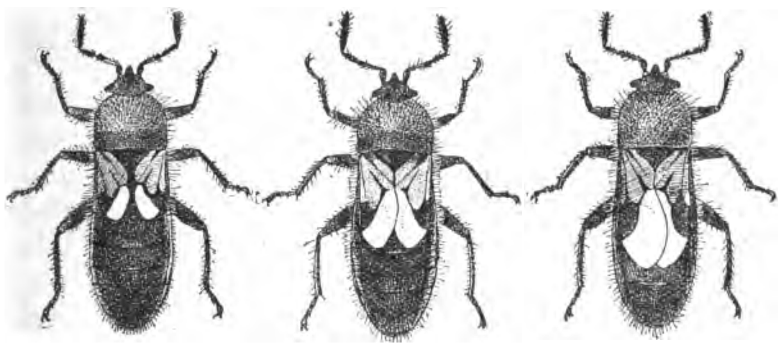

FIG. 5.—Chinch Bug, *Blissus leucopterus*. Adults of short-winged form—much enlarged. (From Webster, U. S. Dept. Agric.)

THE LIFE HISTORY OF THE CHINCH BUG.

In the spring, as soon as settled warm weather appears and the grass begins to grow, the adult chinch bugs that have passed the winter come forth from their hiding places and fly about in great numbers in search of suitable food. In some springs the insects at this time are so numerous that they attract a great deal of attention from people in the towns by alighting upon them, sometimes by the dozens, especially is this the case if they chance to drive out into the country a little ways. It appears that, in Missouri at least, this is the great migrating season, a season in which the chinch bugs seem to scatter over vast areas and cover greater distances than is the case with the fall migration just previous to their seeking winter quarters. Of course a great many of these chinch bugs do a great deal of crawling instead of flying, but it has been my observation that the vast majority of chinch bugs coming out in the spring from their winter quarters fly instead of crawl; while the migration in the fall is to a very large extent confined to crawling instead of flying. After the insects have found suitable fields or suitable plants for their food, they alight and crawl about, inserting their beaks through the tissues of the plant and sucking its sap. Chinch bugs in seeking their proper food plants in the spring alight in immense numbers in our wheat fields. If the wheat field happens to be near a wood, or Osage orange hedge fence, or a wind break, or a place where there is plenty of shelter in which vast numbers have hibernated during the winter, then, in this case, the chinch bugs are very apt to come out from their winter quarters and crawl in vast numbers to the wheat field. In such instances they are usually found collected or massed together on the plants nearest the hibernating quarters, and their presence will soon be detected by the effect that they have upon the plants. It seems that chinch bugs, when they insert their little beaks into the plant, involuntarily inject a little poison, which poison causes an increased flow of sap to that place, and has more to do with the injury to the plant than the amount of sap that the insect actually extracts. A wheat field attacked in the way just mentioned will appear bleached in the area or strip attacked. If left undisturbed, the chinch bugs will gradually spread from plant to plant, so that the area of infestation will increase and move onward, gradually covering the entire field.

While a great many chinch bugs mate in the fall, the vast majority of them mate in the spring soon after leaving their winter quarters, and presently the females begin to deposit their eggs in the wheat fields or other places, usually just below the surface of the ground under little clods of earth about the roots and base of the plants. In about sixteen days these eggs will begin to hatch, and presently the agriculturist will detect the little yellow or reddish bugs in his wheat. In about six weeks these insects will have reached the adult condition, and his wheat field will be literally over-run with chinch bugs. Meantime, the young bugs have been drawing their nourishment from the wheat plants by sucking the sap, and have done more or less damage according to the number of bugs in a field. Since each female lays upwards of five hundred eggs, one can form an idea of the extent of the multiplication of these insects since leaving their winter quarters. As the females take about three weeks to deposit their eggs, and as these insects hatch at different periods according to the weather, we find that new adult chinch bugs are appearing for three weeks or more after the first ones have appeared. At about this time the chinch bugs have become dangerously numerous in the wheat field, the great bulk of them have become adults, and have done a great deal of damage, and the wheat plant has become ripened and no longer fit for their food. The chinch bugs in such a field now take it into their little heads to seek green pastures, and they usually do so all at once, and migrate in a body leaving the old field. In this migrating army we find the adults with fully developed wings and perfectly capable of flight, and the young in various stages of development. It is a curious fact that in this migrating army of chinch bugs, the adults with fully developed wings rarely attempt to fly, but crawl along with the mass the same as those immature bugs that cannot fly. In fact, it seems difficult to induce the adult chinch bugs to fly at this time, and it is curious to watch such a migrating army when they attempt to cross dusty roads or plowed fields. The adult bugs will struggle along with the wingless immature ones and not attempt to fly, when by so doing they could readily span the difficult places.

At this season the chinch bugs are very sure to migrate in the above described way from the wheat field to the corn field, and when they reach the corn field, they are tired and hungry, and undoubtedly thirsty, for they attack the first corn plant and begin to insert their beaks and immediately suck the sap from the plant. At this time the bugs will cover the first few rows of corn to such an extent as to render it black with them, and especially is this the case with the lower part of the corn plant. The bugs will remain here on the first few rows of corn for a short time, and then they will gradually disperse throughout the corn field. The adults pair and lay their eggs for another brood, and this second brood of chinch bugs, in addition to the first brood which has now migrated, infest the corn and causes the vast amount of mischief so well known to the farmers of Missouri.

By the time the bulk of this second brood of chinch bugs in the corn have reached the adult condition, the time has approached for them to seek winter quarters, and the fall migration begins to occur. If the proper winter quarters are near at hand, the bulk of the insects will migrate on foot to those places; otherwise, the winged forms will now readily take to flight and travel considerable distance in search of suitable places in which to pass the winter. If the corn is cut at this time and stacked in shocks about the field, the farmer has given these chinch bugs the best kind of winter quarters, and they will readily seek them and hibernate in vast numbers in these situations. It will be seen then that chinch bugs have three migrating periods. A period in the fall during which they migrate by crawling and by flight in search of winter quarters; a migrating period in the spring when the insects come out from their winter's hibernation and fly about in search of the proper food plants; and a mid-summer migration in which the chinch bugs crawl in a mass in search of a fresh supply of food and rarely take to flight. There are, in Missouri at least, only two broods of the chinch bug each year, but these two broods always occur.

NATURAL ENEMIES.

Unfortunately for the agriculturist at least, the chinch bug has few natural enemies; especially is this the case with its insect enemies. Most insects are held in check by other insects that are either predaceous, (that is devour them,) or parasitic upon them. But the chinch bug seems to be largely immune from the attack of either the predaceous or the parasitic insects; at least they are not in sufficient quantities to do us any particular good in that direction, and it therefore seems hopeless for the agriculturist to ever expect that the chinch bug will be held in check by other insects. One of the predaceous insects most destructive to the chinch bug is shown in figure 6. There are some birds, however, that feed upon chinch bugs, but, unfortunately, the birds are so scarce now-a-days that we can hope for very little help from this source. The quail is perhaps the most beneficial bird that we have along these lines, for they devour great numbers of chinch bugs, but quail are sought as a game bird with such diligence, that they are becoming extremely scarce. Meadow larks also devour immense numbers of chinch bugs—perhaps as many as do the quail, but here again these birds are also killed as game birds. Prairie chickens, red-wing black birds, cat birds and thrushes also readily feed on chinch bugs.

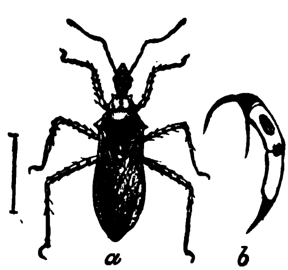

FIG. 6.—A Predaceous Bug, *Milyas cinctus*, which feeds on chinch bugs by sucking their blood. (From Riley, U. S. Dept. Agric.)

There are certain fungoid and bacterial diseases that attack chinch bugs under certain conditions, and these diseases do more good towards keeping the chinch bugs in check than all the other natural enemies of the chinch bug combined. However, we cannot hope to ever see the day in this region of the United States when the natural enemies of the chinch bug will ever keep it reduced in numbers to within harmless bounds. We must assist nature with her task by artificial means. From what has been said in regard to the habits and the life history of the insect, it is apparent to anyone giving the subject any particular thought, that the chinch bug has several weak places that we may take advantage of.

REMEDIES.

It is advisable that the agriculturist resort to every means possible within the bounds of reason looking toward the suppression of the chinch bug. There can be no doubt, that if all or the great bulk of agriculturists will see to it that proper means are taken each year to hold the chinch bug in check and reduce its numbers, that in the course of a few years the chinch bug will cause no more loss than is caused by a great many other injurious insects. The great difficulty, however, is to educate the mass of the agricultural people up to the point of living up to such rules. The farmers are busy during the summer, and, as a rule, do not feel like taking any time to the fighting of insects. They feel like relying more upon some remedy that can be easily applied, with a hope that it will suffice; and in the great bulk of cases, they will not take the pains to do this in as thorough a manner as they should.

In the first place, every agriculturist should take advantage of the fact that chinch bugs hibernate in the adult condition during the winter under rubbish of various kinds, as before described. If the farm is kept thoroughly clean, and no rubbish of any description, or no hedge fences or other places where the insects can readily hibernate are allowed, then there will be little chance of the chinch bug hibernating on that farm. In other words, clean farming will do a great deal towards lessening the number of chinch bugs. If the rubbish of various kinds is gathered from the fields and from about the corners of fences, and placed in piles or in rows early in the fall, and allowed to remain there until the chinch bugs have collected under these for their winter quarters, and these are then burned, vast numbers of the chinch bugs will be destroyed with them. There are a great many hedge fences in this country that contain dead grass and weeds, and rubbish of various kinds, that could well be set on fire late in the fall, and thereby destroy the hibernating bugs. If dead leaves and the like, especially those along the side of forests and other wind breaks in the neighborhood of cultivated fields that are infested, are burned over in late fall, great numbers of hibernating bugs will be killed.

Then again, if the farmers will sow millet at the proper time so that the millet will be up early in the spring, it will attract the migrating chinch bugs that are coming out from their winter quarters, and they will collect upon the millet in great numbers, and can readily be destroyed by spraying with kerosene, or by scattering straw over the millet and setting fire to it. This millet trap can profitably be used along the border of those places where the chinch bugs hibernate, or along the line separating an agriculturist's farm from his neighbors.

The practice, which is so common in Missouri, of stacking the corn in shocks in the field, and then cultivating and sowing wheat there, is a very bad one for the chinch bug proposition, because the chinch bugs in such a corn field hibernate under these shocks in vast numbers, probably the bulk of the chinch bugs in such a field seeking this place of hibernation, and in the spring, they have but a few feet to crawl before they are upon the young wheat plant, and in that way the farmer simply reinfests his fields in as thorough a manner as could possibly be done. Once the chinch bugs are in a wheat field, practically no artificial means can be taken, from an economic standpoint at least, looking towards any help from this evil.

We cannot economically kill chinch bugs that are scattered over a wheat or corn field; but it sometimes happens that the chinch bugs in the spring coming from their winter quarters, especially if the wheat field be near a forest, will get upon the first few rows bordering such forests, and collect in great numbers, forming a band but a few feet wide along this area. In such cases, it would pay to spray that badly infested area with kerosene emulsion or ten per cent kerosene, as will be described later on.

A great many people send to this office in the spring of the year for the chinch bug disease, with the idea of scattering this disease about the fields of wheat and killing the chinch bugs infecting them. It is a fact that under certain climatic conditions this chinch bug disease, which, by the way, is nothing more or less than a minute fungous plant, will kill great numbers of chinch bugs. But, from seven years' experience and observation with this disease in the wheat fields throughout the State of Missouri, I am firmly convinced that the artificial use of this disease by the farmers of Missouri does very little, if any, good. This tallies with the experience of other Entomologists who have had considerable to do with this matter in other states. While this statement may seem strange to a good many, the reasons are perfectly obvious when properly understood. In the first place, the chinch bug disease is a natural one, found in nature, and is not an artificial one. What we did was to collect the spores of this fungous and put them in boxes containing a great many living bugs. The air and the soil in these boxes were kept continually moist and warm, and, as a result, the spores readily germinated, and the mycelium of the plant found its way inside the bugs and fed upon them, killed them, and produced spores again on the outside of the bugs. It was these white fungous covered bugs that we distributed throughout the State to anyone applying for them. The persons receiving these bugs were supposed to place them in boxes similar to ours, and keep them under similar conditions, and thereby develop large quantities of this fungous disease, and to scatter these throughout the wheat field. As a matter of fact, I have each year found that over half of the farmers do not go to the trouble of cultivating this disease, but simply scatter in their fields the bugs that we send them.

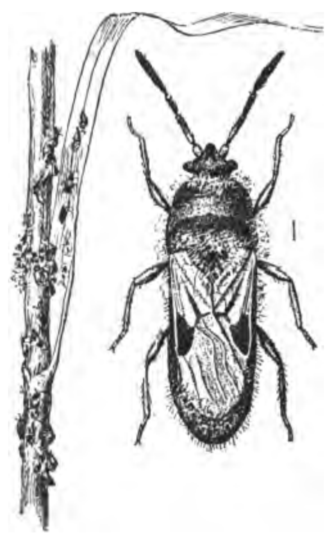

FIG. 7.— Chinch Bug, *Blissus leucopterus*, killed by the fungous disease, *Sporotrichium*. The mycelium is within the bug, and the fungous is starting to develop the white spores on the outside and ultimately cover it. (After Lugger.)

The spores of this fungous require for their germination practically the same conditions that the seed of your wheat or corn requires in order to germinate, that is, the spores must have a considerable amount of moisture in connection with heat, otherwise they will not germinate. If the chinch bugs are in large numbers and the weather is hot and very moist, these spores will germinate on the bugs, and the fungous plant will kill them in great numbers. But if the weather is hot and dry, or too cold, although it may be moist enough, then these spores will not germinate, and no agriculturist has the power to bring about the proper conditions in his wheat field that will enable them to germinate. Hence you see that, although the farmer may obtain the chinch bug disease and scatter it in vast quantities throughout his field, if the climatic conditions are not right, the chinch bug disease will not take, and will do absolutely no good whatever.

But some may say that in obtaining these diseased chinch bugs from this office, and putting them in their fields, they introduce there the spores that will germinate when the proper conditions are right. I wish to say that it is very doubtful whether there is a wheat field or a corn field in Missouri that does not now naturally contain spores of this disease. I have been impressed with this fact every summer; because, almost invariably, when the person applying for the chinch bug disease sends to this office living chinch bugs that have been placed, as they should be, in a tin box containing no dirt, but some green vegetable matter, as, for instance, pieces of green corn, wheat or grass, and that box closed up as it should be, perfectly tight, thereby generating moisture in the box from these green vegetables, that by the time these bugs reach me, the box contains more diseased fungous covered bugs than we return; thus showing that the spores were already there in his field, and all that was required was the proper amount of heat and moisture in order to enable them to germinate. Knowing these facts, I can do no other than to conscientiously advise the farmers of Missouri not to trouble themselves with obtaining and scattering this disease about their fields; but to rely entirely, as they ultimately will have to do, upon nature to bring about the proper climatic conditions for the development of this disease in their fields. Even if it were possible for the farmer in any way to develop the proper conditions in his wheat field, then there would be no grounds for him obtaining this disease from any other source whatever.

Bear in mind, that while I can not advise agriculturists to trouble themselves with this chinch bug disease, because of the reasons above given, nevertheless, I am far from claiming that this disease does not do a great deal of good. The facts are, that when the chinch bugs are in a field in great numbers, or massed in places about the field, and warm rains appear, that this fungous disease spreads rapidly through the mass of chinch bugs, and kills them in immense numbers regardless of whether the farmer has ever introduced the spores into the field or not. This whole chinch bug disease then is one entirely out of and beyond the control of the agriculturists. I am perfectly well aware of the fact that it frequently happens, that within a few days after we have sent out this chinch bug disease that the farmer will write back and tell me that he scattered the disease in the field, and that within from two to three days the chinch bugs died in vast numbers, and were all but exterminated. Such letters are of daily occurance during the chinch bug season; and any one knowing the nature of this disease, and of the chinch bugs, would know at once that the chinch bug disease that he received from us did not cause their death, because of the fact that the time that elapsed from the putting in of the disease to the death of the chinch bugs was far short of the possible time for the disease to take. This again simply shows that the proper climatic conditions had occurred to cause the disease to develop naturally among those bugs, and before he had introduced it.

Another great error that farmers frequently make is due to the fact that the chinch bug, when it comes to shed its skin and transform from the last nymph condition to the adult, does so after climbing down between little clumps of earth and about the base of the plants, and there casts its skin. It frequently happens that this is done by vast numbers of chinch bugs within a day or two; and the farmer, if he has artificially introduced the disease into his fields, and happens to go out to observe whether the disease has caused any deaths among the bugs or not, notices these cast skins, and mistakes them for killed chinch bugs. This mistake is very readily made, and he immediately jumps to the conclusion that the chinch bug disease that he has recently introduced, has killed vast numbers of his chinch bugs. But there is no need of saying anything further in regard to this chinch bug disease. I think that I have said enough now to enable the agriculturist to see the folly of wasting any time in trying to send for and cultivate and introduce the chinch bug disease into his wheat or corn field.

Chinch bugs cause a great deal of worry on the part of the agriculturist at about the time they are migrating from the wheat to the corn, and, fortunately, this is one of the best times in which to combat this insect. It frequently happens that at this time the chinch bugs migrate in a mass and in great numbers, leaving the wheat field and crawling in the direction of the corn field. When this is the case, whether the bugs are leaving your own wheat field or your neighbor's wheat field, and are moving in the direction of your corn field, this corn field can be protected from the ravages of these bugs without any great amount of labor. This is done by taking advantage of the fact that this migration occurs almost invariably on foot, that even the adult chinch bugs in the migrating army do not readily take to wing, that these chinch bugs have great difficulty in passing over the loose and unprotected soil, such as a dusty road or a plowed field, and that the hot sun readily kills great numbers of chinch bugs that can find no place for shelter. While it is a well known fact that chinch bugs thrive better in hot and dry seasons and are easily killed or held in check by damp seasons, yet it is a fact that the chinch bugs cannot endure to any considerable extent the direct rays of the sun on a hot day. They are, for that reason, found in fields where plants are numerous enough to give them shelter, and are not apt to occur in fields where the plants are scattering and shelter from the direct rays of the sun not so easily obtained.

It is a fact that a migrating army of chinch bugs will be held in check in hot sunny weather by a dusty road, and die in immense numbers before many of them will succeed in getting across. We can take advantage of this fact, and, when we find the chinch bugs are about to migrate from the wheat field to the corn field, plow a belt around the corn field, or at least along the sides toward the migrating army of bugs. This plowed belt should be about ten feet wide. After plowing, the ground should be harrowed with a disc harrow, and rolled so as to break up all the lumps, and then reharrowed, dragging brush after the harrow so as to make this ten foot belt just as dusty as can be made; then a log or a V-shaped trough should be drawn lengthwise along this dusty belt two or three times so as to make furrows running lengthwise. Along one of these furrows at least it is well to dig little postholes, which can be readily done by means of a post-hole auger. When the bugs try to cross this barrier, they will have great difficulty in even crossing the dust to these furrows. Once they reach the furrows, they will try to crawl out, and, if the furrows have steep and dusty walls, the chinch bugs will not succeed in getting over, but will crawl along the furrows and fall into the holes, where they may be killed by turning on kerosene or tar, or where they may be covered up and other holes dug between.

One will see that the chinch bugs find it almost impossible to pass this dusty barrier, that the hot sun striking them without any protection will kill vast numbers of them, and that just so long as it remains hot and dry, this arrangement will form a complete protection for the corn field. It is well, however, to have one or two men, as is needed, to attend this barrier during each day, and, by means of a hoe, to fix the places along the grooves where the chinch bugs may find places to escape, to see that the chinch bugs do not occur in too great numbers in the furrow or in the holes before they are killed, and to do the utmost not to allow any of the bugs to find places through which they may reach the corn field. It is not absolutely necessary to make these furrows along this dusty belt, although it is advisable.

If one does not make the furrows, or in case it should rain soon after the plowed strip has been made or before the migrating bugs have been captured, one can turn coal tar in the form of a band the length of this dusty barrier and a few inches in width, and, as soon as dried, put tar on again, and so on until the tar will not run down through the soil, but will remain on top, and the chinch bugs will not cross this barrier or band of tar. If it should rain after you have made this dusty barrier and the bugs have collected in vast numbers about it, the rain will undoubtedly start the fungous disease among such a mass of the bugs and practically exterminate them, or you can maintain the barrier by means of the ribbon of tar.

When the chinch bugs collect in good numbers along the dusty barrier, or in the trenches, or along the coal tar barrier, or in case the farmer has neglected to make this barrier, and the chinch bugs have collected upon the first few rows of corn in immense numbers, then he should immediately stop all other work and at once spray those chinch bugs with either kerosene emulsion or ten per cent kerosene and water mixture. In spraying the chinch bugs that have collected in the trenches or along the barrier, one would do well not to wet the dust any more than possible, but spray those places where the bugs are most numerous so as not to destroy the dust as a barrier. It sometimes happens, although not often, that where the bulk of the chinch bugs making this migration are adults with fully developed wings, and find themselves confronted with a barrier, they will take to wing and fly over, and in such cases they may collect upon the first few rows of corn, where they can be readily killed by means of kerosene.

It is a fact that chinch bugs die like magic before a spray of kerosene emulsion or ten per cent. kerosene mechanically mixed with water; and if we could always be sure that in this migration from the wheat to the corn field, the chinch bugs would collect in immense numbers upon the first few rows of corn, and stay there long enough to allow of spraying them, this would be the ideal method of exterminating them from the corn field, or of preventing them from entering the corn.

An agriculturist should watch the chinch bugs, and when he finds them collected on the first few rows of corn or in masses along his barrier, he should be thankful, because he now has the bugs in the very best condition possible for obtaining his revenge. When the bugs collect in such places, the agriculturist should drop every other work and spray these insects at once, especially if they are upon the first few rows of corn, since they will soon spread through the corn; and when this happens he is barred from any further method of killing them.

I would advise the agriculturist to purchase one of the new pumps with the kerosene attachment. These pumps are made by the better manufacturers, and cost very little more than the pumps without such attachments. They save an immense amount of time and labor, especially for such purposes as chinch bug extermination. The pumps do away with the necessity of making kerosene emulsion. All that is needed is to turn pure kerosene or coal oil in the receptacle attached to the pump for that purpose, and set the indicator at ten per cent; put the pump in a barrel of water and spray without any further trouble. This ten per cent mixture of kerosene kills the bugs readily, and does not injure the plants.

In spraying for chinch bugs it is necessary to touch every bug in order to kill it, because these bugs are killed by contact with the kerosene. This necessitates thorough work, and one must, therefore, spray on all sides of the plant that is infested with these bugs; but where the bugs have collected in this way in immense numbers, the agriculturist will be delighted to do the work and see the bugs die so rapidly and in such great numbers.

Where one has no modern spray pump with the kerosene attachment, then an ordinary spray pump may be used; but one must make kerosene emulsion. This is made in the following way: Dissolve one-half pound of hard soap (in case you wish to use soft soap one pound should be taken), in one gallon of boiling soft water; after the soap has been thoroughly dissolved and stirred through the water, remove this from the fire and add two gallons of common kerosene or coal oil, while the liquid is still hot. Remove the spray nozzle from your pump, put the pump into this mixture, and pump the liquid right back into itself. This will churn it, and do so more thoroughly than any other process that we know of. This churning should be done vigorously and kept up continually for ten minutes, at the expiration of which time, a complete emulsion will have been formed, and the liquid will have increased about one-third in bulk; hence the necessity of putting it into a larger receptacle than will exactly hold it in the beginning. After the emulsion has been made, add nineteen gallons of water to it, stir thoroughly, and spray with this.

These two methods of killing the migrating army of chinch bugs when they try to enter the corn field (that is by barriers or by spraying the bugs with kerosene), if followed out, are worth more to the agriculturist than all the other methods combined. In one day, we, in this way, practically exterminate the mass of chinch bugs in the immediate neighborhood, and we do so at a time just previous to the depositing of eggs for the second brood, and, therefore, prevent that numerous increase which would otherwise occur. Hence it would not be unwise to again call your attention to the fact that when the chinch bugs come to migrate from the wheat to the corn, they should be stopped by means of a dusty barrier around the corn field, or, if this can not be done, you should spray them with some form of kerosene immediately after they occur in large numbers on the first few rows of corn.

THE HESSIAN FLY.

Cecidomyia destructor, Say.

INTRODUCTION.

The United States Department of Agriculture, Washington, D. C., has carefully estimated the average annual loss to the Agricultural interest of the United States, caused by the ravages of injurious insects on cultivated plants only, and finds that $300,000,000 per year is as near as can be estimated of the above loss. The wheat plant suffers as much, perhaps, from the ravages of insects as any other single crop grown in the United States, and two insects cause by far the greatest amount of this damage. One of these is the Hessian fly, which in some single years has caused an estimated loss of $60,000,000 in the United States alone. In some foreign countries, this insect has been the cause of great famines. By referring to the map of the United States in figure 8, one can obtain a good idea of the general distribution of this insect in the United States, and it will be readily seen from this map that Missouri is completely within the area of dangerous infection. The Hessian fly is found throughout the entire State of Missouri, and is, next to the chinch bug, the most destructive insect attacking our wheat and menacing the general farm revenue.

Judging from the large number of letters received by this office each year making inquiries in regard to this insect and the best means of suppressing its ravages, the average agriculturalist does not understand the life history of this pest, or the few simple methods of farm practice which may be varied so as to prevent its destructive work. Unfortunately, there is no literature on this subject that is accessible to our people, and to which they may be directed for information, and hence no apology is necessary for the publication of this bulletin, which was preceded by three years' continuous and successful tests, on sixteen widely scattered farms, of the methods of combatting this insect herein described.

Although the original home of the Hessian fly is not known, it is generally believed to have been introduced into the United States by the

Hessian soldiers during the war of the Revolution. It is probable that it was transported in the "flaxseed" stage in straw used for bedding and other purposes of the soldiers, and thus obtained a foothold in Long

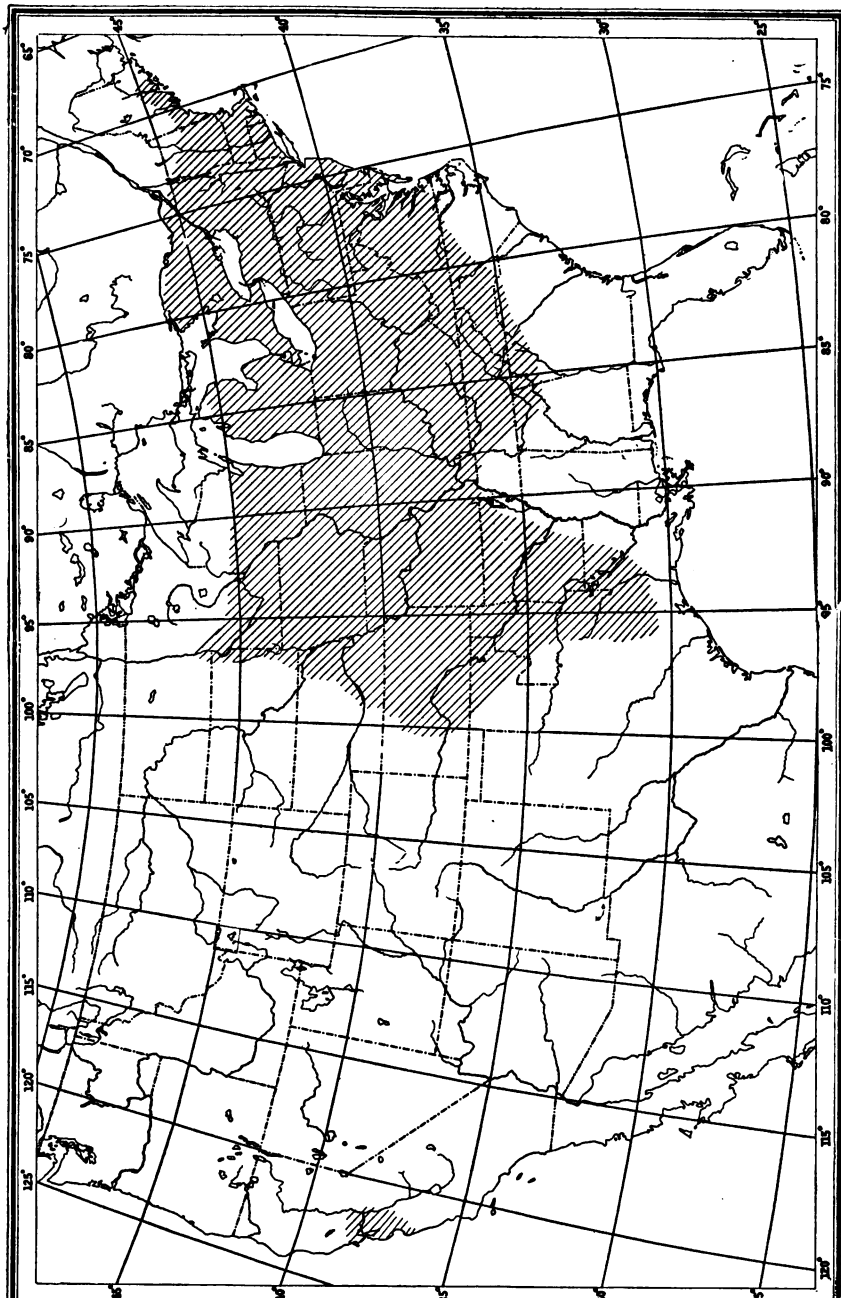

FIG. 8.—Map showing distribution of Hessian Fly, *Cecidomyia destructor*, in America. (From Osborn, U. S. Dept. Agric.)

Island, New York, in about 1776. From this locality it gradually spread at the rate of about twenty miles each year, until it occupied the wheat-growing region of the Eastern United States; and ultimately and more rapidly spread to all the wheat-growing regions of the United States east of the Rocky Mountains, south of the 45° of latitude and east of the 100° of longitude, and now has established itself in California.

The name Hessian fly was first applied to this pest about 1778, but it was not until 1817 that it was scientifically described by Say, who gave it the appropriate name of *destructor.*

HABITS AND LIFE HISTORY.

How It Spreads.—The adults of the Hessian fly have two well developed wings, which enable them to fly about and to spread over the neighborhood, thereby extending the distribution of the species; but it is doubtful if they travel in this way more than ten miles as a rule unless aided by the wind, and ordinarily they will deposit their eggs and perish in the immediate vicinity where they emerged, provided food plants be plentiful. The life of the adults is ordinarily of very short duration, lasting only long enough to enable them to mate and to deposit their eggs. The distribution and spread of the species over long distances is no doubt attained by the transportation of the puparia or "flaxseeds," either in the straw or in the chaff.

Its Food Plants.—The Hessian fly attacks wheat, barley and rye; but has not yet been known to infest oats, although in California it is said to be able to exist to a limited extent on certain grasses; not enough, however, to threaten contamination from that source. We have no record of its perpetuating itself on grasses in Missouri. It is well to note, however, that according to Marchal the oats of France is now attacked by a closely allied species, which he believes has directly descended from the Hessian fly.

Its Effect on Plants.—The effect of the presence of the Hessian fly upon the plants is very characteristic, and differs with the season, or rather with the stage of development of the plant. In the fall, the eggs are deposited upon the leaves of the young plant, and the larvae, as soon as hatched, crawl down the leaf into the sheath, and down as far as the surface of the ground, or below, and even to near the roots. Their presence and feeding at this point causes an increased local growth of the base of the leaf and culm, resulting in a swelling, which is scarcely enough to be called a gall, but which is very noticeable. The plant, when first attacked, develops a dark green appearance, and the infested tiller later turns brown and then yellow. If the plant is attacked early it may fail to tiller, and the death of the entire plant will be the result. If the plant has already started to produce tillers the larvae may attack only part of them, and the other tillers may develop into healthy plants. In the spring, the plants being larger, the eggs are deposited on the lower leaves, and the larvae when hatched crawl down the sheath to just above the first joint as a rule. Here they feed, and so weaken the stalk that it bends over until the upper portion is horizontal. Occasionally the larvae will be found higher up the stalk, to the second or third joint, but not often; and sometimes they will be down even below the ground, but this is rarely the case, and when it does occur, the stalk falls at this point.

Its Life History.—The adult Hessian fly deposits her eggs in the furrows on the upper side of the lower leaves of the plant, and usually deposits a large number of them on a single blade. Figure 9, *e*, shows an adult female, natural size, ovipositing. The eggs, one of which is shown enlarged at Fig. 9, *a*, hatch in about four days, and the young larvae crawl down the leaf to the sheath and between the sheath and the stalk to near the base of the culm, and there they feed. This position is usually below the ground in the fall wheat, and just above the first or second joint in the spring wheat. The larvae now remain at this point and feed until full grown, which usually takes about three weeks. A full grown larva is shown magnified in Fig. 9, *b*, and at its side a line indicating its natural size. The larva now shortens and shrinks away from its old skin, which now forms a puparium or "flaxseed" within which the larva remains in a quiescent stage for a varying length of time depending upon the climatic conditions. At Fig. 9, *c*, is shown one of these "flaxseeds" enlarged. It seems certain that moisture is now necessary for further development. If the conditions are right, this larva ultimately changes to a pupa within the puparium or "flaxseed;" and here again, we find the duration of this stage greatly varied and dependent on climatic conditions of temperature and moisture. Fig. 9, *d*, represents a pupa much enlarged, the line at the side indicating its natural size. When the conditions are favorable, the pupa forces off the end of the puparium, and makes its way out and up the sheath to the open, then the adult emerges. At Fig. 9, *f*, is shown an adult female greatly enlarged, and *g*, an adult male also enlarged.

Number of Broods.—Under what may be termed normal conditions prevailing in Missouri, the Hessian fly has three broods each year; but under more favorable climatic conditions, such as an unusually damp season, the insect's development is so accelerated that there may be four broods; while, on the contrary, an unfavorable season caused by an unusually dry one, will retard their development to such an extent as to allow the emergence of only two broods. Probably no other insect is more susceptible of variation in the number of annual broods for a given locality; and it is of the utmost importance that the cultivator understand the causes controlling these variations, in order that he may govern him-

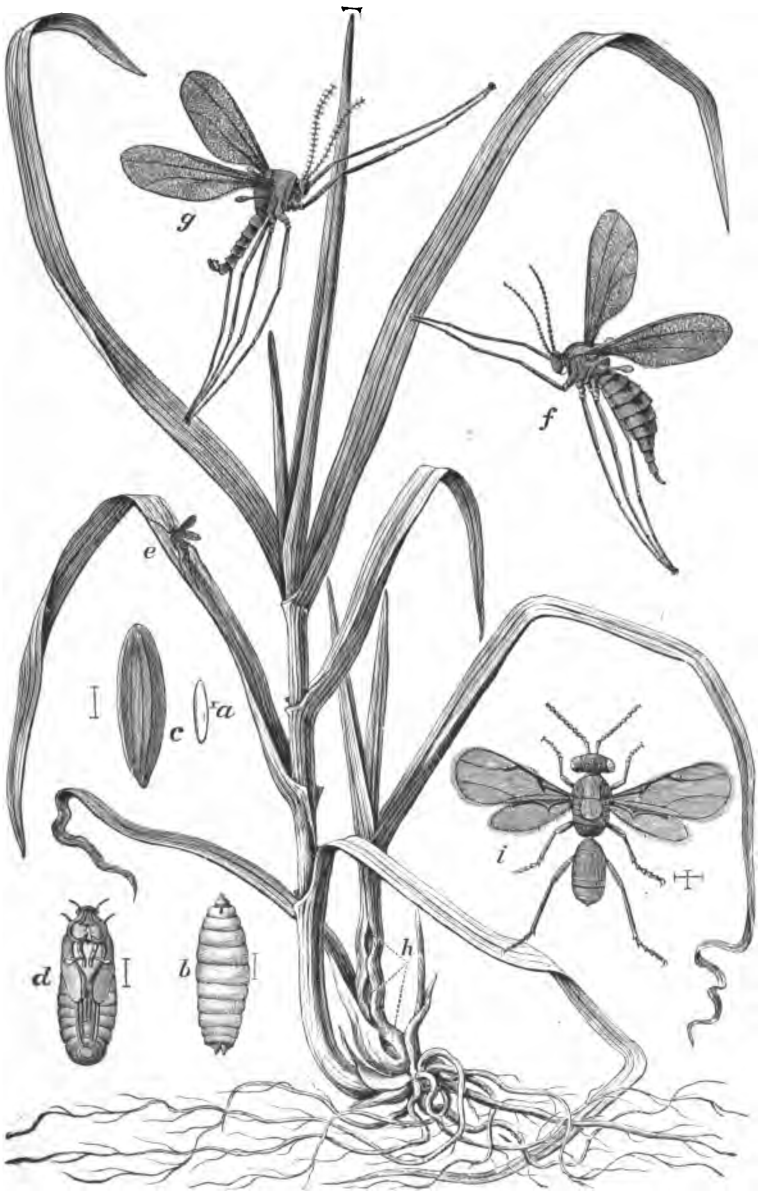

FIG. 9.—Wheat Plant Attacked by Hessian Fly, *Cecidomyia destructor*, and showing the different stages of the insect; also its adult parasite at *i*. *a*, egg of Hessian fly greatly enlarged; *b*, larva enlarged; *c*, puparium, "flaxseed" or pupa case enlarged; *d*, pupa; *e*, adult female depositing her eggs, natural size; *f*, adult female, enlarged; *g*, adult male, enlarged; *h*, "flaxseeds" in position between sheath and stalk. Lines at sides of figures indicate natural size of each. (From, Osborn, U. S. Dept. Agric.)

self accordingly in his effort to suppress their ravages, for upon it depends the success of our most important remedial or preventive measures. It is the general want of a knowledge concerning these facts and principles that results in so much failure on the part of our grain growers to contend with the pest.

Under normal climatic conditions, the adult Hessian fly will appear early in October, and will soon deposit her eggs on the young fall wheat. By the approach of cold weather the larvae will have reached the puparium or "flaxseed" stage, and will, in this stage, hibernate over winter, and in the early spring change to pupae, and emerge as adults about the middle of April. These adults will now deposit eggs on the wheat, and will mature adults about the latter part of May. Those flies will now deposit eggs on the spring wheat, and will reach the "flaxseed" stage before harvest, in which condition they may remain until fall, when the adult flies will appear. If the summer and fall be unusually dry, the adults that emerge in the fall will be later than usual in appearing and depositing their eggs; in fact, an exceedingly dry and hot summer and fall will so retard and dry up the "flaxseed" stage of the Hessian fly, as to cause the death of a large per cent; while if the late summer and fall be an unusually moist one, the adults will emerge and deposit their eggs much earlier than usual. If the spring be an unusually dry one, the first brood will be so retarded that the insect will still be in the "flaxseed" stage by harvest time, thus cutting out one brood from the normal number. On the contrary, if the summer be an unusually wet one, the insects that otherwise would have passed the summer in the "flaxseed" stage will emerge as adults, which will deposit eggs on volunteer wheat, thus producing one brood more than the normal number.

Cause of Variation in Number of Broods.—All the facts of observation go to show that warm and moist weather will greatly accelerate the development of the Hessian fly, while cold or dry, or even warm and dry, weather will greatly retard their development. So great is the influence, that the number of broods may be doubled in unusually warm and wet seasons, to what they are in unusually dry years. While temperature has a marked influence on the acceleration and retardation of the rapidity of development of the fly, it is evident that humidity has even a greater influence; and the two influences combined may cause wonderful differences in the number of broods from year to year. It is generally known that the climatic conditions which favor the chinch bug is unfavorable to the Hessian fly, and vice versa, so that we find the two pests alternate in their years of greatest destruction.

Description of the Hessian Fly.—For many and obvious reasons it is desirable to have an accurate description of the Hessian fly, such as will enable one to separate it from closely allied species found feeding on closely allied plants. To this end we can do no better than to quote the excellent description given by Professor Osborn.

Adult.—"The adult (Fig. 9, *f* and *g*), like other members of the family Cecidomyidae, to which it belongs, is a small, gnat-like, two-winged creature, about half as large as a common mosquito, which it resembles in form.

"The female is about one-tenth of an inch long (2.5 mm.), of a dark color, the abdomen in freshly issued specimens appearing red, with black patches or bands of black, and with red bands at the articulations, depending upon the amount of distension.

"The head is small, somewhat contracted dorsally, with a row of bristles on the posterior margin; eyes black, antennae long, black, semi-pallid, usually of 17 joints, this number varying in different specimens from 16 to 18; joints rather short, cylindrical, and joined by a very short filament, each provided with an irregular whorl of fine hairs. The thorax has two rows of long backwardly curving bristles near the median line, and a patch on either side. The legs are long and delicate with a dense covering of blackish scales dorsally, the basal joint of the tarsus very short. The wings appear smoky black from scaly covering, but the scales are very narrow, not broad, as those on the body and legs. The halters are yellowish, with broad blackish scales covering the outer part, the broad part naked, except a narrow border.

"The abdomen is long, ovate when contracted, but capable of great extension for the terminal segments. The ovipositor is compressed, cylindric, very minutely hairy, with an oval lobe at the extremity, which is minutely striate and more densely hairy than the basal portion.

"The male is smaller, more slender, and appears darker than the female. The antennae are larger, the joints more distinct, 17 to 19 in number or 16 to 20 for extremes, and connected by a much larger filament and the whorl of hairs is much more prominent, the hairs larger, and arranged in a more perfect vertical. The outer claspers are very robust and apparently loosely connected to the abdomen. The basal part is heavy, with numerous strong tubercules and a few scattered bristles. The distal part is, when at rest, at nearly right angles with the basal part, narrower, faintly tuberculate, very minutely hairy, and with a strong clear-like tooth at end. The inner claspers are broad, oval, minutely hairy, the posterior margin with a row of fine hairs, and toward the apex three or four blunt teeth. Between the claspers is a strong chitinous process, and anterior and dorsal to them two pairs of finely haired, slender, finger-like processes directed dorsally; anterior to these, and forming the posterior border of the abdominal segment, is a prominent hairy rim, broken at the median line dorsally.

Eggs.—"The egg is characterized as about one-half millimeter long, cylindric, roundingly pointed at the ends, glossy translucent, slightly reddish in color, and becoming deeper red with development.

Larva.—"The larva has usually been described without reference to distinct stages, but Marchal has defined three forms, the first of which, just issued from the egg, is capable of locomotion and travels from the point of hatching to the location under the sheath. Its size is slightly larger than the egg from which it hatches, and it presents thirteen segments, of which the first constitutes the head. It is distinguished from the second form principally by the presence of two triangular, plerby, ear-like appendages, lightly incurred below on each side, and comparable to tentacles; the anterior buccal border is trilobed, and beneath is the mouth in the form of a small triangular opening. The last segment is lightly emarginate posteriorly, and each of the two lobes thus formed carries four setiform papillae.

"The second larva form, which is fixed to the stalk and is the one usually described by writers, is, when grown, 3 millimeters long by a little less than 1 millimeter wide, of a flattened, cylindrical form, and so transparent that the internal organs are easily seen. There are twelve segments besides the head, which is small and more or less retracted. The anterior end is narrowed and usually somewhat bent. The posterior end tapers, is bluntly rounded, with two lobes on the posterior segment. The segments are but slightly indicated externally, but are plainly marked by the internal masses of adipose tissue arranged in series along each side, as well as the respiratory organs; the spiracles being plainly visible under the microscope as minute openings in rounded yellowish tubercules. The mouth part is indistinct, and the sternal spatula is, until the larva in ready to pass to the next form, either entirely wanting or inconspicuous. The digestive, nervous, tracheary and adipose systems, which are very plainly visible in the larvae, have been described in particular by Marchal, whose paper should be studied for details in this regard.

"The third larva form—that enclosed within the paparium—is distinguished especially by the development of the sternal spatula or 'breastbone.' In other respects there is little difference anatomically from the preceding, but it is a quiescent not a feeding stage. The sternal spatula, which becomes conspicuous at this stage, is a horny structure projecting from between the first and second body segments, and is provided at its anterior extremity with two pointed spurs. The bifurcate form of this spatula is used by Marchal to separate this species from *avenae,* in which there is but one point, the use of this organ, which projects forward under the first segment and rests against its vertical surface, has been a subject of considerable discussion. The explanation which is best supported was proposed by Enock and is sustained by Marchal. This is that the spatula is used by the larva to reverse its position in the paparium so that, whereas the larva rests at first with its head downward and toward the roots of the plant, it rests, after turning, with its head upward and toward the upper part of the plant, a position which has obvious advantages when we consider the direction in which the pupa and imago must escape.

Pupa.—"The pupa when first issued from the puparium is white, but acquires a rosy tint. It presents a very delicate appearance, the pupal case being extremely thin. On the front is a prominent pointed chitinous rostrum of a brown color, the function of which is considered to be the cutting of the puparium to permit the exclusion of the pupa. Above the origin of the antennae are the horns, called by Marchal the cephalic horns, and posterior to them two larger, curved, thoracic horns which contain, according to Marchal, trunks of the tracheary system."

NATURAL ENEMIES.

The great importance of the work of various parasitic insects in destroying the Hessian fly and preventing its undue increase can scarcely

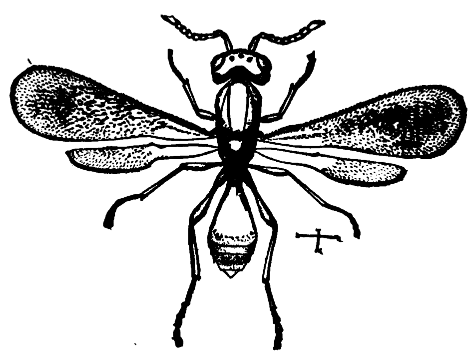

FIG. 10.—*Platygaster herrickii*: A Parasite on the Hessian Fly. The hair lines at the right show its natural size. (From Osborn, U. S. Dept. Agric.)

be overestimated. Undoubtedly these parasites kill practically every year from fifty to ninety per cent of the Hessian flies before they reach maturity, and in some years even a greater per cent are thus destroyed. Still, notwithstanding this great reduction by parasitic insects and also by unfavorable climatic conditions, these insects frequently become unduly numerous and consequently destructive. It is not only because of the economic importance of these parasites of the Hessian fly, but also because of the fact that otherwise the cultivator would not, as a rule, be able to distinguish them from the Hessian fly itself, that we have thought best to give an illustration of two of the more common species of these parasites found in this State. A glance at the illustrations shown in figures 10 and 11 will go much further toward acquainting the average agriculturist with these insects, and of enabling him to recognize and separate them from the Hessian fly, than any amount of description would do; and hence we will not enter into a description of each species. It *should be observed* that the Hessian fly has but one pair of wings, the second pair being represented by a slender stub-like rudiment; while in all the parasites there are two pairs of wings, the first pair, however, much larger than the second pair. In one species, *Baetomus subapterus,* not figured, the insect is frequently found without wings at all. Although the Hessian fly and its various parasites look alike to the casual observer, the above facts will enable one to note the difference, if followed with a little close observation and sharp eyes, especially if one be provided with a hand lens.

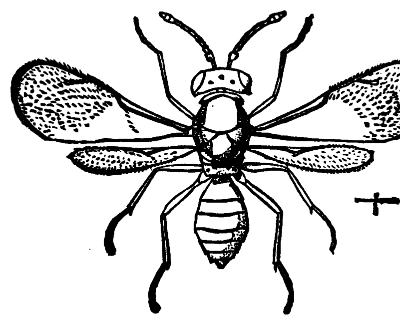

FIG. 11.—*Merisus destructor*: A Parasite on the Hessian Fly. The hair lines at the right show its natural size. (From Osborn, U. S. Dept. Agric.)

REMEDIES.

The use of insecticides for the suppression of the Hessian fly is practically out of the question, and recourse must, therefore, be had to preventive rather than remedial measures. To this end, one must thoroughly understand and be perfectly familiar with the habits of the insect, and with the conditions affecting its early or late appearance and variations in the number of broods. Knowing these, it is possible to so alter and arrange ordinary farm practices as to practically escape damage from the Hessian fly. No single measure or method of procedure will give the excellent results to be attained by an intelligent and systematic application of two or more according to the climatic conditions of the season. Primarily, the modifications of the preventive measures are based on the prevalence of wet or dry weather.

When the grain is harvested, if the weather is wet, the stubble should at once be burned over or deeply plowed under and rolled, while if the weather is very dry, this may be deferred until later, in order to allow the parasites to emerge; but in all cases, it should be done before the fall rains begin, and before it becomes grown up with weeds, or volunteer grain appears. In either case, the field should be plowed under and rolled as soon as volunteer grain appears, and hence the plowing under and rolling has an advantage over simply burning. All volunteer wheat about stacks should be thus destroyed.

The planting of winter wheat should be deferred as late as practicable, in order that there may be no grain up when the fall brood of Hessian flies appear. The exact date when the fall planting can be safely done will vary greatly from year to year. If the summer and fall be a very dry one, it will have to be postponed much longer than will be the case if the fall be a wet one.

Late Sowing of Fall Wheat.—From what has previously been said, it is evident that this method of escaping the Hessian fly is the simplest, as well as in many respects the most effectual. Since there is such a considerable seasonal variation from year to year for a given locality, and since latitude, and temperature and moisture have such a marked influence on the early and late emergence of the adults, it is not wise to give definite dates for the sowing of fall wheat, even for a given locality. Our experience for the past three years, in many localities and with many agriculturists, has been that not more than one in ten will miss the proper time when told to sow their wheat just as late as they possibly can for their locality and the season, and not to sow until after they have had some good fall rains. No doubt still fewer would miss it if they understood more fully the habits of the pest, and the conditions influencing and varying their development. Obviously, the wheat must be sown early enough to enable it to obtain sufficient growth to withstand the winter, and still be sown late enough so that it will not be above ground until all the Hessian flies have emerged, deposited their eggs, and died; and in order to do this intelligently, one must take into account all that has been said in this bulletin, and supplement it with a little observation. Should one succeed in escaping the Hessian fly by this late sowing of fall wheat, it will not be absolutely necessary, as a rule, to follow other methods, although advisable to follow both the above and the following for the best protection. But if you should fail to escape the fly in the fall, it would be well the following summer not to neglect the practice of the following method:

Burning or Plowing Under the Stubble.—This method of fighting the Hessian fly has for its immediate object the destruction of the insect while still within the wheat, and before it has emerged as an adult. Where the conditions are favorable, the burning over of the stubble will be found effectual. To this end it is well to cut your wheat very high, so as to leave as much straw as convenient, in order to more readily burn over the field, and also to be the more certain not to remove any of the "flaxseed" with the wheat. The burning should be done soon after the harvest and before any of the adults have emerged, or before weeds have grown up in the field. Later, if volunteer wheat appears, it must be plowed under, in order not to allow the development of any Hessian flies from those that might have escaped burning.

If, for any reason, burning is not resorted to, then the stubble should be plowed under as deep as possible, and the field then rolled, so as to compact the earth and prevent the emergence of the flies that might develop under the ground. Obviously this plowing under of the stubble must be done before any of the Hessian flies have emerged. In many cases it can be done soon after harvest, and the field then planted to another crop, as corn, on which the Hessian fly does not feed. If the weather continues very dry after harvest, the plowing under of the stubble can be postponed, since the insects will not, as a rule, emerge, but will remain dormant, and those that may emerge, will not find volunteer wheat on which to rear another brood, and will perish without doing any harm. If, however, the weather be wet during harvest, or should it later become wet, the Hessian flies will emerge and the volunteer wheat will appear, on which they will deposit their eggs for another brood. Hence it will, under these circumstances, be necessary to immediately plow under and roll the field, preferably before the Hessian flies have had time to emerge or the volunteer wheat to sprout.

While no sort of wheat is absolute proof against the attack of the Hessian fly, it is a well known fact that those sorts or varieties that have a strong hard stem and develop tillers freely, and these in turn freely develop secondary roots, will resist the attack and injury from this pest to a great extent. Such resistent varieties are the Clawson, Underhill, Mediterranean, Red May and Red Cap.

THE WHEAT BULB-WORM.

Meromyza americana, Fitch.

INTRODUCTION AND WORK.

This insect is a very common one in the State of Missouri, but its work is usually ascribed to the Hessian fly. The effect of the work of the wheat bulb-worm is indeed similar to that of the Hessian fly. The wheat bulb-worm is a true fly belonging to the order Diptera, while the Hessian fly belongs to the order Hymenoptera, and it is not to be won-

FIG. 12.—The Wheat Bulb-Worm, *Meromyza americana*, Fitch. Adult fly, enlarged, in upper figure; and natural size resting on stem to the right; larva and puparium, enlarged, at lower right hand corner; and puparium, natural size, within a stem just above. A parasite of the wheat bulb-worm is shown, enlarged, at the lower left hand corner. The hair lines at the side of each figure represent its natural size. (After Lugger.)

dered at that the agriculturist should ascribe all the injury to the work of the well known Hessian fly. Frequently there are many wheat fields more or less damaged by this bulb-worm when no Hessian flies appear to be present. As a rule, the bulb-worm does not cause the extensive loss that the Hessian fly does throughout the entire State. It is usually found in more or less numbers in wheat fields associated with the Hessian fly, but the great damage to wheat is usually done by either the one or the other, and not by the united efforts of the two. That is to say, a wheat field may be ruined by the Hessian fly in one locality, and in another locality a wheat field may be ruined by the wheat bulb-worm. It is not every year that these bulb-worms occur in sufficient quantities to cause any serious complaint, since the agriculturist has learned to attach a certain amount of injury as a matter of course, and unless the damage exceeds his usual expectations, no complaint is received from that source. While I have known of wheat fields being entirely ruined by this insect, as a rule the five per cent injury is the more common.

The effect of the work of the wheat bulb-worm in the fall wheat is almost identical with the effect of the work of the Hessian fly. The wheat becomes yellowish, either in spots throughout the field, or in badly infested fields the entire field may become bleached and yellow, and it is impossible for one to simply look over a wheat field and determine whether the injury is due to this insect or to the Hessian fly. If one pulls up a clump of wheat at this time and examines it closely by removing the leaves and the sheath from about the base of the stem, if they have sharp eyes they may be able to determine which insect is causing the trouble. If the trouble be due to the presence of the wheat bulb-worm, one will find, near the lower joint and between the sheath and stem, minute, light, watery green colored, footless maggots, a little less than a quarter of an inch in length, tapering from a compartively large central portion down to a small point at each end; and by looking at the head, especially with a magnifying glass, two minute black bodies will be seen projecting forward and curving downward. See figure 12 where a larva is shown, enlarged, at the lower right hand corner. If the injury be due to the Hessian fly, one may readily determine this point by examining the head of the grub, since in this case no indication of the two black bodies will be seen. Then again, by closely noticing the way in which the grub works, one can usually determine what insect is with him. The Hessian fly grub will always be found between the sheath and the stem, and frequently in a little hollow place within the stem, that has not been excavated by the insect itself, but is due to the way in which the stem has grown about the insect. While in the case of the grubs of the wheat bulb-worm, the stem will be seen to have been gnawed and lacerated, and the grub will be found within this lacerated and gnawed channel.

When the injury is noticed about the time the wheat is ready to ripen, one can quite readily determine whether the injury be due to the Hessian fly or the wheat bulb-worm by the fact that in this case the wheat bulb-worm will be found just above the upper joint, while the Hessian fly work is still confined to the lower part of the plant. By taking hold of the head of wheat and pulling slightly, it will be readily removed from the sheath, and the lower end will look lacerated and torn, and by pulling the sheath down, one will find just above the joint the grub of the wheat bulb-worm that has caused this injury.

To be sure, the direct effect upon the plant is practically identical, whether the cause be the Hessian fly or the wheat bulb-worm. The Hessian fly relies upon its presence between the sheath and the stem to irritate the plant sufficiently to cause the sap to exude at that point, while the grub feeds upon the sap. There is no laceration or eating of the tissues. The grub of the wheat bulb-worm, on the contrary, lacerates and tears the tissues of the stem, and thereby causes the sap to flow and thereby enable it to feed. There is very little doubt but that the grub feeds upon the sap, the lacerating and tearing of the tissues being simply a means to cause the sap to exude in sufficient quantities at that point. But in either case, the plant suffers in the same way, due to the checking of the flow of sap above the point of attack, and causing it to wither and die above. If the injury be in the fall wheat, it makes its appearance by causing the wheat to bleach and turn yellow, and ultimately die; while if the injury be near the ripening period of the wheat, the lower portion may look perfectly healthy, while the heads will be seen to prematurely ripen and die. This is due to the fact that the insect now works just above the upper joint, and has prevented the proper flow of sap to the head, and has caused it to prematurely ripen. If such heads of wheat be examined, it will be found that they will, in many cases, contain no kernels whatever; and in those that do, the kernels will not be matured, but will be very small and shriveled, and unfit for either food or germinating purposes. A stalk of wheat attacked in this way by the second brood is absolutely ruined, while the wheat that may be attacked in the fall is not necessarily ruined, because the plant will send out tillers and frequently make a good crop from them.

The wheat bulb-worm infests rye and oats as well as wheat, and there are good reasons for believing that the insect will work in timothy and blue grass, although we have no absolute proof of this as yet.

DESCRIPTION.

The *adult* wheat bulb-worm is a very small fly, not quite two-fifths of an inch in length. It is of a yellowish-white color, with a black spot on the top of its head, and three black stripes along the back of the thorax, which become interrupted at the separation between the thorax and abdomen, and are then continued down the back of the adbomen with more or less interruption. The eyes are bright green in color. While this description is by no means complete, yet, I think, it will suf-

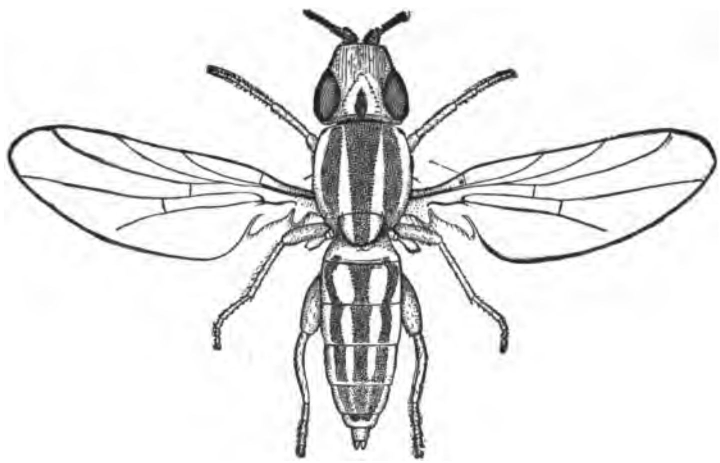

FIG. 13.—Adult Wheat Bulb-Worm, *Meromyza americana*, greatly enlarged. (From Forbes.)

fice to describe the fly to the ordinary agriculturist, especially in connection with the figure. One of the adult flies, greatly enlarged, is shown in figure 12, near the middle of the plate, the hair line at the right showing the natural size of the fly. A much larger figure of the fly is shown in figure 13.

The *larva* is a small footless maggot of a pale watery green color, tapering anteriorally, and about one-fourth of an inch in length. The head is provided with a pair of black, hook-like organs. A fairly good idea of the general shape of the larva may be had by referring to figure 12, where one will be seen, enlarged at the lower left hand corner, with a hair line at the side, showing the natural size of the insect.

FIG. 14.—Larva of Wheat Bulb-Worm, greatly enlarged. (From Forbes.)

The *pupa*. The true pupa is enclosed within a delicate skin, called the puparium, which is really the last larval skin, and through this delicate skin the wing pads and legs of the pupa may be seen. A puparium is shown enlarged near lower right hand corner in figure 12, and still more enlarged in figure 15. The color of the pupa is greenish, and

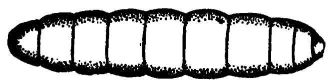

FIG. 15.—Puparium of Wheat Bulb-Worm, greatly enlarged. (From Forbes.)

is about one-fifth of an inch in length. A figure of a pupa, greatly enlarged, is shown in figure 16. This puparium is quite readily distinguished from the well known "flaxseed" which is the puparium of the Hessian fly.

FIG. 16.—Pupa of Wheat Bulb-Worm, greatly enlarged. (From Forbes.)

LIFE HISTORY.

The fly which is the adult of the wheat bulb-worm lives through the summer, and in the fall, when the wheat or rye is up far enough, she deposits her eggs there by pushing her abdomen down between the leaf and the stalk near the base and inserting a little egg. As a rule but one egg is deposited in a stem. This is usually done about the latter part of September. After busying herself depositing her eggs in this way the adult perishes. These eggs hatch in from ten days to two weeks, and the little grub immediately crawls down the sheath, and begins to lacerate the tissues, causing the sap to flow, upon which it feeds. It gradually increases in size and lacerates more tissue, until finally the stem is almost entirely destroyed just above the joint. This naturally kills the plant above, and it, therefore, turns yellow and bleaches out, giving the well known appearance to an infested field.

By the approach of cold weather, the grub has become nearly full grown, and it now remains in this place and hibernates in the grub stage during the winter. In the spring the grub again begins to work and do additional damage, killing those stems of wheat that did not happen to die during the fall. About the middle of April the grubs begin to transform to pupae, and by the forepart of May practically all of them have entered the pupa stage. This pupa stage lasts about two weeks, and then the adults appear; hence we may look for the adults to emerge about the first of May, and they will continue to appear for upwards of two or three weeks, so that we may expect the adults to emerge throughout the entire month of May. They at once pair, and the females begin right away to deposit their eggs. They do so by alighting upon a stem of wheat, walking up and down, and finally inserting their abdomen between the sheath and the stem above the upper joint, and there depositing a single egg. They then fly to another stem and do likewise, keeping this up until they have deposited all their eggs.

It will be noted, then, that this brood of adults in depositing their eggs, do so in an entirely different place than do the adults that deposit their eggs in the wheat during the fall. The adults in the fall deposit their eggs between the sheath and the stem at the base of the plant, while these spring adults deposit their eggs between the sheath and the stem just above the upper joint of the plant. This

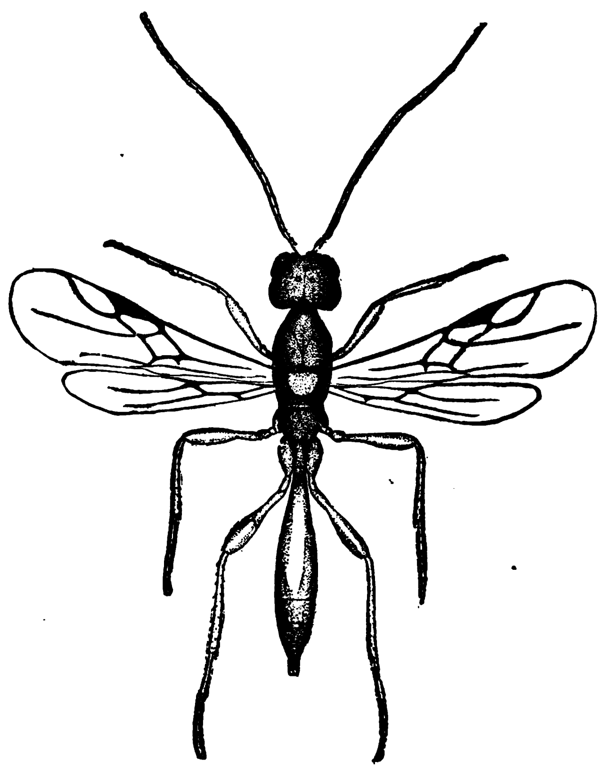

FIG. 17.—A Parasite, *Caelinius meromyzae*, on the Wheat Bulb-Worm, greatly enlarged. (From Forbes.)

depositing of the eggs usually takes place in Missouri during May. The eggs hatch in about ten days, and the larvae or young grubs feed on the young pedicles of the heads just above the upper joint, where they lacerate and tear them, causing the sap to flow at this point, and thus preventing the heads from filling out their seed, or entirely preventing their development, depending upon the time of attack. In all cases they absolutely ruin that head for any purpose whatever. About the first of

July these larvae change to pupae, and the adults soon emerge and then usually wait until fall for the fall wheat to come up in which to deposit their eggs. In some instances, however, they have been known to deposit eggs for another brood in volunteer grain.

From what has been said, it is evident that the great damage resulting from an attack by this insect is due to the spring brood, because here every stem of wheat that is infested is ruined; while in the fall, a stem of wheat infested with this insect, although itself ruined, is not such a great loss to the agriculturist, because that plant will send up tillers, which will necessarily be free, and these tillers will make a crop of wheat, provided they do not become infested the next spring. Many fields of wheat and rye are injured more or less by the spring brood, and yet the attention of the agriculturist is not called to it, because the wheat appears all right, except that it apparently prematurely ripens. If these prematurely ripening heads are gathered and examined, they will be found to contain either no kernels at all, or else minute shriveled kernels, that are absolutely worthless. It is not an uncommon occurrence for wheat fields to be frequently reduced from five to ten per cent as a result of the presence of these insects. Where the fields are reduced to twenty-five or thirty per cent the agriculturist usually complains. Cases have been known where the entire crop has been ruined.

NATURAL ENEMIES.

Like most other insects, this one is attacked and more or less held within bounds of reasonable numbers by a small hymenopterous parasitic insect. This little creature is illustrated in figure 12, greatly enlarged at the lower left hand corner, a hair line at the side, however, representing the natural size. It is also shown still more enlarged in figure 17. This friend of ours stings the grub of the wheat bulb-worm, lays an egg within its body, and the larva hatching from this egg, feeds upon the tissues of its host and kills it.

REMEDIES.

Fortunately for the agriculturist, the wheat bulb-worm can be combatted and its ravages greatly lessened, if not entirely done away with, by the same methods as we employ in combatting the Hessian fly. The adult flies, as we have just seen, are about during the summer waiting for the wheat and rye to come up in the fields, and are ready to lay their eggs just as soon as these plants reach the proper stage to enable them to do so. They finish laying their eggs and disappear, or at least are perfectly harmless, quite early in the season, as a rule by the first of October, provided some wheat or rye is in a suitable condition for them by that time; hence, if the wheat is sown in the fall just as late as can possibly be done, such a field will almost invariably escape an attack from these insects. It is not necessary for the farmer to pay any attention to the climatic conditions prevailing during the summer or during the fall to help him as a guide in the proper time to sow, because this insect does not depend upon these climatic conditions, that I have described in regard to the Hessian fly in order to enable the insect to transform to the adult stage; but on the contrary, this adult of the wheat bulb-worm is about and ready to lay its eggs regardless of such climatic conditions, it having hatched out early in the summer. It is advisable, especially in the case of this wheat bulb-worm, to sow early a row or strip of wheat around the field, so that this will be sufficiently above the ground to attract the attention of the flies, and enable the adults to lay their eggs before the main mass of wheat is up. In such a case, one forces these insects to deposit their eggs in this early strip of wheat, while the main wheat will escape. This trap strip of wheat can then be plowed under deeply and rolled, and the insects thereby buried, and the strip can then be resown to wheat. By following these two methods, one can escape the ravages of this insect even more certain than is the case with the Hessian fly. A frequent rotation of crops or the abandoning of wheat or rye for a year or two in the region badly infested with these insects, will also tend to practically do away with their injurious numbers for a year or two.

THE WHEAT STRAW-WORM.

Isosoma tritici.

The wheat straw-worm does not occur in such great numbers nor do such extensive injury to the wheat crop of Missouri as the other insects that we have just discussed. It is perfectly capable, however, of doing fully as much damage, but is held in check by our ordinary methods of farming, which interfere with the habits of the insect. This is one of the very few insects attacking wheat, where the general farmer can hope to do considerable good by combatting the insect on his own farm, regardless of whether his neighbors take any means looking to the suppression of the insect or not. The reason for this is that the bulk of these adult insects have no wings and, therefore, cannot fly, and their method of transportation is thereby so retarded and restricted, that they are not readily disseminated from one man's field to his neighbor's.

The adult wheat straw-worm is a very small hymenopterous insect, measuring scarcely one-tenth of an inch in length, and of a glossy black color. Not more than one in twenty of them have wings at all. The other nineteen out of the twenty being wingless, and looking very much like extremely minute ants or wasps without wings. By referring to figure 18, *f*, you will observe an enlarged illustration of one of these adults, with a little hair line down at the lower right hand part of the figure indicating the natural length of the insect. At the right *g*, and *h*, show the wings that are occasionally found upon the adults. These adults appear during the latter part of March, hatching out from the straw in straw-stacks and the stubble remaining in the old wheat field. They deposit their eggs in the wheat during the latter part of April and the forepart of May. The larvae hatching from these eggs feed inside of the stem of the wheat, sometimes being found inside of the lumen, and at other times within the walls of the stem. They are usually found

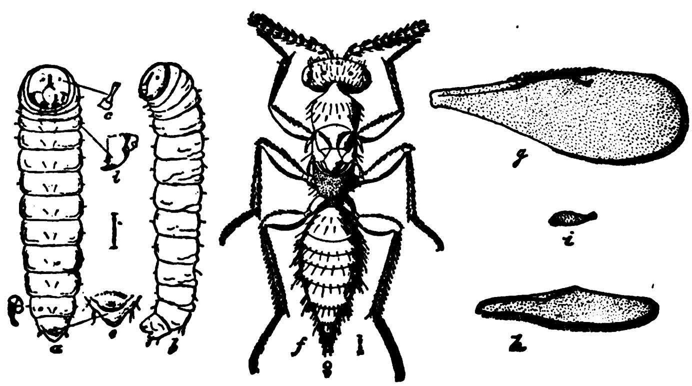

FIG. 18.—Wheat Straw-Worm, *Isosoma tritici*: *a*, larva, ventral view; *b*, larva, lateral view; *f*, adult, female, greatly enlarged; *g*, *h*, front and hind wings of exceptional individuals; *i*, aborted wing of normal individuals. All figures greatly enlarged, the hair lines indicating their natural size. (From Forbes.)

just above the third joint, although some may occur below this, and others near the top of the stem. The larvae when full grown are small, pale, yellow grubs, scarcely one-fifth of an inch in length. A good idea of the general shape and make up of these larvae can be had by referring to figure 18, *a*, and *b*. The larvae feed in the stems of wheat, causing it to be checked in its growth, but not killing the stem as is the case with the other insects just described. Usually but a single larva is found within the stem. These larvae continue to feed upon the plant, causing the wheat to become stunted and the heads to become smaller, and to not contain as much wheat as they otherwise would were these insects not below sapping the life out of the plant.

When the wheat is cut, the bulk of these larvae will be left in the stubble, especially if the wheat be cut rather high. Those that happen to be above that part will be carried with the straw and ultimately reach the straw stack, or be scattered through the barn yard when the straw is used for bedding. Towards fall, usually along in the latter half of October, the larvae transform to pupae within the stems of straw, whether they be in the field as stubble or in the straw stack. The pupae pass the winter in these situations, and transform to adults along in the latter part of March the following spring. It will thus be seen that these insects are single brooded. This fact is of great advantage to the wheat grower, and of a decided disadvantage to the insect. So, likewise, is the fact that the bulk of the adults have no wings. On account of these two peculiarities in the life history of this insect, is due the fact that the creature does not, as a

FIG. 19.—Pupa of Wheat Straw-Worm, *Isosoma tritici*, greatly enlarged. (From Forbes.)

rule, become such a decided foe as it otherwise would. Where fields are sown to wheat from year to year without any rotation of crops, these insects have been known to cause considerable injury by preventing the development of the proper amount of wheat in the heads.

It is a very simple matter, however, to elude this insect. The simple rotation of crops will lessen the number of these insects to a surprising extent. This is due to the inability of the insect to readily migrate from the old field to a new one. Where the insects are numerous enough to warrant it, one should mow the stubble field, and leave the grass and weeds long enough to thoroughly dry out, and then set fire to such a field, and allow it to burn over. This method will burn the insects that are in the stubble

FIG. 20.—A Parasite, *Eupelmus allyni*, of the Wheat Straw-Worm. (From Forbes.)

and it may also, in some cases, be advisable to burn the remains of the straw stacks early in the spring, about the latter part of February, and thereby prevent the adults that may hatch out from such places from escaping. In case an old wheat field that is infested with these insects has not been burned and adjoins a new field of wheat, the insects may migrate to and attack the first few rows of wheat in the new field, but will rarely spread any distance.

While destroying the stubble and the straw containing these insects, and the frequent rotation of crops in the wheat field, will practically control these insects, nevertheless, it may be of interest to know that certain parasitic insects also infest these wheat straw-worms, and do a good deal of good in keeping them within bounds of reasonable numbers. Frequently these parasitic insects have well developed wings in the adult condition and can readily fly from place to place; and as they hatch out early in the fall or during late summer, it is well that these facts be known, and that, therefore, the agriculturist cut and burn the stubble as late as he can well do, so as to allow what parasites there may be in the field to mature and to escape, and leave only the wheat straw-worms to be destroyed and burned.

THE ARMY-WORM.

Leucania unipuncta, Haworth.

INTRODUCTION.

The army-worm belongs to the great family of moths known as Noctuidae. There are a great many insects belonging to this family and closely related to the army-worm, which under certain conditions may, in the larva stage, leave the field in which they are feeding and march in a body, and hence it has come about that several distinct species of insects are popularly spoken of as army-worms, when these marches occur. But there is one insect that is known as the true army-worm, and it is this insect alone that we will describe in this article. Let it be distinctly understood that the marching of the larvae of even the true army-worm in numerous masses as they sometimes do, is, like the marching of the closely allied species, an entirely abnormal state of affairs.

The true army-worm is found in various places over the world, but, with the exception of Australia where the insects cause some damage, that part of the United States and Canada east of the central portion of Kansas and north of Tennessee, seems to be the region in which these insects occur in great numbers and cause such a vast amount of damage. Practically every year the army-worm causes several hundred thousand dollars damage in some portion of this region of the United States and Canada, and occasionally more or less throughout the entire region in the same year.

While we cannot say that the army-worm is on a whole so destructive as the Hessian fly or the chinch bug, yet within certain restricted

FIG. 21.—Army-Worm, *Leucania unipuncta*, at work on corn plant; nearly natural size. (From Slingerland.)

areas it does, in certain years, cause more damage. The western part of the little State of Massachusetts lost upwards of five hundred thousand dollars by the ravages of one brood of this insect in a single season. About eight hundred thousand dollars worth of oats alone went down the throats of these army-worms in one season in the states of Indiana and Illinois. Just what the damage in any one year in the State of Missouri due to the ravages of the army-worm has been, I am unable to say, but certain it is that many thousands of dollars are lost nearly every year in some portion of Missouri as a result of the ravages of this insect.

Fortunately the army-worm does not occur in sufficient quantities to attract the attention of the agriculturist every year. Nevertheless, let it be understood that the army-worm is with us in our fields and meadows every year, but only in certain years do these insects multiply in such vast numbers as to destroy the food plants in their locality and cause them to march in armies in search of fresh food. When these marches occur, the agriculturist has his attention called to it at once, and then wonders where these army-worms came from and what becomes of them. As a matter of fact, very few agriculturists know the adult insect that lays the eggs from which these army-worms hatch, and very few know anything about the life history of these little fellows. It is important, therefore, in order to intelligently understand the control of these insects, that he should at least know briefly the general outline of the life history and habits of these worms.

THE INSECT DESCRIBED.

The adult of the army-worm is a small, brown or fawn colored moth, somewhat speckled with black scales, and with a distinct white spot near the center of the front wing; the hind wings are of a lighter dusky color with the outer margin and the veins darker or blackish. The expanded wings of these moths measure about an inch and a half to an inch and three-quarters. By referring to figure 22, *b*, one can obtain a good idea of the general size, shape and markings of these adults. This figure is natural size, and the one shown at *a* is also natural size, but has the wings folded showing the insect at rest. In *c* the insect is shown twice its natural size.

The eggs are small, round and whitish or very light yellow in color, and are deposited in rows in grasses and other places, and smeared over with a glutinous excretion from the insect. The larvae or worms, or caterpillars as many people call them, are, when full grown, about an inch and a half in length, of a dark greenish color, with three stripes along each side. The head is of a greenish brown color, mottled with black, and this mottling is found more or less over the entire body. The stripes along the body are greenish yellow with whitish margins. A good idea of the general appearance of a larva can be had by referring to figure 24, where the larva will be seen natural size, and to figure 23, where the larvae will be seen magnified twice their natural size. The pupa stage,

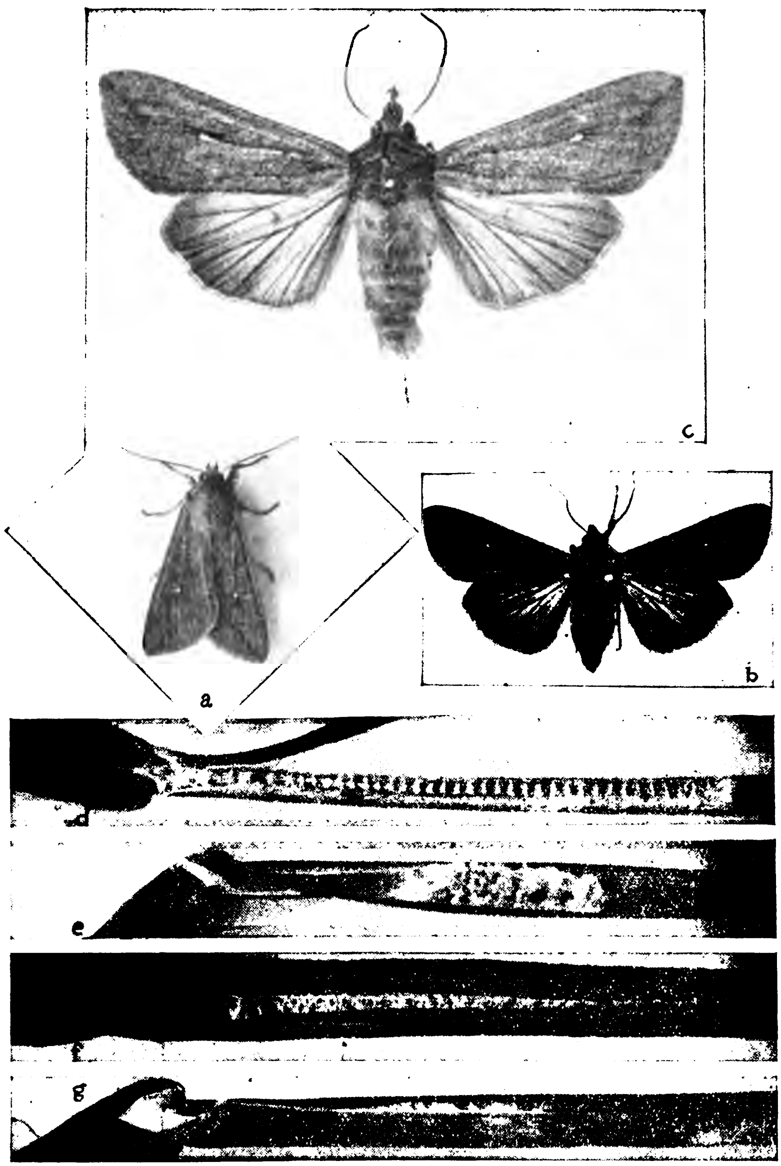

FIG. 22.—Adult Army-Worms, *Leucania unipuncta*, and their eggs: *a*, adult at rest, natural size; *b*, adult with wings expanded; *c*, adult, twice natural size; *d*, *e*, *f*, *g*, eggs of army-worm moths as they are laid in grass leaves, much enlarged. (From Slingerland.)

which is passed under the ground, is not unlike the pupa of a number of others insects, some of which you have probably removed from coccoons. The pupa is dark brown in color and measures about seven-eights of an inch in length. Two pupae are shown, natural size, at *a,* in figure 25, and two enlarged in same figure.

THE LIFE HISTORY AND HABITS.

The adult moths appear in the spring and seek those places in the fields and meadows where the vegetation grows the rankest, and deposit their eggs in masses under the leaves of grass near the stem. The eggs are placed as a rule in a row, and are then smeared over with a glutinous substance that fastens the eggs together and to the leaf. The female, after laying a bunch of eggs in one place, passes on to another suitable place and deposits another bunch of eggs. Each female is capable of laying upwards of seven hundred eggs, and herein lies one of the secrets that influences the development of these army-worms at certain times. The moths fly at night, and the depositing of the eggs by the female is done principally in the forepart of the night. During the day time the moths remain concealed in some sheltered or protected place.

The egg laying season for Missouri varies from the middle of April in the southern portion of the State to the forepart of May in the northern part of the State. A corresponding difference occurs as regards the hatching and appearance of the various stages of these insects throughout this State. In central Missouri the eggs begin to hatch about the first of May, which is about one week after the eggs are deposited. The young larvae or worms, as soon as they hatch, feed upon the leaves of their food plant.

The plants that these insects will feed upon include especially the members of the grass family. They are not very particular in their menu, but, nevertheless, seem to prefer oats, corn, timothy, wheat, barley, rye, Hungarian grass, millet, sorghum and flax. While they seem to prefer these plants, they will eat onions, peas, beans and other garden crops.

The worms seem to shun the direct rays of the sun and seek sheltered places. This is usually provided for them by the fact that the adult moths seek those places containing the rankest growth of grasses and other vegetation. The larvae feed especially on cloudy days and in the evening and night, and when disturbed they have a tendency to drop to the ground.

The grass or the wheat in which these larvae hatch may be very badly infested without their presence being detected by the agriculturist. When these worms are very numerous, they succeed in eating the plants to such an extent that by the time they are half grown the proper amount of food in that locality has become too scarce for them, and they then take it into their little heads all at once to crawl in search of a fresh supply of food. In doing so these worms crawl in a mass, each one seemingly to have taken it into his little head to perform this march at the same time. This marching of the worms in an army is brought about purely and simply by the scarcity of food in the place they had thus far been feeding. In these marches we find millions of worms massed together and all moving over the ground in the same direction, and it is this habit that has given these insects the common name of the army-worm. No one who has not seen an army of these worms traveling in search of a fresh supply of food can form any conception of the vast numbers, and of the destructive work that these insects are capable of causing. At such times the insects seem to be unusually hungry, and will utterly destroy nearly every green vegetable substance in their line of march, especially any members of the grass family, which of course includes our corn and wheat and other grains.

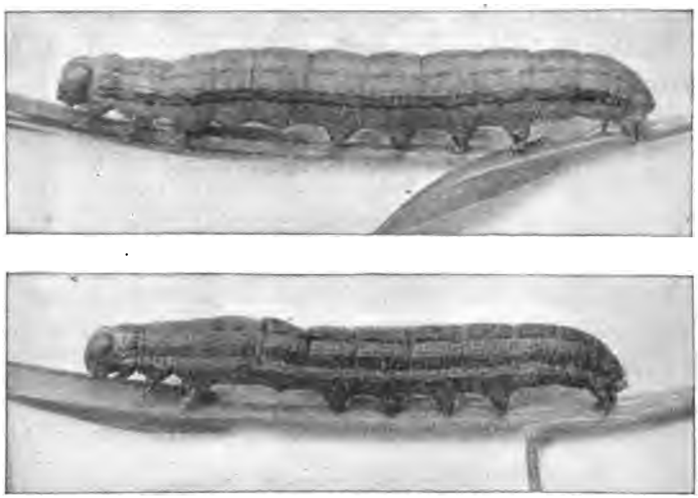

FIG. 23.—Light and dark varieties of Army-Worms, *Leucania unipuncta*, twice natural size. (From Slingerland.)

When these insects encounter a field of wheat or a corn field, they devour practically every green leaf and cut off the heads of the wheat. An ordinary marching army of these insects will completely destroy two acres of wheat or early corn in one day. When they attack a certain field, they usually march forward as fast as they are able to devour the plants. It is usually the case that these army-worms develop in low places about the meadows or wheat fields where the plants are more thrifty, and should their number not be unusually great, they confine their feeding to this locality; but where they occur in immense numbers, as soon as they have obtained about half their larval growth, their appetites become so ravenous, and they devour so much more than they did previously, that the plants in this particular area are not sufficient to supply their food. It is in such cases, then, that the well known migration occurs. Whether the larvae have migrated or not, when they become full grown they enter the ground a little ways blow the surface, and wiggle their bodies back and forth in order to pack the earth and make a little cell, and then presently change to pupae. The larvae usually require about twenty-five days in order to become full grown larvae, and the pupa stage usually lasts about seventeen days. At the expiration of this time, the adult moths emerge from the pupae. Hence in central Missouri we find these larvae as a rule marching about the first of June. At this time the wheat plant is in the milk stage, and should an army of these worms encounter a wheat field at this time, the amount of damage that they will do cannot be appreciated by anyone who has not actually seen their work. Two acres of wheat will disappear down the throats of an ordinary army of these worms each day.

Soon after the adults have emerged they pair and lay eggs for another brood. These eggs are deposited in the same situations as were those for the first brood. If conditions are favorable for the development of the army-worms, this second brood of larvae coming from these

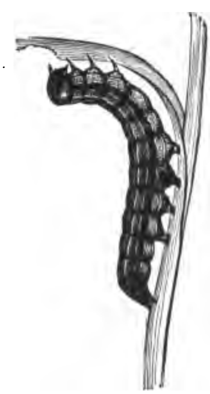

FIG. 24.—Larva of Army-Worm, *Leucania unipuncta*, natural size. (From Smith.)

eggs will be several hundred times more numerous than were the larvae of the first brood, and it frequently happens that this second brood is the one that does the most damage by marching in armies, and attacking the corn at this season of the year. The wheat plant in Missouri usually escapes this second brood, but the corn plant suffers severely. By referring to figure 21 you will observe a number of larvae photographed in the act of stripping a corn plant. These insects are not quite natural size.

In due course of time the larvae of this second brood enter the ground in order to pupate, and the moths which hatch from this brood appear during the forepart of August.

This second brood of moths again pair and lay their eggs for a third brood of worms, which appear in the central portion of Missouri usually about the middle of August. It is not often that the migrating horde of the third brood of army-worms do very much damage here in Missouri. During the latter part of September or the forepart of October the third brood of adults appear. These adults seek sheltered places later in the fall, and there pass the winter hibernating as do the adults of the chinch bugs. They seek as a rule the loose bark on trees, secluded places under logs, and in piles of rubbish. We have no data to show that in central Missouri, at least, the winter is never passed in any other stage. I have never been able to determine that the pupae

FIG. 25.—Pupae of Army-Worm, *Leucania unipuncta*; *a*, *a*, natural size; the other two enlarged about three diameters. (From Slingerland.)

ever fail to transform to adults in the fall if they are going to transform at all, neither have I ever been able to find that the larvae have ever failed to make pupae in time to allow the adults to emere. It is quite different, however, with the states north of us, where there seems to be good reason to believe that the winter is passed not only by the hibernating insects, but by the pupa, and occasionally by the larval stage. It will thus be seen that the army-worm in Missouri has three distinct broods each year.

The army-worm has its ups and downs, but fortunately for the agriculturist of any given region, it is more often downs than ups. It is a well known fact that the appearance of army-worms in great destructive numbers never has occurred in any given locality for two consecutive seasons. While the army-worm is with us in small numbers every year and can be readily found by a person searching for them in pastures and meadows and wheat fields, yet the insect is held within bounds by a number of foes, some of which will be discussed later on. It appears that it is only about once out of ten times that these natural enemies fail to do their duty, but when they fail, the army-worms succeed in multiplying sufficiently to cause the larvae to take upon themselves the habit of marching in great masses, and practically devour every green thing within their path.

NATURAL ENEMIES.

While the cutworms are greedily preyed upon by a number of different birds, especially the robins and thrushes, and while poultry of all kinds thrive on this luxuriant food, and also while certain parasitic fungi and bacteria also kill numbers of the larvae and pupae, yet the great

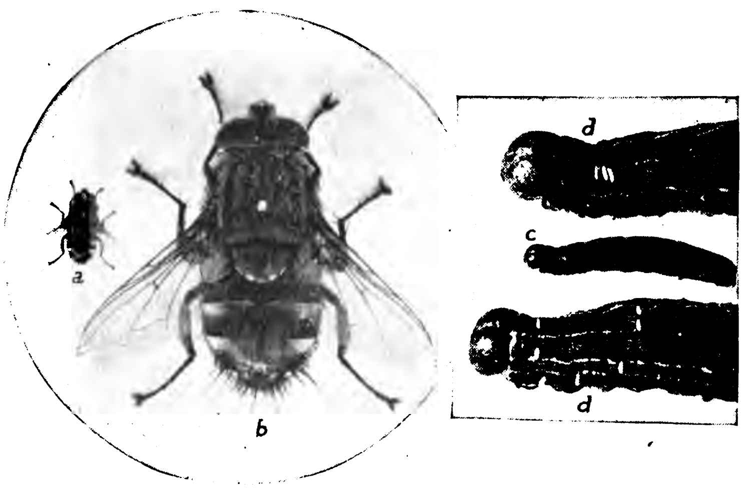

FIG. 26.—The Red-Tailed Tachina Fly, *Winthemia 4-pustulata*, a parasite on the Army-Worm; *a*, the fly, natural size; *b*, same, much enlarged; *c*, army-worm on which the fly has laid eggs, natural size; *d*, parasitized army-worms, enlarged. (From Slingerland.)

war raged against these insects is particularly due to the presence of certain parasitic ones. Some Ichneumon flies string the larvae and deposit their eggs within their bodies, and the resulting grubs feed upon them and kill them. Certain parasitic flies especially do an immense amount of good in holding these army-worms in check by depositing their eggs upon them, and the grubs which hatch work their way within and feed upon the tissues of the army-worms. Probably every agriculturist who has observed the army-worm marching in great numbers has had his attention called to the presence of vast numbers of flies that buzz around or about the marching army, and have caused him to wonder why and what they were there for. One of these flies is shown in figure 26, natural size at *a*, and greeatly enlarged at *b*. A part of an army-worm on which you will see the white eggs of these flies is shown in figure 26, natural size at *c*, and enlarged at *d*. They are to be found in great numbers wherever the army-worms occur in quantities such as is the case when on the march, and they may be seen darting down and depositing an egg upon the body of the doomed army-worm. The agriculturist then should be delighted to see these flies about the fields that are seriously infested with army-worms, for it indicates to an almost certainty that the next brood of army-worms will be so reduced as to not become especially troublesome.

REMEDIES.

Ordinarily for any particular given locality, it is not especially necessary to take any means of fighting the army-worm each year, because it does not ordinarily occur in that particular locality in sufficient quantities to warrant such precedure; and from this very fact is due no doubt the want of a knowledge on the part of most of the agriculturists in regard to the habits, life history and methods of controlling this insect; while those insects that are injuriously abundant each year, the agriculturist soon learns to combat. Unfortunately the army-worms may be very numerous in a meadow or in the low and rank growing places of a wheat field and yet not attract any attention from the owner until the larvae have become about half grown, when he will suddenly discover that the plants in such places are being destroyed, and by that time the worms have undoubtedly taken it into their little heads to seek fresh feeding ground. If an agriculturist be fortunate enough to discover the presence of vast numbers of army-worms in the meadows or fields, he may resort to some means of destroying them there, and not allow them to migrate or march to other places. It is possible to spray the badly infested areas with strong arsenical poison, or kerosene mechanically mixed with water as described under chinch bugs, and in that way practically exterminate the colony, but, nevertheless, it is a rare thing that such a discovery is made in time. The next best method is to plow a few furrows around the badly infested area. These furrows should be as deep as possible and should have their vertical sides away from the infested area. Post holes should then be dug every six or eight feet along these furrows. When these army-worms start to migrate, as they are sure to do when they occur in quantities sufficient to attract the attention of the agriculturist, they will not be able to readily get across these furrows. They are rather clumsy worms, and once they find they can not ascend the perpendicular walls they will walk along the furrows in the hope of finding some escape, and will tumble into the holes where they may be killed by sprinkling with kerosene or by burning them. I have seen hundreds of bushels of army-worms captured in these holes. This method absolutely prevents further damage by the army-worm, and, as a rule, up to the time of marching the damage from army-worms is not a great one; hence it is a comparatively easy matter to confine the army-worms by this method to a small area, and prevent the destruction of large crops. In case the army-worms are on the march or have escaped from the original badly infested area, or in case they are upon a neighbor's premises and you have fear of their ultimately marching upon your fields, then you should plow these furrows about the fields you wish to protect, except that in this case the vertical side should be towards the field to be protected. Holes should be dug along these furrows every few feet and the same method of killing the worms resorted to as given above. In case there be some doubt as to whether the worms are coming to your field or not, the furrows may be readily plowed and the digging of the holes left until you are satisfied the worms are approaching. This furrow and post hole method has such an advantage over the coal tar, the lines of fire, or the dragging of a log through the furrow, that it seems to me unnecessary to discuss them.

THE FALL ARMY-WORM.

Laphygma frugiperda, S. and A.

INTRODUCTION.

While as a rule the true army-worm does not occur in devastating numbers in the fall of the year, another insect, the fall army-worn does frequently occur in immense numbers in the fall of the year, and, like the true army-worm, when the proper food in the locality in which it was born gives out and the insects occur in sufficient numbers, they migrate in a mass and march in search of fresh fields. This has given the name of army-worm to this particular insect, and since this migration in great armies occurs in the fall of the year, it has been called the fall army-worm. The insect is, to be sure, closely related to the true army-worm, but can readily be distinguished from it.

The moths differ from one another greatly, but are, as a rule, of a light-gray color with the hind wings more or less whitish and semitransparent. The insect is a little smaller across its expanded wings than the true army-worm, as a rule not greatly exceeding one inch. In collecting a good many of the moths, one will notice that they vary from the color just described, to those individuals that have a considerable admixture of bluish white. The markings on the fore wings are quite different from those of the true army-worm. A good idea of the general appearance, size and variation of the fall army-worm may be had by looking at figure 28.

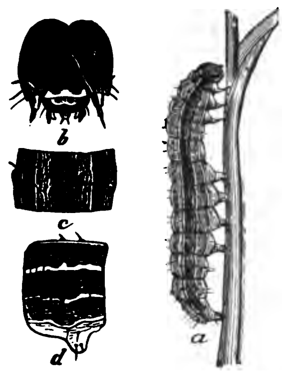

FIG. 27.—The Fall Army-Worm, *Laphygma frugiperda*: *a*, larva, natural size; *b*, its head, enlarged; *c*, *d*, its body segments, enlarged. (From Smith.)

The larvae or worms are also quite different and readily distinguished from the true army-worm. They are not quite as large when they are full grown. The bands along the side are broader, and the insect is spotted with small dark or black tubercles, on the end of each of which a short black hair is found. The head has a V-shape mark upon it, which is not found on the true army-worm. The worms when full-grown are a little over an inch in length, with a brown head, the body striped with greenish-gray above, and a broad dark stripe along the sides, below which is a band of dull yellow. Underneath, the insect is greenish-gray, and on the back are three lines of yellow. A good illustration showing the general size and characters of this larva will be found in figure 27.

The eggs are deposited by the parent moth more frequently on the under side of leaves, on small twigs in trees, and on bushes in the neighborhood of low meadows, as well as on the rank growing vegetation. There are also three broods of this insect each year in Missouri, but unlike the true army-worm, the larvae of this insect rarely occur in great numbers until the third or fall brood, by which time the insects may become so extremely numerous within certain areas as to destroy the plants upon which they are feeding, and thereby be forced to migrate in a mass.

These insects, if they attract the attention of the agriculturalist, usually do so in the fall wheat to which they march from nearby meadows. If the green wheat or other grains or grasses be unhandy, they will attack corn and devour not only the leaves but eat of the stem, and frequently eat their way through and about the green ear of corn. In the great majority of cases, however, these fall army-worms enter the wheat fields in the fall and devour the young green wheat. Agriculturalists frequently become very much alarmed by the presence of vast numbers of these worms eating the wheat, but frequently they do much less damage than the agriculturalist is as a rule disposed to admit. The fact of the matter is, that these larvae may eat off very thoroughly every vestige of wheat above the ground in the fall of the year, and yet the wheat suffers very little, if any, from such an attack. The wheat will come up in the spring as if nothing had happened, and may even grow considerable in the fall after the worms have ceased to work.

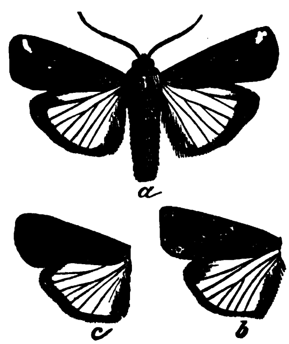

FIG. 28.—The Fall Army-Worm, *Laphygma, frugiperda*; *a*, adult moth, natural size; *b*, *c*, wings showing variations, natural size. (From Smith.)

Like the true army-worm, the larvae of the fall army-worm in their various broods enter the ground in order to pupate. The winter is passed in the pupa stage, rarely in the adult stage.

While the true army-worm feeds upon almost all the members of the grass family with an occasional change of diet, the fall army-worm seems to be broader in its selection of food, and while the grasses including, of course, the grains and corn, form its principal diet, yet the insect has been known to attack the fall fields of turnips and ruin them, and also various other succulent garden vegetables and plants, even feeding upon the leaves of certain trees.

NATURAL ENEMIES.

Why it is that the first or the second brood of the true army-worm is so great in numbers while the first or second brood of the fall army-worm is so reduced in numbers as to attract no attention is something which we cannot understand. One would expect that the birds and predaceous and parasitic insects that succeed in preventing the early development of the fall army-worm, would likewise check the early development of the true army-worm at that season of the year. The facts are, however, that the fall army-worm seems to increase in numbers with each succeeding brood throughout the season, so that it is only the fall brood that ever becomes unduly numerous. While on the other hand, the true army-worm frequently becomes unduly numerous in the spring and early summer broods, and then is held in check and prevented from being too numerous by its natural enemies. Some birds that prey upon and devour so greedily the larvae of the true army-worm, also feed just as readily upon the larvae of the fall army-worm. The same may also be said of the parasitic insects that destroy them. Like the true army-worm this fall army-worm does not occur in damaging quantities every year, neither has it occurred in one locality in damaging quantities in two consecutive seasons.

REMEDIES.

The fall army-worm may be prevented from spreading away from the badly infested areas in our meadows or fields, or may be prevented from entering our fields, by the same methods as were described under the true army-worm. It is frequently an easy matter to successfully kill vast hordes of these larvae when in the wheat field by the simple process of rolling the field. This should be done when the field is hard enough, and comparatively free from stones or rough places, so that the insects will be crushed while the wheat will not be injured in any particular way. Late plowing will destroy vast numbers of these insects in their winter quarters, and the continual rotation of crops will have a great deal to do towards checking their undue development.

It would also be a good plan to turn poultry of all kinds into the infested fields and allow them to devour the worms. It sometimes happens that in the marching of the fall as well as the true army-worm, that they are detected trying to cross a road or lane, and in such cases one can crush them in immense numbers by drawing a roller back and forth over the area across which they are marching.

Where these larvae occur in gardens or fields containing late vegetables, they sometimes do considerable damage, and will also attack the flower garden and devour sweet peas, pansies and other varieties. Where garden vegetables are in the immediate vicinity of fields badly infested with these worms, the garden plants may be protected either by the plowing of furrows or by scattering rows of poisoned bran around the field. This will necessitate, however, the keeping of the poultry out of such patches, otherwise the poultry will be killed. The poisoned bran may be made by mixing a pound of Paris green or a half pound of pure arsenic with a bushel of bran. This should be stirred up thoroughly in a dry condition, and then made into a thick dough by means of sweetened water. This should then be scattered about the plants, or along the sides of the garden nearest the worms.

THE WHEAT-HEAD ARMY-WORM.

Leucania albilinea, Guen.

The wheat-head army-worm differs from the other army-worms in that the larvae have the peculiar habit of eating the heads of wheat, rye and timothy, and occasionally other grasses. The larvae are somewhat smaller than the ordinary cut-worm and are brighter in color, longitudinally striped with yellow, and with light and dark-brown bands. A general idea of the appearance of these larvae and of their size may be had by referring to figure 29, *a, a,* which shows two worms in the act of feeding upon a head of wheat.

When the larvae are full grown they display many variations, but the best marked specimens may be described as follows: Along the back is a broad, dark-brown line, along the middle of which is a fine white, more or less obsolete band, and beneath on the sides is one of about the same width with a yellowish tinge on the lower edge; next below this is a narrow dark-brown band in which the white spiracles are situated; just below this band is a yellow band, and then a less distinct, light-brown one; the under (ventral) surface is pale yellow, the head is straw-colored and comparatively large, with two attentuated brown marks from the tip to the lower part of the face.

The adults are also quite different from the other army-worms, and may be distinguished by the fact that they are about one and one-half inches across their expanded wings, with the fore wings of a pale yellow or straw-color, with a narrow, silver-gray margin and a dusky stripe through the center of the wing, and a white streak just above it. The hind wings are of a satiny-white color. These moths are quite variable. A good idea of the general size and appearance of these adult wheat-head army-worms can be had by observing figure 29, in which one is represented, natural size.

The eggs differ from the eggs of the common army-worms in that they are shaped like flattened spheres, of a pale yellow or light-slate color. They are deposited in rows of from ten to fifty, there frequently being several rows in the cluster. The female moths place them between the sheath and the stalk, not covering them with an adhesive fluid.

The adult moths are decidedly nocturnal in their habits, as is also the case with the other army-worms. They appear during May, and soon lay their eggs as just described between the sheath and the stem

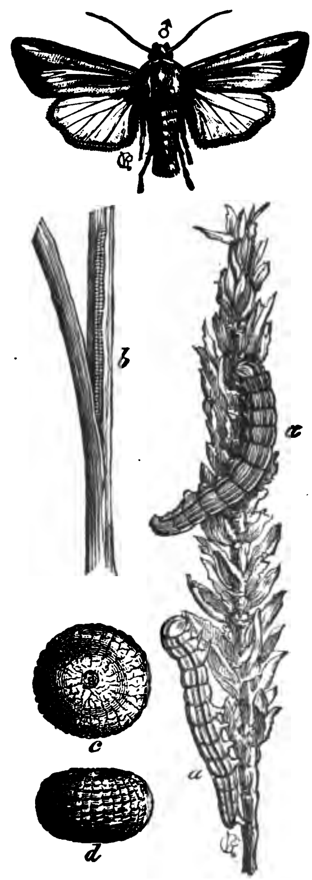

FIG. 29.—The Wheat-Head Army-Worm, *Leucania albilinea*, *a*, *a*, larvae, natural size; *b*, eggs under a leaf sheath, natural size; *c*, *d*, eggs, enlarged; adult moth, natural size, at the top. (From Smith.)

of wheat, rye and timothy, and probably other grasses. These eggs hatch in from three to five days, and the larvae feed usually during the evening or early part of the night, rarely on bright sunny days. On cloudy or rainy days they will feed more or less during the day time, but keep themselves more or less concealed during the bright days. They rarely attract the attention of the agriculturalist during this time, These larvae continue to feed upon the leaves of the wheat, rye and timothy, and perhaps other grasses, attracting no attention and doing no particular amount of damage, until they have become about one-half to two-thirds grown, when the larvae assume the peculiar habit of abandoning the leaves as food, and feeding from this time on upon the heads of grasses, wheat or rye, and eating not only the young and developing seed or kernels, but also devouring more or less of the seed coverings. At this season the wheat has reached the milk stage.

If the larvae are already in the wheat field, the adults having deposited their eggs upon the wheat, they remain there. But if the larvae happen to be in nearby meadows, where the adults have deposited their eggs, then they are very apt at this stage to migrate more or less all at the same time, and crawl to the nearby wheat, where they now attack the heads only. From this time on until the larvae are full-grown, they continue to feed upon the heads of the wheat or the grass, as the case may be, and do a vast amount of mischief. The larvae simply crawl up the plant to the heads and feed upon them.

It is at this time that the wheat grower's attention is called to them and to the great amount of mischief that a single larva is capable of doing in a comparatively short time. They appear to be quite wasteful when feeding upon the heads, and in passing through an infested field one will find the ground in the worst infested places literally covered with the chaff the insects have caused to drop. Some agriculturalists use the expression "that the ground appears covered with chaff as though they had been threshing there." The amount of damage that these insects do to the wheat and rye crop varies considerably in the different localities from year to year according to the number of worms that season. In some instances they have been known to destroy ninety per cent. of the crop of wheat in a given field, but of course this is exceptional. As a rule they are not found in sufficient quantities to cause such a great loss, but it is no uncommon thing for them to cause twenty-five per cent. of the wheat to be ruined.

From the time the larvae hatch from the eggs, until they reach the full grown larval stage, requires about three weeks at this season of the year. When they have become full grown, they work their way into the ground for about an inch in depth, and there wiggling their bodies and packing the earth so as to make a little cell, they change to the pupa stage. The pupa stage lasts about two weeks, and then they transform to the adult moths.

The moths of this brood usually appear about the latter part of July. They soon pair and lay eggs for a second brood of worms. The larvae appear during the month of August, and are confined at this time almost entirely to timothy meadows. This larval stage lasts about four weeks, when they then enter the ground near the base of the plants upon which they have been feeding, and there just below the surface change to the pupa stage about the first of September.

These pupae remain in the ground throughout the winter and transform to adults the next spring during May.

It will thus be seen that there are two broods of these insects each year, and that it is the larvae of the first brood that cause the damage to the wheat and rye crops in this State. The larvae of the second brood feed almost entirely upon timothy and perhaps some other grasses. It will also be seen that it is the larvae that have at least attained one-half their growth that cause trouble, since it is only when they are at least half grown that they abandon the habit of feeding upon the leaves and take to the destruction of the head with its content of seed.

These insects are preyed upon in the larval condition by a number of birds, also by some parasitic insects, the most important of these being the fly which deposits her eggs upon the body of the larvae, the resulting grubs feeding upon the tissue within and destroying it; and also two species of parasitic Hymenopterous insects known as Ichneumen flies, both of which sting the larvae and deposit eggs within, the resulting grubs from which feed upon and destroy the tissues and thereby kill the wheat-head army-worm.

Unfortunately, the agriculturalist will have to depend very largely upon these parasitic insects and the few birds that will devour them to hold this wheat-head army-worm in check. Very little can be done by the wheat grower in the way of successfully combatting this insect. About all that is worth considering is the frequent rotation of the crop, and late plowing of the previously infested field, with a view to the killing of the pupae that are in the ground.

When one discovers the presence of injurious numbers of these insects in a wheat or rye field, and this will not occur until the wheat is in the milk stage, if the grain is far enough advanced to warrant it, it would be advisable to cut this and thresh it, even though this may be earlier than would otherwise be advisable. If this is not done and the worms are in goodly numbers, they may ruin practically all of the grain before it has reached its proper maturity.

THE DINGY CUTWORM.

Feltia subgothica, Haworth.

We have in Missouri a great many species of cutworms, and while at certain times numbers of these different species may infest the wheat as well as other farm and garden crops, nevertheless, two species are usually the ones found doing the most damage to wheat. Of these the dingy cutworm is the most important.

Like all cutworm moths the adults of the dingy cutworm are unattractive and inconspicuously colored. They are about an inch and a quarter across their expanded wings, and the general color of the fore wings is a smoky-gray. By referring to figure 30, one can obtain a good idea of the size and appearance of these adult cutworm moths. Like most of the other members of this family, the moths are nocturnal in their habits, and during the day remain concealed in sheltered places upon the bark and twigs of trees, bushes and fences, etc., and fly about after sundown in search of sweets, and for the purpose of mating and laying their eggs. They are readily attracted to light and will for that reason frequently come into our open windows in the evening.

The moths appear during August and the forepart of September, and begin to lay their eggs during the latter part of August or the forepart of September, not long after they have emerged. The eggs are deposited in clusters upon the stems and leaves of various trees and bushes, in the neighborhood of which there is plenty of food in the form of various weeds and grasses, also upon the stems and the leaves of shrubs and weeds, and sometimes upon stones.

These eggs hatch in about ten days, and the young larvae soon crawl to the nearby plants upon which they feed in case they are not born upon suitable plants, and some of them may feed for a very short time upon the leaves of trees and bushes upon which they are born, but very soon crawl down or drop down to the ground and seek various weeds and grasses, feeding there upon their leaves. These larvae are not at all particular about what kinds of plants they feed upon, but will be found feeding upon almost any green succulent plants, whether they be various weeds or grasses, or other uncultivated or cultivated plants. They are usually unnoticed by the agriculturist at this time, and when the cold weather approaches, they seek some sheltered place in which to hibernate, doing so under stones, under a quantity of leaves or, as a rule, enter the ground a little ways at the base of the plants upon which they have been feeding, and there hibernate through the winter as partially grown larvae.

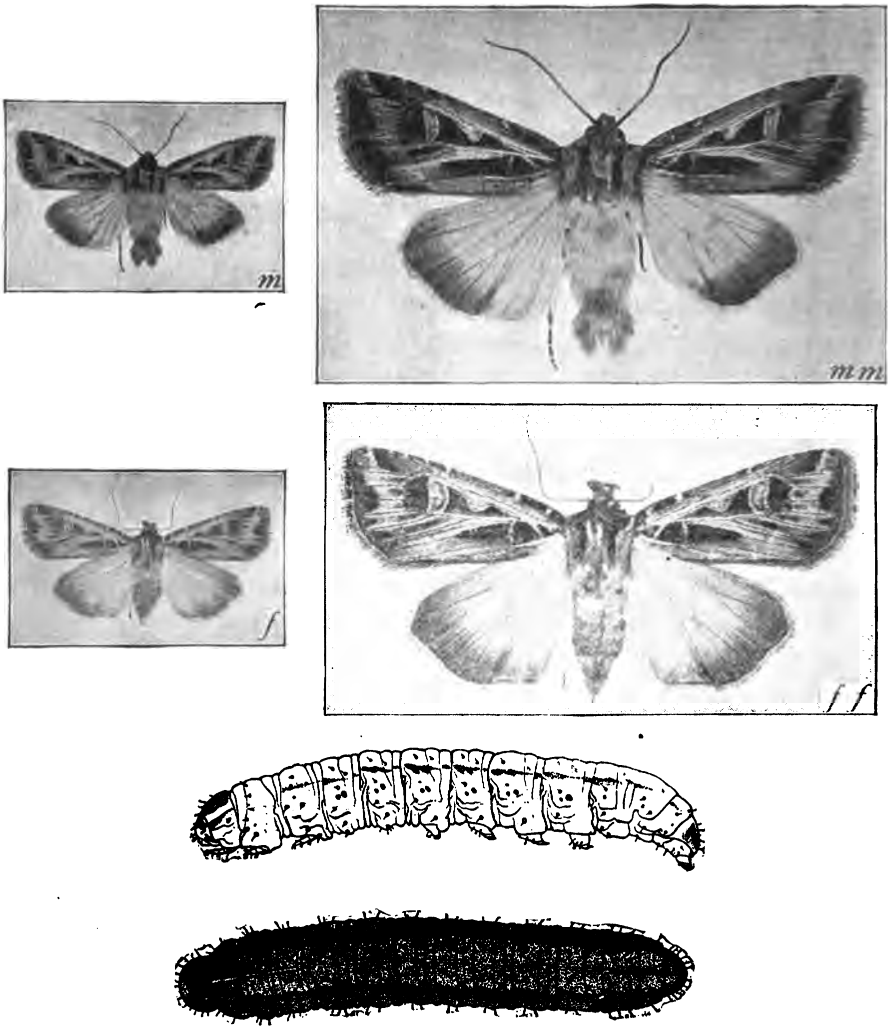

FIG. 30.—The Dingy Cutworm, *Feltia subgothica*: *m*, and *f*, male and female moths, natural size; *mm*, and *ff*, male and female moths, twice natural size; larvae, side and back views, twice natural size, at lower part of plate. (From Slingerland.)

In the spring when settled weather appears, these larvae come out from their winter quarters, and during the night crawl about in search of some green vegetable substance upon which they may feed. They are now even less particular in their choice of food plants than they were when younger, and will attack not only all the various green plants and other field crops including corn, but will attack various grasses, weeds and other uncultivated plants, and will get into the garden vegetables and feed upon sweet potatoes, strawberries and the like.

During the daytime they hide under rubbish of all kinds or under stones, or bury themselves a little ways in the ground, sometimes trying to carry part of the way with them pieces of the plants upon which they have been feeding, evidently with the intention of feeding there out of sight during the daytime. In the evening they come forth again and feed in their characteristic manner, doing more or less mischief according to the plant upon which they are feeding and according to the numbers in which they appear.

At this season of the year these insects have a peculiar habit of eating through and cutting down, just above the surface of the ground, the various small and succulent plants, like wheat and corn. They thus feed and gorge themselves, rarely remaining at the same plant until they have partaken of sufficient food, but pass on to other plants and cut them down in like manner. At this stage of the larva, which is now nearly full grown, the creature appears as a fat, smooth larva, of about an inch and a quarter to an inch and a half in length, with a wide gray stripe down the back, and a dusky or dingy-gray along the sides. The head is dark-brown in color, and there is also a dark-brown area on the back of the tail-end of the worm. The spiracles or breathing pores are black. A good idea of the appearance of these larvae may be had by observing the two enlarged ones in figure 30.

The amount of food that these larvae now consume during the night is amazing. They gorge themselves until they appear ready to burst, and the damage they do when in sufficient numbers in a wheat field is considerable, because of the fact that they cut down so much more wheat than they eat. This same rule applies to their habits in a corn field or in the vegetable garden.

During June these larvae enter the ground about two inches and soon change to mahogany-colored pupae. They now remain here in the pupa stage for a long time in comparison with the summer pupa stage of most insects, for they do not change to adults until during August and the forepart of September. It will thus be seen that with this dingy cutworm there is but one generation each year, and that the damage the insect does occurs in the late spring and early summer, from the time the larvae come out from their winter hibernating quarters until the time they enter the ground to pupate.

Since the parasitic and predaceous enemies of this insect and the methods to be used for controlling it are similar to those for most other cutworms, we will defer the discussion of these points until we have discussed one other cutworm. (See under variegated cutworm.)

THE VARIEGATED CUTWORM.

Peridroma saucia, Hubner.

This variegated cutworm is equally as common as the dingy cutworm in the State of Missouri. Sometimes one and sometimes the other appears to be the most numerous in the wheat fields whenever they occur in sufficient quantities to attract attention.

The adult moth of the variegated cutworm is somewhat larger than the preceding species, it being about one and three-quarters of an inch across its expanded wings. It is likewise an inconspicuously colored moth, the front wings being of a dull grayish-brown, tinged with reddish, and with a darker margin. The hind wings are of a pearly-white color, with the margins tinged with light-brown, as are also the principal veins. A better idea of these adult moths can be had

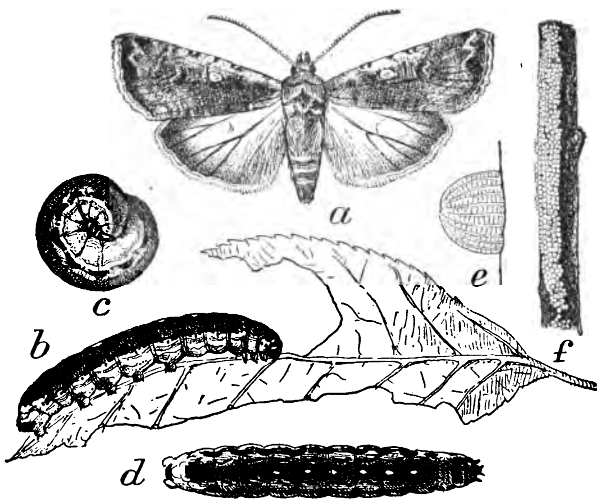

FIG. 31.—The Variegated Cutworm, *Peridroma saucia*: *a*, adult moth, natural size; *b*, normal larva, natural size; *c*, same in curved position; *d*, dark colored larva, dorsal view; *e*, egg, greatly enlarged; *f*, egg mass on twig, natural size. (From Howard, U. S. Dept. Agric.)

by observing figures 31, a, and 32, c and d—a and c are natural size. This color, however, varies considerably with the different individuals, the species being quite variable in the adult condition as well as in the larval stage.

These moths are likewise nocturnal in their habits, seeking sheltered places such as the bark of trees and about rail fences, where they remain during the day and, like the preceding species, are rarely noticed by the ordinary observer unless they should happen to take flight, which, by the way, they do not readily do at this time. Their color so closely resembles that of the object on which they are resting, that they escape not only the notice of persons, but, undoubtedly, are more or less protected thereby from the attack of predaceous animals like birds that may perhaps feed upon them.

Most entomologists writing on this insect seem to think that it has two and perhaps three broods each year, but my observations in this State lead me to believe that the insect is only single brooded, in Missouri at least. I have never been able to find good reasons for believing otherwise.

The adult moths are to be found throughout the greater part of the spring, summer and fall, but these are no doubt from the same brood, the moths themselves living for a long time. So far as my observations go, it appears that these insects hibernate as adults during the winter, and come forth early in the spring as soon as warm weather appears, and lay eggs upon the stems and twigs of various trees and shrubs, frequently in orchards, especially where these orchards have become more or less grown up with weeds and grasses, and also laying eggs upon leaves and stems of weeds.

The eggs are found in large masses. Each egg is semi-spherical in shape and beautifully ribbed and marked as can be seen by referring to figure 31, e, and 32, a, which represents these eggs greatly magnified. In 31, f, and 32, b, we have a cluster of these eggs upon a twig, shown natural size. These eggs hatch in about fifteen days.

The young larvae appear during the latter half of March and the first half of April. They feed at first upon the egg shells from which they have been hatched, and then attack the leaves of the plant upon which they have been born and feed there for a short time. They then either crawl or drop down to the ground, leaving the trees and shrubs, and then feed upon the leaves of the various grasses and weeds near at hand. By May these larvae have become from half to two-thirds grown, and they then assume the characteristic cutworm habit of cutting down various succulent plants. These insects are likewise general feeders, and attack almost any green vegetable substance found in the uncultivated fields in the form of grass or weeds, or in our cultivated fields on corn, wheat, timothy, alfalfa and clover, or in the garden upon almost any vegetable that may be growing there, even relishing tobacco and onions, and attacking berries, squashes, potatoes and the like. During the latter third of the development of these larval cut worms, which usually occurs during the month of May, these creatures do an immense amount of damage to garden crops, and also to corn and wheat.

When the larvae are full grown, they measure about an inch and three-fourths in length. They are also fat looking worms, of a dark, dull, brown color, sometimes with a greenish tinge, and are faintly mottled with gray and dark along their backs; while along the ventral surface they are much lighter in color. The head is of a reddish

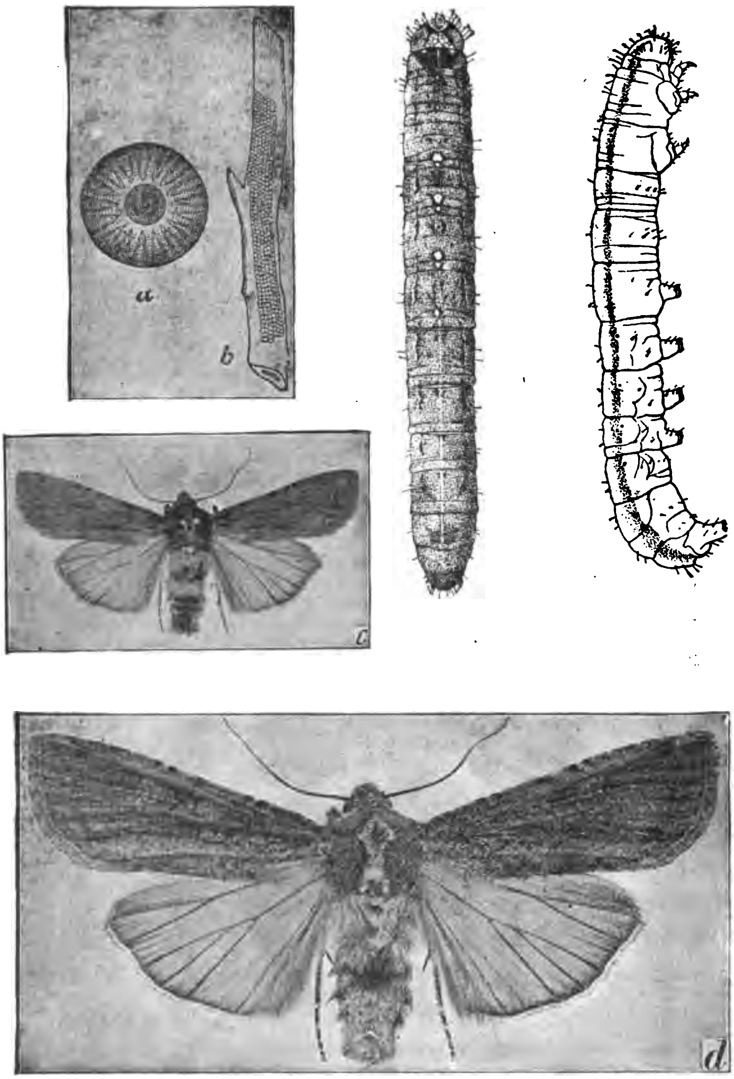

FIG. 32.—The Variegated Cutworm, *Peridroma saucia*; *a*, an egg, greatly enlarged; *b*, cluster of eggs, natural size; *c*, adult moth, natural size; *d*, adult, twice natural size; the larvae, twice their natural size, in upper right hand corner of plate. (From Slingerland.)

yellow color. These larvae differ considerably in their general appearance. The light form is shown natural size in figure 31, b, and a darker form at d. Two larvae, twice natural size, are shown in figure 32. When disturbed these worms curl up as is shown in figure 31, c.

Occasionally where these cutworms, and also the preceding cutworms, occur in vast numbers over a comparatively small area, they may tend to migrate more or less or at least scatter about in search of food. Usually about the forepart of June these larvae become full grown and then enter the ground, wiggling their bodies until they have packed the earth away and formed a little cell, and then change to pupae. This pupa stage lasts from two to three weeks. The adults emerge during the latter part of June and the fore part of July.

The fact that these adults appear so early in the summer has undoubtedly led many writers to suppose that they now soon lay eggs for a second brood, yet no one has been able to demonstrate the presence of such a brood; and there are reasons, which I will not take the time to discuss, which lead me to believe that the so called second brood does not occur, at least in Missouri, but that these moths now live until cold weather approaches and then seek sheltered places under loose bark of trees, under logs and in protected rubbish, and there hibernate during the winter, coming out early the next spring in order to deposit their eggs. We have, however, some species of cutworms which are known to be double brooded.

NATURAL ENEMIES.

Both the dingy and the variegated cutworms are preyed upon, sometimes greedily, by certain birds. Fowls of all kind devour them readily, crows, blackbirds, robins and blue jays are known to feed upon them; toads will also devour them; certain species of wasps likewise make use of them, and some ground beetles in both the adult and larval stages likewise feed upon them; but above all, the parasitic insects are the great enemies of these cutworms. Especially is this the case with at least two species of flies belonging to the sub-family Tachininae and known as Tachinia flies.

These insects, one of which is illustrated in figure 26, persistently lay their eggs upon the bodies of the cutworm larvae; and the young grubs hatching eat their way through the skin and feed upon the tissues of the larvae, reducing them and weakening them to such an extent, that should they even be able to make pupae, they will never be able to transform to adults. One instance is recorded where cutworms appeared in such immense numbers that they were ruining a clover field, and upon close observation, it was found that ninety per cent of these worms were infested by these parasitic flies, and probably not more than one per cent of the larvae in that field ever reached maturity on that account. There are several species of Ichneumon flies that greatly devastate the ranks of these worms.

REMEDIES.

The means and methods to be taken, looking to the control of cutworms and the protection of various crops from their ravages are similar, regardless of whether we are dealing with the dingy cutworm or the variegated cutworms. It is well known that the fields that have been in meadows for two or more years, and are then plowed up and sown to wheat, corn or other crops, are much more liable to be injured by cut worms than are fields which have been cultivated for the past two or three years, or even for the past year. Meadows and pastures are very apt to become infested with cutworms in a year or two. While these insects may not attract any special attention in such places, because of the fact that there exists a great many plants in proportion to the number of worms, yet, when such fields are plowed up and a cultivated crop sown to take the place of the other, these cutworms, deprived of the great bulk of their food, and the number of plants existing in the field many times reduced, become thereby proportionately greater in numbers. Hence it is that when these cutworms feed, their injury becomes apparent; and in the case of corn this is still more true than it is with wheat.

It is no uncommon occurance to have to plant corn two and three times before one can get a stand, on account of the presence of cutworms; and in the case of wheat fields, it is not uncommon for large areas to be completely cut down by these creatures. It is not my intention in this connection to enter into a discussion of the work or the methods of fighting the cutworms in garden vegetables or such field plants as tobacco, potatoes, etc., and hence the methods here suggested are to be regarded as applying only to wheat, and incidentially to corn.

It is advisable to plow the meadow in which wheat or corn is to be planted just as early in the spring as possible, so that the cutworms will be deprived of their natural food in the form of grasses and weeds, and when they come out in search of suitable plants will be forced to abandon the plowed fields and seek other places where a food supply can be obtained. This applies likewise to the fall sowing of wheat. If these intended wheat fields are plowed early, the larvae there will be likewise forced to abandon those fields, so that by the time the corn or wheat is up, the cutworms will not be found, at least in sufficient quantities to cause any alarm. The practice, so general in many localities, of plowing the wheat field and sowing it to corn, and later of plowing a corn field and sowing it to wheat, is not especially favorable to the destruction of cutworms, because of the fact that the various weeds and grasses are growing in the field intermediate between the time the corn is unfit for their food until the sowing of the wheat; and as this comes up soon, the insects are not deprived for any great length of time from finding sufficient food to sustain them in that particular locality, and hence they attack alternately the wheat and the corn plant, as these two are usually rotated. However, these alternate rotations of wheat and corn in the same field from year to year are much better from the cutworm standpoint than allowing the wheat or corn field to grow up to grass, clover or weeds for a year or two, and to then plow it up in the hopes of raising wheat or corn free from the attack of cutworms.

Perhaps the best direct method of fighting cutworms is the following, which I have advised for a number of years, and which has almost invariably given good results: The corn or wheat field may have certain areas, well known to the owner, in which the cutworms are more abundant and destructive. In such cases, it will not be necessary to apply this method throughout the entire field. In other instances, the field may be so situated as to suffer more or less along the sides bordering a meadow, especially a newly plowed meadow, infested with these worms, which would then tend to leave the newly plowed meadow and migrate to the wheat or the corn. In such cases, it would be especially advisable to apply the following method along that portion of the field which we wish to protect:

The method I have reference to is what is known as the poisoned bran method. A bushel of bran and one pound of pure Paris green, or a half pound of pure powdered arsenic are to be stirred up thoroughly together while dry, and then some sweetened water is to be added in sufficient quantities to make a thick dough. If one needs to use a large quantity, and can get glucose, it will be found to be much cheaper than molasses or sugar for the purpose of sweetening this water. It is well to use a fairly good quantity of this sweetened substance, because it will tend to hold the particles of bran together so that in drying it will not fall apart and become lost, as it will if the sweetened substance is not used. This poisoned bran is then to be scattered along in rows, through or around the field to be protected, or in which the cutworms are to be killed. In the case of corn, this posisoned bran should be placed there before the corn comes up, and in the case of spring wheat, it should be placed there just as early as warm weather appears, so as to kill the cutworms before they have had time to injure the wheat. Cutworms will feed very readily upon this poisoned bran and be killed, and in some instances they seem to prefer this bran to the plants. Of course it is necessary to see that the poultry and live stock are not allowed access to such fields while the poisoned bran is there. In case one does not wish to or cannot readily use bran, a clover field or hay field may be sprinkled or sprayed with Paris green in the proportion of one pound of Paris green to one hundred gallons of water, and as soon as this has dried, the sprayed portion should be mowed, and the clover or hay scattered in little clumps about the field to be protected. From experience, however, I cannot advise the use of these poisoned plants where it is possible to obtain bran.

THE WHEAT WIREWORM.

Agriotes mancus, Say.

The well known wireworms are the larvae of beetles that are known under the popular name of click beetles, snapping beetles or snapping jacks. These beetles are well known to every country lad, and more or less even by the town boys, because of the peculiar habit these beetles have of bending their bodies when one is held in the fingers and suddenly straightening out with a snapping sound, which results in a considerable jerk, and also because of the fact that if these beetles be placed on their backs on a hard substance, they will go through this same motion and therby be thrown suddenly into the air for a considerable heighth, and perhaps alight upon their feet. This habit enables these insects to regain their feet should they fall and light upon their backs, for otherwise they are not able to turn over.

There are in Missouri about one hundred species of these insects, and while a great many of them are injurious in the larval stage, we will confine our remarks to one species which has gained the common name of the wheat wireworm. Do not understand, however, that this particular species is the only one that infests and injures wheat. There are several species that have been known to attack wheat, and especially is this the case with a somewhat smaller one, known under the scientific name of *Drasterius elegans,* Faber, which in many places is at times as injurious to wheat as the one we are to discuss. The adult of the *Drasterius elegans* is represented in figure 34½, enlarged seven and one-half diameters. A larva enlarged seven diameters is represented at figure 34½. I do not think it necessary to enter into the life history and discussion of the methods of work of both of these near related beetles, because of the fact that their habits and life history are so similar.

The adult wheat wireworm beetle is a small, dark, brown, oval shaped beetle, nearly one-third of an inch in length, with the body densely covered with minute hairs, which, however, would not attract the attention of the ordinary observer unless he were to look at the creature under a hand lens. The beetles are hard and quite slippery when held in the fingers, and are very apt to wiggle away from one when thus carelessly handled. A good idea of the general appearance of these beetles can be had by observing figure 33, which represents one magnified seven diameters. These beetles appear along in the

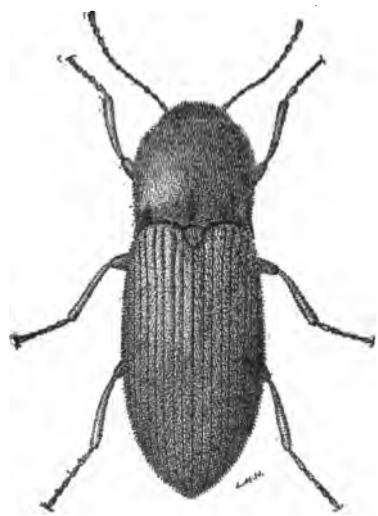

FIG. 33.—Adult of the Wheat Wireworm, *Agriotes mancus*, enlarged seven diameters. (From Forbes.)

spring of the year, usually during April, at which time they may be found hiding under clumps of grass growing in meadows and pastures, and along the fences and byways, also under logs, stones and other secluded places in the fields and along outskirts of forests. These adults fly readily and also scramble over the ground with considerable rapidity.

They lay their eggs in cultivated and uncultivated grassy meadows and other places. When these eggs hatch, the little larvae burrow in the ground and feed there upon the roots of various grasses.

These larvae grow very slowly indeed, at least in comparison with the larvae of some insects, still not as slowly as do some well known insects, as for instance, the seventeen year locust. The larvae remain burrowing through the soil and feeding thus upon the roots of the grass until the approach of cold weather, when they hibernate wherever they happen to be, usually, however, having previously entered the ground to a somewhat greater depth for this purpose.

Next spring they become revived and feed again upon the roots of the grass and allied plants, continuing thus to feed and gradually growing during this second summer. At the approach of cold weather again, they likewise hibernate under the ground near the plants upon the roots of which they have been feeding. The next spring, at the approach of warm weather, they again become active and feed as before until July. By this time the larvae have become full grown. They are generally about three-fourths of an inch in length, of a pale, waxy, yellowish brown color, cylindrical in shape, being practically of the same diameter from end to end, and tapering or rounding bluntly at the two extremities. They are distinctly ringed, and are unusually hard, so much so that when taken in the hand their bodies do not seem

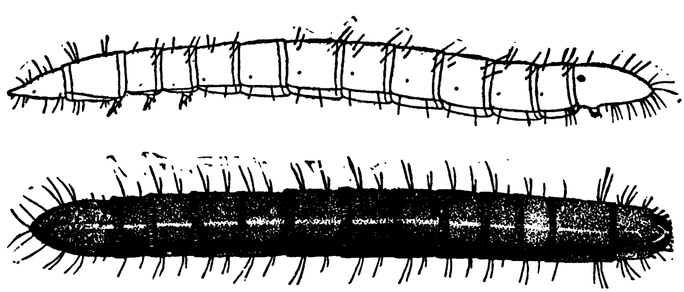

FIG. 34.—Larvae of the Wheat Wireworm, *Agriotes mancus*, enlarged five diameters. (From Forbes.)

to give, and if stepped upon on an ordinary plowed field, will be pushed into the soil instead of crushed. This hard character of the body, together with the shape, has given to them the well known name of wireworms. Their bodies are thinly clothed with a few hairs, which, however, are not ordinarily observed by the agriculturist. An excellent idea of the general shape and appearance of these wireworms will be had by observing figure 34, which represents a dorsal and a lateral view of one of these larvae mangified five diameters.

This particular species can be readily distinguished from the other common wireworms by observing the last segment of the body, which is smooth and conical in shape and has two dark colored pits upon its dorsal surface, as can be seen by referring to the figure just described. The wireworms have three pairs of small joined legs, one pair on each of the three first segments following the head, but the rest of the body is devoid of the fleshy prolegs, which are so commonly seen in ordinary caterpillars with which the farmer is so familiar.

During July these full grown wireworms crawl a little deeper into the soil, and there wiggle their bodies until they have packed the earth away and thus made a little cell in which they change to pupae. These pupae are entirely different in shape from the wireworms, and more closely resemble the adult beetle in shape. They are a little longer, however, and their bodies are almost pure white in color. While the wireworm larvae are so extremely tough, these pupae are extremely and unusually delicate and tender—a character we may take advantage of in controlling this insect in our cultivated fields.

In three or four weeks these pupae change to adults. These new adults are of a light cream color, and are likewise extremely deli-

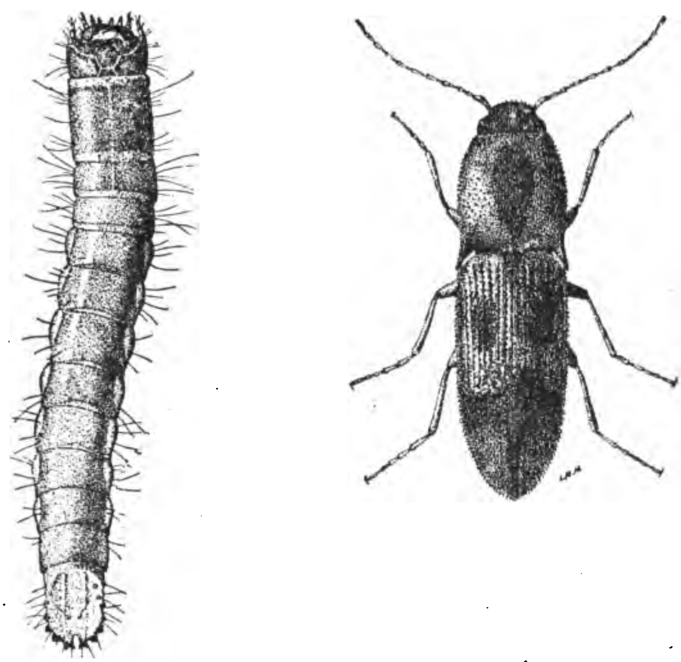

FIG. 34½. A Common Wireworm, *Drasterius elegans*; Larva magnified seven diameters; adult beetle magnified seven and one-half diameters. (*From Forbes.*)

cate and tender. They remain in these earthen cells, and very gradually attain the normal color of the insect, and also gradually become hardened. These adults now remain in these earthen cells during the rest of the summer and fall and throughout the winter, and come forth the next spring, usually during April.

From what has been said, it will be seen that the larvae are three years in reaching their full grown larval stage, during which time they remain almost constantly beneath of the surface, readily burrowing through it and feeding upon the roots of various grasses. The pupal stage lasts but a comparatively short time, and the adults that come from these pupae remain in a quiescent condition for an exceedingly long time before they attempt to free themselves and assume an active life. It will also be seen that while the larvae are unusually tough and hard to destroy, as are likewise the adults that have appeared above ground, yet the pupae and the young adults are unusually tender and very susceptible to any disturbance of their subterranean cells. It might be well to mention in this connection, however, that not all wireworms require three years in order to reach the full grown larval condition, and that we have reasons for believing, on the contrary, that others required even as much as five years in order to complete their full larval life.

Meadows and pastures and other grass lands may be very badly infested with wireworms and yet show no particular indications of their

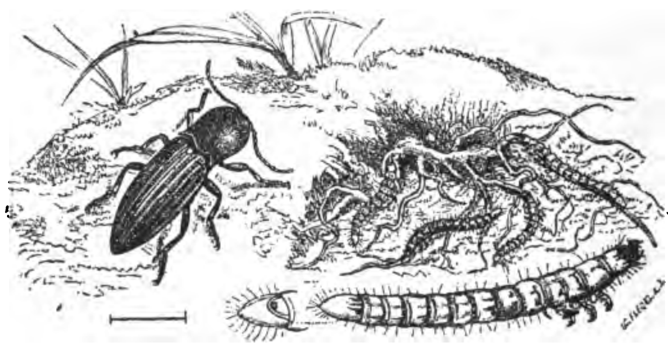

FIG. 35.—A Common Wireworm: Adult and larva, enlarged; and young larvae feeding on roots of grass. The line below the beetle indicates its natural size. (From Brehm.)

presence or at least do no appreciable amount of damage such as the farmer would observe. These grassy fields and byways may be thus badly infested for a good many years and their presence not observed until such places are plowed, when they may find these wireworms in such immense numbers that a single cubic foot of earth may contain fifteen to twenty of them.

When such infested fields are plowed and planted to some crop such as wheat or other grains or corn, or in fact most any farm or garden crop, these wireworms are deprived of their great abundance of food, and then show their presence by the great injury which they do by feeding upon the roots of the comparatively small amount of plants that have been introduced there by the agriculturist.

Wireworms do not confine their attacks to the roots of wheat and other cultivated plants, but will attack the corn or seed when put in the ground and before it has had time to germinate, and will eat holes through it, hollowing it out inside or devouring it entirely. Those seeds that have succeeded in germinating are also attacked and the young developing roots eaten, or the plant that has succeeded in reaching several inches in heighth will have its roots eaten or holes eaten through them or more or less undermined, and even the base of the stem eaten into and the plant killed. The farmer, however, usually complains most severely of the attack upon the seed of the corn before it has had time to germinate. It appears that those wheat fields (this also applies to corn fields) which are in low ground, or those portions of larger fields that are low or in hollow places, are more liable to injury from these wireworms than are the higher and better drained fields or portions of fields. In some instances it also appears that wheat planted the second year after the plowing of a meadow or pasture seems to suffer more from injury from the attack of wireworms than it did the first year from plowing. In such instances it appears that the young wireworms had sufficient food remaining in the form of the roots of the original grass to sustain their life for the first season, and that by the next spring the roots had decayed and disappeared sufficiently to deprive them of food and force them to then attack the cultivated plants. It is also frequently the case that the wireworms do the greatest amount of damage during the spring, apparently their long winter fast having sharpened their appetites, which become somewhat satisfied later in the season.

REMEDIES.

It is almost impossible to poison the wireworm, either in the adult or larval stage. Certainly the poisons in our ordinary insecticides are not strong enough to kill them. The application of various chemicals to the soil will not injure them unless used in such unreasonable quantities as to utterly unwarrant any such a procedure. The only successful method of killing the wireworms that I know of is to take advantage of the weak point in their life history, which I have before described, viz., the extremely delicate condition of the pupae and newly developed adults. It has been found by Prof. Comstock that these insects are so readily killed when in the stages mentioned, that by plowing the ground to a depth of at least six inches and harrowing it thoroughly, that this disturbance of the insect due to the rupturing and destroying of its earthen cells, is sufficient to kill it at this time. This explains the well known fact that plowing is the best remedy.

Infested wheat, corn and other grain fields, or sod land intended later for such crops, should be plowed deeply during August and harrowed several times, and if necessary, plowed and harrowed again before September, with a view to destroying the insects in the stages mentioned. It must be borne in mind, however, that since these insects require three years in order to reach their full grown larval condition, that only one-third of the insects in a field may be destroyed; but it must be borne in mind that unless this one-third is destroyed they will hibernate, and the next spring deposit eggs for a greatly increased number of wireworms to follow.

If this simple method just described is carried out each year, one will soon cease to be troubled with wireworms. Fields that are plowed during August of each year, or that are plowed even during September of each year, are rarely infested with wireworms in sufficent numbers to cause any mischief.

THE CRANE FLY.

The larvae of the crane flies are known to most argriculturists under the name of meadow maggots or leather jackets. The adult crane fiies have been observed by every person living in the country or small village. They look for all the world like enormous mosquitoes, and occasionally fly about the house where they attract the attention of people. Their bodies are long and slender, and they have one pair of well developed wings, and their legs are enormously elongated. You will have no difficulty in recognizing the crane flies from the illustrations of the adults of the two species represented in figure 36 and figure 37.

These insects appear in the meadows and grassy places, especially in low places about the farm and along streams. In walking through such grassy places during May, one is sure to have his attention called to these insects, which fly up before him. They lay their eggs during May in these grassy situations, and the larvae feed usually just below the surface of the ground upon decaying vegetable matter, dead leaves of grass and clover, and more or less upon the living roots themselves.

The maggots reach their full grown larval condition by the latter part of July, by which time they appear as dirty white or gray, footless maggots, about one and one-half inches in length, with extremely soft bodies. The general appearance of these maggots is illustrated in the picture of a larva at the left of the adult shown in figure 37. These larvae are apt to be noticed in the low places that have become temporarily overflowed or unusually wet, when the larvae are apt to come to the surface and crawl about on top of the ground.

During the latter part of July these larvae change to pupae under the surface of the ground, and transform to adults again during August. These adults soon lay eggs in the grassy fields and meadows, usually during the latter half of August. The larvae or grubs hatching from these eggs live as did the other brood of larvae, and when cold weather appears, hibernate in the ground in the nearly full grown

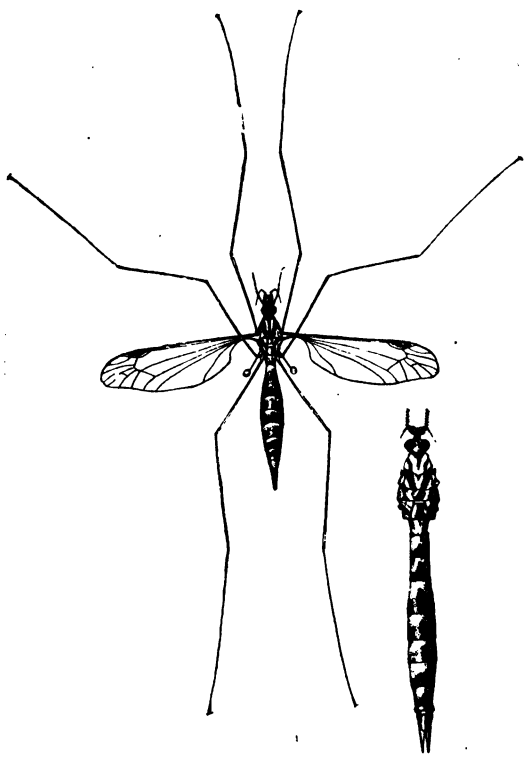

FIG. 36.—A Crane Fly, *Pachyrrhina sp?*, natural size, also body somewhat enlarged. (From Webster.)

larval condition. The next spring, along about April, these larvae revive and feed upon the roots and base of the stems of various grasses and clover, doing as a rule no great amount of damage, although some complaints have been received where these larvae have more or less ruined the clover and pasture fields situated in low mucky or wet places. The larvae change to pupae the latter part of April, and the adults from these emerge during May, which completes the life history of the insects.

It will thus be seen that there are two broods of the insects each year, although some species are known to have but a single brood. It was not thought advisable to divide these crane flies and treat of them individually according to their species, but to give this general outline of their life history.

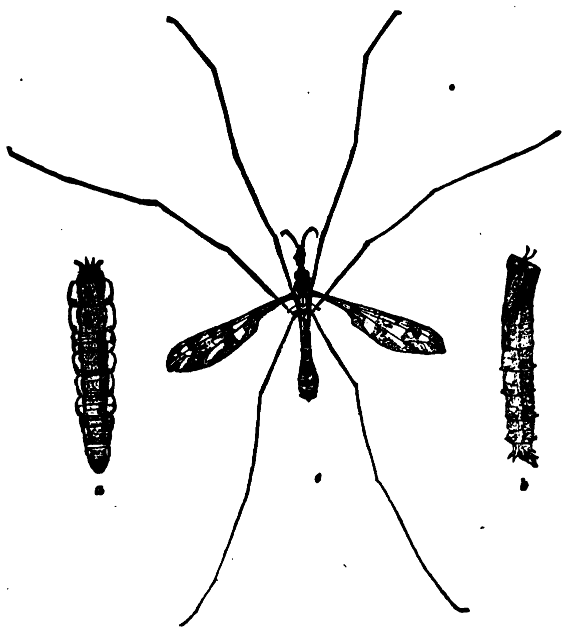

Fig. 37.—A Crane Fly, *Tipula hebes*, natural size, also a larva and a pupa, natural size. (From Webster.)

Reports have been received where these insects have destroyed fifty per cent of the wheat in certain fields. These cases of extreme injury are, however, not universal throughout the State, yet nearly every year such complaints are received from some portions of the State. Almost invariably the wheat fields that have become injured by these maggots are those that have stood in grass or clover the previous year, and are also such fields or sections of fields as are situated in the low, wet places.

These insects usually come to the surface of the ground after a heavy rain and crawl about until the ground dries sufficiently to enable them to work just below the surface. In such cases these worms are preyed upon by some birds, and are subject to the attack of their insect enemies. There is very little that a farmer can do towards combatting these pests, provided he has sown his wheat in low, damp places previously occupied by clover or grass. The most we can do in this case is to plow such intended wheat fields early in September, or pasture as large a herd of sheep as possible in this low field. The tramping of the sheep over the ground will crush and kill a great number of these maggots. The wheat fields situated on high, well drained ground are not injured by these insects.

THE GRAIN PLANT-LOUSE.

Siphonophora avenae.

THE WHEAT PLANT-LOUSE.

Nectarophora cerealis.

These insects resemble very closely in appearence the other well known plant-lice that the agriculturist is so familiar with infesting his fruit trees and garden vegetables. They are all small, greenish or brownish creatures, occuring usually in clusters or colonies, as can be seen by referring to figure 38, which represents a colony of these aphids on a portion of a wheat head, greatly magnified. Figure 39 shows a wheat head with plant-lice, natural size.

These insects, although very small and not attracting attention every year by any means, are, after all, of considerable importance, because in certain years these insects do a great amount of injury, sometimes absolutely ruining certain fields of wheat. During last fall, winter and spring scarcely a day passed without my receiving inquiries in regard to these insects. The great bulk of these inquiries came from the southwestern portion of Missouri, over which region these insects caused considerable alarm, since they occured in very unusual numbers upon the wheat plants, and caused the plants to wither and bleach, thus attracting the attention of the farmers, who, on examination, finding these insects in such vast numbers, supposed that their wheat fields were being ruined.

Our very open winter that year enabled these insects to unduly multiply and to live throughout the entire winter upon the wheat plants. Early in the spring the prospects seemed still more hopeless to most wheat raisers in that region, but, fortunately, a minute parasitic Hymenopterous insect made its appearance in the fields and soon effectually checked further injury by killing the great bulk of these aphids. The numerous samples of wheat containing aphids that were sent to this office at that time demonstrated the effectiveness of the work of these minute parasites. Not a single sample was received that did not contain parasites, and some of the samples of wheat

FIG. 38.—The Grain Plant-Louse, *Siphonophora avenae*, on a head of wheat. All greatly enlarged. (From Forbes.)

plants that had been enclosed in boxes and mailed to me, contained not only hundreds of plant-lice, but also hundreds of these little parasites. In some instances there appeared to be more parasites than plant lice, and I then informed my correspondents of this fact, and advised them not to worry, since this little insect was undoubtedly destined to relieve them of any further trouble from plant-lice; and this proved to be the case, for later, as the warm weather appeared, these minute parasitic insects did almost exterminate the aphids from the fields.

These parasitic insects just referred to are very small, black, winged creatures, much smaller than the plant-lice, and are extremely active, flying about and seeking the plant-lice, and may be observed by any person with sharp eyes or anyone who has a hand magnifying glass. If one will carefully pull up a clump of wheat, these parasites will not be disturbed to any great extent and will busy themselves performing their duties, apparently without notice of the fact that they are being watched. At such times one can readily observe the females approach an aphid and sting it and lay an egg within its body. Of course this egg is so small that it cannot be seen. Some of the aphids will show no apparant concern, while others will move their bodies a little as though they had been hurt. As soon as the egg is deposited the insect will quickly approach another aphid and do likewise.

FIG. 39.—The Grain Plant-Louse, *Siphonophora avenae*, on a head of wheat, natural size. (From Forbes.)

In this way a single parasite will deposit a great many eggs in the bodies of as great a number of plant-lice. These eggs hatch, and the resulting grubs feed upon the tissues of the plant-lice, and, when full grown, change to the pupa stage within the host's body. Of course, the plant-louse dies. Its body becomes somewhat swollen and distended, but its body remains upon the plant and turns brown. These swollen, dead plant-lice may be seen in great numbers at such times. In fact, the greater bulk of aphids sent to this office during last fall, winter and spring were thus killed when they reached me. When the little parasite transforms to an adult within the body of the aphid, it cuts a little circular flap through the body wall, leaving a little place uncut as a hinge, and by pushing up this trap-door, escapes. Such aphids with the trap-door part way open are readily found by any agriculturist at such times, and can be readily seen by means of a little hand lens. One of these parasitized plant-lice is shown in figure 40, *d*, greatly enlarged, and with the trap-door open, the parasite having emerged.

The life history of the grain and wheat plant-louse is briefly as follows: The aphids feed by sticking their little beaks through the tissues of the plant and sucking its sap. They are found frequently upon grass. At certain seasons some of these plant-lice will be found to have wings. Such a winged form is shown in figure 40, *a*. Some of these winged forms will fly from the grass to the wheat field, and there they will bring forth living young, which will suck the sap from the wheat plant and soon bring forth living young. These in turn will soon bring forth others in the same way. So rapidly is this development and multiplication, that under favorable conditions a single aphid will soon cause the development of a large colony upon that plant. It has been estimated that a single aphid will be the cause of millions of aphids in a single season, this method of development being much more rapid than is the case where eggs are deposited. Winged forms soon appear among the colony of aphids on the wheat, and some of them will fly to neighboring wheat plants, and when the

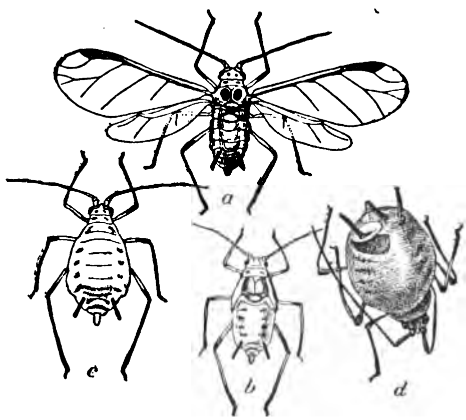

FIG. 40.—The Wheat Plant-Louse, *Nectarophora cerealis*: *a*, winged migrant; *b*, nymph of winged migrant; *c*, wingless parthenogenetic female; *d*, parasitized aphid showing the trap-door out of which the adult parasite emerged. All figures greatly enlarged. (From Marlatt, U. S. Dept. Agric.)

wheat becomes too mature to furnish further food for the aphids, some of them will then fly to grass and thereby perpetuate the species there.

There is nothing that the agriculturist can do in a practical and economic way towards destroying these plant-lice in his wheat. As a rule, the parasitic insects, the habits of which we have just described, will prevent any serious injury, but in those cases which sometimes actually happen where the plant-lice have nearly ruined a field of wheat, there is no help for it.

THE ANGOUMOIS GRAIN MOTH.

Sitotroga cerealla, Oliv.

This minute moth is well known to the wheat raisers on account of its injury to the wheat while in the field as well as to the grain while stored in the granary. The insect was originally an imported one, having come from the Province of Angoumois, France, where its injuries are well known. It has now spread throughout practically all of the grain-growing regions of the United States. Two years ago it seemed to be unusually abundant in the southwestern part of Missouri and a great many inquiries, with specimens of the insect and its work, were received by me at that time.

The adult moth is a small grayish-brown insect, about half an inch across its expanded wings. The hind wings are beautifully bordered with long delicate hairs. The insect is represented in figure 41, *c*, enlarged about three diameters, the hair line just below indicating its natural size. The moths emerge in the spring from granaries and other places where the grain has been stored, either threshed or in the shock, and fly to the wheat fields and there deposit their eggs in the heads of the developing wheat at about the time the wheat is in the milk stage. Each female lays a large number of light-red eggs, one of which is shown greatly enlarged in figure 41, *e*.

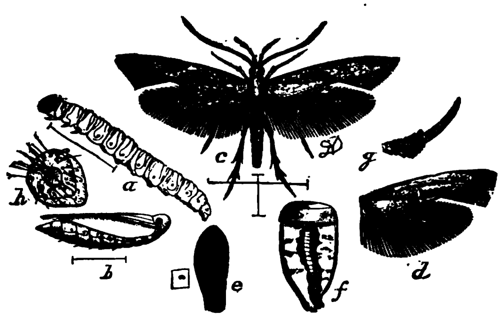

FIG. 41.—The Angoumois Grain Moth, *Sitotroga cerealla*: *a*, larva; *b*, pupa; *c*, adult moth; *d*, wing; *e*, egg; *f*, larva within grain. The lines near each figure indicate its natural size, most figures being enlarged. (From Howard, U. S. Dept. Agric.)

These eggs hatch in a few days into minute larvae or caterpillars, which eat their way through into the developing kernel of wheat, feeding within upon the starchy material. When this wheat ripens and is cut and stacked in shocks, the larvae soon reach their full development, by which time they are upwards of a half inch in length and of the general appearance and shape represented in figure 41, *a*. They then spin a little cocoon within the hollowed out kernel of wheat and transform to pupae, one of which is represented in figure 41, *b*.

These pupae transform to adults during the latter part of July, and the moths work their way out and escape. They soon pair and deposit their eggs for another brood upon the grain from which they have emerged.

If the wheat after being cut is soon carried into the barn, or is threshed and stored away in bulk in the granary, these moths that emerged from the grain deposit their eggs there upon the threshed grain, or in case the grain is not threshed, deposit them upon the heads of the wheat. The larvae constituting this second brood reach maturity during the fall and hibernate within the kernels of wheat, changing to pupae in the spring, and the adult moths appear in May or early June and seek the new wheat fields. If the grain be stored in warm granaries there may be as many as four broods during the year in such wheat.

It appears that the adult moths which deposit their eggs in the wheat field in the early summer come from the nearby barns and other places where the grain is stored, either threshed or unthreshed.

It is advisable not to leave the wheat standing in the field in shocks any longer than is absolutely necessary, because the moths will emerge from such wheat and be scattered through the neighborhood. Neither is it a good plan to store the wheat in an unthreshed condition for the same reason. If the wheat be threshed soon after it is cut, and stored in bulk in the granaries, the moths that will come out from the kernels of wheat that are situated very far below the surface will not be able to crawl out of the stored grain, and will, therefore, be prevented from pairing and depositing eggs which will hatch and produce another brood of larvae. Of course the moths that happen to be in the upper tiers of the wheat will be able to escape and fly about the bin, and pair and lay eggs upon the wheat for succeeding generations. These moths that can thus continue the species and cause the destruction of the grain, can be readily killed by the use of bisulphide of carbon, which you will find described under the head of the Grain Weevil.

The amount of injury to wheat sustained by these little moths is sometimes quite considerable. In badly infested cases the wheat has been known to lose forty per cent of its weight and seventy-five per cent of its farinaceous matter. Wheat infested with these insects is not suitable for milling purposes nor for food for man, and the kernels that are hollowed out to any great extent will not germinate, and hence the wheat is greatly damaged for germinating purposes.

Where one has suffered more or less from these moths, the careful following out of the plans suggested will prevent future trouble. These insects not only infest wheat but also other small grains and corn, and develop and breed generation after generation in corn stored in cribs and other places about the farm. Hence it is necessary in order to successfully combat this insect in the wheat to attend to its destruction in other places, especially in the corn. It must be understood, however, in this connection that there is no way of combatting this pest in corn or other grains stored in the open bin or crib.

For methods of fighting this insect see under The Grain Weevil.

THE GRAIN WEEVIL.

Calandra granaria, Linn.

This minute beetle is about one-seventh of an inch in length and of a glossy, chestnut-brown color, the head is prolonged into a beak on the end of which the mouthparts are placed, the angular antennae being situated on the upper part of the beak. By referring to figure 42, *c*, you will be able to obtain a good idea of the appearance of the insect when seen under a magnifying glass, and just above it the outline of one of the beetles natural size.

These beetles, fortunately for the agriculturist, infest the grain only when it is stored and will not be found infesting wheat in the field. These beetles eat holes in the grain for food purposes as well as for depositing their eggs, which they push down in some of the holes they have eaten. The larvae hatching from these eggs are small, footless, fat, grub-like creatures, one of which is represented greatly magnified in figure 42, *a*.

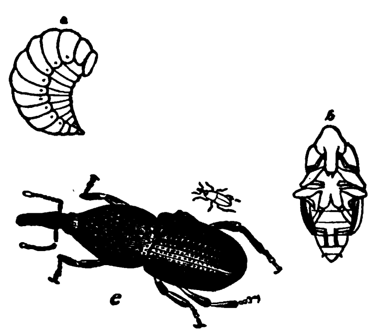

FIG. 42.—The Grain Weevil, *Calandra granaria*; *a*, larva; *b*, pupa; *c*, adult. All greatly enlarged, except the outline of small beetle just above the large one. (From Howard, U. S. Dept. Agric.)

These larvae feed within the kernel, mining it out, and when they become full grown transform to the pupa stage within the kernel, similar to the grain moth previously described, but not, however, by first making a little cocoon as do the moths. Presently these pupae transform to the adult beetles, and they eat their way out of the grain and lay their eggs for another brood. It requires about six weeks from the time an egg is deposited until the adult stage is attained.

These insects breed generation after generation in the stored grain, and under favorable conditions in this State we find upwards of five broods a year. These insects multiply very rapidly, the adult female beetle laying a great many eggs and laying these during quite a long period. These beetles are also much stronger and more powerful than the grain moth, and for that reason are able to escape from the stored grain at greater depths. For this reason also they are able to do more injury.

REMEDIES.

The angoumois grain moth and the grain weevil, as well as a number of other insects that feed in stored grains and seeds, may be readily killed by proper fumigation with bisulphide of carbon. The following method should be strictly adhered to: In the first place, it must be distinctly understood that in order to kill these insects in stored grain, the grain must be confined in a tight room, granary or box as the case may be. If such places are not tight, then every crack and crevice must be stopped up with rags or by other means, because the first essential is to have a close place where there will be no possibility of the fumes escaping. The door should also be looked after and arranged so that it may be closed without leaving any cracks. The bisulphide of carbon is then to be placed in shallow basins, and these are to be placed *on top* of the grain. The bisulphide of carbon may be thrown on top of the grain, or rags may be saturated with it and these be placed on top.

It is absolutely important also that this bisulphide of carbon be placed *on top* of the grain to be fumigated, because the fumes from this bisulphide are much heavier than the air and therefore settle. If the bisulphide is allowed to evaporate on top of the grain, the fumes will penetrate down all through it, but if the bisulphide be placed near the floor, it will evaporate, but the fumes will not rise and the bulk of the grain will not be fumigated at all.

The amount of bisulphide of carbon to be used depends upon the nature of the room or bin holding the grain, and also upon the quantity of grain to be fumigated. As a general rule, if the bin, granary or room be very tight, as will be the case if matched boards are used, then two pounds of bisulphide of carbon will properly fumigate every one hundred bushels of wheat. If the room or bin be not made of matched material, more bisulphide of carbon should be used. If the room or bin be a comparatively large one for the amount of grain it contains, then one should use two pounds of bisulphide of carbon for every five hundred cubic foot of space, regardless of whether this space contains grain or not.

As soon as the proper amount of bisulphide of carbon has been placed on top of the wheat or other grain or seed, the person should leave the bin at once, close the door and keep it closed for three days. It may then be opened and the fumes allowed to escape. It is well to thus fumigate grain, including corn, soon after it is thrashed and put in the granary, and if it is badly infested, it is a good plan to fumigate again in the spring.

This fumigation will kill not only the insects that may be within the room, but will also kill mice and rats confined in such places.

There is one precaution in the use of bisulphide of carbon which should not be overlooked. While bisulphide of carbon is perfectly harmless to handle, yet one should not use it near a lantern or a lighted pipe, or near any trace of fire whatever; neither should one enter the room, granary or bin while the fumes of this bisulphide of carbon are there with a lantern or a lighted pipe, because in so doing an explosion would be sure to follow. Do not let this precaution, however, prevent anyone from using this material, since it is one of the best substances that we know of for killing insects that are confined within a closed place. It is hardly necessary to caution a person about staying in a room too long where the fumes are very dense, because few people would stand the disagreeable odor of this substance long enough to be injured.

The bisulphide of carbon is a clear, heavy liquid that evaporates immediately, and will not injure the grain for germinating purposes nor for milling purposes when used as directed.

Bisulphide of carbon may be obtained from the manufacturers in fifty-pound cans, which are about the size of five-gallon cans, for ten cents per pound. It is therefore a comparatively cheap substance considering the amount of good one can will do.

CORN AS A STOCK FOOD.

IMPORTANCE OF CORN AS A STOCK FOOD—CHEMICAL COMPOSITION—DIGESTIBLE NUTRIENTS—INFLUENCE OF MATURITY ON FEEDING VALUE—INCREASING THE VALUE OF CORN—VALUE OF STOVER—SILOING, FIELD CURING, SHREDDING, GRINDING, COOKING, SOILING.

By H. J. Waters, Dean Missouri Agricultural College and Experiment Station, Columbia, Mo.

It is not possible within the limits of this paper to present a treatise on animal nutrition, and no attempt is here made to discuss any of the many interesting and important scientific principles which form the basis of the rational feeding of animals, beyond those problems which are intimately related to the proper and profitable utilization of the corn plant. In no case is it possible or indeed advisable to attempt to set down fixed rules or definite directions for the guidance of the feeder. Local and varying conditions with reference to the abundance, convenience and cheapness of certain classes of food stuffs, the class, quality and value of the animal product sought to be produced; the convenience to market, etc., are important and usually determining factors to which it would be impossible to make a general adjustment of any set of fixed rules.

IMPORTANCE OF CORN AS A STOCK FOOD.

Corn is the great American stock food. No other plant compares with it in its wide and general distribution, in the ease, certainty and cheapness with which it may be produced; in the yield of valuable food material per acre, and in the close relation it bears to the development of the live stock interest of the country. Pracitcally every State in the Union is reported as growing corn commercially. Where corn is grown extensively, there the live stock interests are extensively developed and prosperous. A corn center is synonymous with a live stock center, and the geographical distribution of corn production is in a general way an index to the distribution of live stock production. Eleven prominent corn states, of which Missouri is one, producing something over 75 per cent of all the corn of the United States, produce practically 60 per cent. of the horses, mules, cattle, hogs, milch cows and sheep of the country. From these states are drawn the chief supplies of well finished beeves and hogs, and well developed horses and mules. They are the feed yards of the nation. It is a significant fact also that in this territory are concentrated the great herds of blooded cattle, horses, hogs and sheep. A country pre-eminently adapted to corn growing, is at once pre-eminently adapted to the production of a high class of live stock. Even the stockmen and dairymen on the high-priced lands of the East find it profitable, indeed necessary, to make corn the basis of the rations for their stock.

An idea may be formed of the importance of this crop to the feeding operations of the country when it is realized that the normal corn crop of the United States is in round numbers two billion bushels and that more than one and a half billion bushels of this crop are normally required for the feeding of our own stock, leaving only about 200,000,000 bushels for export, and the same quantity to be converted into manufactured products such as flour, starch, glucose, whisky, alcohol, beer, high wines, etc.

IMPORTANCE OF CORN TO MISSOURI.

All that has been said of the importance and prominence of corn in the United States applies with even more force to Missouri. No other crop compares with it, either in acreage, total yield, or value. Upon no other crop do the farmers and stockmen so fully and completely depend for their sustenance and profit. A failure of this crop means the forced sale of their stock in an unfinished condition on a dull market; the restocking of their farms later at high prices, or delay until their herds may be replenished by the natural increase. It means the complete derangement of their plans, and virtually forces them out of business for that season and leaves them poorly prepared for the next one.

The normal acreage, yield and value on the farm of the more important staple crops of the State are shown in the following table compiled by Secretary Ellis.

NORMAL CROPS OF MISSOURI.

	Total acres.	Total yield bu.	Av. yield bu.	Total valuation.‡
*Corn	6,378,000	191,340,000	30	57,400,000
*Wheat	1,159,000	14,487 000	12.5	8,981,000
*Oats	1,013,000	25,325,000	25	6,078,000
*Hay	2,375,000	3,114,000	1.3 tons	20,116,000
†Potatoes	90,000	6,750,000	75	3,105,000

*Average 8 years.
†Average 3 years.
‡Valuation average 10 years, 1891 to 1900.

CHEMICAL COMPOSITION.

In the subjoined tables will be found the average chemical composition of the grain, mill products, etc., of the different types of corn*:

	No. of analyses	Water, per cent	Ash, per cent	Protein, per cent	Fiber, per cent	Nitrogen free extract, per ct.	Fat, per cent
Grain:							
Dent—All analyses	86	10.6	1.5	10.3	2.2	70.4	5.0
Flint—All analyses	68	11.3	1.4	10.5	1.7	70.1	5.0
Sweet—All analyses	26	8.8	1.9	11.6	2.8	66.8	8.1
Pop varieties	4	10.7	1.5	11.2	1.8	69.6	5.2
Soft varieties	5	9.3	1.6	11.4	2.0	70.2	5.5
All varieties and analyses	208	10.9	1.5	10.5	2.1	69.6	5.4
Mill and waste products:							
Cornmeal—All analyses	77	15.0	1.4	9.2	1.9	68.7	3.8
Corn and cornmeal	7	15.1	1.5	8.5	6.6	64.8	3.5
Corn cob	18	10.7	1.4	2.4	30.1	54.9	.5
Hominy chop	12	11.1	2.5	9.8	3.8	64.5	8.3
Corn bran	5	9.1	1.3	9.0	12.7	62.2	5.8
Corn germ	3	10.7	4.0	9.8	4.1	64.0	7.4
Corn germ meal	6	8.1	1.3	11.1	9.9	62.5	7.1
Cream gluten meal	......	10.1	.8	33.7	1.7	51.1	2.6
Chicago gluten meal	......	12.3	1.3	36.5	1.4	45.8	2.7
King gluten meal	......	7.4	.5	33.7	1.2	52.6	4.6
Gluten feed	11	7.8	1.1	24.0	5.3	51.2	10.6
Buffalo gluten feed	......	9.6	2.3	27.1	6.7	51.1	3.2
Peoria gluten feed	1	7.5	.8	19.8	8.2	51.1	12.6
Rockford gluten feed	.....	8.9	.8	23.6	6.6	56.6	3.5
Chicago maize feed	3	9.1	.9	22.8	7.6	52.7	6.9
Gluten feed and refuse	2	6.5	1.1	20.7	4.5	56.8	10.4
Dried starch and sugar feed	4	10.9	.9	19.7	4.7	54.8	9.0
Starch feed, wet	12	65.4	.3	6.1	3.1	22.0	3.1
Corn fodder, green:							
Dent varieties	63	79.0	1.2	1.7	5.6	12.0	.5
Dent varieties—Kernels glazed	7	73.4	1.5	2.0	6.7	15.5	.9
Flint varieties	40	79.8	1.1	2.0	4.3	12.1	.7
Flint varieties—Kernels glazed	10	77.1	1.1	2.1	4.3	14.6	.8
Sweet varieties	21	79.1	1.3	1.9	4.4	12.8	.5
All varieties	126	79.3	1.2	1.8	5.0	12.2	.5
Leaves and husks—Green	4	66.2	2.9	2.1	8.7	19.0	1.1
Stripped stalks—Green	4	76.1	.7	.5	7.8	14.9	.5
Corn silage	99	79.1	1.4	1.7	6.0	11.0	.8
Corn fodder—Field-cured (2)	35	42.2	2.7	4.5	14.3	34.7	1.6
Corn leaves—Field-cured	17	30.0	5.5	6.0	21.4	35.7	1.4
Corn husks—Field-cured	16	50.9	1.8	2.5	15.8	28.3	.7
Corn stalks—Field-cured	15	68.4	1.2	1.9	11.0	17.0	.5
Corn stover—Field-cured (3)	60	40.5	3.4	3.8	19.7	31.5	1.1

(*) Arranged from Jordan's "The Feeding of Animals—1901."

(2) By corn fodder is meant the entire plant, including the ear.

(3) By corn stover is meant the portion of the plant remaining after the ears are removed.

A more detailed study of the chemical composition of the corn kernel has been made by the New Jersey Experiment Station*. One hundred grams of corn kernels were separated as nearly as possible into skin, germ, and starchy and hard portion, and the different parts analyzed with the result shown below.

*New Jersey Experiment Station—Bulletin No. 105.

PERCENTAGE OF DRY SUBSTANCE OF DIFFERENT PARTS OF THE CORN KERNEL.

	Proportion of parts, per cent......	Ash, per cent.	Protein, per cent......	Fiber, per cent......	Nitrogen free extract, per cent......	Fat, per cent.
Original kernel	100	1.7	12.8	2.0	79.4	4.3
Skin	5.5	1.3	6.6	16.4	74.1	1.6
Germ	10.2	11.1	21.7	2.9	34.7	29.6
Starchy and hard parts	84.3	.7	12.2	.6	85.0	1.5

These results are of particular interest in connection with a study of the by-products of corn such as the gluten feeds, germ meal, hominy chop, corn bran, distillery slops, etc., resulting from the manufacture of starch, hominy, glucose, beer, spirits, etc., from corn. These corn feeds are now offered on the markets in such quantities as to be of considerable commercial importance and to be worthy of the careful study of the feeder.

The cut (Fig. 1) which we are permitted to use through the courtesy of the New Jersey Experiment Station, will help the student to a clearer understanding of the particular parts of the corn kernel referred to in the tables above, and what parts enter chiefly into the composition of the different corn by-products now on the market.

It will be observed that the starchy portion constitutes more than four-fifths of the entire kernel, that the germ, which is only about one-tenth of the kernel, contains practically two-thirds of the fat and almost two-thirds of the ash of the entire kernel. The crude fiber is largely in the skin.

Most of the so-called feed is what is left after the starch has been removed more or less completely from the grain. This is accomplished by mechanical means, and leaves the residue uninjured by the process, which in brief is as follows:

The grain is ground into meal, usually in warm running water or after it has been thoroughly soaked and the various parts of the kernel named in the table are separated in water by gravity. The skin or hulls forming the bran, float on the surface; the germs sink to the bottom, while the starch and hard portions of the kernel carrying, in addition to the starch, a considerable portion of gluten cells, are held in suspension in the water. The water carrying the starch and gluten in suspension is then conducted slowly through long troughs, where the starch being the heavier settles to the bottom, and the gluten is carried on to be recovered by evaporating the water.

The composition therefore of the by-products will depend upon the particular part of the kernel from which it is made. When derived largely from the hulls, as in the case of the bran, the content of crude fiber will be relatively high, and the content of protein and fat will be relatively low. If made from the germs as in the case of the germ meals,

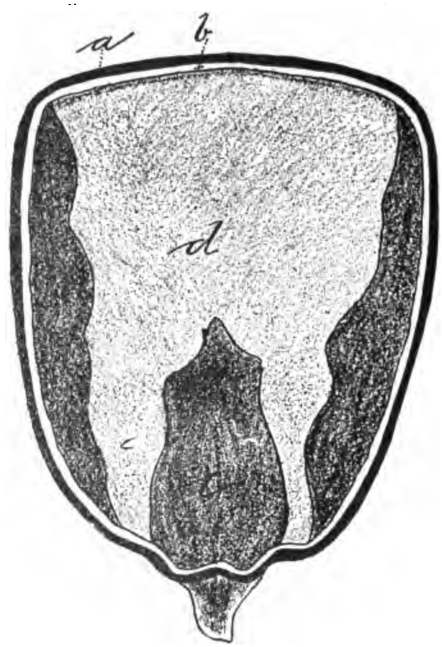

FIG 1. *a.* The husk, or skin, which covers the whole kernel. It consists of two distinct layers, the outer and inner, which, when removed, constitute the bran, and contain practically all of the crude fiber of the whole grain.

b. A layer of gluten cells, which lies immediately underneath the husk; it is yellow in color, and cannot be readily separated from the remainder of the kernel. This part is the richest of any in protein.

c. The germ, which is readily distinguished by its position and form, also contains gluten, though it is particulary rich in oil and mineral constituents.

d. The large portion is composed chiefly of starch; the dark color indicates the yellow, flinty part, in which the starch-holding cells are more closely compacted.

it will run relatively high in fat and ash and moderately high in protein. The gluten as separated from the starch when unmixed with other materials, is distinguished by its high content of protein.

"As found in the market, the principal brands are 'sugar corn' or 'starch' feed, made up mostly of hulls and germs; gluten meal, which comes from the flinty portion of the kernel, and gluten feed, which is now a mixture of hulls and the gluten part. When unmixed with other

Ninety-five head of yearling Angus steers that sold for $8 per 100 pounds. Fed by Turner McBaine, McBaine, Missouri.

parts of the kernel, the hulls are also known as corn bran and the germ portion from which the oil has been pressed is called, when ground, germ oil meal. The corn bran contains the least protein and the gluten meal the most, while the gluten feed and germ oil meal occupy a position between these. It should be remarked that the commercial names for gluten products are not always a safe guide in their purchase."*

All foods of this class, including such other by-products as wheat bran, wheat middlings, linseed meal, cottonseed meal, etc., should invariably be purchased on the basis of a guaranteed content of protein, fat, nitrogen free extract and fiber just as commercial fertilizers are now purchased, on a guaranteed content of nitrogen, potash and phosphoric acid.

DIGESTIBLE NUTRIENTS.

While the foregoing tables, showing the composition of the different varieties of corn and the different parts of the plant cannot fail to be interesting and instructive to the student of animal nutrition, at the same time it should be borne in mind that only a part of any vegetable food is digested by the animal, the undigested portion being voided in the form of dung as so much worthless or waste material.

In general the grains and concentrated feeds are more completely digested than the coarse fodders. A larger proportion of the corn grain is digested than of the corn stover. A larger proportion of wheat than of the straw. It is worthy of remark in passing, that the corn grain is one of the most concentrated and is the most completely digested of any of the grain feeds.

Then, too, the digestibility of any food stuff may be affected within certain narrow limits by its palatability, by the quantity consumed by the animal, the stage of growth or development at which it was harvested, and its combination with other food stuffs.

Contrary to the general impression, the digestibility of a feed does not appear to be affected either favorably or unfavorably, at least to any considerable degree under ordinary circumstances, by cooking, soaking, grinding, or the method of preserving or drying, so long as it is not subjected to mechanical loss of the finer parts in drying and handling, or to molding or fermenting in the process of preserving, unless such process add materially to its palatability.

The amount of *digestible nutrients*, therefore, is a far safer measure of the feeding value of any substance than the mere chemical composition. For, aside from its palatableness, the value of a food depends first upon the amount of digestible material supplied and second upon the

*Jordan—The Feeding of Animals.

proportion of protein, carbohydrates and fat in this digestible material.

To present this information concerning the products of the corn plant in a form convenient for reference, the following table has been arranged:

The average percentage of digestible nutrients supplied by the grain, the mill products and the different parts of the corn plant.*

	Protein per cent......	Carbohydrates, per cent......	Fat, per cent.
Grain, mill and by-products.			
Corn, all determinations	7.9	66.7	4.3
Dent corn	7.8	66 7	4.3
Flint corn	8.0	66.2	4.3
Sweet corn	8 8	63.7	7.0
Corn and cob meal	4.4	60.0	2.9
Cob meal	0.4	52.5	0.3
Corn bran	7.4	59.8	4.6
Gluten meal	25.8	43.4	11.0
Germ meal	9.0	61.2	6.2
Starch refuse	11.4	58 4	6.5
Grano gluten	26.7	38.8	12.4
Hominy Chops	7.5	55.2	6.8
Glucose meal	30.3	35.3	14.5
Sugar meal	18.7	51.7	8.7
Starch feed-wet	5.5	21.7	2.3
Silage, Fodder etc.			
Corn silage	0.9	11.3	0.7
†Corn fodder, green	1.0	11.6	0.4
Corn fodder, field cured	2.5	34.6	1.2
‡Corn stover, field cured	1.7	32.4	0.7

†The entire plant.
‡What is left after the ear is removed.

INFLUENCE OF MATURITY UPON YIELD OF DIGESTIBLE SUBSTANCE.

The stage of development of a plant at the time it is harvested may materially affect its value as a feed in two ways. (1) In the quantity of digestible material produced. (2) In the palatableness of the fodder. Aside from these considerations, the greater certainty and convenience in curing the more mature plants; the mechanical loss of the finer portions due to storms or to the handling of the plants in harvesting when they are too mature, affect in practice, to a considerable degree, the time of harvesting each crop independently of the yield and the palatability of the product. It is also true that in handling large areas of any crop, it is not convenient or profitable to arrange for sufficient force of men and machinery to harvest the entire crop in precisely the stage that is considered to combine the maximum yield with the highest degree of palatableness. Hence the harvest must usually begin at a stage when some sacrifice in yield is made and extend to the point where some loss in palatableness is sustained.

* Henry. "Feeds and Feeding."

In the case of the corn plant, the impression has long prevailed that after the roasting ear stage is reached, nothing is actually added to the plant, that it then contains all the nutrients it will ever contain; that the non-nitrogenous compounds then consist chiefly of sugar which is to some extent at least converted into indigestible compounds in the process of ripening and that by allowing it to ripen a loss of digestible material occurs by reason of these changes.

That the position is wholly erroneous and that the plant continues to gain in dry substance until fully mature, is clearly shown by the results of numerous careful experiments.

WATER AND DRY MATTER IN CORN CROP AT DIFFERENT PERIODS AFTER TASSELING—NEW YORK (GENEVA) STATION.*

Date of cutting	Stage of growth.	Corn per acre, tons.	Water per acre, tons.	Dry matter per acre, tons.
July 30	Fully tasseled	9.0	8.2	.8
Aug. 9	Fully silked	12.9	11.3	1.5
Aug. 21	Kernels watery to full milk	16.3	14.0	2.3
Sept. 7	Kernels glazing	16.1	12.5	3.6
Sept. 23	Ripe	14.2	10.2	4.0

*Henry's "Feeds and Feeding."

It will be observed that the most rapid gain in pounds of dry matter per acre occurred between the roasting ear and glazing stages and that there was a material gain from the glazing stage to the time when the plant was ripe. Had the crop in this case been harvested in the roasting ear stage, the yield of dry matter would have been 2.3 tons per acre, while four tons were secured when the plants were fully ripe. In other words, the yield was practically doubled between the roasting ear and full ripeness.

An elaborate study of this problem by Jordan at the Maine Experiment Station* confirms the results already quoted and adds to our knowledge of the changes that take place in the composition of the plant during the later stages of growth. A summary of the results are shown in the following table:

* Maine Experiment Station—Report 1896, page 62.

PRODUCTION OF THE CORN PLANT PER ACRE AT DIFFERENT STAGES OF GROWTH.

Stage of development when harvested.	Days in period of growth.	Dry matter per acre, lbs.	Gain in dry matter per acre in each period, lbs.	Daily gain of dry matter per acre in each period, lbs.
Ears beginning to form	......	3,064	....	....
A few roasting ears	13	5,210	2,146	165.0
All roasting ears	7	6,060	849	121.3
Some ears glazing	8	6,680	620	77.5
All ears glazed.	9	7,039	358	39.8
Total increase	......	....	3,974	....

In this case the yield of dry matter per acre was more than doubled in 37 days or between the silking stage and the fully glazed stage.

It will be interesting to see what the character of this gain was. The table below furnishes this information.

PRODUCTION OF DIFFERENT CLASSES OF COMPOUNDS PER ACRE AT DIFFERENT STAGES OF DEVELOPMENT.

Stage of development when harvested.	Ash, lbs.	Protein, lbs.	Fiber, lbs.	Nitrogen free extract, lbs.	Sugars, lbs.	Starch, lbs.	Fat, lbs.
Ears beginning to form	286	458	812	1,428	358	....	80
A few roasting ears	339	612	1,314	2,892	1,064	108	154
All roasting ears	376	690	1,192	3,621	1.248	297	182
Some ears glazing	372	639	1,291	4,177	1,407	357	200
All ears glazed	416	650	1,309	4,457	1,161	1,083	200
Gain after first cutting	130	191	497	3,029	802	1,083	129
Gain after second cutting	77	38	95	1,565	97	975	55

"Two facts are clearly shown. First, that the later growth of dry matter in the corn plant is made up chiefly of non-nitrogenous compounds; second, a large percentage of these compounds consist of sugars and starch, substances that are the best of their class for the purposes of animal nutrition."

Not only is the yield increased by allowing the plant to mature, but contrary to general opinion, the mature material is actually more digestible as is shown by the following summary of American Digestion Experiments compiled by Jordan.*

DIGESTED FROM 100 PARTS OF ORGANIC MATTER.

	Corn fodder	Silage......
Out before glazing, 13 experiments.	65.7	67.4
Out after glazing, 10 experiments....................	70.7	73.6

Applying these figures for corn fodder to the yields shown by the New York experiments in the preceding table it is found that an acre yielded of dry digestible matter when:

In roasting ear stage.........	1.5 tons
Fully ripe.................................	2.8 "

Again, when the field-cured fodder is allowed to remain in the shock until required for feeding, as is the custom in the corn belt of America, it has been found that the more mature plants keep much better than those harvested green, and the season is usually sufficiently advanced by the time the corn is reasonably mature to escape the warm wet weather that is so destructive to feed of this class.

In the light of these investigations and the experience of the most successful farmers it is considered that when the outer husks and the leaves below the ear have turned yellow but have not become dry; when the stalk and leaves above the ear begin to show the golden tinge will perhaps as nearly approximate the maximum yield without sacrificing palatability and present a condition when the material may be put up in large shocks without danger of molding. At this stage the kernels are fully glazed and practically mature.

TO INCREASE THE VALUE OF THE CORN PLANT.

The two most important ways in which the efficiency and value of the corn plant may be increased are:

First.—By supplementing the corn and stover with such food stuffs as are relatively rich in protein so as to furnish the animal a more nearly balanced ration than these materials alone supply.

Second.—By carefully saving and properly feeding the great crop

*Jordan—The Feeding of Animals.

of corn stover (the plant after the ears are removed) which now for the most part is allowed to go to waste in this State.

CORN A CARBONACEOUS FOOD.

Notwithstanding the fact that corn is the best single stock food known and that thousands of animals are successfully wintered or fattened each year on an exclusive ration of corn and corn stover or some similar roughage, it is true that it is by no means a perfectly balanced or complete food. As has already been shown by the tables of composition and digestible nutrients, corn contains a very large quantity of carbonaceous matter in proportion to the protein compounds. It does not give a proper balance between the carbohydrates (which includes starch, the sugars, fat and digestible fiber) and the protein. In other words, practical experience and scientific experiments have proven beyond doubt that by combining corn with some feed that will increase the proportion of protein, a more efficient ration will be the result; more rapid gains will be made by the animals to which it is fed; more rapid and healthful growth will be made on young animals; a larger flow of milk will be obtained from the dairy cow; and the steer will carry a smoother finish and a finer coat to market; and under ordinary circumstances, or if the material for balancing the corn be selected judiciously and with a due regard to the cost as compared with the increased efficiency obtained, an increased profit will be returned.

FOOD STUFFS FOR BALANCING CORN.

All stock feeds may be divided into two general classes—one in which the fat-producing and heat-forming ingredients such as starch, the sugars, etc., designated as carbohydrates, and the fats largely predominate and the other class containng a relatively large amount of muscle-making material commonly known as protein. This protein is required for growth in young animals and for breeding stock and animals in milk and is very valuable even in the final fattening process. The line between these two classes of foods cannot be sharply drawn in all cases, some feeds being so nearly between the two as to be as appropriately placed in one class as in the other.

As has already been pointed out, corn is the most important representative of the carbonaceous group, and we are here chiefly concerned in discovering the materials which may be used to supply the protein in which the corn is deficient.

The following table contains some of the more important foods of this class, together with the digestible nutrients supplied by them.

PARTIAL LIST OF FOODS RICH IN PROTEIN.

Percentage of Digestible Nutrients.

	Protein.	Carbo-hydrates.	Fat.
Corn (for comparison)	7.9	66.7	4.3
Corn stover (for comparison)	1.7	32.4	.7
Cottonseed meal	37.2	16.9	12.3
Linseed meal—old process	29.3	32 7	7.0
Linseed meal—new process	28.2	40.1	2.8
Glucose meal	30.3	35.3	14.5
Grano gluten	26 7	38.8	12.4
Gluten meal	25.8	48.3	11.0
Sugar meal	18.7	51.7	8.7
Wheat middlings	12.8	53.0	3.4
Wheat bran	12.2	89.2	2.7
Dark feeding flour	13.5	61.3	2.0
Buchwheat middlings	22.0	33.4	5.4
Oat feed or shorts	12.5	46.9	2.8
Malt sprouts—dried	18.6	37.1	1.7
Brewers grain—dried	15.7	36.3	5.1
Soy bean grain	29.6	23.3	14.4
Horse bean	22.4	49.3	1.2
Cowpea grain	18.3	54.2	1.1
Field peas—grain	16.8	51.8	.7
Alfalfa hay	11.0	39.6	1.2
Cowpea hay	10.8	38.6	1.1
Crimson clover hay	10.5	34.9	1.2
Red clover hay	6.8	35.8	1.7
Skim milk	3.0	4.0	.5
Butter milk	3.9	4.0	1.1

Among those who have essayed to give advice on this subject are two classes of extremists. One who unduly exalts the value of the nitrogenous group of nutrients, and, by inference at least, insists that the ration must have a more or less definite proportion of protein in order to be adapted to a given purpose, even regardless of convenience or cost. The other, realizing the unsoundness of this extreme position, is unwilling to concede that any financial benefit will accrue from attempting to balance the ration to better meet the requirements of the class of animals to which it is to be fed.

It is not difficult to discover the absurdity of the position of the first class when corn is worth, delivered to the railroad, from 20 to 25 cents per bushel—equivalent to $7 to $9 per ton, and corn stover may be had in abundance for the labor of cutting it, and the extra labor involved in husking the corn from the shock—amounting all told to not over $1.50 per ton—and when cottonseed meal or linseed meal costs from $20 to $30 per ton. It is clear that it would be necessary for the balancing of the ration to exert a profound influence upon its efficiency in order to meet the increased cost involved. A study of the experimental results with balanced and unbalanced rations for different classes of stock which follow in this chapter, while showing a decided and uniform advantage in favor of the balanced ration, yet fail to show sufficient difference for most purposes to justify the expense in the particular case noted above.

Clearly there is no law of nature or nations requiring the feeder to balance his rations beyond the point of profit.

On the other hand if, as will be clearly shown from the experimental data submitted, there is in practically every situation an opportunity to so combine materials at hand or materials that may be purchased at a reasonable cost as to practically balance the ration, and in so doing increase the profits correspondingly, the conservatism and prejudice of the other class of extremists must at once yield.

In general the best ration is made of such a combination of food stuffs as will give the proper proportion of protein and carbohydrates for the particular class of animals or the special purpose for which it is to be used, *at the same time that careful attention is given to the cost of the material to be used, the palatability of the ration and the convenience with which it may be obtained and fed.* In short the controlling factor in making up every ration should be its cost in proportion to its productiveness, but as has already been stated the taste and appetite of the animal should be catered to and heed should be given to the adaptability of the ration to the special use to which it is proposed to be put. A vast majority of the feeders of America find it necessary and profitable to use the product of the corn plant as the basis of all rations and for all classes of stock. It is clear that when feed is to be purchased, it should, as far as practicable, be selected with reference to supplementing, balancing or adding to the value of the material already on hand, rather than to purchase more of the same class. For example, it would not be good business to purchase timothy, kafir corn, sorghum, millet, or any of the straws to feed with corn and stover, since such a combination adds nothing to the ration above the sum of digestible nutrients contained in the two feeds. Whereas, if clover, alfalfa, cowpeas, bran, middlings, gluten meal, cottonseed meal, or linseed meal be selected to combine with the corn products, the feeding value of the resulting ration would be directly increased. As illustrations of the value of combining such materials with corn products the following results of careful experiments are cited:

Dairy Cows.—Jordan* reports the result of an experiment in which the yield of milk from cows when fed on six pounds of corn daily and all the timothy hay they would eat was compared with the quantity of milk obtained from the same cows when fed on a balanced ration consisting of two pounds corn meal; two pounds of cottonseed meal; and two pounds of gluten meal together with all the timothy hay they would eat. Both rations supplied practically the same quantity of digestible nutrients, but the proportion of protein was nearly twice as much in

*Maine State College Annual Report 1893, page 81.

the mixed grain ration as in the corn meal ration. The results showed that during the time the cows were fed the balanced ration, they produced from one-fifth to nearly one-third more milk than when they were fed on the unbalanced ration, and that the yield of milk solids was from 30 per cent. to 40 per cent. greater.

Growing Steers.—The results of several years' work with yearling steers, at the Missouri Experiment Station* are reported, in which a gain from corn and timothy hay is compared with that from several other rations, in which the corn was at least partially balanced with cowpea hay, clover hay, etc. The following tables present a summary of the results:

COMPARISON OF BALANCED AND UNBALANCED RATIONS FOR WINTERING YEARLING STEERS.

First trial—1899—00—104 days—4 steers in each lot—4 pounds of corn per day per head.

Kind of feed.	Corn eaten, lbs.	Hay eaten, lbs.	Total gain, lbs.	Av. daily gain, lbs.	Grain per pound, gain lbs.
Corn and timothy hay	1,568	6,536	260	.64	6.00
Corn and cowpea hay	1,568	7,757	624	1.54	2.51

In this trial the substitution of cowpea hay for the timothy more than doubled the gain.

Second trial—1900-01—80 days—4 steers in each lot—6 pounds of shelled corn per day per head.

Kind of feed.	Corn eaten, lbs.	Hay eaten, lbs.	Total gain, lbs.	Av. daily gain lbs.	Grain per pound gain, lbs.
Corn and timothy hay	1,926	4,543	318	1.00	6.06
Corn and clover hay	1,926	5,719	640	2.00	3.01
Corn and millet	1,926	3,941	119	.37	16.10
Corn and sorghum hay	1,926	4,727	166	.52	11.60

The results of the two experiments are in full accord. Note the difference in the amount of gain and in the number of pounds of corn required per pound of gain of the steers that were fed a balanced ration, in comparison with those which were fed an unbalanced ration of corn with either timothy hay, millet or sorghum. The corn when fed with either clover or cowpeas was more than twice as efficient as when combined with any of the other materials named.

*Missouri Experiment Station—Board of Agriculture Bulletins September and October.

Fattening Steers.—Corn is conceded by all authorities to be the best single grain ration for fattening animals—especially when its low cost is considered. At the same time the combination of corn with such food stuffs as will increase the proportion of protein in a ration, will result in a more rapid gain, as is clearly shown in the following experiments by the writer:*

COMPARISON OF BALANCED AND UNBALANCED RATIONS FOR FATTENING STEERS.

First trial—1899-1900—119 days—4 two-year old steers in each lot—full fed on shelled corn.

Kind of feed.	Corn eaten, bu..	Roughness eaten lbs...........	Total gain, lbs..	Av. daily gain per steer, lbs...	Pounds grain per lb. of gain......	Gain per bushel of corn, lbs.....
Corn and timothy hay....................................	166	3,813	802	1.69	11.51	4.87
Corn and cowpea hay....................................	188	3,662	1,257	2.64	8.31	6.74

Second trial—1900—01—105 days—4 two year old steers in each lot—full fed on shelled corn.

Kind of feed.	Corn eaten, bushels.....	Roughness eaten, lbs...	Total gain, lbs.........	Av. daily gain per steer, lbs...	Pounds grain per lbs of gain........	Gain per bu. of corn, lbs.
Corn and timothy hay.........	157.5	2,540	789	1.97	11.19	5.00
Corn and clover hay.........	176.2	4,768	1,135	2.84	8.69	6.44
Corn and cowpea hay.........	175.3	4,783	1,134	2.84	8.65	6.47

These results are worthy of the most careful consideration. Taken in connection with those reported for yearlings, they indicate that the combination of clover or cowpeas with corn exerts a profound influence upon the efficiency of the ration as compared with corn and timothy hay. It will be noted that with the unbalanced ration of corn and timothy, each bushel of corn produced in one trial 4.87 pounds of gain and 5 pounds in the other, or an average of 4.93 pounds for the two trials. When, however clover or cowpea hay was substituted for the timothy, each bushel of corn produced from 6.44 to 6.74 pounds of gain, or an average of 6.58 pounds—an increase of 1.65 pounds of beef from each bushel of corn fed. With steers selling at five cents per pound, this means that the feeder is getting 8¼ cents a bushel more for his corn by balancing his ration with some such cheap material as

* Missouri Experiment Station—Board of Agriculture Bulletins September and Octobe 1901.

clover or cowpeas. With corn at 25 cents or 30 cents a bushel, this is equivalent to an increase of 25 per cent. to 33 per cent. in the returns from his feeding operations. On the assumption that one-fifth of the corn produced in the State is fed to cattle of this class, the increased profits from balancing the corn would amount to about two and a half million dollars each year.

Not only is this true, but the steers will command a higher price on the market by reason of having gotten fatter, of finishing up smoother, and carrying more bloom. In the case of young cattle the advantage is not all expressed in increased gain in weight, since the animal, when wintered on a balanced ration is in condition to make better growth on grass or to go into the feed lot and make rapid and economical gains.

Hogs.—Plumb* reports the results of a feeding trial with pigs, in which corn meal was compared with equal parts corn meal and wheat middlings with the following result:

Kind of feed.	Av. daily gain, lbs.	Grain per 100 pounds of gain, lbs.
Corn meal	1.55	4.32
Corn meal and wheat middlings	1.68	4.06

Cottrell† reports the results of a number of experiments in which Soy Bean meal was used to balance the corn. A summary of these trials is presented:

COMPARISON OF BALANCED AND UNBALANCED RATIONS FOR HOGS—SIX TRIALS.

Kind of feed.	No. hogs in lot	Av. gain per day	Grain per 100 lbs. of gain.
First trial:			
Kafir corn meal, wet	5	1.85	471
Kafir corn meal four-fifths, Soy Bean meal one-fifth, wet	5	2.12	409
Second trial:			
Kafir corn meal, wet	3	1.21	559
Kafir corn meal four-fifths, Soy Bean meal one-fifth, wet	3	1.73	408
Third trial:			
Kafir corn meal, soaked 48 hours	5	.66	542
Kafir corn meal two-thirds, Soy Bean meal one-third, soaked 48 hrs	5	1.15	374
Corn meal, soaked 48 hours	5	.74	484
Corn meal two-thirds, Soy Bean meal one-third soaked 48 hours.	5	1.08	369
Fourth trial:			
Kafir corn meal, dry	10	.83	749
Kafir corn meal four-fifths, Soy Bean meal one-fifth, dry	10	1.55	468
Fifth trial, 50 days:			
Kafir corn meal, dry	10	.88	653
Kafir corn meal four-fifths, Soy Bean meal one-fifth, dry	10	1.73	435

*Indiana Experiment Station, Bulletin No. 71.

†Kansas Experiment Station, Bulletin No. 95.

From the above it is seen that in every case the Soy Bean meal had the effect of increasing the rate of gain per day and cheapening the cost of production. Averaging all the work at the Kansas Station, it was found that the six lots of hogs having Soy Bean meal as a part of the ration required 411 pounds of grain for 100 pounds of gain, while the nineteen lots not having Soy Beans and fed either Kafir corn or corn, required 564 pounds of grain for 100 pounds of gain.

CORN AS A FEED FOR HORSES.

So much has been said against the feeding of work horses on an exclusive grain ration of corn that much unreasonable prejudice has been aroused against its use for all classes of horses. This is especially true of horse owners of the eastern states and of Europe. While it is not contended that corn alone should be fed for any great length of time to horses at work or young growing animals, at the same time it is fundamentally true that all things considered it is the most efficient and best single grain for idle horses and for those performing all classes of work, and that it must form the basis of the ration for this class of stock as it does for all others, if due consideration is to be given to the economy of production. Perhaps the most elaborate experiments on record in point of number of horses involved and the length of time over which the observations have extended, are those recently reported by M. Lavalard* of France. His investigations were begun for the Paris Omnibus Company with the view of establishing a rational basis for the feeding of the large number of horses controlled by them under the different conditions of work, and have already extended over a period of 25 years, and later involved saddle horses and light draft horses travelling at a rapid gait; horses handling light loads, and heavy draft horses hauling heavy loads at a slow pace. Altogether the observations have covered some 16,000 horses belonging to the Omnibus Company, about 17,000 army horses, and 1,000 horses used for heavy freighting. In summing up his conclusions with the use of corn, the following should have the effect of dispelling whatever prejudice may exist against the use of this feed for all classes of horses.

"Our first experiments were made with Indian corn. They were undertaken with all kinds of horses and gave most satisfactory results. The *Campagnie generale des voitures* and the *Campagnie generale des omnibus* began about 1870 to feed Indian corn, and the results were so satisfactory that since that time the first named company has almost entirely ceased to feed oats. The latter company has continued to feed

*Experiment Station Record, Vol. XII, p. 14.

both oats and corn, effecting a saving of from 1,000,000 to 1,500.000 francs ($200,000 to $300,000) per year. In view of these facts, the opponents of corn have been forced to admit that it is suitable feed for draft horses. They have insisted, however, that since it does not contain the so-called stimulating principle "avenine" it should not be used for saddle horses and others where speed is required. Examples of the successful use of corn were cited in the author's earlier publications. The horses of the French expedition in Mexico were fed exclusively on corn. Our recent experiments on cavalry and artillery horses have shown that Indian corn may generally replace oats without in any way causing the horses to deteriorate. The horses fed a corn ration were used the same number of hours in the military drill and in the same maneuvers, and were ridden at the same gait as those fed exclusively on oats, and it was practically impossible to perceive the least difference between the two classes. The army officers, prejudiced as they naturally were, were forced to admit that all the horses showed the same energy and vigor. A careful record showed that the sickness and mortality were the same with horses on the two rations.

Corn and oats are quite similar in composition. In experiments made at the laboratory of the *Campagnie generale des omnibus* in co-operation with Muntz, the author found very high co-efficients of digestibility for corn, as shown by the following results: Protein, 86.1; fat, 93.9; sugar and starch, 100; crude fiber, 82.8, saccharifriable fiber, 86.9; undetermined substances, 85.2 per cent. These co-efficients show that the nutritive ingredients of corn are much more assimilable than has been generally believed in Europe. As regards physical character, oats contain on an average 70 to 75 per cent. of kernel and 25 to 30 per cent. of indigestible hull, which resembles straw in composition. The skin or hull of maize amounts to practically nothing. These facts show why horses thrive better and are more apt to maintain their weight on corn than on oats. Our recent experiments have demonstrated that corn can replace oats in the ration of both cavalry and artillery horses, and if substituted weight for weight it increases the nutritive value of the ration. This is the same deduction which was drawn from experiments, now more than 25 years old, made for the two great cab companies of Paris."

Shepperd* compared a ration consisting of equal parts corn and oats, with oats alone, for mules at hard work with the result that the animals on corn and oats made an average daily gain of seven-tenths

*North Dakota Experiment Station, Bulletin No. 45.

of a pound, while those on oats alone lost six-tenths of a pound. He estimates that 77.5 pounds of corn is worth 100 pounds of oats for horses at work.

CORN AS A FOOD FOR POULTRY.

For the fattening of all classes of fowls, corn is conceded to be unsurpassed, but the almost universal advice of poultrymen to eliminate this material entirely from the ration of laying fowls is perhaps based, first, upon the notion that the egg contains a large proportion of protein and, therefore only food stuffs rich in this group of substances can be used to advantage, and second, doubtless upon the unfavorable results obtained in practice from the exclusive use of corn for this purpose.

Some recent experiments by Brooks and Thompson† with several different breeds, in which complete laying records were kept for the two years covered by the experiment clearly indicate that this prejudice against corn, when properly combined with other food stuffs, is unfounded and that by adding a reasonable amount of corn to the ration a large increase in egg production at a decreased cost will result.

In one trial wheat, oats, bran middlings, animal meal, corn and corn meal were fed to one lot of 19 pullets, and to another lot of similar pullets the same ration was given except that the middlings and gluten feed in the morning mash were replaced by corn meal, and the substitution of shelled corn was made for about half of the wheat and oats in the evening feed. The experiments were conducted in both winter and summer. The results showed that the hens having the larger amount of corn instead of so much high-priced material, like wheat, middlings, oats, gluten feed, etc.:

1. Produced from one-fourth to one-third more eggs.
2. At materially less expense for food.
3. That the eggs from the corn fed fowls were of milder flavor and had a yolk of deeper yellow color.
4. That the fowls thus fed gained in weight despite the increased number of eggs produced.
5. That on slaughter at the close of the experiment, the fowls fed corn dressed more and were pronounced by an experienced market judge to be superior to those fed on the higher priced ration.

In another experiment where the corn displaced the wheat and oats entirely as a night feed, but the ration in other respects was the same as in the previous trial, the results were even more strikingly favorable to the use of corn.

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†Massachusetts Experiment Station, Reports 1899-1900.

A part of the First Prize car load of Hereford steers at the Pittsburg Fat Stock Show, November, 1901, sold for $9.50 per 100 pounds. Fed and exhibited by Turner McBaine, Columbia, Missouri.

It is not to be concluded from these results that an exclusive ration of corn would prove satisfactory for this purpose, but that in the case of laying fowls, as with all other stock, corn, judiciously used, is the most economical and profitable food stuff available. For the greatest profit in any feeding operation, it must form the basis of the ration.

THE MORE COMPLETE UTILIZATION OF THE CORN STOVER.*

The second most important way in which the value of the corn crop may be increased to the farmer is in the more complete utilization of the corn stover.

It is estimated that between 80 and 90 million tons of stover are produced on the 80,000,000 acres normally planted to corn in the United States each year. The magnitude of this annual crop of roughness will be more fully appreciated when we consider that the annual hay crop of the United States is between 60 and 70 million tons, and is estimated to have a money value on the farm of something like $500,000,000.

While the stover is carefully harvested and fed in the more densely populated states of the East, it is nevertheless true that in the great corn belt of the Middle West, where more than half of the corn of the nation is produced, there is a prodigious and profligate waste of this valuable material. In this section valuable land is used for the production of timothy hay upon every farm to be used for roughness, and acres of corn stover are allowed to go almost entirely to waste.

It is safe to estimate that something like seven million tons of corn stover are produced in Missouri in the average year. Certainly three and a half million tons or one-half of all that is produced is allowed to go to waste. A better idea of the meaning of this waste may be formed when it is realized that the average hay crop of the State is very little more than three million tons and is estimated to have a value on the farm of over twenty million dollars. It is safe to estimate that half of this hay crop is timothy—a material that supplies the same class of nutrients found in corn stover, as is clearly shown a little later.

*The corn plant after the ear is removed.

COMPARISON OF NUTRIENTS IN EAR AND STOVER.

According to the investigation of Armsby* and others, the digestible nutrients of the entire corn plant are distributed between the ear and the stover about as follows:

	In total crop, lbs.....	In the ears, lbs	In the stover, lbs..........
Protein..................	327	244	83
Carbohydrates..	3,774	2,301	1,473
Fat..	147	125	22
Total..	4,248	2,670	1,578
Per cent..	100	63	37

*Pennsylvania Experiment Station, Report 1887.

These results indicate that approximately 63 per cent, or practically two-thirds of the digestible material of the entire crop is lodged in the ear, and about 37 per cent, or a little more than one-third, is found in the stover.

The corn grower, perhaps, does not realize when he harvests and utilizes only the ears, that he wilfully wastes more than one-third of the crop that he has been at the pains of growing.

COMPOSITION OF CORN STOVER COMPARED WITH TIMOTHY HAY.*

	Whole stover, field-cured, per cent..........	Water free substance.				
		Wholestover, per cent.....	Leaves, per cent........	Stalks, per cent........	Husks, per cent........	Timothy hay for comparison, per cent
Water..	40.1	....	....	....	....	....
Ash..	3.4	5.7	7.9	3.6	3.5	5.1
Fiber..	19.1	33.0	30.6	34.8	32.2	33.5
Fat..	1.1	1.7	1.9	1.6	1.4	2.9
Protein.....	3.8	6 4	8.6	5.9	5.0	6.8
Nitrogen free extract..................................	31.9	53.2	51.0	54.1	57.9	51.7

* Lindsey, U. S. Year Book, 1896.

A bunch of Missouri Shorthorn steers averaging 1,750 pounds.

AMOUNT OF DIGESTIBLE NUTRIENTS IN A TON OF STOVER* AND A TON OF TIMOTHY, COMPARED.†

	Corn stover, lbs.	Timothy hay, lbs.
Fiber	353.7	296.1
Fat	13 5	33.1
Protein	53.1	55.4
Nitrogen free extract	544.6	553.6
Total	964.9	938.2

* Stover computed on basis of 20 per cent moisture.

It is safe to discount these figures for the coarse rank growing stover of Missouri, for experience teaches that this material is not so palatable and probably not so digestible as the smaller and finer stover produced in the north.

At the same time, the results of all experiments and of experience abundantly prove that even this coarse stover has a feeding value that would fully justify the labor, pains and expense of harvesting and feeding it. The waste of this food that occurs in many sections from merely topping the stalk, leaving the blades below the ear and the husks to waste, is not from any point of view justifiable or economical, much less the more common practice all through the corn belt, which includes Missouri, of allowing most of the corn to stand in the field until harvested, and of allowing all of the stover to waste except the little that the stock may eat in gleaning the stalk fields late in the season.

THE FEEDING VALUE OF CORN STOVER.

The results of experiments by the Missouri Station extending over six years, with yearling and two-year old steers, both with and without grain, will enable us to form a fair estimate of the feeding value of this material as compared with timothy hay, which is accepted as the commercial standard of all rough fodders. In all of these trials, large coarse stover from corn yielding 60 to 70 bushels of grain per acre was used. It was allowed to stand in the open field in what is commonly known as "sixteen hill square shocks," until required for feeding, and was fed whole. The timothy was harvested when the seed was in the dough state, and the hay was either preserved in the mow or in large ricks. Un-

†Lindsey, U. S. Year Book, 1896.

doubtedly the smaller stover of the north or the finer material grown especially for fodder, would show a higher palatability and feeding value, but it is this coarse stover which is mainly wasted, and the results of these experiments are therefore directly applicable to the ordinary conditions of the State.

COMPARISON OF FEEDING VALUE OF STOVER AND TIMOTHY.

Yearling steers—no grain—results computed on the basis of 1,000 pounds live weight—three years' work:

	Food eaten daily per steer, lbs.	Per cent refused.....	Dry matter eaten daily.....	Total gain or loss in weight, lbs........
First trial:				
Timothy hay	16.5	23	14.1	29
Whole corn stover	25.5	35	19.5	*2
Second trial:				
Timothy hay	22.3	18.6	18.7	21.7
Whole corn stover	22.9	44.7	17.5	*11.8
Third trial:				
Timothy hay	21.7	12	17.8	30.8
Whole corn stover	28.9	42	22.6	13.8
Average:				
Timothy hay	20.2	17.9	16.9	30.7
Whole corn stover	25.8	40.6	19.9	00.0

*Denotes loss in weight.

From these results it appears that when corn stover alone was fed, the animals neither gained nor lost in weight, averaging the three years' work, while those having all the timothy hay they would eat made a slight gain. More dry matter was uniformly consumed per day by the steers on stover, and a considerably larger proportion of the material fed was refused than in the case of the timothy. Taking all these facts into consideration, it is safe to estimate that ton for ton, stover has approximately half the feeding value of timothy hay when each is used as an exclusive ration. That it is not good business policy, however, to winter cattle in this way in the ordinary season, will be accepted without argument.

INCREASING THE VALUE OF STOVER.

That it is easy to so increase the value of stover by combining it with some such material as clover, cowpea hay or alfalfa, that it will even exceed timothy when the timothy is fed alone or in combination with corn, will be perfectly clear from the results of further trials at the Missouri Experiment Station.

COMBINATION OF STOVER AND CLOVER COMPARED WITH TIMOTHY.

Yearling steers—no grain*—results computed on a basis of 1,000 pounds live weight:

Kind of feed.	Food eaten daily per head.....	Per cent refused.....	Dry matter eaten daily, lbs..	Gain in weight per steer......
Timothy hay...........	21.7	12	17.8	30.8
Equal parts whole corn stover and clover hay	25.2	28	21.6	58.4

In this case a ton of stover and a ton of clover hay when fed together fully equalled two tons of timothy.

Other trials in which a small amount of shelled corn was added to the ration, fully confirm these results as follows:

1899—yearling steers—104 days—4 steers in each lot—4 pounds corn per head per day.

Kind of feed.	Corn eaten, lbs..	Roughness eaten lbs..........	Total gain, lbs..	Av. gain per day per head......	Grain per pound gain....... ...
Corn and timothy hay....................	1,568	6,536	260	.64	6.00
Corn, clover hay and corn stover.............................	1,568	*3,593 +3,631	356	.88	4.40

1900—yearling steers—80 days—4 steers in each lot—6 pounds corn per head per day.

Kind of feed.	Corn eaten, lbs..	Roughness eaten lbs............	Total gain, lbs..	Av. daily gain per head.......	Grain per pound gain..........
Corn and timothy hay.................................	1,926	4,543	318	1.00	6.06
Corn, clover and corn stover....	1,926	*3,619 +2,298	443	1.35	4.45

*Clover hay.

+Corn stover.

FATTENING STEERS.

COMPARISON OF TIMOTHY WITH EQUAL PARTS CORN STOVER AND CLOVER HAY FOR STEERS ON FULL FEED.

1899—two year old steers—119 days—4 steers in each lot—full feed of shelled corn:

Kind of feed.	Corn eaten, bu..	Roughness eaten lbs..........	Total gain, lbs..	Av. daily gain, lbs......	Grain per pound gain, lbs.......	Gain per bushel of corn........
Corn and timothy hay....................................	166	3,813	802	1.69	11.51	4.87
Corn, clover hay and corn stover......................	185	{ *1,626 †1,889 }	917	1.94	11.29	4.96

1900—two year old steers—105 days—4 steers in each lot—full feed of corn:

Kind of feed.	Corn eaten, bu..	Roughness eaten lbs.............	Total gain lbs...	Av. daily gain, lbs............	Grain per pound gain, lbs.......	Gain per bushel of corn........
Corn and timothy	157	2,540	789	1.97	11.19	5.00
Corn, clover and corn stover............................	176	{ *2,475 † 868 }	1,140	2.85	8.30	6.74

Thus it appears in every case, whether fed without grain, with a small allowance of grain, or on full feed; whether with yearlings or aged cattle; a combination of corn stover and clover hay proved superior to timothy hay. In other words, the farmer is able by this means to make the stover serve every purpose in cattle feeding at least, for which timothy is now used. Under these circumstances it is fair to say that timothy and stover have at least equal feeding values. It is quite probable that where such hays as clover, alfalfa and cowpeas are not available, a small quantity of cottonseed meal, linseed meal, gluten meal, or bran may serve the same purpose and accomplish the same result, viz.: of enabling the feeder to use his stover to the best possible advantage, and as a complete substitute for timothy. It is needless to say that the accomplishment of this

*Clover hay.
†Corn stover.

result would be attended by an immense increase in the net returns from the corn crop. The annual stover crop of the United States would then represent a valuation to the farmer of something like three quarters of a billion dollars. Missouri's stover crop would under these circumstances bring the feeder something over forty million dollars every year. No farmer would willfully permit the waste of his timothy crop after it had been grown and required only to be harvested to be available as a feed. There is in the light of the results of the foregoing experiments quite as little justification for the waste of his stover.

SILOING VS. FIELD CURING.

The practice of preserving the green corn plant in the silo has grown rapidly in favor, especially with the dairy farmer.

It commends itself on the ground that:

1. A large quantity of material may be stored in a comparatively small space.
2. Green and succulent food is thereby provided for the winter months.
3. The green plant is more palatable, the coarser parts of the stalk being much more completely consumed when made into silage.
4. The harvesting is done during the pleasant weather in the early fall, and the drudgery of handling dry stover in winter is obviated.
5. It is cheaper on the whole than to be at the expense of husking and grinding the ears and cutting and shredding the stover. It does not appear to affect the digestibility of the material favorably or unfavorably.

COMPARISON OF THE FEEDING VALUE OF SILAGE AND FIELD CURED CORN FODDER.

Experiments have been made at the Vermont and Wisconsin Stations, in which two rows of corn across the field were cut and placed in shocks, while the next two were run through the feed cutter and placed in the silo. By thus alternating until the silo was filled, equal quantities of material cut at the same time and from the same field were obtained. The field cured fodder was later run through the feed cutter and fed in comparison with silage, to dairy cows, with equal quantities of hay and grain.*

*Henry's Feeds and Feeding.

"The results at the Vermont Station were as follows:

14,262 pounds green fodder corn, when dried, fed with a uniform daily allowance of hay and grain, produced 7,688 pounds of milk.

14,262 pounds green fodder corn converted into silage, and fed with the same daily ration of hay and grain, produced 8,525 pounds of milk.

At the Wisconsin Station the results were:

From 29,800 pounds of green fodder were obtained 24,440 pounds of silage, which, fed with 1,648 pounds of hay and 2,884 pounds of grain, produced 7,496 pounds of milk, containing 340.4 pounds of fat.

From 29,800 pounds of green fodder were obtained 7,330 pounds of field cured fodder corn, which, fed with 1,567 pounds of hay and 2,743 pounds of grain, produced 7,119 pounds of milk, containing 318.2 pounds of fat.

At the Vermont Station the silage ration produced 837 pounds or 11 per cent more milk than was obtained from the dry fodder ration.

At the Wisconsin Station the silage ration yielded 377 pounds more milk and 22 pounds more fat—a difference in favor of silage of 5 per cent in milk and 6 per cent in fat."

LOSSES IN THE SILOING AND FIELD CURING PROCESSES.

Whether the changes which occur in the silo be due to the activity of certain ferments, as has been held for a long time, or whether the results of recent investigations, indicating that these changes are mainly due to respiratory processes which continue as long as the plant cells live, be accepted, the more important fact to the feeder remains unaltered, that these changes are accompanied by a material loss of organic matter, and that such loss is largely proportionate to the amount of oxygen or air admitted to the mass. That the more perfectly the mass be compacted, and the more nearly air-tight the silo, the less the loss. The necessary, or at least unavoidable loss under practical conditions, seems to be approximately 15 per cent of dry matter—that is the feeder takes out of the silo between one- seventh and one-sixth less dry matter than he puts in. It is moreover true that the loss falls most heavily on the sugars which are more or less completely converted into acids. To some extent, changes occur in the nitrogenous compounds, which affect adversely their feeding value.

Attention has been sharply drawn to these losses in preserving silage, with the result that many have been deterred from adopting this system. Careful inquiries in a number of states into the losses accompanying the field curing process, amply justify the conclusion that under the most favorable conditions they are quite as large as in the siloing system, and under ordinary circumstances are considerably larger. The loss in feeding the dry fodder—the uneaten portion of the stalk—must be added to the unavoidable loss in field curing. In the experiments already quoted with coarse stover, this loss amounted to approximately 40 per cent of the total weight of fresh substance fed, while in the same experiment less than 8 per cent of the silage was refused. While this portion of the plant is not perhaps as digestible, and certainly not as palatable as the portion eaten, yet experiments by Jordan and Paterson show that a considerable amount of digestible matter is contained in the lower half of the stalk, which is available to the animals if they can be induced by any practical means to consume it. In overcoming this loss, or in inducing the animals to eat practically all of the plant, lies perhaps the greatest single benefit to be derived from siloing.

Finally, the advantage of silage over field cured material to the dairyman, has been proven by an abundance of practical experience. Experiments at the Missouri Station clearly indicate that for wintering stock cattle of all classes, it possesses decided advantages over the field curing system. For cattle on full feed, the testimony is conflicting, and there is yet some doubt as to whether it is feasible under ordinary circumstances to feed steers that are carrying considerable flesh very much silage. For sheep, its value is already well recognized.

SILAGE VS. ROOTS.

Many feeders concede the necessity of some succulent food during the winter months, who, however, insist that some one of the root crops is more satisfactory than silage, basing their opinion upon the belief that a larger yield of dry, digestible matter may be produced with roots than with corn, and that the roots have a materially higher feeding value. It will not be contended that an acre of roots can be grown, harvested and fed as cheaply as an equal area of corn. On the contrary the results of careful experiments and the most reliable estimates from experienced and successful growers indicate that an acre of roots will cost under the most favorable circumstances fully three times as much as an acre of corn.

From an experiment extending over three years at the Pennsylvania Station by the writer*, it was found that the yield of digestible matter in mangels or suger beets was on the average about half that

* Pennsylvania State College, Annual Report 1898.

of corn. In other words, it required approximately two acres of beets to be equivalent in this respect to one acre of corn. Attention is invited to the following table showing the comparative yield of corn and roots at a number of the stations:

YIELD OF DRY MATTER PER ACRE OF ROOTS AND GREEN FODDER CORN—FOUR STATIONS.†

	Maine Station.		Pennsylvania Station.		Ohio Station.		Ontario.	
	Green substance, lbs..........	Dry matter, lbs...	Green substance, lbs..........	Dry matter, lbs...	Green substance, lbs..........	Dry matter, lbs...	Green substance, lbs..........	Dry matter, lbs...
Rutabagas...........................	31,695	3,415	....	....	....	....	42,780	4,877
Mangels..............................	15,375	1,613	16,177	2,382	31,500	3,000	55,320	5,034
Turnips..............................	28,500	2,559	....	....	....	....	46,120	4,382
Sugar beets..........................	17,645	2,590	11,436	2,010	....	....	32,663	4,737
Fodder corn..........................	39,645	5,580	18,591	5,522	....	6,000	41,172	8,135

In view of the fact, therefore, that beets are fully three fold more expensive to grow, and yield only about half as much digestible matter, it would be necessary for them to possess approximately six times the feeding value of corn silage, per pound of digestible matter, in order to establish even a parity between the two classes of feeds.

Careful experiments, however, in Pennsylvania, Ohio and Vermont, show beyond question that there is little or no difference between the feeding value of the dry matter of the two feeds, and the small difference was found to be uniformly in favor of the silage. From every point of view, therefore, the great disadvantage of root crops in competition with corn is perfectly apparent.

SOILING.

No plant now known to us equals corn in its adaptability to the soiling system. Varieties may be selected which will yield a continuous crop of succulent food, mature enough to have a high feeding value, from the middle of June until the severe frosts of autumn. The practice of relying upon corn almost exclusively from the time

†Henry's Feeds and Feeding.

the earliest variety can be brought to a reasonable state of maturity, until the close of the season, is well founded and fully justified by the results of scientific research. Corn has the advantage of yielding a larger quantity of digestible matter per acre at less cost than any other crop suited to soiling, and furthermore it may be harvested, handled and fed more conveniently than any of the other crops used, and has a higher feeding value.

The problem with those who follow this system is to find some plant to cover the period of early spring before corn can be brought to maturity. In the solution of this problem it has been found that corn silage kept over from the preceding season will answer this purpose more fully and more satisfactorily than any crop that can be grown at that season of the year. Thus the corn plant lends itself to the farmer who by reason of limited area and high-priced land is forced to produce the largest possible quantity per acre, quite as well as to the farmer on the broad fertile prairies of the west where the greatest possible number of acres must be managed by one man.

PREPARATION OF CORN FOR FEEDING.

STEAMING, COOKING, ETC.—Upon this point Prof. Jordan has summed up the results of the investigations and practical experience as follows:*

"Much labor and expense have been expended by farmers in giving to feeding stuffs special treatment, such as wetting, steaming, cooking and fermenting, in order to secure a supposed increase in nutritive value, an increase which must come chiefly, if at all, from a more complete digestion. It is plainly noticeable that these methods of feeding have lost in prevalence rather than gained. Practice does not seem to have permanently ratified them, and, so far as digestibility is concerned, this outcome is in accordance with the results of scientific demonstration. The conclusions of German experimenters have been that these special treatments have no favorable influence, their effect being either imperceptible or unfavorable.

German and American experiments unite in condemning the cooking of foods already palatable, because this causes a marked depression of the digestibility of the protein, with no compensating advantages. Digestion trials with cooked or steamed hays, silage, lupine seed, cornmeal and wheat bran, and roasted cotton seed, uniformly

*Jordan. The Feeding of Animals.

show their protein to be notably less digestible than that in the original materials, a fact which may explain the lessened productive value of cooked grains which has been observed in certain experiments. It must be conceded, of course, that when cooking feeding stuffs by steaming or otherwise renders them more palatable, and thereby makes possible the consumption of material otherwise wasted, the influence upon digestibility is a minor consideration."

A large number of careful experiments have been made in this country with corn on hogs with results unfavorable to cooking. Corn was either shelled or ground and in some cases a mixture of corn meal and middlings was used. In most cases the raw food was more efficient than the same food carefully cooked. Averaging all the trials, 476 pounds of uncooked meal or grain were required for 100 pounds gain while after it was cooked 505 pounds were required for the same gain.

GRINDING.—Experiments indicate that corn when ground into meal or the grain and cob crushed together will be somewhat more digestible than when fed whole. The difference, however, is so small that when corn is very cheap the increased efficiency may not meet the expense of grinding.

The following concise advice from Professor Henry is commended:*

"This subject is a difficult one to discuss owing to the great variety of conditions existing as to both grain and animals. Directions are here given which may serve to guide the feeder in his practice. For horses which are out of the stable during the day and worked hard, all grain, with the possible exception of oats should be ground. For those at extremely hard work, all grain should be ground and mixed with chaffed hay. For idle horses oats or corn should not be ground, nor need the hay or straw be chaffed. A cow yielding a large flow of milk should be regarded as a hard working animal and her feed prepared accordingly. Fattening steers and pigs may be crowded more rapidly with meal than with whole grain, though there is more danger attendant upon its use. Sheep worth feeding can always grind their own grain. In general, idle animals and those having ample time for mastication, rumination and digestion do not need their grain or roughage prepared as carefully as do those with only limited time for these essential operations. Experiments quite generally show increased gains from grinding grain, but in many cases they are not sufficient to pay the cost of grinding."

*Henry. Feeds and Feeding.

It is believed that it will pay to grind or crush corn for calves, colts and all young cattle in the average season, particularly if they are to be fed strong, and it will undoubtedly pay to prepare corn in this way for dairy cows in any season. It is not believed that the cob has any considerable nutritive value, but it seems to have a very favorable effect upon the mechanical condition of the grain in the stomach of the animal. For steers two years old and over, with hogs healthy and bringing a good price it is very doubtful if any preparation, except shelling toward the close of the feeding period in winter, or shelling and soaking for 12 hours in summer on grass, will be profitable in the average season. For hogs the value of the food may be increased by soaking a few hours provided care is taken to feed it sweet. A number of experiments on this point indicate that the soaked feed is about 7 per cent. more efficient than the same material fed dry. This appears to be about as much gain as will be derived from grinding. Soaking in warm weather is much cheaper than grinding. It should not under any circumstances be fed in a thin slop, but should be thick enough to cause the animals to chew the food rather than attempt to drink it.

SHREDDING OR CUTTING STOVER.

The recent perfecting of machinery for husking the corn and shredding and ricking the stover at one operation, and at a slight advance in cost over the ordinary expense of husking shock corn by hand has brought this method of preparing the stover into much prominence.

The experiments intended to compare the feeding value of shredded and whole fodder have yielded very conflicting results. Shelton* experimented three years with cut and uncut stover for cows, and found that instead of most of the cut fodder being eaten, an average of 31 per cent. was refused. In one experiment it was observed that the finer it was cut the larger the proportion refused by the cows. He summed up his experience as follows: "I am abundantly satisfied from accurate experiments made to test the point, and from a large general experience, that the chief, almost only, value of cutting fodder is found in the fact that such chopped fodder can be placed in the manger and generally handled much more conveniently than the unchopped."

Experiments with shredded and whole stover at the Missouri Experiment Station by the writer, extending over two years with

*Kansas Experiment Station. Report 1889.

yearling steers in which the stover was in each case the sole feed, showed the following:

Method of preparation.	Eaten per head per day, lbs ...	Refused, per cent.	Dry matter eaten.....	Gain or loss in weight.... ....
First trial:				
Whole stover.......	22.9	44.7	17.5	*11.8
Shredded stover.....	19.1	39.1	17.8	*15.6
Second trial:				
Whole stover......................	28.9	42.0	22.6	13.8
Shredded stover..	22.1	33.0	18.5	*7.7
Average:				
Whole stover.	25.8	40.6	19.9	00.0
Shredded stover....	20.6	36.0	18.1	*11.6

*Denotes loss in weight,

These results show that almost as much of the shredded stover was refused as of the whole stover, the percentage being 36 for the shredded and 40 for the unshredded ,or 720 pounds per ton of shredded and 800 pounds for the whole stover.

In no case did the steers do as well on the shredded as on the whole stover, and in every instance the whole stover was more palatable. This appears to be accounted for by the fact that when the material is offered in its natural condition the animals have an opportunity to select the portions they prefer and discard the coarser and unpalatable parts, whereas in the case of the shredded stover the blades, husks, etc., are so intermingled that no opportunity is offered for selection. On the contrary, Henry* reports three trials with cows in which the results were quite favorable to shredding in point of yield of milk and the completeness with which the stover was eaten. The cows were fed grain and hay in addition to the stover. It is possible that the smaller stover of the north would be much more completely eaten in any case than will the coarse stalks of the south. The reports by conservative farmers who have tried the shredding are likewise conflicting, many claiming that practically all of the shredded material is consumed while others find no benefit in this direction.

It must be conceded that when the corn can be husked and the stover shredded at practically the usual cost of husking the corn, the practice must commend itself to every farmer on account of the greater convenience with which the material may be fed, and the preservation of the material in the mow or rick. But to be at the expense of shred-

*Wisconsin Experiment Station. Report 1886.

ding the stover after the corn is husked, would in all probability be unprofitable.

Shredding fodder undoubtedly relieves the farmer of some very disagreeable work in handling the coarse stalks in bad weather, overcomes the necessity of digging the material out of the snow in winter and makes it possible to feed the material in the barn and use the portion refused by the stock for bedding. The manure may be handled much more conveniently, and in short the greatest drudgery of winter feeding is removed.

On the other hand, the farmer with the regular force he would probably keep in any case can handle the fodder crop without additional cost or outlay if it be fed whole, whereas if it be shredded or siloed the work is concentrated into a few days and much extra labor must be hired for the purpose. This is the chief argument against shredding, especially since the results of the experiments already quoted fail to show an increased feeding value due to the process.

Finally it seems safe to say that corn fodder is too cheap in the ordinary year and likely to be too cheap in the great corn belt for many years to come to warrant the expenditure of much money in increasing its feeding value. The investment of this extra money in saving more fodder will likely pay better than putting it on the amount that is now ordinarily cut.

SOME LESSONS FROM EUROPEAN AGRICULTURE.

By F. B. Mumford, Professor of Agriculture University of Missouri.

In comparing the systems and practices of agriculture of America with those of Europe one must continually bear in mind some fundamental differences. In Europe the farmer is confronted by certain conditions which determine his methods of farming. First, the high price of products, second, nearness to market, third, cheap labor, fourth, the small holdings, and fifth high priced lands. We find in these conditions the explanation of many practices which to the average American farmer seem impracticable and possibly primitive. Thus it happens that we find in all European countries hand labor is universally employed, and moreover for the production of all farm crops far more labor is expended than is the case in the United States. It is perfectly safe to say that the amount of hand labor expended in the production of a bushel of wheat is at least twice and probably three times that required for the production of the same quantity in this country. It is, therefore, easy to understand how it is possible for the cultivators of the soil to employ cheap labor for the production of high priced products and secure profit therefrom. In America on the other hand, far removed from the great markets of the world and confronted with the conditions of scarcity of labor, and dear labor at that, we find practices and methods in vogue which seem to the European farmer wasteful and extravagant.

One of the first facts of importance observed by the American farmer is the general absence of improved machinery. A very large per cent. of the hay in Europe is still cut with the scythe and most of this is raked by hand. The sickle is still a common instrument for harvesting grain crops. On the smaller holdings many acres are still spaded by hand, and the hoe is a more widely used implement than the plow. The barn buildings and the whole equipment of the farm leaves one with the impression that human labor is counted cheap There are few conveniences. The American farmer has been compelled to employ improved machinery. One man on a western farm, supplied with the improved machinery in common use does the work of at least five men on the small farms in Europe. If we keep constantly in mind these widely different conditions it will be easier for us to discuss intelligently the practices which we find prevailing in the various countries of Europe.

HOLLAND.

Probably no country with equal area in the world supports so many domestic animals per acre as Holland. In riding over the dairy districts in Holland one is impressed with the fact that almost the entire country is laid down to grass. The author saw very little grain of any sort. The farms are low, flat and in some cases marshy; but generally the canals and ditches drain away all surplus water. The farms, in many cases, are below the level of the sea, the sea being held back by huge dikes. The land is drained by canals at regular intervals and the water from these canals is pumped out by quaint wind mills. Hundreds and thousands of wind mills meet the eye on every hand. The land itself is very low sandy land and naturally almost barren. The Dutch farmer has by constant attention to dairy farming and the purchase of foods rich in nitrogen, succeeded in building up this thin land to a point where its productiveness is not excelled by the same area any where in the world. The water so near the surface makes this ideal grassland and so we find magnificent pastures. One is struck at the absence of fences, but here as elsewhere cheap labor solves the problem. The older women and children tend the flocks and herds while the able bodied men and women are employed in heavy field labor.

In many cases the canals are the line fences. Groups of willow trees about the farmstead and the ever present wind mill tend to relieve the otherwise dull monotony of a flat and featureless landscape. Many of the canals are lined on either side by rows of willow trees. As a rule, the farmers live in small villages adjoining their farms. These villages are made up of red tiled roofs, of quaint wind mills and shady streets, and all of these combined presents to the eye the choicest bit of rural scenery to be found in Europe.

The wagons used on the farms in Holland are very heavy and rudely built affairs, often without poles. One can see how these might be used for an absolutely flat meadow or other farm field, but they certainly could not be used on the fine macadam roads one every where sees in this country. Still it is hard to understand why farmers persist in using an implement which must be inconvenient to guide and impossible to back. I have seen on the streets in Holland some very elaborate farm wagons, decorated with carved wood and very neatly painted. These seemed to be reserved for holiday occasions.

A novel sight to most Americans is the large number of women employed in the fields and generally bearing heavy burdens. Some of the kinds of work which the author has seen performed by women are: raking hay, pitching wheat, digging potatoes, hoeing, pulling sugar beets and mangels and doing all the work connected with threshing grain. Many times I have noticed threshing machines at work and all the workers, except, perhaps, the feeder, were women.

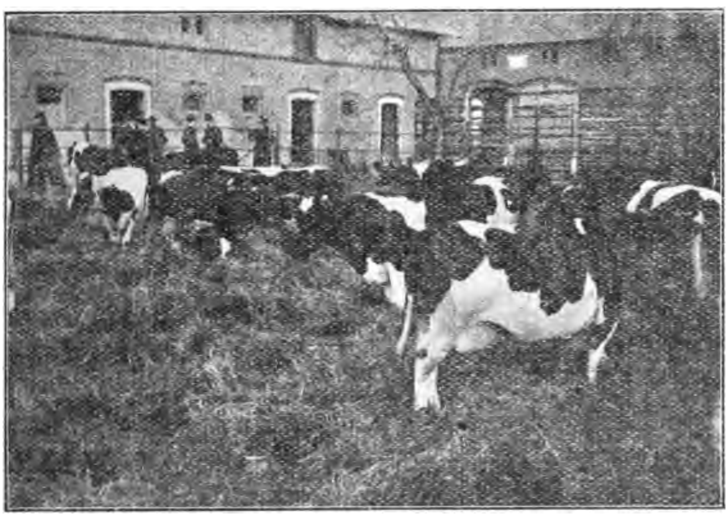
The hand implements in general use are large, rudely constructed and very awkward. The scythes all have straight snathes and require much bending of the back to manipulate in an efficient manner. The hoes especially are very heavy and are well calculated to produce Millet's purely imaginative conception, "The Man With the Hoe."

American agriculture is indebted to Holland for that magnificent breed of cattle, the Holstein Friesian. These cattle have been developed upon the rich productive lowlands above described, and there is evidence on every hand to show that they have yielded to their owners' comfort, prosperity and happiness.

GERMANY.

The farmers of Germany are unquestionably among the most successful cultivators of the soil in the world. Whether we consider their intelligent efforts directed toward the selection of varieties adapted to varying soils and peculiar climatic conditions of a particular locality, or whether we measure his skill by the scientific accuracy with which he saves and judiciously applies barnyard manure, we must accord him a place well toward the front in the ranks of the progressive modern farmer. In making this statement it is to be understood that it applies only to the production of farm and garden crops and not to the breeding and feeding of live stock. The farming lands of Germany in many localities have been cultivated for centuries and for much of that time undoubtedly they have been imperfectly cultivated and their resources exhausted. But in more recent times the German farmer has learned what we in America have not yet learned with any degree of definiteness, namely, that there are soils and districts especially adapted for the production of special crops and that these crops and soils require special and peculiar treatment in order that their fertility may be conserved and maximum crops be secured. Thus we find on the sandy lands of the north potatoes and sugar beets to be largely grown; in the soils farther south, in Saxony, we find more diversified agriculture, wheat, rye, clover and also potatoes are the chief crops. But here, as in Holland, we find on many of the smaller holdings that much of the labor is still performed by hand, and even on the larger estates they have not yet come to a point where they fully appreciate the value of the many labor saving contrivances well known and used by the American farmer. For example on examination of some of the larger and most noted estates in Saxony the author did not find a single hay rigging for unloading hay into the barn.

In Saxony, as in most other portions of the German Empire, we find that the picturesque villages with their plastered houses and tiled covered roofs mark the earthly abiding place of the German peasant. The isolation of American country life is here unknown, either in Northern or in Southern Germany. In the Province of Bavaria the farmers do not live in houses upon the land which they cultivate, but always in villages. In every village the most conspicuous building is the "Gasthof" or country inn, and here the country people gather nightly to discuss the events of the day. Generally these public houses are the scene of the feast day frolics so common in rural Germany, and the measured tread of the country lads and lassies, the



A Holstein Friesian dairy herd in Saxony.

sweet music and the gay shouts and laughter, all combine to drive dull care away. The front doors of the farm house, of the barn, and of all other farm buildings open into the general court yard which corresponds closely in character, use and odor to the average American barnyard. Here the ambitious German goose marches in stately grandeur or peers with ludicrous curiosity at the unwelcome intruder. The manure pile is generally in the middle of this barnyard and enclocsed with a pole fence and in this enclosure cows and young cattle are turned daily for what little exercise they get. Pasturing is little practiced in Germany. The soiling system is every where the custom. The grain crops are cut and carried to the cattle and often also to the sheep throughout the year.

But the farmer of Saxony, however successful he may be as a cultivator of the soil, is not an unalloyed success as a feeder and breeder of live stock. A careful study of the fat cattle slaughtered at some of the greater slaughter houses revealed the fact that most of the prime beef consumed in this region comes from oxen that have served an apprenticeship at the plow, and half fat cattle of the beef, milk and work type. I saw no where fat cattle that could hope to

"On many of the smaller estates the only draft animals employed are milking cows."

win a prize at a county fair in this country in the fat stock class. With two notable exceptions, the character of the farm live stock of this region is decidedly common. The exceptions are swine and the mutton wool type of the Merino sheep. The swine, particularly those bred by the larger farmers, are of unquestionable merit. They combine the early maturing and rapid fattening qualities of some of our best American breeds with the characters which are most desirable in the bacon hog, as nearly as such a combination is possible, and to a greater extent than any breed known to the writer. The large Yorkshire variety has been quite extensively imported from England

and is very popular. The American Poland China has been tried to a limited extent, but has not found much favor. The mutton wool type of Merino is the most popular sheep and after a personal examination of several breeding flocks numbering from one hundred to four hundred I am convinced that the sheep breeders have succeeded in developing a most useful type of sheep for the general farmer.

The dual purpose cow in Germany becomes a triple purpose animal, so constituted as to produce milk, beef or labor as demanded by the special requirements of the individual owner. On many of the smaller estates the only draft animals employed are milking cows. In one place the writer saw a cow, evidently in full milk, drawing

"Work is aecomplishsd on the larger estates almost entirely by oxen."

feed for her own nutrition and later saw her drawing her own milk to market. The cow becomes a very useful animal to the smaller peasant, when she not only furnishes food to the family, but is compelled to help produce the food she herself eats and then transport her own product to market.

Work is accomplished on the larger estates almost entirely by oxen, and these, on the best estates, are almost invariably of the hardy and powerful Simmenthaler breed. The yokes are applied as shown in the illustration to the foreheads of the animals and generally consist of a band of iron three or four inches wide, under which and between it and the forehead is placed a padded cushion. These yokes appear to be entirely comfortable and seem capable of permitting the animal to exert his full power. They are usually driven in pairs, but as shown in this illustration they may sometimes be driven three abreast.

On the larger estates in Germany the managers have solved the problem of utilizing waste products more successfully than is the case in this country. A large, modern farm in Germany is an enterprise, including many divisions and departments. During the month of November, 1900, the writer visited a farm of some distinction in Saxony under the control of Mr. Schirmer of Neuhaus. This estate is not far from Delitzsch. A description of some of the departments found here and some of the activities will be interesting as indicating what one may find on many others. Among the agricultural operations on this farm we found horse breeding, cattle breeding, sheep breeding, swine breeding and feeding, and the growing of potatoes for the manufacture of starch and alcohol, the growing of sugar beets and a fish breeding establishment. The horses were English shires, and were a very inferior lot. The sheep were splendid specimens of the Rambouillet breed. The potatoes were grown upon the estate, harvested and placed in a large under ground cellar, and later manufactured into starch and alcohol. The fish were produced in a large artificial lake and were regularly caught out with a net, the larger ones sold and the smaller ones returned to the water. We saw here several silos. The silos, however, were mere holes in the ground cemented up and were used for storing the leaves of rape and sugar beet leaves. These materials were packed into the silo and piled up four or five feet above the top and then covered with straw, and over all a two-foot layer of earth. We saw upon this estate two American self binders. We were shown with a great deal of pride on the part of the owner a new hay barn, but there was no attempt made to introduce any labor saving contrivances whatsoever. A great part of the hay must necessarily be pitched over a very high beam. On many of the larger farms small breweries are maintained for the malting of the grain produced upon the farm.

The roads throughout the country in Europe are thoroughly well built, generally of broken stones and are carefully maintained. One sees at intervals on all country roads piles of stones, and will invariably find nearby a workman, who is continually employed in maintaining the public highway. These roads are laid out with skill and in accordance with the best knowledge of road building. In Saxony the sides of the road are planted to fruit trees. These are generally plum trees, and when the writer visited this region, in September, the trees were loaded with luscious plums. In many cases school houses attended by two or three hundred pupils, were near these roads, but in no case did I ever see school children attempting to knock off the fruit. The fruit of these trees is the property of the adjoining land owners, and the fact that fruit is grown unmolested along the public highway indicates the respect of the average German boy for the property of others. This is in marked contrast to the American custom of considering all fruit public property, even though it may be on the other side of the fence.

Another thing that impresses the ordinary traveler is the great care exercised by the German citizen in the protection of game of all sorts. It is a crime to shoot hares out of season or in fact at any time without a license, and the killing of deer is a very serious offense indeed. As a result of this one sees frequently numbers of hares feeding upon the wheat or cabbage fields. In the forests deer are plentiful. I saw one day within one mile of the large city of Leipsic, twelve deer, and another day a deer actually found his way to the public park within the city, and was seen by many people. In the winter these deer are fed and sometimes attempts are made to provide shelter for them. It is said, however, that they will not voluntarily enter any shelter provided for them. The hares are also carefully protected and passing through the country in the winter, one may often see structures especially for the protection and shelter of these animals. As a result of this protection, the hares are in some localities a great menace to young trees. The most common method of protection seems to be a rope of twisted hay carefully wound about the tree.

The condition of the average German workman is not an enviable one; his hours are long, his work is hard and his rewards are small. Women perform a very large part of the heaviest and most menial work. The absence of labor saving machinery makes their work doubly hard, and it is not to be wondered at that we find at least two very distinct classes of people in the German Empire. A careful study of the conditions existing has lead the writer to believe that the average German workingman and his family have little ambition or desire to rise to higher things. In Germany once a farm laborer, always a farm laborer, is the rule. A popular professor in the University of Leipsic lecturing to students, said: "The university and educational institutions in Germany are for the rich, the poor do not and cannot attend them. There is no hope for the poor classes of Germany under present conditions to rise to better and higher things." Much has been said about the advancement of Germany in the sciences, in the arts and the professions, but it must always be remembered that only the few can hope to be numbered among this progressive class, and that the majority of the inhabitants of the German Empire are and must always be, if the present conditions prevail, merely hopeless laborers.

The term peasant, as applied to the German farmer, has very different significance in the different provinces. For example, in earlier times the word peasant referred to well to do land owners. At the present time it is applied to renters in Austria under certain circumstances, in Westphalia and the Black Forest, it is a name of honor, and is applied to farmers with large holdings, and who own at least six horses. Farm laborers are not properly called peasants, but are always spoken of in Germany as "Landarbeitern."

In passing through the country, one is everywhere struck with the large number of signs forbidding the passer-by to trespass, to traverse private roads, to pick the fruit along the way, to walk on the grass and hundreds of other prohibitions greet the eye at every turn. These prohibitions are not merely signs that are not to be obeyed, but one finds, sometimes to his sorrow, that the least infraction of these suggestions will be met, sometimes immediately by the skill and vigilance of the police officers. It may for example sometimes happen that as the weary traveler wends his way over the dusty roads, he sees in the cool shade of a spreading tree an inviting seat and he hastens his steps to refresh himself for a brief time in the shade, only to find upon reaching the seat, that it is reserved for children, and if he should disregard this reservation, he will nine times out of ten be somewhat roughly informed by the policeman in the vicinity that the seat is reserved for children.

Most of the animals in Germany are slaughtered at the municipal slaughter houses. These slaughter houses are very carefully conducted, and the meat of all animals is subjected to very rigid examination on the part of experts. Everything is wonderfully clean. The live stock is shipped to these slaughter houses from various sections of the country, and here the dealers go, generally on Mondays, to select the animals that they wish to kill. When they have selected the animals suitable for their trade, they are killed at a fixed rate, inspected and labeled. There is a peculiar scheme of live stock insurance in connection with these slaughter houses, which insures the owner against the possible detection of disease in the carcass of the slaughtered animal. For example, an animal sent to the stock yards, if found diseased, is confiscated by the State, but if insured and the premium paid, full value is returned to the owner. In the slaughter house at Leipsic the meat of tuberculous or otherwise diseased animals is boiled for a given time in huge vats and is then pronounced safe for food consumption, and is sold at a somewhat reduced price. In passing through the cooling rooms of the Leipsic slaughter house I was struck by a very large carcass that presented a peculiar yellowish color, which to the unexpert eye appeared to be badly diseased, and upon inquiry we were informed, as a closer examination proved evident, that the carcass was the carcass of a horse, and that horses are killed and sold regularly in all of the large cities of Germany. There is one market devoted exclusively to the sale of horse meat in the city of Leipsic. Goat carcasses were also seen and it may not be improbable that certain of the cheap hotels serve mutton chops from the carcasses of the goats that are being continually slaughtered. In no case were the animals in these slaughter houses fat, but would be classified in our markets as half fat animals.

The writer had been frequently informed that it was common for cattle and folks to live together in South Germany. A somewhat extended experience among the agricultural districts and frequent visit to the smaller towns of South Germany revealed the fact that there might be some truth in this statement. The author found in one place at least a building in which the animals and the family were separated only by a thin partition, and a history of German agriculture records the fact that some hundred years ago the peasants of South Germany lived, dined and slept in one end of the common house and the cows and pigs occupied the other end of the same room. It is common among the poorer as well as the more thrifty farmers in this region for the families to live in the same building with the live stock. As a rule the barn portion of the house is separated from the living rooms by a hall way. In this hall way is stored much of the feed fed to the animals and leading out of the hall way is a stair way, which leads to the second floor. When it is remembered that the cows are stabled throughout the entire year, it will be seen that this sort of arrangement is not altogether desirable. However, it has the advantage of convenience.

In South Germany one sees hundreds of cow teams, and cows are everywhere used for draft purposes, for plowing, harrowing and for drawing wood and stone upon the public streets of the smaller towns. It is interesting in this connection to note that the cows used for draft purposes do not at all resemble the highly specialized dairy cows of our modern breeds. In many of the German descriptions of these working breeds of cattle we find frequent reference to their adaptability for the production of milk, labor and beef. Many good authorities in America believe that it is not possible that the same individual can successfully combine beef and dairy qualities. But here we find numerous examples, not only of dual purpose cattle, but triple purpose ones. These cows are hardy, rugged looking animals, with powerful muscles and deep, broad chests, they are low down, but can scarcely be called blocky. The joints seem to be somewhat coarse. Whatever else may be said of them they are certainly successful work animals. The question naturally arises, how it is possible for an animal to perform any great amount of labor and at the same time be expected to yield any considerable amount of milk and butter. Experiments of this kind have been conducted and the results seem to indicate that a moderate amount of labor is not incompatible with the maximum production of the animal, but whenever excessive amounts of labor are required of the animal, the milk and butter yield is invariably diminished. The quality of the beef produced from these triple purpose animals is decidedly inferior and in no case has the writer been able to find a prime bullock descended from these breeds.

On all of the smaller farms in Europe, Holland, Belgium, Germany and Switzerland, one finds numerous household industries as a regular part of the work of the peasant family. In South Germany, in the region of upper Bavaria, basket making occupies a large per cent of the population. This work is carried on by the younger members of the family and the women, when the men are engaged in farming operations, but in the winter the men are also engaged in basket making.

The question of fuel is a serious one. The middle class purchase some wood, but mostly pressed bricks made from dust coal. These are called brickets. These brickets are, all things considered, the cheapest commercial fuel used throughout the larger portion of the German Empire. The poorer people resort to many curious expedients to secure fuel for their simple needs. It is customary to allow the poorer people to pick up sticks or fagots in all the public forests, and they are also permitted to trim the trunks of trees to a certain height and use the sprouts thus secured for fuel. These are bound in bundles and carried upon their backs to their homes.

Fall plowing seems to be quite common in Southern Germany. The plow used seems to be a very short stubby plow with a very abrupt mould board. In many places the ground was plowed in ridges, that is, what is here called simply cutting and covering, the furrow turned upon an unplowed ridge so that the land is left in ridges.

AGRICULTURAL EDUCATIONAL INSTITUTIONS.

The system of agricultural education in Germany is well planned and executed. Not only are there institutions for higher learning in which advanced students may work for the higher degrees, but many schools of secondary grade make it possible for even the poorer peasants to secure technical education in agriculture. The scheme of agricultural education is not widely different from that in vogue in the United States. They have, as do we, university courses in agriculture, and their secondary schools correspond in many cases very closely with our so called short courses in agriculture. They have carried specialization to a still greater point than have the educators in this country, and we find therefore schools for instruction in dairying, forestry, brewing, fruit growing, vegetable growing, production of farm crops and of animals. Their short courses are far more numerous than in this country so that technical education in agriculture is more accessible to the German farmer, than is yet the case in our own country. These schools are all supported by the government.

In addition to the regular established schools for agricultural instruction, we find in certain portions of the German Empire, and in Austria what are known as traveling teachers, who go from locality to locality teaching agriculture wherever they may find classes to teach. This system is especially employed in Austria. The agricultural schools in Germany are not overrun with students. There are, however, several conditions which tend to make some of the higher institutions fairly well attended. On many of the larger estates owned by the nobility, the lands are in some special sense under the general control of the central government, and individual owners are required by law to employ specially trained managers that have passed a government examination. These managers or inspectors secure their training exclusively in the agricultural universities. As there is considerable demand for these specially trained men ,there is always likely to be a certain number of students in the German universities. The agricultural training in the German University is largely theoretical and based principally upon the science of chemistry. We find little effort in most institutions to harmonize the results of science with those of actual practice.

SWITZERLAND.

The life of the Swiss farmer is closely bound up in and dependent upon the industry of dairying, first, last and all the time. The entire work of the average Swiss farmer is the production of food for the cow and the manufacture of her product. As a natural result of the great importance of the cow to the Swiss agriculturist, we find that the Swiss are very skillful breeders. No country on the continent can lay claim to greater skill than the Swiss breeders in the development and improvement of the cow. In no other country in the world does there exist cattle that so closely accomplish the dual purpose—beef and milk type—as do the three leading breeds of Switzerland. The most noted, and perhaps highest developed breed is the so called Brown Swiss. These cattle are, and have been, chiefly developed north of the Lake of Lucerne, and are here found in their greatest perfection. As a breed, they are very uniform in color, type and productive capacity. They are hardy, vigorous and powerful animals, well suited to the mountainous country in which they live. The pure air and exercise which they secure in grazing upon the high altitudes has developed in them these peculiarly valuable qualities. The principal feed of the cows in full milk is grass, cut and carried to them. They receive no grain feed, whatever, with this. In win-

A Swiss farmstead on a rock road.

ter they receive hay, with very little grain. The owner of a large and successful dairy herd told the writer that his cows averaged six thousand pounds of milk a year, and that their daily grain ration in winter was four pounds of grain. It must be remembered, however, that the hay fed these animals is a mixture of many nutritious plants. No where have I seen such bright, fragrant and well cured hay. The results secured from feeding hay in Switzerland could never result from the feeding of timothy or similar hay, such as is grown in this country.

The manual labor necessary on the average Swiss farm is exceedingly arduous. The steep mountain sides are too steep for the use of improved machinery and often too steep for the use of the horse or beast of burden of any kind. The hay is cut by hand, it is raked by hand and frequently the members of the farmer's family carry it upon their backs to the barns. All manure is very carefully saved and applied to the grass land, but this too must be carried in large baskets upon the backs of the workmen. In some places one finds the mountain sides terraced, walls being built and filled in with earth and then above it on the mountain side another wall and so on toward the top of the mountain. The milk is sold in the towns or made into butter or carried to the cheese factory, where it is made into the famous Swiss cheeses, chief of these is the Emmenthaler. The Emmenthaler cheese, wherever one finds it, is of very uniform quality. One would suppose that a product of such general uniformity would be made under the same conditions, presumably by some large establishment. The reverse seems to be the case, because all the Emmenthaler cheese made in Switzerland is made in very small quantities, where but a small amount of milk is received daily. The author visited five or six cheese factories in one-half day, walking all the way. The smaller farmers, here, as in Germany, use the cows for draft purposes. The yokes are applied to the neck, rather than to the foreheads. The houses are very substantially built. Many of them of squared logs, but well lighted, large and convenient. The barns are also very commodious and comfortable.

Each district seems to have its own peculiar dress. In many of the country districts the costume of the peasants, both men and women, is exceedingly picturesque. These costumes are the same that have been worn for a great many years, and they have come to be permanent uniforms, which indicate the district from which the peasants have come. In many of the districts bordering the larger lakes grape growing for the manufacture of wines is common. In Southern Switzerland, in the side valleys, opening into the larger Rhone valley, very elaborate systems of irrigation have been supplied. These irrigating systems frequently bring water from high up in the mountains, at the head of some great glacier, carry it through tunnels, over deep chasms and eventually distribute it over the lands farther down the valley. These irrigating systems have in almost every case been constructed and planned by the owners themselves, and are maintained and repaired from time to time by the same parties, and without the aid of skilled engineers. In these mountain towns one sees all stables and granaries built upon posts with a broad flat stone between the post and the granary. This is similar to our practice of placing large tin pans under the supports of granaries for the purpose of keeping out mice and rats. The mice are very numerous and very destructive in the higher altitudes, so much so that no farmer thinks of building unless using this protection against them. In Southern Switzerland also one finds a large number of mules used as draft animals. These hardy sure footed animals are peculiarly adapted for burden bearing upon the steep mountain sides. They carry, of course, all burdens upon their backs. Hay is balanced in great baskets on either side, and carefully carried down the mountain. The grain is harvested in the same way and the manure is carried out upon the fields. Many of the localities are communistic to a certain extent, certain work is performed in common for the benefit of the community. For example, as the sun melts the snow upon the higher altitudes and the grass starts, all of the cows belonging to the community are brought together in one large herd and these are driven to the pastures high up on the mountain. To watch these cows, to milk them and manufacture the butter or cheese a certain number of families are delegated. A curious sport has arisen in connection with this time of turning the cows out to pasture. It is always a holiday. All the inhabitants gather around the great herd of cows that have been collected. The cows naturally enjoying freedom for the first time in many months, engage in battles and soon a fierce contest is on for the leadership of the herd. It is now that the inhabitants begin to gamble upon the final results, and many small amounts change hands before the final victor of the herd is determined. She is called the "queen of the herd" and her owner is for many days thereafter a notable man in the community.

Another very interesting custom among these people is the migratory character of their agricultural operations. In the early days of spring their labors are confined to their vineyards along the Rhone; as spring advances and the grass begins to sprout at the foot of the mountain, they move to their second location. As the snow gradually melts they push up the mountain side sowing their oats, rye and vegetables and finally as the early fall comes with its frequent snow storms and icy cold they are driven down again to the valley. It thus happens that the wealthier farmers have four or five different residences which they occupy sometime during the year. Their journeyings from one place to another are often accomplished in the night in order that they may not lose time for labor during the day. These people are very hardy, independent and religious. At one time a few years ago, in the district known as the Eifischthal, the country was almost completely destroyed by a fearful avalanche. The cattle and all the crops of the industrious people were destroyed and many of the houses were completely wrecked. People of other parts of the Swiss nation immediately came to their rescue, subscribing money for the relief of these people, but these independent, liberty loving mountaineers refused to accept any alms and courageously went to work to repair the damaged condition.

The writer saw more American agricultural tools and machinery in Switzerland than in any other country visited, particularly hand tools, but also mowers, hay rakes, etc.

GREAT BRITAIN.

If one can judge from outward appearances the English farmers are the most prosperous, progressive and intelligent farmers in the world. The natural beauty of the rural districts in England is unsurpassed; the picturesque rivers winding through fertile valleys and plains; the magnificient specimens of improved breeds of live stock and the comfortable country homes all conspire to make the rural scenery of England and Scotland the most delightful to be seen anywhere in the old world. The first thing that impressed the writer, was the great area of farming land laid down to grass. There is a growing tendency among all the farmers of Great Britain to supercede grain growing by grazing. Lands that were chiefly cultivated in rotations, formerly producing barley, wheat, clover, turnips, etc., are now laid down to grass and the luxuriant pastures have not a little to do with the excellence of their live stock. The pastures are fenced either with stone walls, or more commonly with hedges. These hedges also extend on either side of the roads so that it is almost impossible to secure a good view of the adjacent farming lands while walking or driving along the highway. One of the principal grain crops is wheat, and on many farms the rotation centers around this crop. The soils of England are naturally adapted for the growing of wheat. Large quantities of commercial fertilizers are used throughout the United Kingdom and these in connection with judicious rotation and the growing of clover and turnips, maintains the land in good condition. In most sections, however, and on most of the better farms, the crops produced are all hinged upon the production of live stock and those crops only grown which contribute directly to the profitable production of the domestic animals.

LIVE STOCK OF GREAT BRITAIN.

Great Britain is more famous, agriculturally speaking, for the improved breeds of live stock which have been developed within its borders than for any other phase of its agriculture. In the better districts one is continually impressed with the fact that the average standard of excellence among breeders is far higher than the average standard in this country. If we devote our attention to horses, for example,, we find that among draft horses the magnificent English Shire and Clydsdale are common in all of the localities and much attention is paid to their improvement and development. One of the most aristocratic bodies of live stock breeders in the world is the English Shire Horse Breeders' Association of Great Britain. This association continually encourages the breeding of these animals by securing prizes at agricultural shows and by encouraging their exportation to other countries. Other breeds of horses that find many admirers and that have been greatly improved, are the Hackney, the Hunter and the Cleveland Bay. Unlike the practice in this country in many localities, the farmers and breeders thoroughly recognize the importance of line breeding or pure breeding, and one therefore sees distinct

Booth Shorthorns at home. Mr. Richard Booth in the foreground.

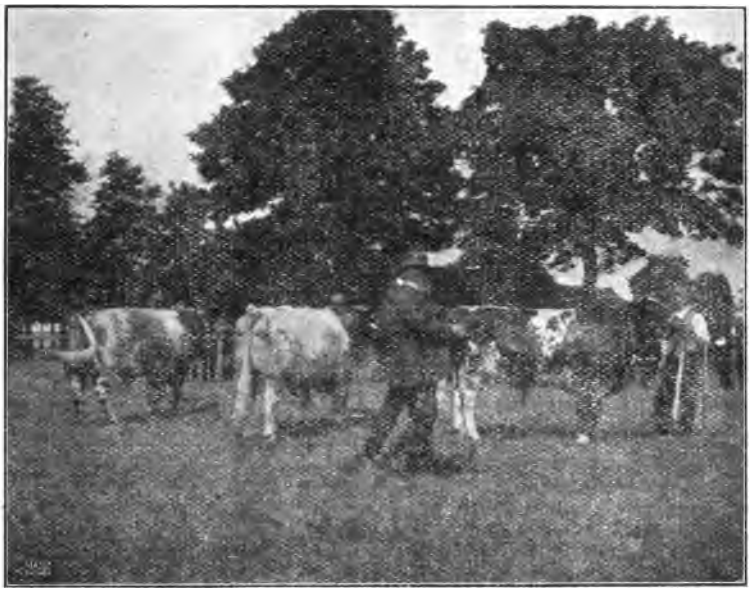
types and never evidences of indiscriminate mixing of draft horses and roadsters as frequently happens in this country.

The renowned breeds of cattle that have originated in Great Britain need scarce be mentioned in this connection, but the magnificant Shorthorns, Herefords and Aberdeen Angus that one finds are sufficient testimony to the skill, patience and perservering labor of the English breeders. The climate has undoubtedly aided in the development of the improved characters that are so popular in these breeds. The English breeder is firm in his belief that other countries must ever come to Great Britain for the best specimens of these breeds. He believes that this must be so because of the peculiar adaptation of climate and he is also as firm in his belief that the English farmer is a far more skillful breeder than are the breeders in any other country. We might be inclined to take issue with these gentlemen and point with pride to the results already secured in our own country. But it must be admitted that there are more good breeders in proportion to the number engaged in the business in England than in this country and that we have not yet reached a point where we can consider ourselves as a nation equal to our English cousins in the matter of breeding live stock. It is perfectly safe to say, however, that there are many breeders in America that are unexcelled, even by the best in the United Kingdom. The specialization of breeds of cattle is also as distinct as among horses. Crossing and mixing for improvement is not generally followed, and only in a few special cases do we find crossing practiced for the production of animals for the butchers' block. It must be said, however, that specialization of breeds of cattle is not interpreted in exactly the same way as in this country. It is firmly believed by most English breeders, for example, that the best dairy animals are to be found among the Shorthorn breed and at the Royal Agricultural Show this year the writer saw a large Shorthorn dairy cow that won sweepstakes for the best dairy cow at the show. This cow did not possess the ideal wedge-shape desired in this country in dairy animals. She did show a decided tendency to beefiness. There are some peculiar breeds of cattle in Great Britain that are of more than passing interest to the average foreigner. The Dexter and Kerry cattle in Ireland are miniature pony-built animals, weighing not more than five or six hundred pounds. These seem to be peculiarly adapted to certain conditions prevalent in Ireland and are of sufficient commercial value to be bred pure. Many of these little cows are exceptionally good dairy animals. It must be said, however, that their breeding is largely carried on by wealthy land owners more because of their diminutive size, than because of any economical value which they may possess. The West Highland cattle possessing rather long horns, long furry coat and rugged, vigourous constitution have proven themselves unexcelled upon the semi-barren districts of the western coast.

It is interesting to note in this connection that the breeds of cattle from England have influenced the cattle stock of more countries and have been influential in fixing certain characteristics upon the domestic animals of the world to a greater extent than the breeds of any other district in the world. In studying the history of development and improvement of the breeds of live stock on the continent, one frequently finds reference to the importation of the Shorthorns used in the improvement of these continental breeds. The Holstein cattle for example undoubtedly owe much of their beef excellence to the early use of the Shorthorn bulls. It is probably the case that many of the other breeds in other portions of the German Empire have been influenced in the same way.

Romney Marsh sheep in an English pasture.

While America can lay claim to having developed the most remarkable breed of wool sheep that the world has ever known, we must yield the palm to England for having produced the most profitable types of mutton sheep. The Englishman is a natural born shepherd, he loves his flock and no amount of discouragement of low prices, of disease or death can destroy his preference for his flocks. The history of the development of these English breeds of mutton sheep shows plainly that sheep require especial and continuous persevering care to secure from them high class mutton. Sheep require not only special care, but the different breeds of sheep require care that is peculiar to each type of animals and we find the English shepherd specially efficient in giving to these particular types of sheep the attention required. Among the long wools we find the Cotswold, the Lincoln and the Leicester, large vigorous and profitable food consumers. Among the medium wools are the Downs, the Shropshire, Hampshire, Oxford and the Southdowns. All these have contributed to the improvement of the sheep stock of the old world. More mutton is consumed per capita in England than elsewhere, and the chief profit from sheep husbandry arises from the sale of mutton. We find therefore the English breeder to have succeeded in developing the mutton type of sheep to the greatest perfection and comparatively little attention has been paid to wool.



Judging the King's Shorthorns at the Royal Agricultural Show.

One feature of English agriculture that undoubtedly has much to do with promoting its advancement and continued growth is the large number of agricultural shows that are held in different agricultural centers at various times during the year. The premiums awarded at these shows are the results of careful work on the part of experienced judges and the experienced judgment of these men has undoubtedly done much to bring about a uniform type among the various breeders. The encouragement of the breeding interest which these shows have brought about cannot be overestimated. The culminating event of the year is the Royal Agricultural Show, which will hereafter be held at London. At this show the finest and most highly improved stock is exhibited, society encourages this event by it's presence, royalty approves by the exhibition of animals from the royal flocks and herds and frequently the King sends a personal representative. This show attracts visitors from all parts of the world and it is here that the breeders make the acquaintance of future buyers.

Not only do the agricultural shows contribute to the social intercourse of breeders and the uniformity of standards in breeding animals, but the market days that are so common in all of the leading agricultural districts have from time immemorial been the monitors of the development of live stock in England. Auction sales are frequently held in connection with the show and on the market days, and in many ways, the social intercourse of farmers is encouraged and always, it would seem, with beneficial results.

It is fashionable for people to live in the country in England and as a result we find some magnificent country homes in every section of Great Britain. Interest in country life is everywhere observable. The country roads are better, the country towns more prosperous and country life more delightful because of this interest and sympathy upon the part of the rich.

There are few agricultural colleges in England and still fewer experiment stations. It is interesting to note, however, that the oldest station and one of the most renowned is located north of London, at Rothamstead, near St. Albans. There are two agricultural societies in England that have done much to promote and encourage the agricultural community; the Royal Agricultural Society with offices in London and the Highland Agricultural Society of Scotland. Each of these societies publishes frequent reports, many of them of very great scientific and agricultural value.

CONCLUSION.

It is not always easy to select those methods and practices which are found to be of economic value under one set of conditions and apply them to radically different conditions in an entirely different location. We must always therefore proceed with caution in attempting to apply any of the intensive methods of agriculture so common in Europe to the conditions which obtain in America. In America cheap land, expensive labor and improved machinery have made it profitable to work large areas. As a consequence of extensive methods far less labor is required in the production of any given quantity of agricultural product. The result is that a bushel of wheat, a pound of wool and a pound of beef cost far less to produce in our country than under the conditions present in the older countries, and so long as our farmers continue to find these methods profitable it is not the part of wisdom for us to encourage them to adopt the intensive methods which may have been found profitable under entirely different conditions. However, it is unquestionably true that many of the methods commonly practiced in more settled communities, and that have been learned as the result of hard experience can be and should be practiced in many cases under our own conditions. One thing is certain that the care and labor bestowed upon conserving, handling and the application of farm manures are worthy of emulation in our country. Millions of dollars yearly are lost because of the careless, wasteful handling of farmyard manures in this country. It is not a question of more labor and more expense, but it is purely a question of better knowledge and timely care. It costs less to apply farmyard manure right before it has wasted away by lying under the eaves for many months.

In methods of feeding it is also unquestionably true that we are wasteful and extravagant. We feed heavily and not always wisely. The European farmer has learned that it is economy to vary the feed of the domestic animals and that judicious mixtures will unquestionably accomplish better results that a continuous ration of one or two kinds of food stuffs.

The European farmer has learned to make use and profitably dispose of all the products of the farm, products that with us are called, and properly called, waste products, are all used by the old world farmers to help increase the revenues of the farm.

It is possible that we may also learn what not to do by studying conditions that do actually exist in many of these countries. In the first place it seems to the writer that human labor is counted too cheap in Europe. A great portion of the heavy menial labor that now falls to the lot of the poor laboring men and women could be as well and better done by the use of improved machinery. Much of this hand labor is undoubtedly due to the small holdings of the peasants, and it may be that the tendency in certain sections of our country may lead eventually to a similar result. It seems to me that, other things being equal, it is more desirable on the whole for the farming class to own a certain minimum of acres, which shall not be too small, in order that the cultivator of the soil may take advantage of all the help that improved machinery and draft animals may yield. This will tend to a higher intellectual, material and social life for the farming class.

It is also frequently suggested by writers upon the social conditions surrounding country life that a gradual movement of farmers toward centralization in small villages, like that found in Germany, will do much to alleviate the isolation which now prevails in certain localities. In the writer's opinion this would be for many reasons a retrograde movement and not conducive to the social betterment of the rural community. Material advancement and higher intellectual ideals will do more to promote the social life of farmers as a class than will mere segregation in gossiping villages. There is no occasion for alarm that there will ever develop in this country a landed aristocracy, because a landed aristocracy can only exist as a result of government favor and so long as it is possible for every man by business sagacity and persevering toil to accumulate landed property so long will it be impossible for a landed aristocracy like that of Europe to exist here.

The present tendency in the United States of wealthy people toward country life should be encouraged in every possible way. This movement will tend to increase the esteem in which agriculture as a vocation is held and to dignify the calling of people so engaged. The American farmer is particularly fortunate in possessing unbounded resources, opportunities for continued improvement and a rapidly increasing population, all of which will conspire to bring to the American farmer increased prosperity, and it is only necessary that we should learn to properly use all these resources and possibilities, and fruitful opportunities which surround us. The educational system now existing and the increasing tendency toward pushing high schools farther into the country with free rural delivery and country libraries, all are bringing about a condition which will make country life by far the most desirable and most attractive in America.

FARMERS' INSTITUTES.

ABSTRACT OF LECTURES.

PROPAGATION AND PLANTING OF FRUIT TREES.

By W. L. Howard, Assistant in Horticulture, Missouri Experiment Station, Columbia, Mo.

It is not generally understood among the farmers that they can propagate and grow their own fruit trees at little or no expense. To start a small home orchard a man need make no cash outlay at all. For apples he can save some seeds, plant them, grow seedlings, and on them graft any and all of the varieties of the fruit he wishes to have. Peach, plum and cherry seeds may be planted in the same way and the desired varieties of each budded on the seedlings. All of this is easy to do if one only knows how. The process of grafting and budding is regarded by many as a mysterious art which only a favored few may understand. How this impression came to be abroad, it is hard to say, but it exists nevertheless, and it is the purpose of this article to show how easy it is, and that there is no magic at all connected with the process of making "budded" and "grafted" trees. Nor need any one be deterred any longer, from owning a small orchard on account of the expense usually involved in purchasing the trees.

In describing how to propagate fruit trees it is necessary to begin at the beginning—that is, with the seeds. In the fall or early winter save the seeds from the apples used about the home. If it is convenient to get apple pomace (the ground up and squeezed out refuse of apples) from some place where cider is being made, the seeds can be collected rapidly. Pour the pomace into a barrel two-thirds full of water, and stir the mass with a stick. The seeds will settle to the bottom as they are separated from the flesh of the apples, and the heavier pomace can be skimmed off. The fine particles of pulp will settle down with the seeds and unless one has a wheat sieve at hand to help, it is a tedious matter to wash all of the seeds clear of the pomace. It is nicer, of course, to have all of the seeds separated from the pomace, but it is not at all necessary. When apples are being dried or canned it is a good job for children to cut the seeds from the cores. A surprisingly large number may be secured in this way in a very short time. To get best results the seeds should not be allowed to dry out, but should be stored in sand for the winter. This is done by putting a layer of common sand in a box, spreading over it a layer of seeds, then more sand, and so on, until the seeds are all used up. Place this box on the north side of a building, sinking it in the earth until it is level with the top of the ground, in order to keep the sand moist. Do not cover the box, but leave it exposed so that rain may get in and help to keep the sand from drying out. This is called "stratifying" the seeds and it does not matter if there is some pomace left with them when they are put in the sand.

The seeds are to remain stratified until they are ready to plant, which will be in the spring at gardening time. Select a place where the soil is deep and fairly rich. It is very important that the soil be deep so that the roots can go straight down, for it is roots we are after, and the longer they can be made to grow, the better. Plow the land deeply and prepare as for garden truck. Lay off rows four feet apart and sow the seeds not too thickly in the rows. Instead of using soil it is a good idea to cover the seeds with *thoroughly rotted* chip dirt, straw or manure, but whatever is used should be free from weed seeds. Give the seeds only a shallow covering. Give the little seedlings good cultivation throughout the summer and keep them growing vigorously. Late in the fall after the leaves have been shed, the plants are to be dug up and stored in the cellar. Cut off the tops, tie the roots in bundles and pack them in green saw dust. Sand that is slightly moist may be used, but it is not as good as fresh saw dust.

The scions for grafting on the roots may be taken from the trees at any time after the leaves have fallen, but it is well to cut them before the first hard freeze. Never cut scions while they are frozen; if cold weather comes on suddenly, before the scions are taken, wait until they are thawed out. In the first place, decide what varieties are wanted, then go to a healthy tree that is known to produce good crops of the desired sort, and cut from it the best twigs of the last season's growth. Wood that is two years old is not suitable for grafting. Get the switches as long as possible, but they can be used if the growth has not been more than four or five inches. Water sprouts, when they have sprung out well above ground, may be used if they are well matured. Never use soft, spongy, immature wood, or any which refused to shed its leaves. If the scions are taken from the trees early, they should be packed in green saw dust like the roots. Grafting may be done almost any time in January or February, or even in March in the northern half of the State, but February is perhaps the best time to do the work. The grafting is best done in a cellar or basement room, but may be done in a moderately warm living room. Do not do the work about an open fire or near a hot stove as the roots may be dried out and seriously injured.

GRAFTING.

If the twigs have made a sufficient growth, make the scions six or seven inches long, but they may be shorter if necessary. On the butt end of the scion make a sloping cut about an inch to an inch and a half long, as shown in Fig. 1, *a*. Use a sharp knife and make the cut smooth and uniform. On the sloping surface about one-third of the way from the end of the twig, make a "tongue" by a downward cut from one-half to an inch deep, along the grain of the wood. With nurserymen it is customary to form the sloping cut, make the "tongue" and then cut off the scion of the desired length. Follow the same process with the root. Begin at the crown (the part of the root that was just at the surface of the ground), and form a sloping cut, taking care that it is of the same slope as that of the scion, and making also a "tongue" in the same way and at the same distance from the end of the root as in the scion. See Fig. 1, *b*. This done, cut the root off, having the piece about four inches long, and repeat the process until the root is all used. If the seedlings have made a good growth and the soil has been porous enough to let them go down, the roots will usually make two, and sometimes three pieces.

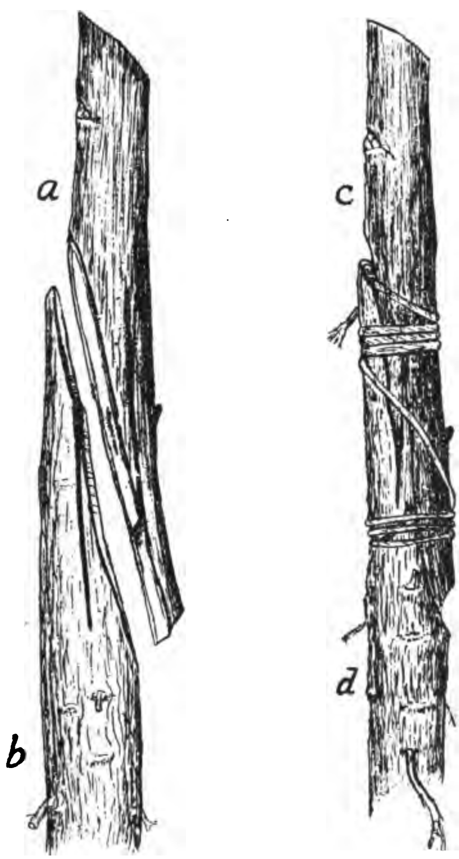


Fig. 1.

How to make "whip" or "tounge" graft. *a* shows how to make the sloping cut, and the slit, or "tongue" in the scion. *b* shows the corresponding sloping cut and "tongue" for the root. *c* and *d* illustrate the proper manner of uniting and tying the scion and root, forming the finished graft.

Join the root and scion by pressing the two sloping surfaces together and forcing the tongues to interlock. At this point, the main thing to be observed is, to see that the bark line of one side of the scion comes exactly in contact with the bark line of the corresponding side of the root. This is highly important for this is where the two are to grow together. The scion and root may not be of the same thickness—in fact, seldom are, but this makes no difference at all if the above instructions are followed.

Figure 1, *c* and *d*, shows the scion and root properly united. After pressing the two pieces together it will be necessary to wrap the graft with No. 18 or 20 cotton knitting thread. Lay the end of the thread on the wood near the end of the cut, wind two or three rounds on top of it, at the same time pressing scion and root together with the thumb and finger; then work the thread up to the other end of the cut by winding it two or three times around the graft during the distance, then two or three times around the other end of the cut as in the beginning, and fasten the end of the thread by drawing it down in the cut and, by a sharp jerk, break it off as shown near *c*, in Fig. 1. This completes the graft, as it is not at all necessary to wax the place of union. This process is known as "whip-grafting." Pack the grafts in bundles, each bundle being tied up, in green saw dust, where they are to remain until planting time. The wound at the point of union will actually begin to heal over and partially grow together while the grafts are in the saw dust and on this account they should not be disturbed until they are taken out to plant. Keep the box of grafts in a cellar or moderately cool room. They must not be allowed to freeze nor neither must they be permitted to dry out.

As soon as the ground will do to work in spring, select a place where the soil is deep and moderately rich, on which to plant the grafts. Do not plant them on the site of an old strawstack as that would be entirely too rich. Plow the land deeply and otherwise prepare as for a garden spot. The rows need not be long, but should be perfectly straight. To get them straight, stretch a line or wire across the plot. The rows should be four feet apart but are not to be laid off with a plow. After lining up the row go along with a sharpened pole and punch holes in the ground along the line, about eight inches apart, withdrawing the pole carefully so as not to allow the soil to tumble in. Plant the grafts by placing them down in these holes so that but one or two buds of the scion will be above ground. This will necessitate the ground being plowed deeply. *Be sure to press the soil up well against the roots of the grafts;* this is best done by means of a dibble or short, sharp stick which is forced into the ground beside the grafts and crowds the soil against them. The grafts can not grow if hollow air spaces are left around the roots. Here is where more people fail than at any other point. Give the little trees good culture, including two or three hoeings, during the summer, and, with a reasonably favorable season, they will reward their owner with a vigorous growth.

There is another form of grafting often of use to the farmer, that will be considered briefly. This is what is known as "cleft-grafting." If an apple tree reaches bearing age and is found to be an undesirable variety, the kind that is wanted may be worked on the tree by this method of grafting. The method is also sometimes called "top grafting." As many varieties as there are branches to put them upon may be top-grafted upon a single tree. New varieties may be hurried into bearing by being worked on the branches of an old tree.

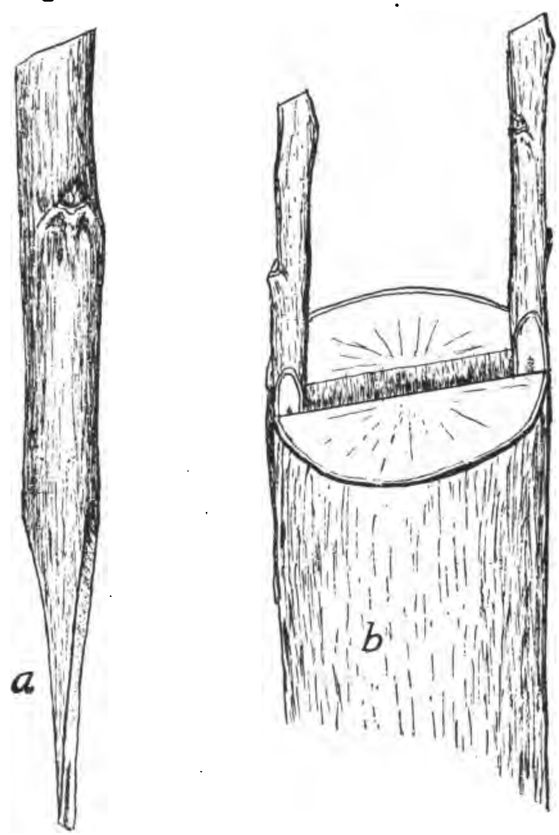


FIG. 2.—How to make a "cleft" or "top graft;" *a*, the scion whittled to a wedge-shape; *b*, a sawed-off trunk or branch with two scions correctly inserted in the split end.

To do the grafting, saw off the old branch, or even the body of the tree if it is not more than three or four inches thick, and split the stump down through the center with a knife or hatchet. This work is to be done in spring just as the buds are beginning to swell, but the scions to be used must have been collected some time previously when the wood was perfectly dormant. The scion should be four or five inches long and at the butt end whittled to a wedge-shape, as shown in Fig. 2, *a*. In making the wedge, the slope must be long and uniform, the wood being whittled from both sides of the scion. Pry open the split in the trunk or branch to be grafted, and carefully insert the scion so that its bark will be exactly in contact with the inner growing bark of the old stub or stump. See Fig. 2, *b*. This is very important, for here is the place where they are to grow together, and they can not do so unless the bark of one piece is in line with the bark of the other. If the old branch or trunk of the tree to be grafted is large enough—that is, thick enough, it is advisable to use two scions, as this will double the chances for success, in case one of them does not grow. If both scions grow, by all means cut one of them out. If both are allowed to stand a forked tree will be formed, which is always to be avoided. When the scions are in place, it will be necessary to cover over all of the cut surfaces with grafting wax. The wax may be melted in a tin can at the house and carried to the orchard, if not too far away. It is best to have a little paddle with which to dip up the molten wax and spread it over and around the scions in such a manner as to exclude the air and thus keep them from drying out until they unite with the old wood. This wax is never to be disturbed afterwards as it will not injure the tree. Make grafting wax as follows: Common rosin, 7 lbs, beeswax, 2 lbs, and tallow, 1 lb. If so much is not desired, divide each of the above items by 2, 3 or 4, as may be needed. Melt all of the ingredients together in a vessel over a slow fire, and stir thoroughly. When well mixed, pour a part of the mass in a small tub of water until partially cooled, then take it out and pull like taffy candy until it becomes too stiff to work.

To propagate pears, the seedlings may be grown and cared for like apples, but when it comes to grafting, the roots must be left whole and the place where scion and root are united covered over entirely with grafting wax. Plant and cultivate like for apple grafts.

BUDDING.

Peaches, plums and cherries are propagated almost wholly by budding, the work usually being done in summer or early fall. The process—including the growing of the stock, is practically the same for all of the above named fruits, so that a description for peaches will answer for the whole.

Peach seeds may be planted in the fall, or stratified during the winter as described for apple seeds, and planted in the spring. They should not be allowed to lie in the sun and dry out during late summer and fall. The seedlings will make a vigorous growth with a reasonably favorable season, and may be budded in August or early in September. In general, the budding should be done when the bark peels best.

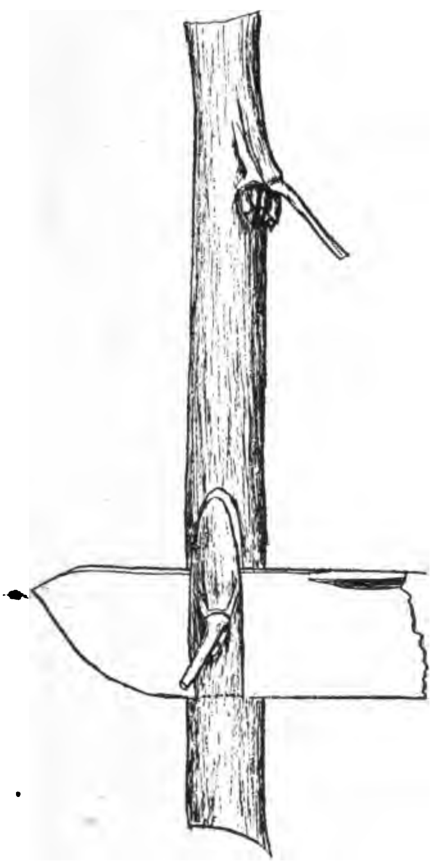


FIG. 3.—Method of removing a bud from a "budding stick."

The buds are to be selected from the desired varieties when the work is ready to be done. Take a young branch that has grown during the current season and cut away that part of it which is soft and immature. The best wood buds are usually found toward the middle of the twigs and may be distinguished from the fruit buds by remembering that they are smaller, flatter, and never so plump. A fruit bud can do no particular harm if there is also a wood bud. The wood bud is what makes the wood growth that we desire, while a fruit bud will simply bloom out and die, and that is the end of it. A wood bud will often have a flower bud on each side of it as is the case above the knife blade in Fig. 3. When this occurs, the outside ones may be broken off as they are of no use. After a little observation and practice it will be easy to select the proper kind of buds.

The weather is usually very warm at budding time so that it will be necessary to wrap the sticks from which buds are to be taken, in a damp cloth or heavy piece of paper to prevent their drying out. Trim off the leaves, leaving a piece of stem about half an inch long to hold to when the buds are being inserted. The manner of cutting the buds from the twig—known as a "budding stick," is shown in Fig. 3. Hold the budding stick in the left hand, upside down, and with the other hand force the knife through the bark and into the wood and make a slice down to the dotted line shown at the bottom of the blade. Now withdraw the knife and, at a point shown at the dotted line, make a cut cross-wise just through the bark, and no deeper. If the bark peels easily—and it should at budding time, the bud may now be lifted up and the bark will part from the wood as smoothly as a peeled onion. We prefer to have no wood adhering to the buds.

The little seedling peach trees should be budded as near the ground as it is convenient to work, which will be two or three inches from the surface of the soil. The first thing is to make a slit in the bark, length-

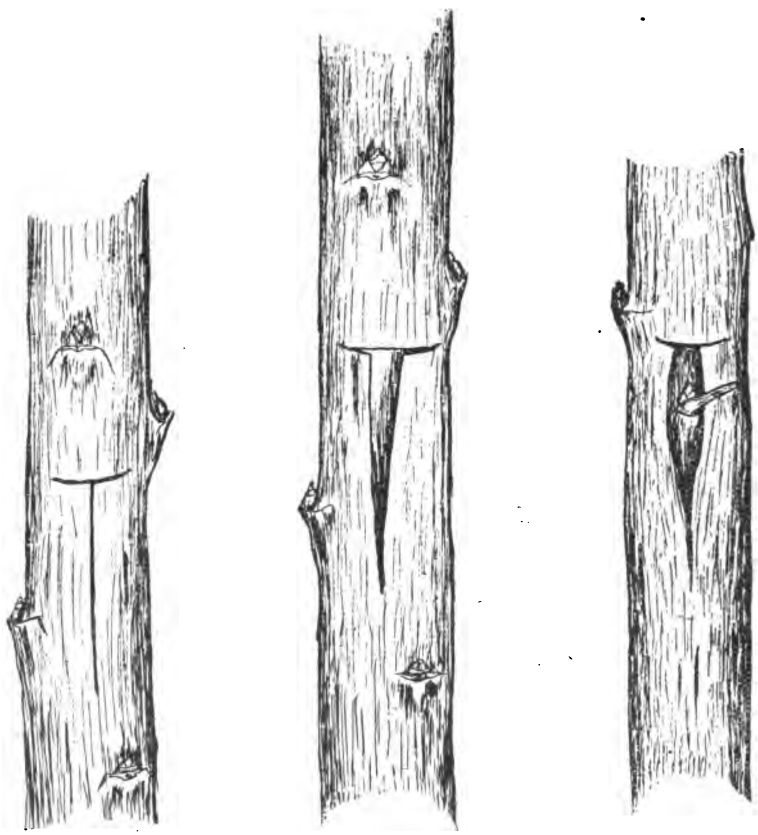


FIG. 4. FIG. 5. FIG. 6.

FIG. 4.—T-shaped cut made in the bark of the seedling or other tree to be budded.
FIG. 5.—Same as Fig. 4, with the bark partially raised for insertion of the bud.
FIG. 6.—The bud in place.

wise, and at the upper end of this slit a cross cut, thus forming a T-shaped figure on the bark of the sprout, illustrated in Fig. 4. The bark should peel readily, and in Fig. 5 may be seen how it has been gently raised with the point of the knife, and the flaps slightly rolled back. At this point the bud should be cut from the budding stick, as directed, and inserted beneath the bark of the sprout by holding to the short stem left for the purpose, and forcing it gently downward, sharp end first, until the square cut end of the bud gets down to where it will fit against the cross cut in the bark of the stock. In Fig. 6 the bud is seen to be in position and ready for wrapping. In order that the bud may form a union with the growing bark of the stock, it is necessary to press it closely against the tree by binding with some sort of a string. Nurserymen usually use a kind of grass, called "raffia," which is wet before applying and adjusts itself to the parts to be covered, and makes an excellent wrapper. A good substitute for raffia, within reach of every farmer, is strips of some kind of old, thin, cotton goods. Whatever is used is to be bound around the newly inserted bud as indicated in Fig. 7,

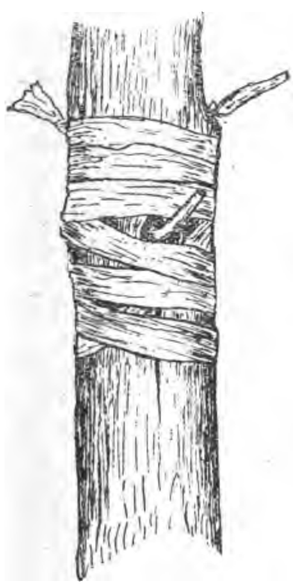


FIG. 7.

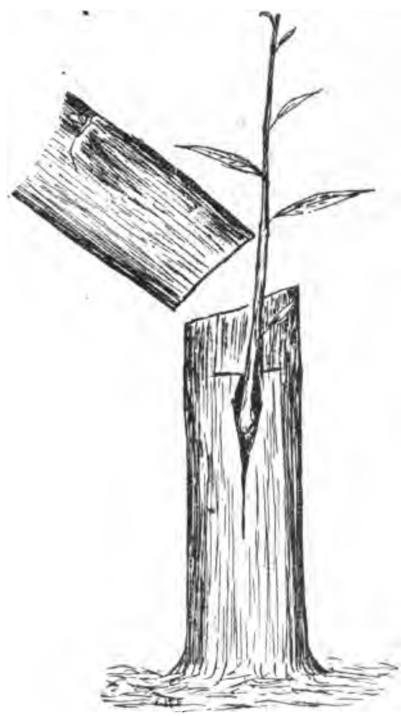


FIG. 8.

FIG. 7.—Inserted bud properly wrapped with a piece of raffia grass or strip of cotton cloth.

FIG. 8.—Where to cut off the seedling the next spring after budding.

in such a manner as to leave only the stem of the leaf left on the bud, sticking out. This leaf stem will serve as an index to show whether the bud has united or not. If the stem remains green, we may know that the bud is living, otherwise it will turn brown in a day or two. Do not wait longer than a week before examining the buds to see if they are living. If they have united with the tree, release the string by cutting it on the opposite side from the bud, in order not to disturb the healing wound. This early examination and cutting of the string must not be forgotten as it is very important. At this time the little trees are making a very rapid growth in thickness, and in a remarkably short time will grow over the strings and literally choke the trees to death, or, what is more to the point, will make a deep ring in the tree and cause it to break off where the bud is inserted.

During the season the bud is inserted in the tree, it will do no more than make a firm union with the stock, the bud itself remaining dormant. The following spring our bud will begin to grow along with the other buds of the tree, and now the little tree must be cut off from one-half to an inch above the bud. See Fig. 8. This will throw all of the growth into the new bud and it should shoot upward rapidly. A large number of little sprouts will be sure to spring up around the stump and it will be necessary to examine them about twice and rub them off, so as to keep the growth where it is wanted.

After the buds that were inserted have made one season's growth, the trees are ready to be planted out in the orchard. In average soil, peach trees may be planted a rod apart each way, which gives 160 trees to the acre. At the time of planting, prune the peach trees by cutting all branches back to stubs an inch or so long, thus leaving about two buds to each stub. The top should also be cut back into firm wood. The roots may be cut back to a length of six inches and the tree is ready for planting.

A few good varieties of peaches are: Mt. Rose, Family Favorite, Elberta, Champion, Old Mixon, Pickette's Late and Salway. This is by no means all of the good ones, but includes some of the leading sorts. For clingstones, Old Mixon Cling and Heath Cling are the best. Others may be added at the pleasure of the planter.

Apple trees may be planted in the orchard when one year old from the graft but most people prefer to have them two years old. When planting, prune the trees to a cone-shape, that is, leaving the lowest branches the longest and gradually tapering in toward the top, and leaving a central stem as a leader, untouched, to continue the upward growth. Prune the roots the same as the peach, and plant in rows 25 to 30 feet apart each way. Where the soil is thin and the trees are not apt to make a vigorous growth, 25 feet apart is sufficient. Give the trees clean culture or sow in cow peas. Do not seed the orchard to either clover or timothy. At the time of planting, wrap the trees with wooden wrappers— a special kind of thin shingle made for this purpose, and sold by all box and basket companies, to protect the trees from the hot sun, to prevent the borers from getting in, and in winter to protect them from rabbits. Put the wrappers on loosely, so that the trees can continue to grow, and let them stay there until they rot off, going through the orchard each spring and sticking them down in the ground again, where the ends have rotted off.

Varieties to plant depend on what they are wanted for; if for commercial purposes, that is, to place them on the market, then Ben Davis, Gano, Jonathans, and Grimes Golden would probably be the best short list for all localities. A home orchard should include the above, and, in addition, some early summer varieties so as to have a succession of fruit. Red June, Keswick Codlin, Early Harvest, Maiden Blush, Lowell, Rambo, Rome Beauty and Winesap, are desirable varieties for early and late summer use.

The principal insects of the apple which we are concerned with, are the borers, codling moth and canker worm. For borers, use wooden wrappers as directed; for the codling moth, *do not use trap lanterns, for they are humbugs,* but fight the insect by spraying early in the season with Paris green at the rate of one pound to 175 gallons of water, also adding three pounds of fresh lime. Spray first a week after flowers fall, then make three more applications at intervals of about ten days. Keep canker worms off of the trees by placing bands of cotton around the trunks; if they get on the trees, spray with Paris green when they appear, using the same amount of the poison as for codling moth.

The most important fungous diseases are the scab and bitter rot. For these, spray with Bordeaux mixture, which consists of four pounds of bluestone (also called copper sulphate or blue vitriol), and four pounds of fresh lime to fifty gallons of water. Spray the first time as buds are swelling, again after the flowers have fallen, and twice more at intervals of two weeks. If bitter rot appears later in the summer, begin spraying again, giving two or three applications, at intervals of eight or ten days. Keep the orchard clean and diseases will not be so likely to appear.

BERRY GROWING.

By Geo. W. Williams, Humansville, Mo.

The first requirement in berry culture is a good supply of common sense coupled with energy enough to push the business to success. The man who embarks in the berry growing business with the idea that when his plants are once set the work is done, is certainly doomed to disappointment for it takes lots of hard work to grow berries; but what farm crop does not require lots of work?

To be successful we must make fruit growing something of a study. There is hardly a farm in Missouri but what will grow some kind of fruit, but the owner must not go at it with his eyes shut. Often an orchard or berry patch is planted where it would not have been had the work been done intelligently. The land for berries ought to be well drained. The majority of people know this, yet how many times have we seen blackberries, raspberries and strawberries set in low marshy land with no attempt at drainage?

It is possible that a farm has no suitable site for a berry patch, or at least one not naturally suited, and if not naturally suited and it cannot be made so by artificial means, you had better not embark in that industry, but let your more fortunate neighbor grow berries while you devote your time to grain and stock.

How does fruit growing compare with other farm products for profit is a question that is often asked. Before this question can be intelligently answered there are several things to take into consideration; the distance from market, convenient shipping point and character of the wagon road, if it must be hauled any distance in wagons. If the roads are very rough it would not be as profitable to grow them even within a few miles of market as a more distant location with smoother roads to haul over, and after hauling if they must still be shipped to market, the time of day that you can get them into the hands of the commission merchant or on the market, is an important factor in obtaining good prices; especially is this so if sent in open cars—that is by express—for if berries must lay over one night (twelve hours) they are at a disadvantage with those put on the market fresh. Where these conditions are favorable, fruit growing pays much better than grain and stock raising, for the amount invested.

The growing of small fruits requires more labor to cultivate and take care of than any of the cereal crops and also requires a richer soil, either naturally rich or made so artificially. It is therefore better suited to the small than the large farmer; with the small farmer it will come distinctly under his supervision, while with the man of large estate it must be done by proxy, and as much of the success in berry growing depends upon looking after the *small* details, a thing that few proxies understand or care to take the trouble to do, it is better for the grower to be his own supervisor. There are some sections where it is possible for one man to control large berry fields and make good profits, but they are the exception and not the rule.

In selecting a location for berries or any other fruit, select a site reasonably safe from late killing frosts in spring. Usually such a site can be found on a gentle slope that terminates in an abrupt break or ravine. In these abrupt valleys or ravines, we find the cold air drainage which is as essential to the air as water drainage is to the soil. Bottom land usually would be an admirable soil for small fruit, if it was not too uncertain in its fruit production on account of injury by frost.

Any good, well drained corn land will be suitable for blackberries and the red raspberry, while for strawberries and the black-cap raspberry it is more difficult to find a suitable place. In fact, about the only way to find out if a certain location or soil is adapted to strawberry growing is to test it. The habits of the different varieties vary so much that one variety that does well on one part of the farm may be a failure not twenty rods away.

The preparation of the soil for berries should be thorough, that is, eradicate all weeds before planting, that no seed will be left to come up among the plants.

For blackberries anywhere in Missouri they can be set in the fall. Do not try planting root cuttings, they are not satisfactory. Especially is this true to the novice. If intended for close, one way cultivation, set them in rows eight feet apart and thirty inches in the row. Any hoed crop, like potatoes, can be planted between the rows, thus getting a half crop off the land the first year. After the first year the blackberries will require all the ground. If set in what is called the hill system, set in rows six feet apart and five feet in the row, running rows each way. This enables nearly all the cultivation to be done by horse and cultivator.

Run all berry rows north and south. This is necessary that all the berries ripen uniformly. Rows running north and south get equal benefits from the sun, the east side in the morning, the west side in the evening. If the rows run east and west, the north side gets no sunshine and the berries on that side ripen slowly and are not so bright colored, while those on the south side ripen too fast.

The blackberry will need but little attention the first year, only good cultivation, but after that it will need its annual pruning. Starting with the second year, cultivate the same as first year. When the canes get about thirty inches high, pinch the top out; this stops the upward growth and causes lateral canes to start out at each leaf on the cane, and instead of a single long cane like a fishing pole, we have a bush of many branches. Early the next spring, before the sap starts, go over the field with pruning shears and clip off about one-third of each branch; this insures a uniform size of berries and much larger than if not pruned and it is more convenient to cultivate and pick the berries. There is no mulching so good for blackberries as a dirt mulch. The cultivation can and should be kept up until the picking is finished.

As to varieties, after testing nearly all of the new kinds introduced, the writer finds that for commercial purposes there is none better than the Early Harvest or Early Cluster, for early, and the Snyder and Kittatinna for the late, or main crop. The Kittatinna would be the leading variety if it were not so subject to rust.

Strawberries require a higher, dryer location than the blackberry. They will not live on wet land. While there can be no ironclad rules to cultivate strawberries by, there are a few general rules that will hold good in nearly all soils. The preparation of the field should begin in the fall before setting in the spring. Never set strawberry plants in the fall. If the land is not well drained, it can be aided very much by a system of subsoiling, breaking with an ordinary two-horse turning plow, following each furrow with another team hitched to a slim, strong "bull tongue," running the "bull tongue" in the bottom of the furrow, which breaks up the soil very deep but does not throw it out on top. This manner of breaking has a two-fold object, one is it forms an under drainage that carries off the surplus water, the other, it forms a reservoir that holds moisture and furnishes the plants with "drinking water" during a drouth. When ground is plowed, cover with barnyard manure, putting on from ten to twenty tons per acre. Next spring at the proper time to set plants, which is when the earliest blooms have opened, disc or cultivate the ground over until it is thoroughly pulverized. Mark off the rows north and south four feet apart—a light wheelbarrow makes a good marker. In setting, follow the track made by the wheel, as a guide is all that is needed. Set plants from eighteen to twenty-four inches apart, setting with a narrow spade. In selecting plants, they should be taken from beds that have never borne fruit, that is from beds set the spring before. By following this plan year after year, and the proper selection of plants, the strawberry can be improved.

Wait until the fruit stem has grown up and the bloom buds ready to open. By waiting until this time, it enables us to select only such plants as show a strong tendency to be prolific. By earlier setting, we are apt to set many barren plants and many more that make a weak fruit growth. Another and labor-saving advantage is that as the plants are taken up, the bloom buds can be pinched out, a thing that *must* be done some time, no matter when the plants are set, and if the plants are set early this pinching out comes some weeks after they are set, and it is a back-breaking job, besides the danger of loosening the plant, unless done by careful hands. Plants set after the fruit stems have run up and the bloom buds formed, are more likely to grow, as they are in a thriving condition and will make more plants during the season than earlier set plants. It will also save one hoeing and much after work, for the seeds of weeds have come up and can be killed by thorough harrowing before the plants are set. These savings are quite an item in the cultivation of a large field.

Cultivation should commence a few days after setting and be thorough through the entire season. It can be done shallow unless there are heavy rains that pack the ground and in that case it should be stirred five or six inches deep; but never stir the ground wet. When you can pick up a handful of dirt and squeeze it and make a mud ball, it is *too wet;* let it get dry or the cultivation will do more harm than good. When the runners start out, they should be kept turned with the row. This can be done by getting up close to the plants with the harrow—(one-horse harrow with handle to it and only about three feet wide at the wide end) or cultivator always going the same way. When the runners have met between the hills begin to "shy" off a little from the plants, giving them a wide berth that they may spread sideways. By the time the plant making season is over, there should be a matted row ten or twelve inches wide. They should never be allowed to get over twelve inches wide. If the season is an extra good one for plant making, and the rows are becoming too wide, reverse the cultivation, that is, run the cultivator against the ends of the runners. This will keep them torn loose and the late plants cannot root.

When the ground is frozen hard enough to bear up a wagon, mulch. Perhaps there is nothing better for this than straw, and it should be straw that had stood in the weather for over a year, as by this exposure to the rain and sun it has become partly rotted and the wheat and cheat left in by the thresher has either germinated or heated until their germs are killed. Leave the mulching on until after all reasonable danger of frost is passed, then rake it off lightly, pulling it between the rows, leaving it there for the pickers to walk over, who will have it about all worn out by the time the picking is over.

After the picking, run a mower over *at once,* and when it gets dry and there is a brisk wind blowing, burn it off. Wait a few days after the burning and begin cultivating again; do this by first running a double shovel plow, letting it down deep between the rows, going up and down one row two or three times or until the center of the row is well mellowed. Then with a one-horse turning plow, well sharpened, cut the row down to four or six inches, throwing the dirt on this mellowed dirt between the rows. With a hoe cut out in the row, leaving a square of plants every twenty-four inches. With the one-horse cultivator, pull the ridge between the rows down and the after cultivation should be similar to the first season. Get two crops and then plow under as soon as the second crop is picked, sowing cow peas, buckwheat or any quick growing crop on the land. In the cultivation of the strawberry it must be borne in mind that it is a hard plant on the land and soon exhausts the fertility, and this must be kept supplied if good results are obtained. There is nothing much better for this purpose than well rotted barnyard manure.

In selecting varieties, the pistillates are the most prolific if properly fertilized. Set every sixth row staminates, leaving the outside row on the west side a staminate; the prevailing wind during the blooming season is from the south and west, this pollen row on the west gives us the advantage of the wind.

SOME ORCHARD PESTS.

By Prof. J. M. Stedman, Entomologist to the Experiment Station, Columbia, Missouri.

I wish to say a word in reference to the plum curculio, about which Mr. Murray told you the value of chickens to rid one of this pest. This plum curculio is the great bugbear in the raising of plums, and also does a great deal of mischief in peaches and apples. I see here on the table some of Mr. Murray's apples, one of which I hold up, and it would be a number one apple were it not for the blemish made by that plum curculio. This apple contains no codling moth, apple scab or anything of that kind. The curculio stings the apple as well as the plum although in a different way; and that sting, whether the egg hatches or not, reduces the apple to a number two grade, right away, and your profits are gone. We can not spray for the plum curculio and reach any successful results. The best thing you can do for your apples as well as your plums is to have plenty of poultry in your orchard, and let them not only catch and devour the adults, but the larvae and the pupae also. They will scratch up the larvae or grubs that are crawling about seeking a place to crawl into the ground and pupate. Pick up the apples that fall to the ground or turn live stock into the orchard that will eat these apples when they fall; because the fall is the result of the sting from the plum curculio or codling moth and these apples contain the larvae which have practically reached the mature grub stage and your stock will pick the apples up and devour them before the grubs have changed to pupae.

There is another insect that you can fight more successfully by another method than spraying, and that is the canker worm, the larva of which hatches out about the time the blossoms appear on the trees. The worm is of a dark brown, sometimes almost black color, and moves with a measuring motion, hence the name sometimes given to it of measuring worm. When you jar a limb the larvae of these insects will drop and stay suspended by a silken thread until after the disturbance is over, when they will crawl up again and go to work defoliating the leaves of the trees. They are the larvae of a beautiful moth. Bear in mind that in this locality we have two species of canker worms. They hatch out in the fall of the year and throughout the winter, clear on until spring. The males have well developed wings and can fly like any other moth, while the females have no wings and can not fly at all. They hatch out in rubbish of all kinds about your orchard. The females crawl up the bodies of your apple trees and lay their eggs in the limbs, usually in a mass, consisting some times of a hundred or more. If the female for any reason could not crawl up the tree, she would not be able to lay her eggs there, and you would have no canker worm infesting your tree. Bear that in mind. No matter whether the moth hatches in the fall, spring or winter, its eggs do not hatch out until the proper time in the spring, which is about the time of the appearance of the blossoms. What can we do to prevent the female canker worm climbing up into the tree? This insect works not only in apple trees, but other fruit trees, such as the cherry and plum, as well as forest and shade trees such as the elm. You can fight this insect successfully in this way: Take some ordinary wire mosquito netting, such as you use in the windows to keep out flies, and cut it into strips four inches wide and long enough to go around the body of your trees and overlap about nine inches. Having done that, cut one side of this band by means of scissors at intervals of every three inches about an inch and a half in depth. Go into the orchard and scrape off the loose bark from around the trunks of the trees at a convenient height from the ground and about four inches in width. Apply the band to this place and by means of a common tack overlap a cut edge and tack it; do so at every lap cut, and when all around fasten the ends by means of a wire pin. The cutting and overlapping of the cut edge will cause the wire netting to flare out at the bottom, and if there are no crevices between the wire and the bark, the canker worm females will never get around this band. Put this around your tree early in the fall. You will find that not a single female canker worm will ever pass one of these bands, and they will last about two years and are inexpensive.

Mr. Schoppenhorst.—Does the canker worm affect the foliage only or the fruit also?

Prof. Stedman.—Usually only the foliage, but sometimes they will attack the fruit also.

Now, gentlemen, this remedy beats spraying for this pest; it is done much quicker, it is more effectual and it costs much less, and you can do it at a time when you are not so busy as you are in the season when the canker worm larvae appear. If you are going to spray for other insects of the leaf feeding kind, you will kill the canker worms all right. If you have not put on these bands and the worms appear in your trees, then go to work and spray thoroughly and one spraying will be sufficient, especially if done when the larvae are young.

Mr. King.—I want a little more information about these insects. I am not right sure about the worm of which you speak. I find a few worms in my apple trees and a great many in my walnut trees, but they have not that peculiarity of dropping of which you spoke. They hatch on the under side of the leaf and after the worms attain a certain growth they cluster on the tree and shed their skins.

Prof. Stedman.—That is the Forest Tent Caterpillar. It is not the canker worm. It does not make any tent and that is one objection to its name. There is a group of web worms; some make webs and some do not. You can kill them with any arsenical poison spray, or when you find them in clusters, you can kill all of them readily by a spray of kerosene.

Mr. King.—I have had trouble with ash trees on account of a black worm that eats the tender tips of the shoots of the ash trees. One of their peculiarities is that they drop to the ground when the trees are jarred. They are very numerous, so much so that they stop the growth of the large trees. They bite into the tip top of the tree.

Prof. Stedman.—That is the ash saw fly. Spray with any of the arsenical poisons.

Mr. King.—Do you usually use torches for those that make webs?

Prof. Stedman.—We usually do and burn them late in the evening. The insects that attack your fruit trees should be divided into two classes, when it comes to fighting them. The first class are the biting insects, or those which eat the leaves, fruit or tender shoots, biting away portions of them and swallowing it. You can call them chewing insects if you like that term better. The second class get into orchards and do a great deal of damage, but instead of eating away the tissues of the plant, they stick their beaks right through the tissues and suck the sap only; these we speak of as sucking insects. In fighting insects, no matter where, (except on live stock) you should observe first whether it is a biting or a sucking insect, as upon that depends your method of fighting them; and right here is where most people make mistakes in trying to rid themselves of these pests. They do not observe carefully these two classes of insects. You do not have to find the insect and look at its mouthpart in order to tell to which class it belongs but look at the damage the insect is doing on your plants and you can tell the kind of an insect you have to deal with. If you have a biting insect, put some kind of arsenical poison on the plant and just so long as the poison remains there these insects may come along, and in eating the tissues of the plant, will eat some of that poison and be killed, and you will be surprised what a small amount of poison it takes to kill them. But if you have a sucking insect, though the plant be covered with arsenical poison, it will not hurt the insect at all, since it will stick its beak right through the poison and into the tissues of the plant and suck its sap; hence you can not kill a sucking insect by arsenical or internal poisons, and that is the secret of many failures. For sucking insects we use some form of kerosene, as a rule. Now, I am not going to the trouble to tell you how to make kerosene emulsion, nor ask you to go to that trouble; it is a nuisance, and takes time, and nine people out of every ten will not do it. Buy a modern spray pump from some of the best manufacturers, and get one that has what is called a kerosene attachment. That is a new patent device which consists of a tank connection with the pump into which you place common pure kerosene; then there is an indicator that will cut off the kerosene or allow it to run in up to fifty per cent. Set the indicator at ten per cent., fill the tank with pure kerosene and put common water in your barrel and go out and spray. It is done quickly and saves the trouble of making kerosene emulsion. That pump has another advantage. When you are spraying insects it frequently happens that you want to spray for fungous diseases like apple scab, bitter rot and the like. When you make your Bordeaux mixture, place it in the barrel, putting in some arsenical poison regarding the Bordeaux mixture as pure water and using the proper amount of lime, as the case may be; then fill the kerosene tank and set it at ten per cent., and you can go out and spray your trees for fungous diseases, biting insects and sucking insects all at one time, and save yourself the labor and expense of three sprayings. You can not combine all of these three sprayings unless you get that pump, and it costs very little more than the pumps without it.

I want to say a word in regard to poisons. I advise you not to use London purple at all. Do not use it if you can get anything else. You can not depend upon it; it is refuse matter from the manufacture of aniline dyes, was not made for London purple at all, and hence its chemical composition varies.

Use Paris green if you can get it good and pure. Paris green is adulterated largely, and so is London purple. Some states have laws requiring Paris green to contain fifty per cent. arsenic. While this is done in good faith, so as to bring up the poison to the proper standard, it is liable now to be more dangerous than the want of the proper amount of poison, for some now add pure arsenic, and that substance being soluble in water will injure your plants.

I think the best poison to use is arsenate of soda (for biting insects only). You make it by adding two pounds of powdered white arsenic and eight pounds of sal soda to two gallons of water. Indicate on the vessel where the water comes to; put this on the fire, note the time when it begins to boil and keep it boiling for fifteen minutes. Remove it from the fire and add water to bring it up to the original two gallons, which you can easily do by the mark you made on the side of the vessel. If you do not wish to use this substance right away, you can put it in a jug and label it. When you desire to spray, slack eight pounds of fresh stone lime in a little water to form a lime putty or thick lime; place this slacked lime in one hundred gallons of water and then add your two quarts of arsenate of soda from the bottle, and after thoroughly mixing it is ready for use.

You are troubled, perhaps, as much with the codling moth as any other insect unless it be the canker worm. You can rid yourself of the pest to a great extent by the use of poultry in the orchard and bands of brown paper or burlap around the trees; and examine these trees every week during spring and summer in order to take away the cocoons or pupae which will collect under them.

But we have to spray our orchards if we wish to fight the codling moth to the best advantage. Bear in mind that this moth hatches out early in the spring and commences to lay her eggs soon after the blossoms fall from the apple trees. These moths are continually hatching out throughout the summer and laying their eggs in your apples. They have three broods in this country; these broods overlap completely, and hence the continual laying of eggs. The second and third broods come from the first brood, hence we try to kill the first brood and let the second and third broods take care of themselves.

Take this arsenate of soda in the proportion that I have given you (or one pound of Paris green, three pounds of stone lime, one hundred and seventy-five gallons of water,) and spray your trees thoroughly one week after the blossoms fall. Repeat the spraying eight or ten days after that and keep this up for four successive sprayings. If it rains, spray again and do not count that spraying. If you do not propose to spray four times do not spray at all; it is an absolute waste of time and money. You must regard the fighting of this insect like fighting an illness. You can not cure yourself with one dose of medicine, you must keep it up, and it is the keeping up of the treatment persistently and thoroughly that means success. Hence in fighting the codling moth, if you do not intend to keep up the spraying do not spray at all for this pest. If you follow these directions in your home orchard, you will have fifty per cent. better apples and more of them to bring to your local markets as well as fewer wormy apples to eat at home. In a commercial orchard it is absolutely necessary to spray.

Mr. ——————We had quite a lot of moths this fall, were they codling moths?

Prof. Stedman.—The codling moth hatches all the time during the summer and you can find the larvae right now in your cellar apples. They keep on hatching until cold weather checks them. These insects take nearly a month in coming out in the spring and a month to lay their eggs. If your neighbors have a great number of codling moths, you can fight them in your orchard and not do much good by your killing the first brood, because the codling moth will fly from his orchard and lay eggs in your orchard after the spraying season has passed.

Mr. Goodman.—Then you would not advise any one to spray for the codling moth unless his neighbor does?

Prof. Stedman.—If you have a neighbor within a quarter of a mile of you and he has a good sized orchard full of codling moths paying no attention to it at all, I would hesitate to spray my orchard under these conditions, unless I went to the expense of keeping the spraying up all summer, which no one can afford to do and expect to make money.

Mr. Goodman.—How then can we get a check on these insects by spraying one row in an orchard?

Prof. Stedman.—In that case we get nothing like the results we could get if we could rid the neighborhood of codling moths. Of course, we can see some benefit if we do not wait too long, but I am speaking now to these gentlemen of the dollars and cents saved. Your orchard will be benefited by spraying, of course, but the question is if your neighbors' orchards are neglected and badly infested with moths will it pay you for your trouble. I do not believe it will. If I had a small orchard and my neighbor's orchard had codling moths I would not fight them if I were in the business for the money. If you have a commercial orchard, that is an entirely different thing; then you must go ahead and fight the moths though it is an uphill business if you have a near neighbor to contend with who does not; but the home orchardist can not afford to fight the codling moth if he has an immediate neighbor who is paying no attention to it whatever.

Mr. King.—Is it not true that the logic of your discourse as stated here, would stop all spraying except in commercial orchards?

Prof. Stedman.—For the codling moth under the above conditions, yes; but if you could only cause the people of your neighborhood to take up spraying, it would all tend to increase spraying. Work up a sentiment to get the people with home orchards to spraying. A man with a home orchard may afford to spray when a man with a commercial orchard can not. You would rather give more per half acre for your little home orchard than you would give for hundreds of acres; that would mean something; but when you take into consideration that within a quarter of a mile or less is a large orchard, not sprayed, you must figure out whether you can afford to spray or not. If you are, however, depending upon that orchard for your living you are bound to spray it. Four sprayings are effectual if you can control a very large orchard and have your neighbors spray, especially your immediate neighbors. You will find not one wormy apple in five hundred if you keep up the spraying. It is a perfect success where you can control enough territory.

I wish to call your attention to a little brown beetle, known as the shot or pin-hole beetle. I speak of this because of the fact that many of your trees are going to die from the effects of last summer's drouth. The drouth last summer, while it did not kill many trees outright, injured a great many trees. If you go into your orchards in neighborhoods where the drouth was worst you will probably notice that limbs of the trees are dead, although the tree went into winter conditions apparently all right. That weakening of the tree due to the drouth has attracted this bark beetle, and I noticed while traveling last month that many orchards are seriously damaged by this bark beetle, which would not have attracted particular attention at all, had it not been for the excessive drouth. In an orchard where I have been making observations, I find the trees went into winter conditions all right, but today they are almost half dead, having dead limbs as large as my wrist; and the immediate cause has been the bark beetle. You will find they have infested the trees in immense numbers. I would advise you to go through your orchards and cut into the bark with a knife; you can tell by shaving the bark whether the limb is dead. Cut off these dead limbs and burn them right away. Do not wait until spring for the beetles to hatch and infest other parts of the tree that are now healthy.

I wish to say a word in regard to the aid birds render in ridding you of these insects. Birds do more good than you may suppose, they are not only a remedy, they are a preventive. The woodpeckers, the sap-suckers, the yellow hammers and the like are working away, pecking holes through the bark of your trees hunting for grubs which are there. I was talking recently with a gentleman who had been shooting his sap-suckers and woodpeckers because they had pecked holes in the bark of his trees. He did not know that these birds were hunting for the grubs. Do not shoot the birds.

Mr. Maitland.—Do they find grubs in the telegraph poles?

Prof. Stedman.—I have reference to the slate pencil holes. The woodpecker never takes a healthy tree in which to make his nest, he always takes a dead limb and that is what he is doing in the telegraph pole.

There are other insects likely to cause you trouble that I have not yet mentioned. In fact I have mentioned very few. I want to say a word in regard to the flat-headed apple tree borers. Mr. Murray has advised you to use wooden tree protectors and that is all right. In addition to that, I would advise you to let the birds pick out the borers because the larvae work in the tree three years and if you do not get rid of them the first year, they will do more damage the second year than the first. Do not put wrappers around peach trees. You can whitewash them, but the wrappers will tend to collect more of the borers than if they were not there; but it is a good plan to allow the woodpeckers, and the sap-suckers to get down around the roots and pick out the grubs.

Mr.——— Do blue jays do any good?

Prof. Stedman.—The blue jays do a great deal of good in killing insects.

Mr.——— The blue jays destroy apples.

Prof. Stedman.—Did you ever see them do it? I did not know that the blue jay would injure fruit, but I would not kill them for what little fruit they may eat.

Mr.——— I saw this spring in my own orchard, places on the trees that looked as though some one had inserted a pen knife for a quarter of an inch. The bark had been cut and caused an outward growth from the inside.

Prof. Stedman.—Two insects do that work. The seventeen year locust does that whenever it hatches out in sufficient numbers, but that insect only comes at certain times. Another insect which is with us all the time, which does the same damage, and sometimes it is quite serious, is the Buffalo tree-hopper. It lays its eggs in the small limbs of apple trees and these places are caused by the female pushing her ovipositor through the bark and wood itself. The bark settles down and you see the fibers sticking out. These insects will injure the twig greatly by depositing their eggs. When the eggs hatch the young insects leave the tree and feed on various kinds of weeds and uncultivated plants. Then the adult goes into the orchard and lays its eggs. Keep your weeds down and you will do away with the plants the insects feed upon. It is the orchardist who allows weeds and grass to grow in his orchard or a near field that has this trouble.

Mr.——— I keep my orchard plowed good in the fall of the year and cultivate it thoroughly.

Prof. Stedman.—Are there weeds growing in some adjoining field?

Mr.——— No, there are pastures on two sides and a pike road on the third and a garden on the fourth.

Prof. Stedman.—Then they are not numerous enough to do any damage.

Mr.——— I do not think they do any damage to the trees. I have taken my knife and gone over the trees and cut the places out to see if I could find any larvae. I could not find anything with the naked eye and failed to put it under a microscope.

Prof. Stedman.—It is the work of the Buffalo tree-hopper, but I have never known them to do any serious damage where a man kept his orchard and the surrounding fields clean.

Mr.——— Would it be safe to plow an orchard now?

Prof. Stedman.—I am not a horticulturist, but an entomologist. If I should advise plowing, it might be just the opposite to what you ought to do.

Mr.——— Does not clean culture keep down the canker worm?

Prof. Stedman.—Yes, clean culture is the best thing in the world for ridding one of insects.

Mr.——— Is the worm found in the hickory pole the same as the apple tree borer?

Prof. Stedman.—The twig girdler in the living hickory tree is exactly the same; that in the post is an entirely different worm. The apple tree borer will work in the pear and plum tree as well as in the apple tree.

Mr. King.—Would you advise spraying for the ash tree worm?

Prof. Stedman.—If you find the larvae there and spray with arsenical poison, you can kill them. But the adults will fly over there and lay their eggs there the next season. They only raise one brood a year.

Mr. King.—Do you advise not to kill the jay birds?

Prof. Stedman.—I do not believe we should kill a single bird. Some birds do a good deal of mischief; I have known persons who said they could not grow cherries on account of robins, but the robins get as many worms as cherries.

Mr.———Did not the jay birds eat apples this year?

Prof. Stedman.—Many people confuse the injury done to apples by birds with that of the climbing cut worm or leaf tree roller. You can always tell the difference. The latter will make a more or less circular or irregular place where it has gouged the apple while the bird will make a V-shaped mark where the beak was inserted, exactly like a chicken.

Mr. Goodman.—The birds ate a good many apples last year.

Mr. King.—The jay bird has been a problem at our house for two years because it injures the smaller birds and this year it carried off the chickens. I want to know if they are of any special service that would make it wise to protect the chickens and not kill the jay birds.

Prof. Stedman.—I cannot answer that from personal experience or anything I have read. I do not know that I ever examined a jay bird's stomach. I have examined thousands of crows', hawks' and blackbirds' stomachs and I recall now the fact that every single bird that has been studied thoroughly by the United States Department of Agriculture, heretofore considered a rascal, has turned out to do more good than harm. Such is the case with the crow, the hawk and the owl. You remember as a boy you thought it great sport to chase down a hawk or crow, but they really do more good than harm even though they do catch some of our chickens. Where they get one chicken, they get hundreds of moles and mice.

Mr. Goodman.—The jay bird kills a thousand insects where it attacks one apple.

Mr.——— Is there more than one species of leaf tree rollers?

Prof. Stedman.—Yes, a great many species. The leaf tree roller of the hickory tree and fruit tree is very different.

Mr.——— Will trees infested with the leaf roller bear nuts?

Prof. Stedman.—Yes, on limbs not infested with them. The leaf roller will eat the young fruit when it is tender.

Mr.——— I am sorry to hear that you think cedars are injurious to fruit. All of my trees died except the cedars this year.

Prof. Stedman.—Are there cedar apples on them? As long as they are free from cedar apples they are all right. You can easily pick them off if you will take the trouble to do that.

THE FRUIT INDUSTRY OF MISSOURI.

By N. F. Murray, Oregon, Missouri.

We have in Missouri ten millions of acres of the finest fruit lands in the world. They are to be found along our great rivers and their tributaries and all over South Missouri. Counting all the orchards, vineyards and fruit gardens of the State, both farm and commercial, we have one million acres in fruit, which annually sells for from ten to twenty millions of dollars.

This fruit is of the highest quality, superior to that of the Eastern States or of California; in evidence of which we call attention to scores of gold medals and diplomas awarded to and now in possession of the Missouri State Horticultural Society, and individual members of the same, at the great expositions of the world, over the fruit from all other states and foreign countries.

Some of our home people, finding imperfect, wormy Missouri fruit in our home markets, and more perfect specimens from different states, are inclined to doubt the truthfulness of this statement. This is simply because they overlook the very important fact that all fruit growers from Maine to California carefully select and pack the best and most perfect of all their fruit for distant markets. No other kind will pay a profit over transportation. The culls and wormy trash are kept for home consumption. Many people, of late years, are asking why they cannot buy Missouri apples that will keep; it is for the reason that our perfect apples are sold to large buyers and they go to our large cities and to Europe.

In going out to California last year we noticed many train loads of fruit from the Pacific Coast consigned to the large cities of Missouri and the East. Of course California has the advantage of us in being able to produce semi-tropical fruits, oranges, lemons, foreign grapes, figs and English walnuts and we naturally expect her to furnish these to our markets; but why should we expect her to furnish Missouri with apples, pears, peaches, plums and cherries in a fresh state, and then stock up all the grocery stores in every city and village in our State with canned and evaporated fruits? And yet this is just what they have done, are doing, and will continue to do, so long as we are willing to let them. They grow these fruits on land worth from two to five hundred dollars per acre, pay heavy freights and sell it at a good profit in our cities. Is it not time that Missouri should awaken to her wonderful possibilities in fruit growing?

But some one will say, if these statements are true, and fruit growing in Missouri is successful and profitable, why is it that she is so slow developing her fine fruit lands? For the reason that Missouri is a State of diversified industries. She is not under the necessity of going to market with her eggs all in one basket; she has always been noted for her live stock, agricultural and mining interests. As Missouri has excelled in these interests for a generation, it is but natural for the son, as a rule, to follow in the footsteps of his father and as he did well in these industries, it has been but natural to adhere to the old adage, let well enough alone; hence our people have refrained from entering into what, to many of them, would have proved a more profitable industry, commercial fruit growing.

OVERPRODUCTION OF FRUIT.

Some fear an over-production of fruit; I do not. I have heard the warning cry from timorous souls for forty years that we were sure to have an over-production of fruit! What is the actual condition? What are the facts as to an over-supply of fruit? What about the increased population of the country as compared with the increasing supply of fruit? In the time that it has taken the population of the United States to double, her fruit supply has increased five-fold. In the face of this, we would naturally expect fruit to decline in price. Has it? No indeed; but on the other hand it has gone up and up in price, till it is now beyond the reach of the common people, and only the rich may indulge in the use of ordinary fruit. At the present time one bushel of good apples is worth two bushels of wheat or corn!

We know of apple orchards this past season that sold for two hundred dollars per acre, peach orchards that sold for as much and in some places more, and strawberry beds that sold for from one to three hundred dollars per acre!

In the face of all this, with our millions of acres of superior fruit lands that can be bought at from five to fifty dollars per acre, with a splendid home market and an ever and rapidly increasing foreign demand for all our fruit, shall we continue to let the masses go hungry for fruit and the tables of the rich be supplied with inferior fruits from distant states at extortionary prices?

ALFALFA.

By R. W. Clothier, Cape Girardeau Normal.

Ladies and Gentlemen—You have asked me to talk to you about alfalfa, but I will say that in the brief time allotted to me I cannot begin to tell you all that you ought to know about this valuable plant. It has been justly called the "wonder plant of the 19th century."

It will yield annually several tons per acre of the most valuable stock feed, while at the same time the soil upon which it grows is continually becoming richer. As a stock food it has no equal among hay crops and there are few grains that excel it. It is richer pound for pound in muscle and milk forming elements than wheat bran. When substituted for corn fodder in rations for fattening steers, one-third less than the usual amount of corn is required to put them on the market. Experiments to determine its feeding value have been performed at the Experimental Stations of New Jersey, Michigan, Nebraska, Kansas and Colorado and their results place its value at from $12 to $34 per ton, depending upon the kind and age of the stock to which it was fed. The fertilizing elements contained in it alone figured at their commercial prices are worth $9.50 per ton of hay. All animals eat it and thrive upon it—even chickens. I know of a herd of sixty brood sows that were wintered upon one peck of corn per day and all the alfalfa hay they would eat, and they came out in excellent condition.

But you are waiting for me to tell you how to grow it. I will give you directions in accordance with the experience of the most successful growers.

THE SOIL.

Alfalfa will grow and yield good crops upon any soil that will produce good yields of corn, oats or wheat, and upon some soils that will produce meager yields of these crops. It responds readily, however, to rich soils and manures and is valuable enough to be given the best soil you have upon your farm. Being a tap-rooted plant, the soil upon which it grows should not be underlaid with solid rock, unless it is several feet below the surface. This is even more true in the case of impenetrable clay. The plant does not do well where water stands upon the surface, or where the ground water stands within two feet of the surface for any great length of time, though it is said to be doing nicely in the neighborhood of Caruthersville, Missouri, where the underflow of the Mississippi comes close to the surface for some time each spring. From what I have seen of the soils of Southeast Missouri, I believe alfalfa will be at home here if you once get it started.

PREPARATION OF THE SOIL.

The young alfalfa plant is tender and every means possible should be taken to make its early home comfortable. The soil should contain plenty of available plant food and be in good tilth. Some well rotted manure, thoroughly incorporated with the soil, or a good nitrogen fertilizer, would not come amiss, especially if the soil has become somewhat depleted of its fertility. Plow deeply, harrow and allow two or three rains to fall upon the plowed land before seeding. The subsurface soil should be well packed and if there is not sufficient rain to accomplish this result the same thing can be secured by harrowing several times at intervals of from five to ten days. From four to six weeks is not too long to wait after plowing before seeding. Observe this point well, for it is vital to your success. One of the greatest causes of failure is seeding too soon after plowing. In no case should the seed be sown with any other crop. A gentleman just told me he had drilled his alfalfa in with his wheat and complained that he had not yet seen any plants. He never will see any.

TIME OF SEEDING.

The time of seeding depends upon the condition of the soil and the amount of moisture in it. If these conditions are right it may be sown any time between April 1st and September 15th. Do not sow too early. Wait until the soil is warm enough to bring up the young plant quickly and start it out upon a rapid growth. When you get ready to seed, if there is not plenty of moisture in the soil, wait until there is, if you have to wait a year.

The few alfalfa growers whom I have met in Southeast Missouri have been successful with spring seeding. Spring seeding gives the best results where the land is not too foul with weeds, because the risk of loss from dry weather is less at this time than at any other part of the season. Occasionally a good stand from spring seeding is killed by cold, wet weather, or by heavy beating rains occurring soon after the young plants emerge from the ground. Weeds are the worst enemies to spring seeding. Unless you can entirely control them, you will be obliged to resort to fall seeding. Foul land may be cleaned by cultivating a crop of cow peas upon it during the summer and when this crop is removed the land is in excellent condition for seeding to alfalfa. If there is enough moisture in the fall, I see no reason why fall seeding should not give excellent results in Southeast Missouri.

AMOUNT OF SEED AND MANNER OF SOWING.

The most successful alfalfa growers recommend from 20 to 30 pounds of seed per acre. If every seed should produce a plant this would be much more than is needed, but since this is never the case, I would not recommend less than 20 pounds. The seed should have a high percentage of vitality. There is no way of judging of its quality in this respect except by testing it. This may be done in the following manner: Fold a piece of flannel cloth and cut it so it will fit into a common dinner plate. Put one hundred average seeds between the folds of cloth. Keep the cloth moist, but do not cover it with water. Put a pane of glass over the plate to prevent too rapid evaporation of moisture and set it away in a warm place. In a few days the seeds will begin to sprout and the germinated seeds may be counted and removed each day. The percentage of seeds that will germinate within eight or nine days by this treatment will be about equal to the percentage that may be expected to germinate in the soil. Poor seed should either be rejected or the amount per acre proportionally increased.

The seed may be sown broadcast and harrowed in, or it may be drilled with a press drill set so as to run not more than two inches deep. If drilled the seed should be mixed with corn chop or wheat bran to insure even distribution and should be drilled both ways.

CULTURE.

If the land is seeded in the spring, the weeds must be kept down during the first year by frequent use of the mowing machine, the bar being set so as to run not closer than to within two inches of the ground. Do not let the weeds grow higher than six inches, for they will shade the plants, causing a spindling growth and when the weeds are finally cut the hot sun burns the tender plant and kills it. If your land is foul with crab grass or similar grasses, you cannot succeed with spring seeding.

Do not pasture it the first year. Give the plant a whole year in which to get started, and it will produce bountiful crops every year thereafter for a life time. I know a field that was seeded in 1884, which has produced a minimum of three crops every season since the first year, and it is still at work.

After the second season the plants are greatly benefited by discing after each cutting. This splits the crowns and causes them to send up new plants. Ten average roots from a field not disced produce an average of 16 plants per root, while ten average roots from a field that had been disced produced 35 plants per root. Discing also conserves moisture in the soil. At the close of our hundred days drouth last season I found fourteen per cent of moisture in the first fifteen inches of soil in an alfalfa field that had been disced, while adjoining corn fields contained but nine per cent. The alfalfa was fifteen inches high and this was *the third crop of the season.*

INOCULATION OF SOIL.

Like clover, alfalfa possesses the power of utilizing nitrogen from the air and it is this fact that makes it one of our best fertilizing plants. As in the case of clover, this power is due to bacteria that live in the nodules or tubercules found on the roots of the plant. The germs of these bacteria seem to be in many cases indigenous to the soil, but in other cases they are not. It would be safer to inoculate the soil by securing a little soil from a field known to contain the bacteria and sow it with the seed or upon the roots of the young plants. Soils deficient in lime are not apt to contain the bacteria. There have been cases reported where alfalfa could not be grown until the soil was inoculated in the manner described. If a portion of the field is inoculated the bacteria will spread rapidly to all other parts of the field.

HARVESTING.

The best quality of hay is produced by cutting just as the plants are beginning to bloom. If cut always at this time, an extra crop can be secured at the end of the season, which compensates for the increased yield per crop secured by cutting at a more mature stage of growth. Let the hay wilt in the swath and them rake into the windrow, where the process of curing is completed. Stack with as little handling as possible since the dry leaves drop off easily and they are by far the most nutritive portion of the plant. Do not let the hay get rained upon before stacking, as one heavy rain will completely ruin it. It may be stacked in the open or under a roof built for the purpose, but is apt to mold some when stored in a hay mow. If stacked in the open the stacks should be covered with a tarpaulin or with some grass that turns rain easily.

FEEDING.

Alfalfa hay may be fed to horses, cattle, calves, steers, sheep, lambs, hogs, pigs, etc. In feeding to horses it would probably give better results if mixed with some other kind of hay, such as timothy or prairie hay. It should not be fed to a horse immediately preceding a long rapid drive. With a few pounds of corn alfalfa hay makes a perfect ration for dairy cows. No better ration than equal portions of corn and alfalfa hay has even been discovered for fattening steers. In feeding remember that it is worth as much, pound for pound, as wheat bran and govern yourself accordingly.

PASTURING.

Alfalfa makes excellent hog and pig pasture, but in some cases the swine will root down and bite off the crowns of the plant, thus greatly damaging the stand. It would probably give better results to cut the plant green and feed it to the hogs in the pen or hog corral. Alfalfa causes bloat in cattle and sheep, and pasturing with these animals is always attended with considerable danger. There are two or three men who report having mixed alfalfa with Kentucky blue grass and they claim that such a pasture never produces bloat. I believe the experiment is worthy of an extended trial.

In conclusion, let me express the hopes that the farmers of Missouri will soon give alfalfa an extensive trial, and if they do so, I feel certain that their efforts will be crowned with success.

KEEPING UP THE FERTILITY OF THE SOIL.

By C. D. Lyon, Higginsport, Ohio.

Every farmer must recognize the fact that the continuous growth of any grain or grass crop upon the same land must sooner or later reduce the fertility of that land until there is no longer a profit in crop growing.

There are three ways of keeping up the fertility; first, by the purchase of manures, second by the rotation of crops and third by growing some crop which adds fertility to the soil instead of taking it out.

Excepting in very rare cases the first method is neither practical nor profitable, but it may in a measure be combined with the third method with good results.

Before we go into the question of keeping up the productive power of our farms, we will look for a moment at this point; what constitutes fertility or plant food? There are three elements of plant food that we will speak of, as they are the most important, and the ones most apt to be exhausted; they are Phosphoric acid, Nitrogen and Potash.

Taking what may be called an average yield per acre of the usual farm crops, they take from the soil plant food in pounds as follows.

Crop.	Yield......	Nitrogen...	Phosphoric acid......	Potash......	Value......
Wheat..	20 bu.	28.	9.5	6	$4.88
Straw..	2,000 lbs.	12.	2.5	10	2.40
Corn..	35 bu.	35.5	13.5	8	6.25
Fodder..	2,000 lbs.	21.	6.	28	4.80
Oats..	35 bu.	22.	9.	7	4.00
Oat straw..	1,600 lbs.	10.	3.	20	2.60
Timothy hay..	3,000 lbs.	38.	16.	27	7.70

• Nitrogen 15 cts. Phosphoric acid 4 cts. Potash 5 cts per pound.

Now when a farmer sells the twenty bushels of wheat from that acre for seventy cents per bushel and burns the straw, he has been in partnership with nature, share and share alike, for he has sold $7.28 worth of fertility and has received $14, a profit of $6.72. With the corn crop at forty cents per bushel he has not done so well, as his profit is only $2.95; and with the timothy hay at $7 per ton, a little more. So it may be seen that the real profit in selling such crops is very small when the depleted condition of the land is taken into account, as it must be remembered that each succeeding crop must be smaller, as the drain upon the soil goes on year after year, with no attempt at keeping up the fertility by manures or rotation.

There are other crops that may be grown which are not so exhausting to the soil, as nature has given them the power to take the nitrogen necessary for their growth from the air, and to store it in their substance. Let us look at this table, No. 2:

Crop.	Yield....	Nitrogen...	Phosphoric acid.....	Potash....	Value.....
Clover hay	3,000 lbs.	62	12	66	$13 10
Cow pea hay	4,000 "	78	20	59	15 45
Alfalfa	4,000 "	88	20	67	17 35
Bran	2,000 "	53	58	32	11 90
Cotton seed meal	2,000 "	136	59	17	23 55

The bran and cotton seed meal are mentioned to show their value as fertilizers, as they are standard feeding stuffs and are often purchased with reference to their food value alone.

On our clay loam soils of Southern Ohio we depend upon rotation of crops, using clover in the rotation, as a means of keeping up our lands, and this where we grow large crops of tobacco, which is usually considered to be an exhaustive crop. Where we break a twenty-acre field, the usual plan is fourteen acres of corn and six acres of tobacco, all the manure from the farm being used upon the tobacco crop, and sometimes we use a fertilizer carrying twelve per cent phosphoric acid, three per cent nitrogen and three per cent potash, at the rate of two hundred pounds per acre, in the hill as "a starter" for the tobacco crop.

The corn is cut and shocked in the fall and the entire field sown to wheat, using 125 to 160 pounds of 15 per cent phosphoric acid fertilizer per acre, applying with the grain drill. The fodder is fed under cover to our stock and all the manure saved. Two or three days after seeding to wheat we sow broadcast a gallon of timothy seed per acre, and the following spring, between February 15th and April 10th we again seed to clover and timothy seed, two-thirds clover to one-third timothy, at the rate of a bushel to 8 acres.

As soon as the wheat will do to haul in, it is stacked or put away in the barns, as we do not like to see the spring grass killed out by the shocks standing too long. The grass and clover is clipped with the mowing machine in August and sometimes again in September, as this tends to thicken the seeding and to keep down the weeds. We pasture but little the first fall and do not turn in stock the next spring until the ground is well dried out and the grass has made a good start. This field lies in clover and timothy two years, when it is again broken for a crop; there is seldom any hay cut even for home use, and the land is not often pastured closely. As for crops, let me say that on land that has been cleared from the original forest, more than one hundred years, we often grow 1,500 pounds of tobacco, 50 to 75 bushels of corn or 35 to 50 bushels of wheat per acre, and the land has been treated as I have indicated, as far back as the memory of man extends; land really seems to be getting better in the past 25 years, or at least it now produces better crops than when I was a boy, forty years ago.

Few farms, and even few fields are of uniform fertility all over as there is often ridge land, thin by nature or "points," where the soil washes away. We have made great progress in renovating such places in the past ten years with the cow pea, planting them on thin spots in the regular crop years, and allowing them to rot down where they grew. The most rapid improvement of a thin point I ever saw was on an almost barren clay knob, where a crop of cow peas was "hogged down." This land without the cow peas would not have grown oats six inches high, yet after the cow pea crop it made a full average crop, and what was better, gave a good stand of grass, something unknown on that point in more than thirty years.

It is to the cow pea that we must look for the cheapest and best method of bringing up soils which have been robbed of their nitrogen and humus by years of continuous cultivation in one crop, without manuring. Perhaps the best known plan is a rotation of cow peas and wheat, with the addition of 150 to 200 pounds of fertilizers, carrying 15 per cent of phosphoric acid per acre, used in the drill with the wheat. As soon as the wheat is harvested the land may be plowed or even disked and cow peas sown at the rate of about a bushel per acre. If one wants to get the greatest possible good from the peas, they should be mown for hay or hogged down, the land disked or otherwise well prepared, and again put in wheat, as with the disk drill, the vines and stubble will not be in the way. By pursuing this method, I have known land brought up in four years from a yield of three bushels of wheat per acre to a yield of twenty-four bushels, the respective crops being 3, 8, 15 and 24 bushels per acre. The first two crops of wheat had the peas turned under and had 150 pounds of acid phosphate per acre; the second two years the peas were cut for hay and only a hundred pounds of fertilizers per acre used. Before the peas were grown the soil was hard, tough and sterile; now it is dark, mellow and fertile.

There are several standard varieties, New Era and Warrens Extra Earley being the earliest. I have grown the latter, it having matured seed with me in 54 days from planting. It is perhaps the best variety for hay as it is very upright, has a good stalk, is hard to shell out and retains its leaves better than any other. Large Early Black is the best variety to grow in drills for hogs, it stands upright fairly well, is an enormous yielder of large, well filled pods and it does not shatter badly. It has matured pods for me in from 60 to 65 days. The Whippoorwill sprawls somewhat, loses its leaves when nearing maturity, but yields well and is a favorite in southern states. It matures in from 65 to 70 days, or less. Most of the other varieties are later, the Renovator, Clay and some others seldom maturing seed north of the cotton belt.

Cow peas should not be planted until the ground is thoroughly warmed up in spring; about two weeks after corn planting is early enough, as they will not grow well until the weather gets warm. The earlier varieties may be planted as late as July 25th, and I have had Warrens planted as late as August 10th, to mature a good crop of seed, but it was a favorable season with late frost.

Grow your own cow pea seed, plant on land of medium fertility, never on very rich land; in drills 28 to 30 inches apart, 10 or 12 seeds to the foot; cultivate them well and gather the pods as they ripen; thresh them with a flail or even a stick in a tight wagon box or on a floor in the barn. All will agree that picking seed in this way is hard and tedious, but in this way alone can we secure reliable seed that is sure to grow and which is adapted to our climate. A sixteen-year old boy can pick from two to three bushels of clean seed per day, and it will be several years before such seed will be worth much less than $2 per bushel.

Get your stock of seed of some reliable seedsman remembering that seed grown east and north is much better than that grown south. I have known complete failures to result from southern seed, where seed of the same variety grown in Ohio two years made a full crop.

In talking with farmers from Lake Erie on the north to the southern limits of Missouri and Chattanooga, Tennessee, on the south, I have found but very few men who have ever tried the cow pea as a soil renovator, who did not recognize in it the best means of keeping up and restoring the fertility of the soil, and I regard it as the most valuable addition to our farm crops made in the past fifty years.

NATURE STUDY IN THE PUBLIC SCHOOLS.

By S. A. Hoover, Professor of Agriculture, Warrensburg Normal.

EDUCATIONAL VALUE OF NATURE STUDY.

Mankind has many things in common with other animals. The mother love is one of these. In all of the higher animals with few exceptions, the mother will risk her own life to save her young. Another common trait among animals is faithfulness. The dog will follow his master into any danger. Even cruelty will not drive him away. He has been known to remain with the dead body of the loved one until death ended his vigil. Animals, like man, have their friendships. A horse becomes so attached to his mate that he becomes almost frantic when separated from that mate. Other characteristics they have which show their close relationship with human beings.

Some of these are love of power. Among animals which herd together there is one master. As among savage peoples, there is frequently a battle royal to settle, by strength of body, the leadership of the herd. The peacock when strutting about, admiring his own beauty, or hiding in shame when that beauty is gone, is strangely like his relative, man.

While brute beasts have certain traits in common with humanitv, there are others which they do not have. Man is the only animal capable of self improvement. Domestic animals are trained to do certain things, yet these animals have no power to train themselves. Even the highest man-like apes are no further advanced than they were thousands of years ago. They warm themselves at the fires left by savages in the forests, but they have never learned to renew the fire by putting wood upon it. Although they have seen the rude hut of the Bushman, yet they have never tried to imitate man by building a hut for themselves.

Man has risen by degrees from the most primitive state to his present exalted place through successive steps.

A recent German writer supposes that all improvements *made* have been the result of observations. When in stress of weather man sought the protection of a hollow tree or of a cave, he received the idea of making a protection for himself when neither tree nor cave was to be had. Again as an improvement on nature he twisted together two or more branches of the friendly tree which gave him shade or protection from the storm. The floating log was probably the forerunner of the raft, and finally of the great ocean steamer. The war club was suggested by the arm and the fist; the chisel and the saw by the teeth and the rows of teeth; and, finally, the awl and the scraper by the finger and its nails.

All the culture of the race has come through observing how Nature does things. Through these observations man has come up to his present high state of civilization. From a naked savage, with naught but his own hands to fight his battles, with savage monsters around him, with no shelter except what Nature gave, he has arisen to be the monarch of all the earth. In the fierce battle he has come off victor. Not only has he subdued the animal life of the earth, and made it minister to his wants, but wind and water are made to do his bidding. From the floating log has come the mighty steamer, which sets at defiance the wildest storm. The home and the palace have taken the place of hollow tree and the cave. Instead of the arm and the fist is the great rifled gun throwing a shot twenty miles. Every step in this progress of the human race was the result of Nature Study.

Man has now become so highly civilized that he is losing his touch with Nature. It seems as though there are no more worlds to conquer, and all one has to do is to step in and enjoy the rich heritage for which others watched and labored. We do not need to watch the boiling teakettle, as did a Watts, or the falling apple, as a Newton, but the Universe holds many secrets which it has never yielded up to man. If these unsolved problems are ever solved the solution must come through the same methods which have been used in the past. If Nature reveals to us any of her hidden mysteries, these must be sought in the way she points out.

If for no other reason than the foregoing, children should be brought in close touch with this kindly mistress who has done so much in the past to bless the race.

Man is a very complex being. He has at least three natures. First is his body, and this is the home of the real man, the mind. When the *man* moves out of this house it falls into ruins. While he lives in it though, it should be strong as possible, lest the tenant be uncomfortable. Of prehistoric man we know but little, but what little we know, shows us that our savage ancestor had a superb body. Without weapons except the rudest, he fought with and conquered the cave bear and the cave lion. As he emerged from the darkness of primitive times into the dawn of the historic, every well ascertained fact shows that he was strong of body, keen of sight and fleet of foot. He was compelled to fight for the privilege of living. Not only was this fight with savage beasts, but with equally savage men. Nature compelled him to stay much in the open air and to live upon the plainest food. Of the modern contrivances which weaken the body he knew nothing. When he walked or ran, so far as we can get glimpses of him, his body was erect.

While we do not want to go back to a state of savagery, we *do* want the strong body and splendid *physique* of this child of Nature who lived in the forests so long ago. Nature Study should include the care and training of the human body. To do this requires no expensive apparatus, no well equipped gymnasium. We only need what Nature has placed in easy reach of every one, exercise in the open air. In all our pictures of early man he is shown with a wide chest and an erect body. All of his muscles had been trained and his exercise caused him to breathe deeply. Nature teaches us now the same thing. Instead of bending over we must make ourselves as tall as possible, in standing or in walking. This one little item in Nature will do more to give an erect carriage than all the elaborate training in physical culture. It brings into place and strengthens every muscle of the trunk. It gives one self-respect and causes him to look his fellow-men in the eye. No one who slouches has much self-respect.

Again Nature Study takes us into the open air, into the pure sunshine. The best tonic in the world is a sun bath. The change from the school room to the woods and the fields is itself a tonic. To see the green trees, to listen to the songs of Nature's sweetest singers, to watch the insect build its home, to get glimpses of color such as no painter can ever make, all these send the blood in quickened pulse beats through the frame and make it a joy to live.

If the study did nothing but this it would have an educational value far beyond the power of mathematics to compute. What are intellectual achievements worth in a weakened body? Good health and strong vigorous body fit one to win in the battle of life. Without them defeat is almost certain.

MENTAL VALUE.

True culture developes the whole mind. Pupils are not expected to become specialists until after they have a good general education. They are certainly not prepared to become specialists either in the primary or secondary schools. Nothing tends to widen the intellectual view more than Nature Study.

The pupil comes in close touch with living things. He sees the connection between the inert soil and the live plant, and between the plant and the animal. He learns that no two things are alike, yet that some things are closely related. He also learns that all living things have certain characteristics in common.

This cultivates the power of observation and makes the difference between success and failure in any calling.

1. Close observation is needed by the farmer. He must know the strong and the weak points in a horse. The mark of a good milch cow must be familiar to him. His knowledge of a steer which will feed out well must be accurate. His observations have taught him the difference between a fertile and an unfertile soil, and why a certain crop fails on one kind of soil and succeeds on another. Also why some fields are overrun with weeds while others are free from them.

The young man who takes up farming now meets different conditions from those of a generation ago. Then competition was not so fierce as now and the soil in the Middle West was unexhausted by crops. Where formerly fifty bushels of corn was the yield, now hardly more than twenty-five may be raised. Weeds abound in many cases simply because the soil has become too poor for grain or cultivated grasses. Such being the condition of things, the young man who chooses farming as an occupation must be able to see and to understand things.

2. Nature Study trains the boy so that he will be a better merchant. He will have a finer sense of tne things he deals in, and will give his customers a better class of goods.

3. It will give him a keener insight into the details of professional life. Indeed, whatever the calling in life the young man whose powers of observation are trained will be better fitted to meet its demands than the one who has no such training.

4. Not only is it profitable for boys, but for girls as well. They are better equipped to demand of the world a place by man's side and to achieve victory in the crowded thoroughfare of life. It makes them better housekeepers and better mothers.

5. It teaches drawing and composition. The pupil draws better if he has something to draw. He will compose better if he has something to write about.

6. Nature Study has an educational value in that it cultivates the aesthetic taste. When Turner painted his splendid landscapes he only imitated nature. Any clear day one may see in Missouri a more beautiful scene than ever was put upon canvas by painter's brush. It is more beautiful because real. The one upon canvas is only an imitation.

In the Louvre, that great treasury of art belonging to the city of

Paris, is a wonderful statue, called the Venus de Milo. This statute was dug out of some ruins on the Island of Milos. Although the arms are gone, yet it is regarded as such a great masterpiece that a whole room is set apart for its proper display. The only thing which makes it one of the world's greatest pieces of art is that from the solid marble has been cut a very perfect copy of the human form divine.

NATURE STUDY CULTIVATES THE MORAL MAN.

1. It is said that a fine mechanic is always truthful. The same may be said of the boy or the girl who has learned the great lesson of truth from nature. She is so true and accurate that the pupil who has sat at her feet and imbibed her spirit can never in after life be anything but truthful. We become like that which we admire.

2. It makes the pupil merciful. No boy who has engaged in this elevating work can be cruel to God's creatures. He looks upon life as something sacred. We mean now where pupils have been taught in the proper way and this way is to study living things. The teaching which permits pupils in the primary grades to dissect animals is not true Nature Study. They may within certain limits make collections, but these collections should never include birds or their eggs. The writer was shocked in reading an article about a year ago in a leading educational journal recommending pupils in the public schools to collect birds and their eggs. A teacher who recommends such things has no place as an instructor of youth. There may be collections of insects, provided they are killed in a painless way. Even insects should never be tortured or starved to death.

Any line of study which has lifted humanity from the lowest depths of savagery to its marvelous heights of the present, which strengthens both body and mind and which makes beautiful and happy homes, surely has an educational value beyond the power of words to tell.

NO TIME FOR TEACHING NATURE STUDY.

Almost everything in the way of an educational advance has met with opposition. Twelve years ago people laughed at the idea of manual training in the public schools. They thought that such things as sewing, cooking, or working in wood by pupils was foolishness, and that it never would be taught.

Scarcely a teacher who opposes it can now be found. The teacher of elementary science in primary grades has met with the same opposition. The objectors say that if this is taught, it will leave no time for reading, spelling, grammar and arithmetic. No advocate of this science teaching, believes in doing away with any of these studies. We cannot do without them, but this does not mean that years of time shall be wasted in the solution of puzzles which never did and never will have any practical bearing on the business affairs of life. To solve them is not only a waste of time, but it is a sinful waste of the pupil's nervous energy. The same is true, though perhaps in a less degree, of technical grammar. What is the benefit of the immense amount of parsing and diagramming which is done by the pupil?

Spelling may also be taught in such a way as to be of little benefit to pupils. One never needs to spell a word except when he wishes to write it.

Just here is where Nature Study may be combined with other lessons. Instead of losing on this, the teacher actually gains time, because in the writing up of the Nature Study work, she teaches composition, the correct use of language, spelling and penmanship, as well as the work in science. The teacher who pursues this course will find her pupils doing much better work in all the lines mentioned than if she separated these studies from the practical. After the work is written up it becomes a reading lesson, and when a boy reads something in which he has an interest, he reads it much better than if a lesson had been assigned him in a reading book.

For oral instruction in science, not over twenty to forty minutes a week need be devoted. If properly directed, the pupils will make observations on the way to and from school, evenings and mornings, and when about their work on Saturdays. The teacher may, if she wishes, make short excursions with the pupils at the noon hour. A mere hint from her, that she wants material for this fascinating work will be sufficient to make every boy her willing servant. Rocks, clay, mosses, lichens, ferns, grasses, sedges, toad-stools, puff-balls, insects and reptiles will pour in upon her until she has more material than she can use.

SHOULD BE DIRECTED ALONG ECONOMIC LINES.

While studying Nature the boy should learn some lessons about the farm, and the things which will be of practical benefit to him as a farmer. Especially should he be acquainted with the soil.

Upon the soil and its intelligent cultivation depends, the prosperity of our country. In the wonderful variety of its resources, the products of the soil in the United States hold first place. No other country equals it. Secretary Wilson, chief of the Department of Agriculture in a letter dated August 18th, 1899, says: "Our young people should know more about the soil they walk on and its relation to plants, as well as about the plants themselves and their relation to domestic animals and man. * * * * * Half of the people of the United States are employed in producing from the soil, and all the people of the country prosper because our soil is intelligently cultivated. We sold over twelve hundred million dollars' worth of products last year, mostly from the soil, and we have a balance of trade of six hundred million dollars, because of the productions of our soil; yet scarcely any one has more than a superficial knowledge of the soil."

In most parts of the Middle West the soil is very rich and people seem to get the impression that it will never become exhausted. Every crop, however, takes something from it, and, hence, leaves it poorer. Continually taking out and putting nothing in will surely impoverish the richest soil in America. It would certainly be better for our children to know the soil of their own neighborhood and its capabilities than to know the height and trend of the mountains of Asia. Of the first importance is the knowing how to care for the soil, in order that it may be handed down unimpaired to future generations.

After soils may follow plants and plant enemies.

The enemies which attack the crops belong to both the animal and the vegetable kingdoms.

Rusts, smuts, mildews, blights, rots, etc., are all plants. They belong to a great class of plants called *fungi.*

Along with plant life can be studied animal life. The pupils in the public schools should know that some animals are friends of the farmer, and that others are his enemies. Among the best friends of Agriculture are the birds. Every boy in Missouri should be taught to protect the birds.

He should also learn that while many insects injure crops yet there are many others which are beneficial, because they destroy injurious insects.

In Nature Study he also learns that toads, lizards, and most snakes are among the best friends of the farmer. Many of them work at night and devour immense numbers of insects.

Learning all this, he is prepared to fight his enemies and to protect his friends. A late Agricultural report says when in reference to elementary agriculture as taught in some of the country schools in New York: "Is it not likely that a child who is thus taught will soon begin to see a new value and dignity in farm life and be less envious of the boy or girl who is shut up within the narrow confines of city streets most of the year? And if the farmer's boy learns how to observe accurately the processes of nature with which farm practice deals and the foes with which Agriculture has to contend, are not the chances vastly increased that he will be successful in managing nature so as to get the greatest favors from this coy mistress of his life and fortune?"

A boy who has become interested in farm life is not likely to give up its independence for the struggles of a city life with its bitter disappointments. Perhaps it is because of a lack of this kind of teaching that has led many a young man to forsake the farm for a cheap clerkship in some city, where he is liable, at any time, to lose his place, and where he is barely able to eke out an existence. He has never been able to see any beauty in farming and he longs for the glare and stir of the city. He learns, when too late, that the castles which he erected in air lie about him in ruins. Would it not be better for the teacher to show boys and girls the beauty there is in country life, to teach them how they may beautify their homes by planting trees and flowers rather than to urge them to enter the already over-crowded ranks of clerks, doctors or lawyers?

THE SELECTION OF THE DAIRY COW.

By C. H. Eckles, Dairy Department Missouri Agricultural College.

Success in dairying depends upon several factors. It can hardly be said that one of these is of more importance than another any more than one horse is more important in pulling a load than his mate.

We must have a cow adapted for milk production.

That cow must be well fed and cared for.

The product sold must be cared for and manufactured in the best manner.

The proper marketing of the product must not be overlooked.

To reach the point where dairying becomes profitable, we must give all these points attention, and not confine ourselves to one. Proper care and feeding go a long way towards getting the largest and most economical production of milk, but if the cow that receives these attentions is not adapted by nature for producing milk, the result may be far from satisfactory. The cow is a machine operated on the farm for the purpose of converting farm crops into a more valuable form. Some of these cow machines are best adapted for converting this raw material into beef, while others produce milk from the same feeds. Too many who undertake to carry on dairying fail to select the cows suited by nature for the purpose. Too many times a cow is thought to be about the same as every other cow as far as producing dairy products is concerned, while, as a matter of fact, the difference is very extreme and the nature of the cow may mean success or failure. It has been estimated that at least one-third of the cows used for dairy purposes in the State do not more than pay for their feed, while the profit is made by the other two-thirds. I believe if we could, by a single act, remove every unprofitable cow from the dairy herds of the country the benefit to the industry would be greater than any one other thing that could be done. In discussing the selection of a dairy cow, the question of breed always comes up sooner or later. I am not here as an advocate of any particular breed, as I believe all have their strong points and their value. I do insist that the animal be a good one, whatever the breed may be.

There are a few things worth mentioning regarding the breed question. If the object is to produce dairy products in the largest quantities and at the lowest cost, the breed selected should be one of the special dairy breeds, as the Holstein, Jersey or Guernsey. It is to be expected that these breeds would have this advantage, as they have been bred for generations for this one purpose. However, I am aware that under our present conditions in Missouri, the dairy breeds will not be very largely adopted for some time. I believe the Missouri farmer should make use of what he already has and then improve as rapidly as possible. It is possible to select very good milk cows from the Shorthorns and the Red Polls, and for many these will continue to be the favorite breeds.

The following figures give the result of four years' work in an Iowa herd in charge of the writer:

Number of Cows.	Breed.	Av. yield of Milk per year.	Av. yield of butter per year	Cost feed per pound butter.
18	Shorthorns..............................	5,940 lbs.	279 lbs.	8.5 cents
5	Red Polls....	6,052 lbs.	280 lbs.	8.4 cents
10	Jerseys	5,277 lbs.	340 lbs.	6.6 cents
12	Holsteins..................................	8,338 lbs.	323 lbs.	7.6 cents

The figures go to show that a fair return can be secured for the milk of animals not of the special dairy breeds, but that the latter make the best showing. In figuring the cost of feed, the actual value in the local market was calculated for all feed used, with $1.00 per month allowed for pasture value. The feed was weighed out to the animals in every case.

Among these records we found, as in every herd, some great extremes in amount of production where all conditions are the same, except the individuality of the cows.

The following figures show the difference in production of the best and poorest of each breed in that herd:

RECORD 1 YEAR, BEST THREE SHORTHORNS.

9,896 lbs. milk	474 lbs. butter	cost feed, $27 38
9,326 lbs. milk	449 lbs. butter	cost feed, 23 52
8,046 lbs. milk	381 lbs. butter	cost feed, 24 82

RECORD OF POOREST THREE SHORTHORNS.

3,059 lbs. milk	129 lbs. butter	cost feed, $23 83
2,833 lbs. milk	134 lbs. butter	cost feed, 21 30
2,796 lbs. milk	125 lbs. butter	cost feed, 18 84

BEST RED POLL.

7,225 lbs. milk	361 lbs. butter	cost feed, $25 32

POOREST RED POLL.

5,249 lbs. milk	236 lbs. butter	cost feed, $25 24

BEST JERSEY.

6,523 lbs. milk	532 lbs. butter	cost feed, $26 26

POOREST JERSEY.

4,087 lbs. milk	236 lbs. butter	cost feed, $18 54

BEST HOLSTEIN.

12,111 lbs. milk	538 lbs. butter	cost feed, $29 89

POOREST HOLSTEIN.

6,657 lbs. milk	246 lbs. butter	cost feed, $21 71

The most striking point brought out in the Shorthorn record is that the cost of feeding the poorer cows was but little less than the cost of feeding the three good ones, which made over 300 lbs. of butter more per cow, a difference in income of over $60 between one of the good and one of the poor cows at the market price for butter. It is very evident that if a farmer is keeping a number of cows coming in the class with the poorer ones, he will find dairying unprofitable, because the more cows he has the worse off he finds himself. The poorer Shorthorns in the case referred to did not pay for their feed.

By comparing the figures for the best and poorest cows in the Jersey and Holstein records it will be seen that the question of selection does not apply to any one breed, but to all. The income from the best Jersey and Holstein was about $60 more than that from the poorest. These great variations here noted are not exceptional. I fully believe if any herd of the same number of cows be fed to their full capacity as great differences will be found. In judging of the value of a cow for dairy purposes, two things must be kept in mind: the amount of milk and richness. Too often a cow is judged by the amount of milk she gives, and in other cases especially among the patrons of creameries, the richness of the milk is the criterion by which she is selected. Either one of these methods may lead to making a mistake.

In the records previously given the Jersey and Holstein produced about equal amounts of butter, but the Holstein gave about twice as much milk in doing it. Her milk tested about half as high in butter fat as did the Jersey's.

There is only one certain way to select a cow, and that is by the use of the scales and the Babcock test. The most progressive dairymen are finding this their greatest help in weeding out the unprofitable cows.

Some weigh the cow's milk each milking and test at intervals of a week or month. Possibly the most satisfactory way is to weigh the milk three days in the middle of the month and take the average yield per day for these days as the average for the month. A sample is taken from each of the six weighings mixed together and tested to give the per cent. of butter fat contained. If a man does this, at the end of a year he knows for certain which are his profitable cows and which are the ones to dispose of as soon as possible.

Patrons of creameries can usually get their milk tested by the creameryman with no expense and but little trouble.

The question of selecting cows by their form and indications of dairy qualities is an important one. There is no question but there is a dairy type which most good milkers show more or less, no matter to what breed they belong. The extreme development of this type we see in the finely developed animals of the special dairy breeds.

The typical beef animal is square and blocky, with nearly parallel lines on all sides, while the dairy type has a general wedge-shaped form. The shoulder of the beef animal is broad across the top, while that of a dairy cow is rather sharp with the backbone strong and standing up prominently back to the tail. The hips are broad and stand up strong, making a much greater width than over the shoulder.

The stomach of a good dairy cow must be well developed as this organ must be able to digest large quantities of feeds and coarse fodders. This gives her a great depth just in front of the hind quarters and is one of the most important points to be looked for.

The udder being the gland that secretes milk from blood, it must be well developed also. A good udder is not necessarily an extremely large one, but should show considerable size when distended with milk and when milked out be much smaller with plenty of loose skin. The lower surface of the udder should be almost flat with the quarters evenly developed and the teats of the same size. The farther the udder is developed forward and backward the better we would consider it, as a short, bottle-shaped udder is the characteristic of a poor cow.

My idea of breeding up a herd of dairy cows here in Missouri is to start with the best cows that are on hand or that can be purchased in the neighborhood. Then put most of the money to be expended into a good bull, of good milking ancestry, of whatever breed is decided to be best suited for the conditions. Then constantly weed out the inferior cows and replace them with heifers from your best milkers. In a few years a very good herd will be secured and with a small expenditure of cash. Then the owner learns the business as he goes along, and by the time he has a good profitable herd he will be informed of the methods to be followed to reach the greatest profit.

BREEDING AND FEEDING CATTLE FOR THE SHOW RING.

By J. M. Douglass, Student in Agricultural College.

Real development in cattle breeding began about the middle of the 18th century. Since that time there has been marked improvement in the cattle breeding industry toward a higher standard of excellence. A difference of opinion among breeders as to what the standard should be has often been a drawback to improvement.

In cattle breeding the first thing to decide on is a standard or model to breed to. This must be chosen with two main objects in view. First, you want an animal with qualities and characteristics that make a good breeder. Second, the animal must also possess a good form and body from the butcher's standpoint. A great deal depends upon the selection of the model, for if it is not perfect the final results cannot be.

To determine what standard or type is nearest an ideal, there must be a competitive contest where the best animals are brought together with competent judges to decide the type containing in combination the best points both for the breeder and for the butcher.

There are three reasons why a cattle breeder should prepare and enter some of his animals in the show ring: First, for the encouragement it gives to the general improvement of all cattle. Second, for the advertising of his own cattle. Third, for the money or premiums given to the winners. The degree of success attained in any of these three divisions depends almost entirely upon the ability of the breeder.

Having decided that a show ring is necessary and that the breeder should enter some of his animals in it, the next thing to know is what kind of an animal should be entered and how to get this animal.

The model should conform as nearly as possible to the following general description: The general form should be rectangular, blocky, broad and smooth. Back and under line straight with lines uniformly parallel. Fine silky hair with a mellow, pliable skin of medium thickness. Flesh thick and well marbled, covering a fine bone. Action strong and vigorous but of a mild temperament. Face short and wide, with large, full, bright eyes, showing a quiet disposition. Neck short and thick, with neck vein full, causing neck to blend well into a smooth, compact and well covered shoulder. Chest wide, deep and full, with a moderately projecting brisket coming well down between front legs giving the proper squareness to the general form. Front legs should be short and straight, set wide apart with a full arm and fine bone. Girth large and well filled; crops full and smooth giving a general smoothness to the front quarters. Ribs long, well arched and deep, covered with firm smooth flesh. Back broad, smooth and straight, carrying width of hips forward to the shoulders. Loin should be full, thick and broad. Flank low and well filled, making the underline straight. Hips wide apart, smooth and well covered with firm flesh. Rump long, wide and smooth carrying squareness of form well back to the pin bones, which should be wide apart and smooth. Thigh full, well fleshed and thick, carrying fullness low down on hind leg. Twist deep, full and level with flank. Hind legs straight with fine bone.

The following points are objectionable: Rough or angular form; harsh coat or hard papery skin; dull appearance; long lean head or neck; bare or pointed shoulders; contracted brisket; narrow chest; coarse legs; hollow crops or sloping ribs; rough back or loin; high cut flank; prominent or rough hip bones; narrow, bare or pointed rump; light thigh or twist.

Having a correct model in mind the next thing is to select a breed possessing these qualities. The principal beef breeds are: Hereford, Shorthorns and Angus. Missouri's climate is well adapted to all of these, so select the one that suits your fancy. To begin with buy pure bred animals that are nearest the ideal type.

In breeding for a model there are two great laws that influence results: Heredity and variation. Heredity is the tendency of the offspring to resemble the parent. Variation, is the tendency of the offspring to vary or differ from the parent. The former makes pedigrees valuable, the latter makes improvement possible. Heredity is the result of the natural prepotency of the breed. Variation results from change of climate, feed, care or from change of surroundings.

Now by the use of these laws with crossing, care and selection, and good judgment, knowing that the characteristics of the offspring are the sum of the characteristics of the parents, the model in the breeder's mind should soon become a reality.

Now suppose that we have a calf that we want to prepare for the show ring. It is best to allow the calf to draw the milk from the mother, for in this way it is not so much trouble and few precautions are necessary except to see that it does not get too much milk and cause indigestion, for a backset at this time may cause it to be forever stunted in growth. If the calf is getting too much milk the supply may be diminished by stripping the cow as soon as it has had sufficient for proper nourishment. Also see that the calf gets enough to keep him in a healthy, growing condition. He should become very mild in temperament and easily handled.

At first allow the calf to be with the mother three or four times daily, but this may soon be diminished to twice a day. As soon as old enough teach it to eat a little solid food such as corn meal, bran, oats and clover hay. A very critical period in the life of the young animal is at weaning time, for if not properly cared for and previously taught to eat grain and hay it is apt to shrink in weight and not keep up the growth that is so necessary while the calf is young; for a pound of gain is never again made so cheaply as it is now.

After weaning a good growth is kept up by feeding oats, corn meal, a little oil meal, and plenty of bright clover hay. Fresh pasture is an excellent feed for the young animal, as it keeps him in a good growing condition. Unless the pasture is of the best quality, some grain had better be fed with it.

The calf should at all times appear thrifty, fat and sleek. The animal should soon be able to eat a good deal of bulky food, such as corn stover and hay, which should be before him all the time. Grain may be added in small amounts to keep him growing fast. Constantly keep the end in view never letting the animal lose a pound of gain that has been made, allow plenty of exercise and fresh air. See that the conditions and general surroundings are comfortable, with these and plenty of feed he should build up a large well proportioned body and a strong vigorous constitution.

A change should be made in the feeding and care of the animal from six to eight months before the show owing to the condition of the animal. Now you want to fatten the animal, begin by gradually adding more grain and decreasing the roughage.

It requires from four to six weeks to get the animal on a full feed of grain. This requires a good deal of skill and should be done gradually, for any sudden change is very apt to get the animal off feed, which is always more or less harmful, sometimes causing as much loss as is gained in two or three weeks. The grain ration should consist of corn meal, oats, bran, and enough nice hay to satisfy the appetite. At the beginning of the fattening period about one-fifth of the grain ration should be corn meal, this to be increased the last two months to three-fifths or four-fifths. It is best to have a box stall for each animal at night during the last three months of preparation. The animal should be taught to lead well, and to stand evenly on all four feet without being restless. Blanket at night and curry and rub every morning during the last three or four weeks. The horns and hoofs should be kept clean and even polished before entering the show ring. The animal should be washed off with warm water and rubbed dry as often as necessary to keep the skin clean. The hair may be oiled slightly to give it a more glossy appearance, but this must be rubbed off before the animal enters the show ring, as a good judge can easily detect it.

SPECIAL NOTES FOR THE BREEDER AND THE FEEDER.

An animal should be in good flesh when entering the show ring. Although unless he already has a good form no amount of flesh can give it to him; yet if two animals of equally good form are shown together, the judges always prefer the one in better flesh.

The question often arises as to whether it is advisable to fatten a good breeding cow for showing or not. This question can be answered only when the breeder's skill as a feeder is known. There are many examples which prove that this can be done successfully when great care and skill are used in preparing and feeding the ration. The feeder should begin in time to fatten the animal gradually—avoid forcing—thereby greatly lessening the dangers of barrenness, also the tendency to patchiness is greatly reduced.

Mangels are used a great deal in feeding a show animal. If they are cheap they may be fed to good advantage, for they have a cooling effect on the digestive system, also they act as an appetizer.

The substance of this article was obtained from various breeders and feeders at the International Live Stock Exposition, Chicago, Illinois, December, 1901.

THE DRAFT HORSE.

By J. N. Price, Student in Agricultural College.

The different breeds of draft horses, like the beef breeds of cattle, have drifted toward the common type, until at the present time the essential characteristics of the draft horse are practically the same for all breeds. The Percherons, Clyde, Shire, Belgian, all possess those characteristics necessary in the make up of a perfect draft horse, and are distinguished only by less important characteristics peculiar to each breed. This type of standard has been reached and fixed by careful selection of those animals which conform most closely to the desired type, and by the judicious mating of these animals to secure the desired characteristics in the offspring.

The most popular breeds in America at present are the Percheron, Clydesdale and English Shire.

THE PERCHERON.

The Percheron is a French bred horse and has been developed through many years of careful breeding by the farmers of central and southern France. Of all the draft breeds, the Percheron is probably the most popular in America today. While he possesses a massive form, weighing a ton or more, yet his conformation is such as to give him excellent action, making him extremely well fitted for use on heavy city transfers, where great strength combined with reasonable speed is needed. Neither is he less well fitted for farm work, since he possesses strength which enables him to do heavy work with ease, and his rapid walk is very desirable, both on the road and to the plow. The modern Percheron is short legged, closely and strongly built, with broad deep, well rounded body, broad croup, and full quarters.

The typical Percheron has an active temperament, a trim, intelligent head of medium size, a short, heavy, well arched neck, head and neck carried well up, a broad body, deep-ribbed and well rounded, loins broad, filling up hollow in front of hips, hips broad, smooth and smoothly coupled, with loins and croup broad. The shoulder slopes well back, giving the horse a free, easy action and good speed. The legs are short, with heavy, clean bone, the arm full and the forearm is prominent with well developed muscles. The hoof is well formed, and of lasting material, and the frog should be full and elastic, which has a great deal to do with the durability of the foot, lessening the danger of bone diseases by breaking the shock when the foot strikes the ground. The hind legs are set square under the body, are straight and have excellent bone. The thighs are full and well muscled, the quarters full, making the legs stand well apart. It is very important that the horse should be well developed in these muscles, since it is upon them that he depends for his pulling strength. The hock should be broad when viewed from the front or side and should be clean and free from all excess of flesh. The leg should be moderately straight at the hock. A hock that is either very crooked or very straight shows weakness. The pasterns are sloping, lengthy and strong. The tendons should be strong, and set well back from the canon bone, making the legs wide below the knee and hock. The action should be rapid and showy.

Some of the leading Percherons are: Pourquoi Pas, the winner of first prize as a three-year-old, and of the "grand championship" over Percherons of all ages at the Chicago International Stock Show of 1901. He is a heavy, black horse with a white star in face and white hind feet. His form is broad, low down and smooth, and he has an excellent set of legs which he carries with perfect action. He is indeed a true specimen of the extreme draft type.

Next comes Kruger, another big, black colt, which was the winner of first prize as a two-year-old at the International. He is a massive horse with excellent bone and well developed muscles. His form is exceedingly broad and low down. He is extremely well developed in the quarters, which are so full that he moves a little wide behind, but that does not interfere with his excellent action. He weighs 2100 pounds.

Another excellent stallion is Chambellan, a gray horse of great size and strength and shows good action. He was the winner of the first prize in the class of aged stallions.

Another horse which should not be left without mention is Theudis, a gray stallion with long, flowing mane. He has a good form and, although he is well along in years, his most excellent action brought forth a hearty applause from the spectators. He is probably the greatest sire of Percherons in America, being the sire of a very great majority of first prize winners and many of the winners of lower prizes.

And in company with Pourquoi Pas, Kruger, Cyprien and Rotundo won first prize for best group, the get of one sire. These four massive black colts and their aged sire, with his flowing mane, were indeed a grand group. Cyprien and Rotundo were winners of second prizes.

THE CLYDE.

Next to the Percheron in popularity comes the Clyde. He is probably a little heavier than the Percheron, with rathen a large but intelligent head. He has a heavy, well arched neck, broad, deep, well-rounded body, short back, wide smooth hips and broad croup. His legs are short, with heavy, clean bone, and a fringe of long, silky hair, called the "feather," growing down back of legs below hock and knee. The breeders of the Clyde have paid considerable attention to the development of pastern, and as a result the Clyde possesses a very sloping but strongly built pastern, making his motion easy and springy, yet giving sufficient strength. The Clyde is well muscled and well proportioned, He is an excellent combination of weight, strength and good action. The greatest objection which may be offered to the Clyde is the immense growth of long hair on legs, which is a great disadvantage in muddy weather. The color of the Clyde is dark brown or bay with a white face and one or more white feet. He is a production of the careful breeding of the Scotch breeders. He originated in Clydesdale, Scotland. The Clyde has been bred in America for a number of years and has won a well deserved popularity.

A few of the leading Clydes in America are: Prince William, a black stallion with a white stripe in the face and four white feet and has an excellent coat of fine hair. He has plenty of weight and shows good style and action. He was the winner of first prize in his class and winner of the "sweepstakes" over all breeds at the International.

Royal Cairnton, winner of first prize in the three-year-old class, is a bay horse with good form, trim head, heavy neck, a thick body, well developed quarters and stands upon the right kind of legs, and moves as a draft horse should.

Prince Punctual carried off the first prize in the two-year old class. He is a bay colt, of the true draft type, and shows the correct style and action.

Prince Handsome, a bay colt, with a thick form, and weighing 1,460 pounds, was declared winner of first prize as a yearling.

Cedric is a noted Clydesdale sire, being the sire of a number of the prize winners of 1901.

THE ENGLISH SHIRE.

The Shire very closely resembles the Clyde, so closely, in fact, that it is very difficult to distinguish the two breeds unless one is well acquainted with them. The Shire is an English breed, and has been bred and carefully developed in England for many years. He is a massive, well developed draft horse, of great strength. In general appearance he greatly resembles the Clyde, but is probably a little heavier; the head is less intelligent in appearance, he is less active than the other breeds, and is inclined to be sluggish, yet he often shows excellent action for so large a horse. His shoulder is somewhat straighter than the other breeds. This probably gives him more strength in the collar, but at a sacrifice of the excellence of action obtained by the more oblique shoulder of the Clyde and Percheron. The color of the Shire is black, brown or bay, with white face and one or more white feet.

Some of the best representatives of American Shires are: Blaisdon Pluto, a bay horse, he is well formed, and weighs 2,200 pounds;

Gladstone, a brown horse, with good style, and Bumper, a black colt, with good form and quality. These stallions are all first prize winners of the International of 1901.

BELGIANS.

The Belgian is comparatively a new breed in the United States, but has been bred for many years in Central Europe, and is the prinicpal draft horse used in that section. He resembles the Percheron to some extent, but is not so well proportioned. The typical Belgian is a blocky horse with deep body and well developed muscles. The belly hangs rather low, destroying to some extent the rounded form. The color may be gray, roan or brown.

Some of the noted Belgian stallions of America are: Gaulois, a bay, and Coriolan, also a bay, were both winners of first prizes, and well formed horses, with good quality and flashy action.

THE SUFFOLK PUNCH.

The Suffolk Punch is not extensively bred in the United States. He is of English origin, and is sometimes used, in his native country, for heavy coaching purposes. The Suffolk is the smallest of draft breeds, but has a very smooth form, and his extremely oblique shoulder gives him excellent action.

THE FEEDING OF THE DRAFT HORSE.

The following is the plan of feeding practiced by some of the leading breeders: For the morning feed, give about six quarts of oats. At ten o'clock give a feed of carrots. At noon give a feed of ground oats and chopped hay, with a little salt. Again in the afternoon give a feed of carrots, and at night feed the oats the same as in the morning. Very little corn should be given to the breeding stock, because it is inclined to make them sluggish. The imported horse should not be given corn, because it causes his blood to become impure and weakens his constitution.

The breeding of good draft horses for market is a profitable business, but do not breed draft mares to light stallions, or light mares to draft stallions and expect to get a horse that will sell well. Breed draft horses or breed roadsters.

PRIZE WINNING SHEEP.

By C. H. Hancock, Student in Agricultural College.

The preparation and breeding of successful show animals requires a great deal of labor and expense. It is no easy matter to obtain an animal which will win the blue ribbon. The man who relies on chance producing a good animal is doomed to failure. The man who turns his sheep out on the range with scarcely any care or attention, need not expect them to compete successfully with those which have received daily and individual attention.

One of the first things to consider is the breed. To be successful financially as well as in competition with other breeds, the breeder must select a breed suited to his locality and climate. He must select thrifty animals, good breeders, which are capable of improvement and which fill the demands of his market. In Missouri the Shropshires have become very popular as a medium wool and mutton breed. The Merino holds the place of the best fine wool breed. A few representatives of the long wool breeds, such as the Cotswolds and Lincolns may be found in this section, but they are more extensively raised in the northern states and Canada.

When a breeder has selected a breed suited to his conditions, he must know how to breed them. The breeding animals must be selected as nearly true to the standard as possible. In the past, breeders have made much ado about mysterious methods of breeding, but with the modern breeder the password of success is selection. Select and put animals at the head of the flock which are thrifty, vigorous, full of vitality and possess all the style and qualities of the breed. In buying buy the best possible, and when a good animal is raised do not part with it at any price. The theory that like begets like sometimes seems to fail; but if nothing but good animals are selected for breeding, their offspring will generally be good, although some will be better than others. On the other hand scrubs beget scrubs with few exceptions. In grading up scrub flocks very good results may be obtained by simply using a good ram each year. It is necessary for all show animals to have a pedigree, but too much stress should not be placed on fancy breeding. A good breeder recognizes the value of merit as well as pedigree. It is not always possible with limited resources to have all the advantages needed, but every available opportunity should be used. Under some conditions, mating may be practiced to great advantage. Frequently some particular defect in one animal may be remedied by mating with another which has a tendency in the opposite direction. As, for example, a sire which is rather fine-boned, but good in all the other points, may get a good progeny with this defect corrected if mated to a dam having the good qualities of style and form, but coarse boned.

Most breeders understand that breeding animals should not be very fat to give the best results. During the summer months give them plenty of fresh pasture. The best way is to have more than one pasture and change from one to another as they become short. Some keep their sheep continuously in one place. Their grandfathers had a little sheep pasture off on one corner of the farm, and they say that there is so little money in sheep they cannot afford to have another. When kept in one place for too long a time there is a tendency for the pasture to become foul and diseased; by giving your sheep a change they will eat more and be less troubled with diseases. Give them plenty of good wholesome food and they will pay you a handsome profit. During the winter months feed plenty of clover hay with only enough grain ration to keep them in good shape.

It is a fact, but to be deplored, that in judging breeding animals, the judges favor those with the most flesh. This is one of the great disadvantages of showing breeding animals. They must be made very fat, which frequently injures their breeding qualities. But this danger may be greatly lessened if the breeder understands how to fatten his animals and then how to reduce their flesh when he so desires. Injudicious feeding ruins many fine animals. If your sheep are to be made very fat, begin to feed them several months or a year before you wish to show them. First feed oats and finish with corn, oil meal and bran. Always feed plenty of clover hay and have good pasture in summer. No fixed rules of feeding may be applied to all cases, but the feed must be varied and changed to suit the animals and to prevent them from getting off their feed. Do not stall feed, but fatten gradually and give plenty of exercise so their flesh will be solid. When sheep are fattened too rapidly there is a tendency for the flesh to be soft and blubberly and to be put on in patches. It is very important to have the back well covered with solid flesh, so that the backbone will not feel sharp.

Probably less is known about how to properly take the flesh off than about how to put it on. When sheep, which are very fat, and which have been accustomed to plenty of grain feed are turned out on pasture without any feed, they are often injured. They have been accustomed to high living, so to speak, and such a sudden change injures their digestive organs. Then when the breeders again attempts to fatten them he finds that they do not respond to high feeding as they did before. Their feed should be gradually reduced, or, in the case of breeding rams they may be placed with only a few of the flock at the start. Another very good way is to place the ram in a large lot where the flock can come up to the fence. In this way they will soon wear off their flesh by pacing up and down the fence.

The judge of sheep could not give his decision without feeling of the animal, but the appearance must not be overlooked. The form is fixed, but the appearance to the eye can be easily changed by the hand of the skillful shearer.

Outside of the regular shearing, the wool of some, such as the Merino, requires very little attention. They need to have shelter during hard rains to prevent the oil being washed from the wool and the wool free from trash. The long wool breeds, such as the Lincolns and Cotswolds, need a little more attention. Their wool is long and hard to keep free from trash and untangled. To prepare their wool for showing requires very little or no shearing. Sometimes a few shaggy places about the legs need to be clipped. But the wool should be gone over by hand and pulled apart into small blocks, so that it may be easily opened up anywhere. Then it should be well shaken by taking the hands and raising up from underneath. Doing this often will help give the wool the desired fluffy and curly appearance.

The medium wool and mutton breeds of which the Shropshire, Hampshires and Southdowns are representatives, need more attention given their wool than any of the other classes. Animals of these breeds, which are intended to enter the show ring should have their wool slightly trimmed every few weeks, so as to keep it even and not allow it to grow shaggy. Then shortly before they enter the show ring, they need to be thoroughly gone over by an experienced man. This should be done after they are shipped, if they have to be moved any distance. The shearer needs a good sharp pair of shears, a short fine wire toothed comb and a broad paddle. He first dampens the wool slightly to make it comb. If there is a large number of sheep around, it is a good precaution to use some disinfectant in dampening the wool, as it will serve to prevent disease. When shearing it is best not to cut very much off at a time. It is much better to repeat the process two or three times than to make a bad job. Some places will need to be sheared deeper than others. The object in view should be to obtain a rectangular, blocky and neat appearance. By shearing rather deeply on top of back and on sides, the animal may be made to have a better appearance of width of back and depth of body.

The neck should be arched underneath and thighs well rounded with a neatly cut tail. Just before taking into the show ring the wool may be lightly paddled with damp paddle, to give smooth finish. Some use brown umber or some similar powder to give the wool a brownish cast, but it is altogether a matter of taste whether it be used or not.

The breeder should understand that to distribute prizes is not the only object of the stock show. They serve to advertise the breeder and to encourage him to improve his animals. It is not possible for all who show their stock to win prizes; but with perseverance and the knowledge of and love for animals, the breeder should be rewarded with success.

THE MOST PROFITABLE METHOD OF HANDLING HOGS.

By E. W. Robinson, LaBelle, Missouri.

The first and most important thing is to have good stock. The thoroughbred is none too good, while high grades will do very well. There is no excuse for any man in this great State of ours not having a well bred herd. It is not enough to have the right kind of breeding stock, but they must have the proper care and treatment. In our Corn Belt farmers as a general thing feed too much corn to develop a brood sow as she ought to be. She must have a variety of feed, such as will make bone and muscle, ground oats, ship stuff, bran, oil meal and plenty of range on clover and blue grass pasture. During the winter months when they are deprived of any green food, clover hay is an excellent substitute and hogs relish it very much.

If the proper attention is given to the individual make up of the young gilts, that is so necessary to make a good brood sow, and if they have been selected from the right kind of dams and treated as stated above, success is sure. The next thing to consider is the mating and the kind of a male to use. By all means he should be a thoroughbred of the breed you have chosen. The male is recognized as half the herd, then if this be so no man is acting wisely to let a few dollars stand between him and a good herd header. The difference in the first crop of pigs would pay the price of a choice male two or three times. A thoroughbred male, if individually all right, is cheap at almost any price, while a scrub would be extremely dear as a gift with three or four more like him thrown in for good count.

As to the time of mating every man should be his own judge as to that matter. If one has good warm houses so that the young pigs can be kept warm and dry, should the weather be cold and stormy at farrowing time, it would be well to have a few litters of early pigs from mature sows, but I would not advise early pigs from young sows. I would want them to farrow not earlier than the middle or last of April. The gestation period is one hundred and twelve days, so a man can arrange matters to suit himself. A few words would not come amiss as to how the sows should be fed and taken care of during the period of gestation. They should not have an exclusive corn diet, but more of a mixed ration of ground oats, ship stuff and bran with an occasional addition of oil meal. The soft feed should be increased and the corn decreased near the farrowing period. After the sows begin to get heavy they should have separate sleeping quarters, or not more than two should sleep together. If allowed to pile up there is danger of some of them losing their pigs. A week before farrowing a sow should be kept every night in her own stall. A week after farrowing a sow should be fed on full feed of rich slop, with corn enough to keep her in good condition. The pigs should be taught to eat as soon as possible. Slop should be the principal feed. If you have milk handy, put it in, and should you want to make an addition, why just put in more milk.

They should be kept growing from start to finish. It is a wonderful drawback to any young stock to allow them to get poor and runty. In changing from one kind of feed to another the change should not be too radical, especially changing to new corn. Great care should be taken to increase the feed gradually. The health of the herd should be well guarded by giving them all the pure water they want; see that they have plenty of ashes and salt at all times; keep the feeding pen pure and clean by raking up all trash and filth and applying a good sprinkling of lime occasionally.

In the finish of the herd for market, no better feed for putting on fat can be given than corn, and when your hogs weigh from 225 to 250 pounds, I think is the best time to sell. That weight is made cheaper per pound than heavy weights, for there is more rapid growth up to that weight than ever after. So, brother farmers, watch these small things, and success is yours.

LAYING OUT COUNTRY ROADS.

By J. L. Erwin, Steedman, Mo.

The conception of the Roman engineer was the construction of a road on the shortest lines for military purposes. In later years the movement of freight from shipping points, either railroad, river, ocean or lake on short lines has been the study of the engineer. The development of the railroad has been such that nearly all freight is moved from one point to another by rail. The problems which now confront us are: how to get the products of the farm to the railroad; how to get to school; how to get to church; to market; how to get the postman to bring our mail to our doors, and how to make our homes attractive to ourselves as well as to the passer by. Straight lines will not do this best. To make and maintain a road cheaply, it must be a level surface. Cuts and fills must be avoided as much as possible. Some day all our roads will be lined with homes, and no one would like to live on top of a cut or at the bottom of a fill.

In all hill country, our roads should wind with the hills just as an irrigating canal is laid out. The cow brute exhibits much engineering skill in laying out her path; she will never go straight across a gulch, but will bear up on a level or nearly so until the rise in the bottom of the hollow has reached the level of the point at which she wishes to cross, and keeping nearly at a level she will follow the opposite bank or the point where she left the general course in which she wished to travel, and resume her journey. She has followed the line requiring the least exertion to reach a given point, one requiring the least work to make it passable, and one that will be the easiest to maintain, as it will be the least liable to wash. Water is the greatest destroying agent of our roads.

The road being practically on the surface, every point of vantage may some day be utilized for a building site.

It is only a little while till fences will not mar the beauty of our cultivated fields; only the permanent pasture lands will be fenced.

MISSOURI AT BUFFALO.

By R. M. Yost, St. Louis.

The General Assembly of 1901 appropriated $50,000 for the expense of exhibits of Missouri's resources at the Pan-American Exposition, at Buffalo, N. Y., and at the South Carolina Interstate and West Indian Exposition, at Charleston, S. C. The appropriation bill did not reach the Governor until the latter part of March, when it was promptly approved. The act provided for the appointment of five commissioners, who should proceed at once to collect the necessary exhibits and arrange for the various displays. On March 25, Governor Dockery appointed the following named gentlemen to serve as commissioners at both expositions:

Hon. E. S. Garver, Grant City; John F. Beal, Edina; Robert M. Yost, St. Louis; Charles C. Bell, Boonville; Fayette P. Graves, Doe Run.

This Commission organized immediately by the election of Mr. Garver as president, Mr. Beal as vice-president, Mr. Yost as secretary, and Mr. Bell as treasurer. On the first day of April they opened a temporary office in St. Louis. It was an unusual and tremendous task to prepare ,within four weeks, for the complete representation of the State at a great exposition, but the Commission accomplished it, and by the first of May were in Buffalo with interesting exhibits of Missouri's agriculture, horticulture, mines, forestry, dairy and education. Thousands of Missourians who visited the Pan-American during the summer of 1901 bear universal testimony to the fact that Missouri was surpassed by no other state in the several illustrations of her resources, and the record of the Commission shows that in several particulars our State proved to be superior to those states which had heretofore been recognized as leaders in various lines of industry and productiveness.

It was a matter of special gratification when Missouri was awarded the only gold medal on corn and the highest gold medal on wool. At the same time the splendid State of Illinois, which had heretofore ranked ahead of Missouri in the production of corn, was only able to achieve a silver medal at the Pan-American Exposition. This is cited as an illustration of the intelligent and energetic work done by the Commission in securing the best State exhibits.

The official announcements by the management of the Pan-American Exposition show that the following medals and awards were attained by Missouri at Buffalo, in competition with thirty-four states and all the Latin-American republics:

Agriculture—Five gold medals, six silver medals and nineteen certificates of honorable mention—the last named being to the contributors to the gold medal exhibit of wool.

Horticulture—Ten gold medals, eighty-eight silver and bronze medals and six certificates of honorable mention.

Mines and Mining—Eleven silver and bronze medals and eight certificates of honorable mention.

Education—One gold medal and four silver and bronze medals.

Dairy—One silver medal and eighty-five diplomas of award.

Forestry—Three certificates of honorable mention.

Altogether Missouri won 16 gold medals, 110 silver and bronze medals and 102 certificates of honorable mention—a total of 228 awards.

The achievements by the State in agriculture, horticulture and dairy were so remarkable that they became subjects of newspaper comment throughout the country. The "land of the big red apple" has been advertised from Maine to Texas and from "the northern lakes to the sunlit waters of the southern sea." At butter-making the Missourians demonstrated in Buffalo that this State has no superior. At one exhibit Missouri received 82 awards out of 87 samples of dairy products, the Exposition requiring the samples to show 94 per cent and above. On several occasions the high point of 97 per cent was reached, a percentage of perfection which was only exceeded by one-half a point by the old dairy states of New York and New Hampshire. Our lead and zinc mining was accorded unusual distinction and our building stones equal to the best. Our public school system, placed in direct comparison with the oldest public school systems of the East, was given one of the only two gold medals that were bestowed.

Throughout the course of the Pan-American Exposition the exhibits from Missouri created continuous and favorable comment and when the exposition closed, on November 2, 1901, success had been written across the work of our Commissioners.

MISSOURI AT CHARLESTON.

But our Commissioners had still another tremendous and unusual task to perform. They were required to take down and remove the Missouri exhibits from the Pan-American Exposition at Buffalo, transport them to the South Carolina Exposition at Charleston, procure fresh renewals of all perishable products and again install the exhibits within three weeks. By the most active and earnest efforts the Commissioners again met every expectation, and on the first day of December, when the gates of the South Carolina Exposition were opened, Missouri was the only State found ready for the inspection of visitors. This exposition will remain open until June and at this writing it is impossible to present the details of a record which is now only in process of achievement. But in the meantime we quote the following article from the Charleston Post to show the estimation in which the preliminary work of the Missouri Commission is already held: "Of the many interesting exhibits at the Exposition, none surpass the display shown by the State of Missouri. It can be said to the credit of the energetic commissioners of the State who have the display in charge that they were the first to install their exhibits in the different buildings and have them approximately ready for the opening day. It was said that they accomplished the same result at Buffalo, which speaks well for their enterprise and administrative ability. Not only were the Missouri exhibits ready for opening day, but for variety of display and artistic neatness in the arrangement and finish of their installation, there are none better on the grounds." Indeed, many visitors declare that Missouri easily leads in every line that she exhibits.

"Be that as it may, the fact remains that Missouri is one of the most prolific states in the Union and outclasses most of them in the great variety of her natural productions. It has been said by an eminent writer and traveler that if each state were compelled to live wholly upon her own resources, Missouri could come more nearly to doing it than any other state of the Union. When one looks at the resources of this wonderful State, as represented at the Exposition, he must admit that the compliment passed upon it was worthily bestowed. And it should be borne in mind that what is seen of this State at the Exposition is only a miniature picture of its actual greatness.

"Missouri has within her borders the greatest zinc and lead mines in the United States. She has coal and iron in inexhaustable abundance, with good crappings of gold, silver and nickle. In the southern part she has fine forests of hard pine and other varieties of timber that have never yet been despoiled by the woodman's ax.

"In the production of the cereal crops she occupies a place side by side with the best states of the Union, and her famous blue grass, timothy, clover and other forage crops are the pride of her less favored competitors. In the production of live stock she is well up to the head of the list. The Missouri mule is known and respected everywhere. It is the proud boast of the people of the State that the bray of the Missouri mule, like the English drum beat, is heard around the world. As an horticultural State, she is now the envy of the older states that have enjoyed a monopoly along this line for many years. And yet her horticultural interests are only in the early childhood of their development. When matured to the full line of their possibilities these interests will be bewildering to contemplate. 'Missouri, the home of the Big Red Apple,' is a saying that has traveled from ocean to ocean and been repeated across the waters by thousands who have tasted and eaten the ruddy king of all apples—The Ben Davis. No visitor to the Exposition should fail to see the Missouri exhibit."

STATE INDUSTRIAL MEETINGS.

FIFTH ANNUAL SESSION.

Convened in Chillicothe, Missouri, December 10 to 13, 1901.

ABSTRACT OF ADDRESSES DELIVERED.

(Reported by Miss Snowdon Willis.)

OPENING SESSION.

House called to order by Hon. J. W. Hill.

Mr. Hill: We have here the meeting of the different organizations composing the State Industrial Association. The Swine Breeders, Horse Breeders, Improved Live Stock Breeders, Sheep Breeders, Poultry Breeders, Improved Roads Association and State Grange will hold a meeting this week which ought to be of great interest, and we hope you will all attend and take part in the meeting.

Prayer by Rev. E. C. McVoy of Chillicothe.

WELCOME ADDRESS.

Hon. W. D. Leeper ex-mayor of Chillicothe, was introduced, and on behalf of the mayor, delivered the address of welcome as follows:

Mr. Chairman and Members of the Industrial Associations:

It is my pleasure this morning, on behalf of the mayor, to extend to this convention, the city's welcome. We value at its true and highest worth the recognition which you have shown us by making this city the place of your assembling and deliberations. Under the auspices of the State Board of Agriculture there is here assembled today the fifth annual meeting of the State Industrial Associations of Missouri—a commonwealth that Senator Ingalls once declared possessed such a diversity of natural resources that a stone wall could be built around her domain and yet her people would live and thrive without outside assistance. Better organization is the tendency of the day. Lawyers have their bar associations; physicians their medical societies; capital its corporations and trusts; labor its trades union, and it is but natural and right that you, the original producers of all wealth, should band together for mutual protection and advancement in your chosen field of activity. The farm has ever been, and ever will be the source of all wealth, and that legislation which fails to recognize this fundamental principle of political economy has nothing in it to commend itself to any government. When our farmers prosper that prosperity is shared by all other branches of industry; but when they do not prosper, that stagnation likewise is felt in every department of human action. The old Greek philosopher was right, centuries ago, when he said to the youth who was admiring the magnificience of the Grecian cities, that it is not the splender ot the cities, but the prosperity of the fields that constitutes the true growth and stability of every nation. As Missourians we are justly proud of our great commercial centers; of the great metropolis on the banks of the monarch stream, that alone of all American cities withstood the financial storm of 1893 without a single bank or mercantile failure; we are proud, too, of the great emporium at the mouth of the Kaw, which ranks as the second greatest live stock market of the world; and of the city on to the north that the census of 1900 declared, with one exception, to possess more per capita wealth than any other American city; but prouder still are we of the fact that behind all this municipal wealth, stability and growth stands the Missouri farm which has made possible that prosperity, and a soil that has never yet refused to annually and abundantly give forth some, if not all, of her diversified products. Missouri is truly an agricultural state, and we trust that this may indeed ever be her chief material distinction. The largest stock farm in the world is in Atchison county, Missouri; the largest nursery in Pike county; the largest orchard in Howell county. For several years past the Missouri hen has annually produced almost as much wealth as have the gold fields of the Klondike; while in regard to every kind of high-grade stock, our herds are of the highest rank. The Missouri mule is not only favorably known in every part of this country, but in all foreign lands as well; and we dare say that England would long since have displayed her flag of truce in the Transvaal, had she not been backed up by the persistent, irrepressible, "show me" disposition of the Missouri mule engaged in her service in that far-away clime.

We are glad to welcome you, the reprsentatives of these great industries, to our midst this morning, and not in the least do we also welcome those assembled for the purpose of agitating good roads, the object of which is, at all times, to bring the producers of wealth in direct contact with the markets of the state. It is the marvelous growth and development of these industries that insures the stability of our commercial centers; and it is the continued growth of both farms and cities that will make Missouri, in the near future, the Empire State of the American Republic.

May your sojourn in our midst be pleasant, and may your deliberations be profitable, is the message with which, on behalf of our mayor and citizens, I greet you this morning.

In the absence of the president of the Swine Breeders' Association, Mr. G. W. Waters of Canton, Mo., responded as follows:

Ladies and Gentlemen: I am not sure that these Swine Breeders have started out right in asking me to respond to the address of welcome; maybe they have and maybe they have not; however, not wishing to cause any delay, I will indulge in a remark or two in response to the gentleman's very cordial welcome. It was indeed a very refreshing and pleasant address, and I dare say we all feel better by reason of it. It is something more than a salutatory, it is bristling with some very important facts concerning our grand State.

I will not indulge in any further encomium upon our State. We all know her history. She stands as the foremost State in all expositions held in this country for the last decade or two at least. Missouri is a State of which we are all proud and getting to be more and more so every year, knowing and realizing as we do her wonderful natural resources; and the time comes on in the near future when Missouri will have an epoch making period, when she will make us feel more proud than ever and we shall stand before the world, as I verily believe, in 1903 at the great Louisiana Purchase Exposition in St. Louis as the admired of all admirers.

As to this association and these several associations that meet here this week, these are very properly called the Industrial Associations, and this suggests that we have met here for the purpose of exchanging thought; we have met for the purpose of consulting together; we have met for the purpose of lending each other some assistance as far as we may in solving some of the great problems before us.

There are now before us and especially before the farmers of Missouri two things worthy of our attention. The first is the discovery of truth. There are men and women especially set apart for the purpose of the discovery of truth in relation to agriculture and they are diligently at work day and night looking down into the dark pages, we may say, of nature and making a study of those principles that govern all practices as far as agriculture is concerned. These are they of the experiment stations. The truth they discover there is one thing, and to get that truth out among the people so that they will know and understand it is quite another thing and that is the thing that differentiates this time and age from ages of the past. That which characterized the mediaeval times, the dark ages, and caused them to be dark ages in human history, is the fact that the knowledge and investigation of the truth of the world was locked up in the cloistered monastery. It was not sent out among the people, it did not radiate, the people did not get hold of it and that is the reason why these ages were the dark ages. When that period came on in human history, when that sentiment which was growing in the world and should grow on and on, absolute personal liberty, had grown to such a degree that the declaration of independence was written, it went like a flash of light around the world and that is the reason why this age is such a progressive age. There was abundance of truth discovered in the dark ages, but it did not radiate and reach out among the people. In this age in which we live this truth is reaching out and these problems presented to us are being solved by the people themselves and applied in their business.

We then have met for the purpose of considering some of these problems: take for instance the Swine Breeders (I believe I was to represent that association), there are some important problems that are before them. There has been a development—a progressive development in the machinery, if you please to call it such—by which and through which we produce pork. The animal is the machine by which the farmer makes out of the crude and raw products of his farm the finished product of his pork for feeding the hungry people and for the market. But his machine today is almost immeasurably superior to the classes of machines with which they undertook to make pork before this age.

Now these meetings together and this comparison of ideas will lead us to have a better understanding of our business and that is really the thing that has brought about the progress of this age. It has been brought about by reason of the fact that the great masses of the people have taken hold of these questions. In ages prior to this the masses did not think about these questions as they do now and consequently they did not assist in promoting this progress that characterizes this age. There is such a thing as gathering strength and gathering force by association. Take the utterances of those who have investigated this question most carefully; let us quote, for instance, from Joseph Strong who wrote a book called "Our Country." He said, in speaking of the great progress of this age that it has come by reason of association, which is the soul of great progress. If association is the soul of progress, in associating together and exchanging thoughts we help along that grand progress that characterizes this age; and that is the reason we are met together. We are prone to illustrate this by the heat produced by a lot of burning fagots, an old illustration, but a good one: take the fagots and let each piece of wood burn singly and alone and it will produce but little heat, put two pieces together and the heat is increased, burn three together and the heat is still greater, bind a multitude of fagots together and you get a wonderful amount of heat when you burn them. In like manner one individual working out these problems singly and alone on his own farm makes some progress, two associating together and exchanging thoughts can make greater progress than the one, three can make still greater progress and a convention can make yet more progress and add wonderfully to the interest of the questions at hand, and for that reason we have met to exchange thoughts and to help along with this progress.

On behalf of the State Poultry Association Mr. Steinmesch responded as follows: The Poultry Association is probably the least recognized of all the industrial associations that are represented here today. The chicken itself is only a small matter, still it is only a few years back that the average weight of a chicken was three and a half pounds; but by conventions, by getting together and exchanging thoughts we have succeeded in improving the breeds, we have succeeded in making new breeds, and we have succeeded in making the average weight of chickens not less than five pounds. We have succeeded in making new breeds that command a premium, as was shown a year or two ago when the Armour Packing Company advertised through the papers that they would pay, I forget whether it was a cent or half a cent more per pound for White Wyandotte chickens than for any other chickens that came to the market. Half a cent a pound is comparatively a small amount, but when it is taken into consideration that the poultry product of the State of Missouri is greater in value than that of the wheat and oats raised in this State combined, you can probably appreciate what that half a cent a pound means.

It is said that the man who makes two blades of grass grow where only one grew before is a benefactor of mankind. I would add to this that the man who produces a five-pound chicken where only a three or four-pound chicken was produced before, is also a benefactor of mankind. Only a few years ago producers were shipping stock to the markets of St. Louis, Kansas City and Chicago and got so much a dozen for their chickens; it did not make any difference whether they weighed three pounds or six, whether they were three or six years old. All of these things have changed. Nowadays in sending poultry to market they are graded, classified into young hens and old ones ,young roosters and old ones, and there is an extra price for poultry uniform in color or weight. All these things go to show what progress has been made in the poultry industry, and I believe—in fact I am sure—that the greatest credit for this improvement, this increase is due to the Missouri State Poultry Association.

We are holding today our tenth annual exhibit. Ten years ago the first poultry exhibit was held at Sedalia, Missouri. It was about the first poultry show of any kind that had been held outside of St. Louis, in this State. There had been one or two held in St. Louis, but they were financial failures, people looked upon one chicken just like another. From Sedalia we went to Warrensburg, from Warrensburg to Macon, from Macon to St. Louis, from St. Louis to Lexington, from Lexington to Columbia, from Columbia to Mexico, from Mexico to Sedalia ,from Sedalia to Fayette and from Fayette to Chillicothe. Our object in moving around so is to give the people of the State an opportunity to see our efforts, an opportunity to see our thoroughbred poultry. I feel that while we have accumulated no wealth, while the officers of the Association have worked without compensation, our efforts have been appreciated and in that way the officers have been duly repaid, and I am sure all of them feel that way. We have an extraordinary fine exhibit here which will continue all week, the largest exhibit, I think, we have had in the last four or five years and certainly the best in quality, and I extend to you all a hearty welcome to attend our show.

Mr. C. O. Raine responded on behalf of the State Grange: Mr. Chairman, ladies and gentlemen—I cannot forbear just at this time to preface my remarks along this line with a few remarks in connection with and relating to the work in the future of this Industrial Association. I would suggest, Mr. Chairman, that the representatives of each organization represented here take into consideration the advisability of appointing one man from their respective associations to act as a member of an executive committee with the Secretary of the State Board of Agriculture, as president of this committee to arrange the work for the future, that these several associations may act unitedly, may act jointly, may act for the betterment of each organization. The organization that is strong today in a few years from now may be one of the weaker ones. It is the weaker ones that need attention today and it is evident to me that this Industrial Association cannot last in the future unless some steps along that line are taken soon. For the Grange to formulate a separate line of work, and the Road Association to formulate another, etc., debars and precludes a great deal of work that might be accomplished by the worthy Secretary of the State Board of Agriculture, who should have the hearty co-operation of each association.

Now, Mr. Chairman, in regard to the words of welcome that have been given to us this morning, I wish to thank Mr. Leeper in behalf of the Missouri State Grange for the very cordial words of welcome he has given us, and for the excellent thought in that address. It certainly has inspired us, it certainly will do us all good to take home with us and treasure up the thoughts outlined in that speech this morning.

I wish to state further, Mr. President, in behalf of our organization that as we hold many executive sessions at this time, being compelled to do so, we invite the hearty co-operation of each association represented here this week, and I would urge upon each and every one to lend a helping hand that we may make this the fifth annual meeting one of the greatest meetings ever held.

On behalf of the State Board of Agriculture, the Secretary, Mr. Geo. B. Ellis, responded: Mr. Chairman, Ladies and Gentlemen—I am very glad to add a word this morning on behalf of the State Board of Agriculture, and for the encouragement of the different State associations that will meet in this beautiful little city in the heart of the blue grass region of Missouri. I wish to thank Mr. Leeper for the hearty welcome he has given us, and I would emphasize at least two thoughts expressed in his most excellent address, that is, "organization is the tendency of the day" and that when the "farmers prosper that prosperity is shared alike by all other branches of industry."

The farmers least of all classes are heard in our State Legislatures and in Congress, and why? The farmers least of all have anything to say about fixing the prices of their own products when they are sent to market, and why? It is to my mind evident that it is a lack of intelligent organization. I am not here to raise the pessimistic cry that this country is going to the bad because other industries are organized and working in their own selfish interest, I do firmly believe, however, that it is the duty of the farmers of this State and of this country to organize intelligently into industrial associations for their own betterment as well as the general welfare of the country. It is by association and interchange of ideas that the greatest progress is made. No one individual, however wise, has ever worked out any of the great problems for the improvement of mankind, singly and alone.

Mr. Steinmesch said that the average weight of the chickens produced in this State had been increased one and one half pounds in the past few years. This makes a total increase of nearly 25,000,000 pounds worth at least $1,500,000. Who will say it has not been a great benefit to the people of this State for the poultry raisers to organize? Think of it! An improvement of more than forty per cent. in a few years, by intelligent breeding and feeding. Does any one believe that we have reached the height of perfection in breeding or feeding any kind of live stock? An improvement of ten per cent. in the value of all our live stock would amount to something like $25,000,000. Will it pay to organize?

As another illustration, take our field crops. Missouri corn growers produced in 1900 on 6,400,000 acres a total of 193,000,000 bushels of corn, valued at $60,000,000; on 2,218,000 acres of meadow a total of about 3,000,000 tons of hay valued at $20,000,000; on 1,000,000 acres of wheat a total of 16,000,000 bushels valued at $10,080,000; on 1,000,000 acres of oats a total of 30,000,000 bushels valued at $6,000,000; on 108,600 acres of potatoes, a total of 10,000,000 bushels, valued at $3,500,000. Does any intelligent farmer doubt for a moment that by proper selection of seed, by scientific methods of seed breeding, by an intelligent system of rotation of crops, by a judicious use of domestic and commercial fertilizers, that we can do as well as the poultry people have done and increase our average yields forty per cent? Is it possible to do it? Can we not raise the average yield of corn from thirty to forty bushels, wheat from twelve to twenty bushels, oats from thirty to forty bushels, timothy hay from one and a third to two tons, potatoes from ninety-three to one hundred and fifty bushels per acre? If we can do this, will it not pay to organize an association of farmers interested in every line of farm products?

Other states are organizing their conventions of corn growers, of wheat growers, etc., and why not Missouri? Every citizen should have a patriotic pride in pushing our State that has been so abundantly blessed by nature with a great diversity of soil, climate and products to the very front rank in this great country of ours.

Is there any doubt about the truth of the other statement that "when the farmers prosper all others share that prosperity?" I think not. The more grain and live stock the farmers produce the greater amount of freight for the railroads. The bigger the profit the farmer gets for his products the greater consumer he becomes of other laborers' products in the form of clothing, food, building materials, farm implements, and other articles of necessity and luxury. Show me a prosperous farming community anywhere in the world and I will show you a community where other lines of business succeed. Last summer when the drouth was daily cutting down the farmers' profits, how anxiously were weather conditions watched and discussed by business men, professional men, and laboring men of every class in the country. Why was it? They knew that the prosperity of the whole country would be seriously affected by a failure of crops. I would not have you think, however, that the farmer is independent of other classes. While others may share our prosperity, we too have a share in theirs, and we should cultivate a more friendly relation with people of all legitimate avocations.

Let me say in conclusion, that we are proud of our achievements in the past, but we are not satisfied to stop here. In the great expositions that have been held in this and other countries in the last decade, Missouri has acquitted herself nobly, but are we to be satisfied with what we have done and fold our hands and dream of the past? Only a few days ago at the Chicago Live Stock Exposition, in one class where eight premiums were offered, Missouri breeders captured four, competing with all other states and with Canada. In another class our breeders won three out of eight. But we should not be satisfied with this grand showing. Where we won four prizes this year, let us strive to win five next year.

On behalf of the State Board of Agriculture, let me promise you that each one of these associations will have our earnest co-operation and support in achieving the greatest possible success in the various lines of work.

SESSION OF

Road Improvement Association.

REPORT OF SECRETARY.

By G. W. Waters, Canton, Mo.

To the President and Members of the Missouri Road Association.—For the past five years the burden of our work has been in the endeavor to secure satisfactory legislation. A long stride forward was made by the Fortieth General Assembly. The Forty-first corrected some inequalities and so perfected the general laws applicable to counties not under township organization, that no complaints are heard anywhere. This is in marked contrast with the conditions prior to 1899. We have come up from a condition of chaos to the adoption of a road system based upon business principles.

We realize that laws, or constitutional amendments cannot make roads. We now turn to the practical side of the work, the art of road building and the methods of road maintenance. In our report of last year we called attention to the importance of making each year some permanent improvements. "A portion of the funds must be used for repair and maintenance, but some amount should be applied every year beyond this for permanent work." To undertake the task of grading, graveling or macadamizing all of our roads at once would be a stupendous work—far beyond our means. Hon. Martin Dodge, Director of Office and Road Inquiry, (successor to Gen. Roy Stone) says: "There are eighty thousand miles of public roads in Ohio, and about three million miles in the United States. Ninety-nine per cent of the entire mileage remains as earth roads." Our estimate for Missouri, based on reports made by the county clerk of each county, is that only about one-half of one per cent of our entire mileage consists of free gravel or macadam. Attention was called in a former report to the plan of "continuous care of roads," the year round. Experience and observation emphasizes the value of this method. The present road law was framed with that end in view. To find out the very best methods and most efficient means of keeping our dirt roads in a passable condition for the greatest length of time during the year, and the best possible way of averting damage to them, by floods, has been the constant study of your secretary for the past five years.

I wish to acknowledge the valuable assistance given by the State Board of Agriculture in affording us ample opportunity to investigate the various methods in practice.

At the Sedalia meeting in 1899 we called attention to the method of frequently trimming the road bed with a light scraper or drag, which, if done at the right time, obliterated the ruts, made a smooth surface for travel and had the effect of hardening the surface and preparing it for the next rain, so that the road was seldom muddy. Since that was written, our observations have been extended and the plan has proven even vastly more efficient than we then claimed. If all the road commissioners and road over-seers of the State could stand as I did and take in the view of a piece of road kept in repair for the past five years by D. Ward King, of Holt county, and fully understand in detail his methods and see the results in comparison with the abutting piece of road, not kept in repair, the object lesson would be worth $100,000 per annum to the roads of Missouri. We have persuaded Mr. King to come to this convention and give you his plan. Here and there over the State this method is in use with equally good results. Wm. M. Hamby of Caldwell county says in an article to the Orange Judd Farmer:

"One of the best kept roads I know of anywhere is between Nettleton and Hamilton. I have driven over this road at all times of the year, but have never seen it rough or muddy. * * * * This is the explanation: The road is graded in the middle so the water runs off at once. When it begins to get rough they run a scraper over it."

But I will not anticipate Mr. King, who is present, and will give you the benefit of his experience. We have said that we do not need any more law, but allow me to suggest that as the main thing now is for us to find out the best plans of working roads, we should have conventions of commissioners and over-seers so as to get from each and all the benefit of their experiences. To this end I would favor a law providing for a convention of at least one delegate from each road district in the State, the expenses of delegates to be paid by the State. This is the practice in Illinois. From careful estimate made, I feel safe in saying that there may under the present law be raised ample revenue to keep the dirt roads in splendid condition, the culverts and bridges in repair and leave a surplus each year for permanent roads, where the material is available. The needs now are co-operation, a wise management and better skill in road repair and road building.

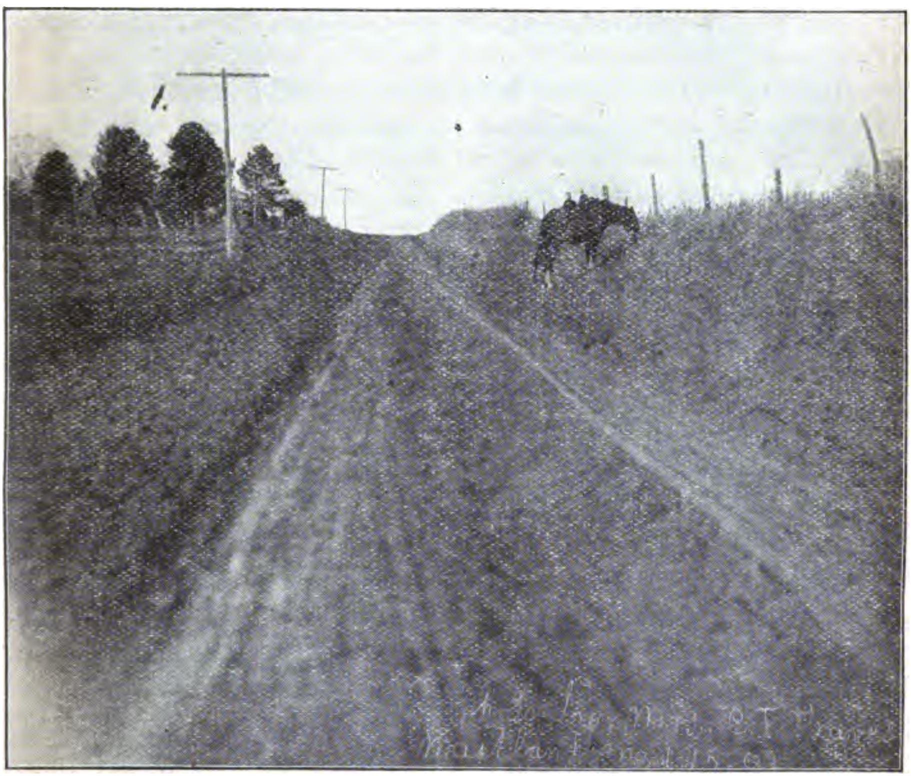
A HARD DIRT ROAD.

By D. Ward King, Maitland, Mo.

Gentlemen of the Good Roads Convention—I did not expect to be here, so I prepared a paper condensed into the shortest space possible; but as I am here, there are certain points I would like to amplify.

My friend Col. Waters took advantage of me and put my name on this program without my consent. And because the Colonel had to manufacture a title he got the wrong one: "The Best and Cheapest Method of Getting Roads Repaired," while I want to talk about, "How to Make a Hard Dirt Road."

When Col. Waters visited Maitland last fall he inspected a stretch



Photograph of road not dragged, showing rough surface.

of road that I have been caring for during the last five years. After viewing the road he asked me to tell you of my method. It is very simple, I merely go over the road with a drag after every rain or wet spell.

The land is rolling prairie, part of the soil is black and part of it is yellow clay. The drag is made by splitting a log, placing the two pieces about thirty inches apart (with the flat sides both facing in the same direction) and pinning them together. The lower edge of the front piece is protected with iron; an old wagon tire will do. The log should be ten or twelve inches thick and about ten feet long. Fasten a chain or heavy wire a foot or eighteen inches from each end by which to haul it. Hitch the team so that the drag will move the dirt toward the centre of the road. The hitch is next in importance to the time at which the dragging is done. The right time is just as the road dries after a rain or when it is thawed on top during the winter and spring, and it should be dragged *every* time.

Of course a smooth surface for travel is thus produced, but a more valuable result is that the road will shed the next rain instead of absorbing it. This is the reason why the road should be dragged every time, so that it always will be ready for the next rain. If I do not say anything else here today that is remembered—and if the people in this association do not get any other thought that they can carry home with them, I want them to get that idea—the way to make a good dirt road is to keep it so that the next rain will not go into it. This means dragging only about once a month on an average. I have kept track of it in order that I might be able to speak with authority as to the amount of time and I find that the average is twelve times a year, that is only once a month; not much to secure a good road. I drag from my own front gate to my neighbor's front gate, a half mile. It takes about twenty minutes. I don't make very many trips to town before I have regained the time I expended in dragging, to say nothing of the gain to my neighbors and to the general public.

This method is very simple, as I have said, but to one who is familiar with the ordinary dirt road under all conditions of season and weather, the results are but little short of marvelous. Teams pass here at a sweeping trot when the other roads are almost impassable. When the other roads are in such a condition that loaded teams must be rested every few rods, the same loads are moved over this road at a free walk and without resting.

This road is high in the center and very hard. Dragging every time not only makes it smooth for travel, but distributes the travel all over the road, packing it evenly instead of just under the tires and under the hoofs in parallel beaten paths, thus increasing the ability of the road surface to shed water. Dragging every time spreads a thin layer of moist dirt over a moist surface and travel packs and pounds it together; every dragging adding just a little soil and the whole being thoroughly amalgamated and consolidated. After five years of spreading and packing I have a road on which anything less than a week's wet weather makes little impression. In the spring when the ground thaws through and unkept roads are so muddy and spongy that we say "the bottom has fallen out" this road remains in fair condition. It also invariably is dry one or two days before the other roads.

A horse's hoofprint will hold from a saucerful to a quart-cupful of water. The neglected road presents a surface of upturned cups and saucers in which the water must stand until it either evaporates or soaks into the road bed. Dragging every time gets the road ready for the next rain and there are never any cups and saucers waiting. This method also does away with mud holes and chuck holes at the bridges. After being dragged a few times the surface of the road stays up with the level of the bridge. One knows, only by the sound, that he has driven on or off a bridge.

More dirt can be moved and more of a show can be made by dragging the road during thaws in winter weather than at any other season. At such time the soil is crumbly and mealy and pushes to the center very easily. If a road is dragged two or three times in March or April it will show the effects all summer. That statement seems rather improbable and yet it is true that where I have succeeded in getting a neighbor out in April, May or even March to go over his road just once or twice, that all through the summer you could tell it had been dragged. The weeds do not grow up on the edge of the road with a slant toward the inside as they do on a road that has not been touched after winter travel. But if one wants a road, such as I have tried to tell you about, he must live up to the motto, "keep your road ready for the next rain," and to secure full satisfaction he must carry out the idea for several years. However, do not allow this to discourage anyone—but make a start.

Nor is an iron faced implement absolutely necessary. I began with a drag made of an old post and a frost-bitten pump stock held together by two or three short pieces of inch board nailed on top. It pulled to pieces at the beginning of the second year. And at first I simply drove a team straddle of one wheel track, going, and of the other wheel track coming back, merely breaking the rim of earth that rises on each side of the wheel track and leaving the road in good condition for teamsters to "straddle the rut." After smashing both ruts I remember I used to look down the road approvingly, pat myself on the back and think I had the nicest road in the country; and while

I did at that time, yet it would look very rough to me at present. These days if my road does not look as smooth as a quarter stretch I expect people to criticise it. I hope you will not think I am exaggerating. Mr. Waters was there and saw it and he will bear me out when I say the road in front of my house and for a half mile south to my neighbor's is in as good condition as any quarter stretch at your fair grounds and it is that way most of the time—of course not

From a photograph taken of Mr. King's road, showing smooth surface.

while it rains—it is not that way until the mud dries up, but just as soon as it dries, and it dries a day or two before the other road, I get over it with the drag just once and have another quarter stretch. If I don't get over it the neighbors are after me to know why I don't. This shows the power in such a condition of education. The people are accustomed to finding that road so that they can drive over it as fast as they wish and if they cannot do so they want to know "what's the matter with King."

This simple method of securing a hard dirt road has been developed into what is known as the "Maitland Good Road System." Perhaps I can best describe this system by relating to you the story of its growth. We endeavored to get all to drag, but found one or two conservatives that were hard to start and the majority allowed the small minority to stop them. You all know how that works. In trying to get past this difficulty, I said to a farmer who lives five miles from Maitland: "If I will drag the road from your house to town ten times in one year, will you drag to town once?" He replied: "You bet." I then went to some of the merchants and suggested that if the road to Maitland was better than the road to Blanktown, the people would come to Maitland, even if Blanktown is closer to them. I said to them: "Now if I will get eight or ten farmers along that road to drag to town once a year and can get eight or ten of you merchants to drag to a point five miles out and back, that would be going over the road sixteen to twenty times a year, which would be oftener than I drag my road and so we will have a fine road to this town." (I did not have to say anything about my road because it has been there five years. It is not any talking that I have done that has improved our road, it is the object lesson there in front of my house.) To make a long story short, I secured twelve to fifteen merchants and about eighteen farmers, though the farmers did not all live right on this road; and we are dragging and we have the best five miles of dirt road I ever saw, though we have been at it less than a year; and have barely made a start, not yet using one-half of the help promised. There are now nine drags on about five miles of road.

Somebody said yesterday that we cannot get men or teams in May and June. Now I have given this matter very careful study, having been a road crank for eighteen or twenty years, and I have learned that if you will "keep your road ready for the next rain," you can do the work in February, March or April, depending a good deal upon the season and upon your latitude. Then you will not find much to be done in May and June. In February, March and April, now notice, in *February, March* and *April* you can get out and work your roads before you get into your fields. The reason we do not get out and work our roads is because it has not been touched since last autumn and is a great big loblolly, but if you had kept it ready for the next rain it would be fit to work. If you kept your road good last fall then it is in shape so that you can drag it when you can do nothing else with your team, because the road dries before your field does. In spring and winter you will find it best to drag the road when the surface is dry, but while the part just beneath the surface, that part reached by your drag, is still quite moist; in summer and early fall you will find it best to drag when the surface is just a little bit wet because after summer rains, the soil an inch or half an inch below the surface gets dry before the surface. This may seem a little thing, but it amounts to a good deal in the course of a year's dragging. If you wait too long, you can not do as much good as if you had dragged just at the right time when the road was soft in the middle.

This road gets dusty, but not so dusty as unkept roads.

Ask a man how often he plows his corn. H answers three or four times. But does he plow it three of four times in one day? No, the plowings are a week apart. We are willing to plow our corn at weekly intervals, but we try to compress twelve months road building into one eight-hour day. You remember the story of the Welchman, who upon hearing that Englishmen combed every day remarked that he combed his head only once a week and it was all he could do to get it combed then. Do we not work our roads like the Welchman combs his head?

We go to the field and plow and harrow, and prepare to plant corn; then we get the check rower and plant it. But we go to the highway and plow and grade it up ready to make a road and then we —quit. Don't we? Isn't that exactly the way we do? We get ready to plant corn and instead of planting it, quit, and then we complain that the law is not right, or that we do not have money enough. But at the foundaion the trouble is with us farmers.

I happened on to this method by accident. If it had not been for the old post and pump stock that I used in 1896 I would not be here today. Col. Waters suggested this plan in his report for 1899, and Prof. Baker of Illinois wrote of this idea in 1901, but it just happened that I began in 1896 and that I stuck to it after every rain until now.

I know something of pikes. I was born in Ohio and lived on the National Pike, but I never saw a pike in finer condition than our road near Maitland nine days out of ten in the year, when it is not actually muddy.

We hear much about enacting a law to make people do so and so. We cannot make people take an interest in the roads by enacting a law, nor can we make a law that will enforce itself. We can only use a law to set a standard. Now I believe that statement is true in all except criminal law. Criminal law says you must not do something or we will punish you; but the road law says you may do such and such a thing, or, such and such a thing shall be done a certain way. It is not the law it all depends on our state of mind. A twelve year old boy must be punished to make him wash and comb and he never blacks his shoes, but the same boy at sixteen years of age wears shoes that are like mirrors in polish and will spend an hour in tying his cravat. It is the same boy, but the attitude of his mind has changed. When he was twelve years old he did not care who looked at him nor how he looked. When he gets to be sixteen or seventeen everybody is looking at him and he is anxious to look right. It is just that way about our roads. If we do not care how the road looks, the road will not look very well, but if we are in a community that cares, or if you are an individual that cares how the road looks then the road will be all right.

Now I want to repeat a few remarks that have been made about this road. I repeat them because they serve to illustrate the progressive spirit that has been aroused and show what has been done. A veterinary surgeon said to me one day as I was dragging: "King, this is the only bridge between Maitland and Blanktown that a man cannot tell when he comes on and goes off it except by the sound." Another man stopped me one day and said: "King, you are getting this road in pretty nice shape." I said, "Yes." He said, "Mr. A——, (a neighbor of mine who lives a quarter of a mile from me)—"Mr. A. has his road in nice shape also and is going to crowd you pretty soon." You see we have aroused a spirit of rivalry and it is a question who will have the best road. He then asked me whose road was between mine and Mr. A's. Now that was none of his business. He had traveled over that road for fifteen years and it had never before occurred to him that anybody in particular ought to look after that quarter of a mile. What made him think of it that way? Was it not the fact that my road and Mr. A's road was good and because on this other stretch of road he had to slow down to a walk and could not trot that he asked whose piece of road that was? I answered, "I don't know." Then he asked: "Is it Mr. B's business to drag that road?" Again I answered, "I don't know." Then he asked: "Well, has Mr. B. ever been out and dragged that road at all?" I answered, "Not that I know of," and he said: "Well, he is a great fellow." Where did he get the idea that a man was negligent because he did not drag his road? From nothing in the world but the fact that he could ride easily and swiftly over the two other pieces of road.

There is a feeling in our neighborhood that this method which we call the Maitland Good Road System, is the solution of the road question. Col. Waters told us last night that ninety-nine and one-half per cent of our roads in Missouri were dirt roads; so if we have solved the question of making hard dirt roads up in Holt county, we have solved the question of making good roads for ninety-nine and one-half per cent of the roads in the State of Missouri. That is something to be proud of.

Col. Waters said something last night that made me feel so good that I have remembered it and I want to repeat it—he said if the road commissioners of the State of Missouri could stand as he did on that road and examine it and understand and appreciate it, that the impression made would be worth one hundred thousand dollars annually to the State of Missouri.

There is another thing I am thinking of trying and I would like an expression of opinion on that subject. Would, or would it not, be best to make a snow plow and push the snow off the center of the road after every snow in the winter time? That is the next thing to do to keep the water out of the road, to get the snow off before it melts.

Another thing I want to see is a road machine that is made in Illinois, I think. It is, I believe, going to take the place of our road graders. Every man who has worked a grader knows that about two-fifths, or from two-fifths to one-half, of the power that is exerted, is used in crowding the wheels against the bank. That is, if you have eight horses, three or four of them pull the machine, while the other three or four are crowding the wheels against the bank. We waste half the power whenever we load the grader heavily. This machine I speak of has two long railroad irons swung on wheels in the shape of a V, so you can let them down when you want to. They go along the road with eight horses hitched to them and one iron offsets the draft of the other one. They throw the dirt in the middle of the road and all the power is used. I believe it is the coming machine. In conclusion, I would like to make the following suggestions:

Don't drive too fast.

Don't walk, get on the drag and ride.

Don't wait for the neighbors to take hold; they may be waiting for you.

Don't bother about a tongue; it is much more trouble and expense and is of little benefit.

Don't wait for the big grader to come up and shape up your road. All you can do first will help to make the work of the grader permanent.

Don't be too particular about material. With an ax and a two-inch auger almost any kind of a log can be made into a drag. The one I have used for several years is box-elder.

Don't try to drag with one piece; use two. One will scoop out all the hollows in the road and deepen them. When two are used the one keeps the other up; and in a month or so the hollow will have filled and become level and hard like the balance of the road.

ROAD MAKING IN SOUTHEAST MISSOURI.

By Hon. W. J. Ward, Idalia, Mo.

Mr. President, Ladies and Gentlemen—You are all perhaps more or less acquainted with the conditions in Southeast Missouri. We have all kinds of soil except gumbo; we have none, I believe, that exactly fills the description of the gumbo in the bottom lands of the Missouri, but we have almost everything else. In our level country, in the extreme southeast, we have sandy river bottom and the stiff alluvial soil; we have the undulating clay lands and further north the Ozark counties with much of as hard stone as can be found and and perhaps as many as there are anywhere. One who knows how to build roads in that country, would perhaps be able to give instruction in road building in Northern Missouri.

Our roads in Southeast Missouri are as poor, perhaps, or have been, as they are or ever were in North Missouri. We have been living under the same chaotic law that you have here. We are concluding now that *Stoddard county is almost the center of the State,* but I presume that you gentlemen will dissent from that opinion. North Missouri is a splendid country, but we are trying to bring up our part of Missouri to at least its equal. Souutheast Missouri is almost entirely a timbered country; some prairie land, but much of it sandy, which is not favorable for road building.

To tell you something of the workings of the law under which we are now living, I suppose will be in harmony with the expectations of this convention. I might say here that I have the honor of being a member of one of the district boards of road commissioners in Stoddard county. Perhaps that honor was conferred upon me because I was a member of the Assembly that passed the road law, and, by the way, I am not the only legislator who serves as commissioner under a law that gives us no salary. We made very little progress for a while after the enactment of the new law. Some of our people were opposed to it. Our district board of commissioners appointed overseers to supervise the work, and that was all we could do. The first year we advertised for contracts, but failed to get bidders. The law provided that the poll tax payers should have the privilege of paying their taxes in either money or labor, and the contractors did not want a contract under those conditions. Only one of the district boards of commissioners (there are seven in the county) succeeded in contracting the first year. In our district the commissioners construed the law, that it was necessary every year to notify the taxpayers when and where they were expected to work out their poll tax and so put upon us the expense of notifying the taxpayers. This was our view of the law and is the construction still placed upon it. The county court has the prerogative to require all poll taxes to be paid in cash, which should be done. This would relieve the board of the expense of giving notice to the taxpayers when and where their work would be acceptable in the payment of taxes, quite a material expense. This working out of the taxes is one of the greatest drawbacks to improvement of the roads with which we must contend, because the labor is unskilled and the men and teams are untrained; however, the law gives ample remedy if the county court will only require by order of record that the poll taxes be paid in money, hence, we ought to have no further legislation on the road question, but let the people and the county courts see to this so that we may go on improving roads.

Last year we did very little work in the county. In our district we bought a road grader and used it some. This year we bought another. We have one hundred and ten miles of road in the district. We made a contract the early part of this season with some gentlemen to furnish their teams and hands enough to run the graders. Early in May we began grading the roads. Last spring the center was the lowest part of the road. We paid those gentlemen by the day for hand and teams, the district furnishing all the tools and machinery with which to do the work. We graded eighty miles of road in our district this season and have about paid for it all.

I believe we have made material progress along the line of road improvement in Stoddard county and I presume many of the road districts in Southeast Missouri have made as much. We, of district No. 4, have exceeded the average road district of our county. Some of them have made very little progress. Our people understand the law more thoroughly and our Board of Commissioners have the interest of the roads at heart and we certainly have improved the public highways of our part of the county.

We, in our county, have a levy of only ten cents for road purposes, a poll tax of three dollars, and then we get our division of the saloon license. If our county court would give us a little additional levy, then we could go on and make material improvements over what we have already done. But with only *ten cents levy,* and three dollars poll tax paid in cash and our saloon license, we can revolutionize the roads of Stoddard county without a doubt. I do not know that that would apply to all of Southeast Missouri, for when it comes to working these mountain roads where there is so much rock, I cannot say that they could make as much improvement with the same amount of money. We have very little rock and can work with the road grader as effectually as you can here. We have some roads with scattering stumps on them, but we have been using dynamite to extract them. So the number of roads upon which machines can be used are steadily increasing with us.

Our county court divided our county into road districts, corresponding to the municipal townships, giving us from fifty to one hundred and thirty miles to the road district.

We are making material progress along this line. I should like to emphasize this idea—let the road law alone. I would like to impress that upon you, and especially the members of the Forty-second General Assembly. For a number of years every session of the Legislature has been changing the road law. That is a kind of chronic proposition. If there is no other way to make variety the legislators must make a change in the road law. Before the present system was established, every change that was made, at least failed to improve matters, if it did not make them worse. One time they gave us three or four school districts for a road district. In our district we got together, held a primary and agreed upon a man who was the choice of our school district. The result was the man we picked on was elected and we had no ground for complaint, but the others complained, the road over-seer did little work and the law came under condemnation. We do not want to go back to the over-seer plan. Let the present law alone and prove the practicability of it. And as the people come to understand it there will be no question about maintaining the law practically as it now stands.

In Stoddard county there are a great many gravel beds, and in many places throughout Southeast Missouri much gravel may be had. We are using this gravel for the improvement of unusually bad places in our roads. Our soil is soft and washes easily and in the spring of the year, when the frost comes out of the ground and in wet weather, it is extremely soft and sometimes our road becomes almost impassable. I have in mind a certain piece of road in the township I represent that for years had been almost impassable at times until the county court three years ago made an appropriation for grading. Two years ago we agreed to haul some gravel for that piece of road, each man hauling whatever amount he wished to, and spread it along the center of the road; we just took our wagon and dropped one load after another in the center and from that time to this the road has at no time been very muddy; just simply from one load of gravel, per wagon length, put on the center of the road. We can gravel our roads cheaply if we will do it.

Under the present system we can spend a considerable sum of money for permanent improvements and at the same time do the ordinary work necessary to keep our roads all in good condition. We have abundance of stone in Stoddard county that we can use when we have the money available to make macadam roads. We want, however, to improve first our common dirt roads yet I think the time has come when we should begin to study the building of rock roads. I suppose nothing would come nearer benefiting all the people in every community all over this land that the improvement of the public roads. It would improve the condition of the farmer, perhaps more than that of any other class of citizens. To my mind the betterment of the condition of the farmer means the prosperity of everybody, the merchant, the mechanic and the professional man. I do not quite approve the argument that the farmer would save just so many dollars and cents by the betterment of the roads; it would vastly improve him by elevating him to a higher plane of social and mental culture. These things have been said so often, it is useless to follow this line of thought longer.

I am not prepared to say what progress has been made in the other counties of the Southeast; I am told, however, that in Dunklin county the requirements of the present law have never been met—that is the county court created no district boards, no list of poll taxpayers was made, and that they have been virtually working under the old law, or rather no law at all.

Judging from the meagre information gleaned concerning the general method of road work in these counties, I feel justified in saying that there is much of this work being done virtually under the old system, if it can be called a system, which is questionable, as under it those who want to work do so and those who do not, refuse with impunity to either work or pay poll tax.

THE QUALIFICATIONS OF ROAD-OVERSEERS.

By Geo. F. Reed, Springfield, Mo.

Gentlemen of the Convention:—The qualifications of road commissioners should be of deep interest to every person who travels the public roads in this State. To define those qualifications necessary to make an ideal commissioner, I am inclined to the opinion that few would be found competent to fill the position as it should be done. The general idea prevailing throughout the country that most anyone can make country roads is erroneous, and has been from its inception. When this idea has been eliminated and we get down to the practical science in road construction, one long step has been made in the right direction.

A road commissioner should be an intelligent, resourceful man, one given to thought and study, not necessarily college bred, but of good common sense, broad and liberal in his views, so much so that any factional interests will not deter him from doing his duty, regardless of personal interests or friendship. He should be a man proud of his country, his state, his county, his district and his personal achievements in life. He should be something of a mathematician, that he could calculate the quantities in a fill or cut and the cost of either. To calculate the area drained and the probable volume of water concentrated at a given point where a culvert is necessary for proper drainage. How a culvert should be constructed of adequate size, and at minimum cost. He should also know something of lines and levels, in the proper ditching and the friction in flowing water and the area to be drained, that the best results may be obtained. These are a few of the qualities necessary to make a successful road commissioner, and any district having three such men, the roads in that district will be properly cared for.

The parties most responsible for the present Road Law appreciating the fact that such qualifications were not possessed by everyone, the law was so amended, giving the commissioners authority to employ a civil engineer to supply them with the information necessary for the proper construction and drainage, and the probable cost thereof. They are not limited in their action in any way only to the amount of money they may have.

The other qualities enumerated must be in the man, for they can not be supplied by any action of law. The person employed as road overseer, contractor or representative of the commissioners in road construction, should be in qualifications superior to the commissioners, from the fact that the actual work is done under his personal supervision. He should have the knowledge and skill of directing a body of men in the most advantageous manner, thereby securing the best results without loss of time, labor and money. The nature and condition of the materials to be worked, and surrounding conditions should be thoroughly examined and the best method of action ascertained by thoroughly planning and laying out the work to be performed before beginning operations. In this way much loss may be saved to the better improvement of the road and to the general public.

When these conditions are put into actual operation, we will then have the art of road building down to a science.

Without detaining you too long I wish to touch upon the county road and bridge commissioner. While it is supposed that the person elected or appointed to the position of county surveyor of a county, is capable of filling the position with credit to himself and to his constituency and possessing the qualifications of a civil engineer, it is too often the reverse. He may be and most probably is capable of subdividing a section of land, one of the most common-place duties to perform, but when it comes to road and bridge construction and the planning thereof, then practical engineering ability is in demand, and he is found to be totally deficient and unqualified to perform the duties as commissioner, as the law intends he should.

There is no comparison whatever in ordinary land surveying and practical engineering, and I am decidedly of the opinion that the law should be so amended, giving county courts authority to employ practical engineers, in the planning and supervision of such work.

THE COMMON DIRT ROADS.

By Hon. H. A. Schoppenhorst, Peers, Mo.

Ladies, Gentlemen, and Members of the Industrial Association of the Great State of Missouri:

I want to preface this paper by the remark that this paper was written a week or ten days ago, and if I trespass on the territory sketched out by other speakers, or touch on points that were discussed here yesterday, I desire that it should be taken as merely additional evidence to the matter under discussion. It is a little discouraging to discuss the road question when other industrial associations have so much to tell us about their victories and their progress.

It is with some embarrassment that I attempt to address you on the subject assigned to me, after we have heard so much of interest and learned more of the different industries—their progress, their victories and the part that each of them takes in making our State *great, progressive and honored.*

The subject assigned to me by our Honorable President is, "The Common Old Dirt Road of Missouri." Roads are an absolute necessity in all civilized communities. If our available means will not permit us to build Telford or Macadam roads, we must do what we can to improve our "old dirt roads." In some places in this State people are awakening to their own interest in the betterment of their roads. In the last two years more attention has been given to the proper location, drainage and permanent improvements with the means at hand, in many communities than ever before. People in many places are beginning to see their own benefit in road improvement.

My observation and experience teaches me that it is pretty safe to gauge the industry, enterprise and intelligence of a community by the condition of their roads, or their attempts toward improvement. If we want to make improvements along this line, we must feel that we need and want them and be willing to give our aid to bring about the desired result. The road question has for many years been earnestly discussed in all parts of our State. It has been ridden as a hobby to the State Legislature, and the result is that our statutes are overloaded on the subject. A pamphlet entitled "Laws of the State of Missouri, Relating to Roads, Highways and Bridges," revised to date, 1901, compiled by Hon. Sam B. Cook, Secretary of State, contains no less than ten distinct and different road laws; some special to certain conditions and localities, others optional to the people or their county court. For years we have been seeking to improve our roads by making laws, when only labor intelligently applied, can improve them. Labor costs money and that is always most profitably and advantageously applied when under the supervision of parties benefited by the improvement. Whenever a community is earnestly desirous of improving the conditions of their common dirt roads they can find no better guide than the law originally framed by the Good Roads Association of Missouri and enacted into law by the General Assembly of this State in 1899 and amended in 1901. This law is so elastic and gives the county court, as well as the commissioners, so much discretionary power, thereby making it applicable to all localities and conditions of the State; and what is more, the means at hand are expended under the supervision of parties near by and most interested in obtaining value received for the money and labor expended. And many enterprising men, seeing the means properly applied, will volunteer substantial aid in money or labor to help the good work along.

Many people do not yet seem to understand the importance of the improvement of their roads, therefore, our work is. not yet done; we must agitate and discuss this question until they *all* see and feel that the public roads are *their own property,* that the money expended thereon **is** their money, and that the improvement of the roads means the improvement of *their own condition* in securing conveniences and pleasures as well as the improvement of their financial condition. Whenever this sentiment takes firm hold in a community, we find that the roads are given necessary attention and that permanent improvements are constantly going on and will in the course of time result in good rock or gravel roads to all important business points.

Permit me to call your attention to one of the most serious drawbacks to the keeping of our dirt roads in proper condition, and that is the universal practice of using narrow tired wagons. If an instrument of destruction had been purposely planned for the destruction of our roads, the narrow tired wagon, for hauling freight on our common dirt roads, could not well be improved on. Just think of the absurdity of attempting to make a vehicle with tires only an inch and a half wide to hold up a load of a ton or more on our spongy dirt roads. You all know the result and have seen the conditions resulting from this useless and expensive custom of using narrow tired wagons, simply because Tom, Dick and Harry does the same. Wide tired wagons have been scientifically and practically tested and have proven to be more economical, easier on the team and a great protection to and a builder of our common dirt roads. In some localities a change for the better is beginning to be in evidence in the use of broad tires with satisfactory results. In European countries this is so well understood that narrow tired freight wagons pay toll, while wide tired ones use the roads free of charge.

One more thought and I will close. The amendment to our State Constitution adopted in 1900, permits the county courts to levy a tax not to exceed fifteen cents on the one hundred dollars valuation for road and bridge purposes. This levy, however, is left optional with the county courts. Very few county courts will have the courage to make this levy unless they are in some way urged on by the tax payers of their county, for fear of spoiling their chance for re-election. This matter should be taken up by the tax payers, or road organizations, where they exist, by calling a convention for the purpose of discussing the matter and passing resolutions urging the county court to make such a levy. The road tax levied under this amendment reaches all the property, even in incorporated cities and towns, and requires them to contribute a small share to improve the roads leading into such cities or towns. Gentlemen, we have all the legal machinery necessary to obtain the means for all ordinary improvements necessary on our common roads, if properly put in motion and the funds properly applied. But I have often thought, when passing newly improved roads and seeing much of the work improperly done for want of proper knowledge as to how to construct certain improvements; what a benefit and saving it would be if someone would formulate a set of rules to be adopted and followed in building roads.

The most expensive blunders are made in putting in culverts, which, in most cases, do not reach the whole width of the road, and are often placed on the up-stream side of the road, leaving the outlet on the down-stream side in the center of the road unprotected, and the result is that one-half of the road will wash away and can never be recovered without great cost. If a rule for building culverts were adopted and followed, many mistakes could be avoided and much money saved. I will venture to suggest as a sample, the following rules for building culverts, to wit:

1. Always place your culvert square across the road.

2. Always begin your culvert on the down-stream side of the road.

3. Always give sufficient pitch and see that the outlet is clear, to prevent clogging, and securely protected to prevent it from washing out or caving in.

4. Always make facing at both ends, of rock or other substantial material, and pack solid, to prevent crushing or washing out.

In relation to the sewer pipe culvert, I will say we have had years of experience with them in my county. We had very bad results at the beginning, but we buy them by the car load still and when properly laid they are the best culverts that we can use. They must be large enough to carry off the water without getting clogged and they must be covered deep enough with dirt and the dirt must be thoroughly packed. The embankment has to be sufficient to hold the water from going over. If properly constructed they are the best and most substantial culverts that we have. We have some that have been there for ten years and have never been touched since they were put in. In the beginning we put them in too loosely, we did not fasten them properly and we lost money. Now we find they are the cheapest culverts we can make and we have put in culverts twenty-four inches in diameter in many places.

Mr. Reed.—In regard to these stone culverts, we have them in Greene county in a good many places. We have a great deal of stone and in some counties a considerable amount of stratified stone from eight to ten inches in thickness is found. We build them in two or three ways. To save the expense of building a frame in the turning of these arches, we make most of them Gothic, laying the stone up and projecting each layer on the other until they are turned out in the Gothic form, like a Gothic arch. There is no expense required for a center, and it does not project far enough for it to tip over. This is easy enough where you have a large culvert that needs to turn a great arch, and in small drainage they just slip them over the same way until they get firmly packed and are covered with a large stone and it is a fixture there.

Mr. Schoppenhorst.—The question has often been discussed in my county as to whether stone or sewer pipe culverts are the cheapest in the end. It is answered thus: Wherever stone is convenient and durable, stone culverts are the best; but we cannot always have stone and often sewer pipe culverts are the cheapest.

ROADS AND RURAL MAIL DELIVERY.

By Hon. W. F. Blair, Breckenridge, Mo.

This subject, with the few remarks that I shall make, is as old as the human race, for Cain, when he went into the Land of Nod, must have used something that was, to him, a road. It has been among the foremost subjects for discussion in all ages. I do not believe that our improvements in our public highways have kept abreast of our improvements in other lines. You may travel this country from one end to the other and you will never see the grain cradle and very seldom the old-fashioned reaper. The hum of the spinning wheel and the stroke of the loom you will never hear. Our country is spanned by railroads and enveloped by a perfect net-work of telephone and telegraph wires; but you will see the team hauling the same wagons over a majority of the same dirt roads with but little improvement. The farmer is quick to take advantage of the improvements of others, but rather slow to improve on conditions wholly his own. He can be taxed without a murmur to build costly State buildings and to maintain expensive State institutions, but when he sees a few cents added to his tax to build his own roads, then he is heard from.

Our system of road building in the past has been so barren of results that the farmer has come to look upon his road tax as so much money absolutely thrown away. The practice in many of our road districts of electing an incompetent road overseer, has brought about this state of feeling. With the improvement in the tools which has been made comes the demand for good roads. Over in our county, Caldwell, we have secured a better class of road overseers than we formerly had, but the time is at hand when we must improve our roads. The State demands it, the farmers everywhere demand it and the advocate of good roads is not talking to empty seats.

Over in our county a few years ago, a very estimable gentleman was elected township trustee and as an experiment he thought he would build a little rock road. There was a very bad place in the road and he had heavy coarse rough rock hauled and put in the middle of the road and then had it pounded down smooth with a stone hammer and for sixteen years that piece of road has not had one cent of money spent on it and it is as good now as it ever was. That was merely an experiment. These experiments when they succeed are object lessons and other neighborhoods will follow the example. We have another piece of extraordinary good road covering a tract of about four miles in length that was obtained in another way and has not been worked for twenty-five years. Twenty-five years ago the people on that line of road put it in splendid condition. Out of their own individual money they built some graders—you have all seen them, three or four heavy planks bound together and faced with steel. They never let that road get out of repair. They followed the axiom that a stitch in time saves nine and kept it in repair continually. These are two ways of getting good roads.

The government is now sending out its agents to us and saying: "we deliver the mail daily to the citizens of the larger towns, and if you farmers will keep in repair a certain line of road, we will deliver the mail daily to every resident on that road with no other obligation except to keep that road in repair."

It might not be amiss to tell you of a plan we are taking up along this line to get all the residents of our rural route to form themselves into a society, elect a president and secretary, meet at stated times and places, and for every resident of that road to report any bad places in the road that the overseer fails or neglects to attend to and let every resident have a general supervision of the road. We believe by making every man personally interested in trying to make his mail route better than any other in the county, in a few years our rural mail routes will be the boulevards of our country.

The rural deliveries were a success from the very start, but they have increased beyond the hopes of their most sanguine advocates. One of our rural mail carriers delivered ten daily papers on his first trip out of our city, and now, three months afterwards, he delivers fifty daily papers on the same rural route. I dare say the other rural routes of the country will show the same improvement.

Our government never did take a stride forward but that it had to meet objections. The calamity howler and the disaster howler are always heard from. The rural delivery has come to stay and its advocates have only to advocate good roads and keeping the rural routes in good repair and after a while every farmer will have his mail delivered at his own door. The rural delivery system can hardly be exhausted. It is like any other good thing, you cannot see too much of it. I believe in getting every farmer interested in good road making and not until we do will we succeed in having good roads all over our State. We have got plenty of the very best material in this State to build roads with and we ought to go to work and have good roads, roads that you could travel over the same in winter as you can in summer. If you happen to have an old fogy in your neighborhood that objects to road improvement, don't argue with him but just drag him right along with the crowd and it will come to him in time.

DISCUSSION.

Mr. ———.—Do I understand you to say that the keeping of the road in repair should rest wholly with the farmer?

Mr. Blair.—No, sir; but the farmer is more directly interested than any other man. He has a greater interest than the merchant in the city. The only interest the merchant has in the roads is to have them good so that the farmers will get to the city and spend their money. But if good roads will enable the farmer to take twice as heavy a load as he could take before the road was in good condition, he had better advocate the keeping the road in good repair than to waste his time in taking the two loads.

Mr. ——.—We will never get good roads until the entire country is made to pay its part. Take this road from Chillicothe to Trenton. I guarantee as many hacks and carriages run over this road as farmers' vehicles, but these people never contribute anything to support it or build it up. That is one thing we have to contend with and they are the very fellows that are going to blame us for not keeping up our roads.

Mr. ———.—Do you not think the railroads ought to share the expense of keeping up the country roads? They too are interested in the roads.

Mr. Blair.—The stock and grain are in the country and have to be gotten to the depot some way, but the railroads are loath to help the farmer, though they expect him to pay the expense of freight.

Mr. Maitland.—I am a farmer myself, but I wish to say a word in defense of the railroads. I have attended road conventions in this State for ten years, and at our first conventions we generally had representatives from the various railroad companies and several times they offered to transport road material that could be used in the State of Missouri for the actual cost of transportation. I say this in defense of the railroad people. They offered to transport crushed rock, gravel or anything of that kind from one point to another for the mere cost of engine and crew.

Mr. ———.—Is it not a fact that the railroads are blockaded for months during the year because of the vast amount of grain that the farmers bring in from the country when the road is in proper condition? If the roads were kept in good condition all the time, the farmers would not have to bring in the grain all at one time and the railroads would not be blockaded. Good roads will greatly benefit the railroads in my opinion.

GOOD ROADS AND RURAL FREE DELIVERY.

By C. O. Raine, Monticello, Missouri.

Mr. Chairman, Ladies and Gentlemen.—In regard to this road question, I would say it has been customary for the master of the State Grange as well as the master of the National Grange to embody in his report something on the subject of good roads. In my address this year I left the subject off because I supposed that not only the people of our own association, but the people of Chillicothe and of the State of Missouri would hear enough said on the road question at this time. It certainly is a question of great importance commercially, but that point has been touched upon by the three speakers who just preceded me. The farmer is benefited commercially by a good road. How so? If he has a good road, he can take his products to the market gradually and he can regulate the market to a very great extent, can regulate falling prices so that the market will not fluctuate, for when the roads get bad, it is difficult to bring the products to the market and the price always advances; and when the roads are good every farmer rushes his products on the market and the price goes down.

I shall not take up the time to suggest as to how and in what manner good roads should be obtained, except that I have always been in favor of assisting in building roads. I want a good road by my farm and I often say to my neighbors, if they have bad roads, fill up that ditch, cut down those weeds so that the passer-by can look over them, so that he will not have to wade ruts and mud holes to see your farm. If there is a place on the road near my farm that I can repair I do it. If the overseer wants to pay me, all right, if not I will fix it anyway.

There are not a great many people who are not acquainted with the nature of this question of free mail delivery, but they do not understand just exactly what has brought about this wonderful result. I am here to tell you this morning that the Grange claims the honor of pushing this work to success. I shall undoubtedly prove this to you before I am through. We have placed within your hands, my good roads brothers, one of the greatest incentives to assist you in building good roads for this country, and that is free mail delivery. Did not the gentleman just tell you, every time a petition is sent in for a free mail route the government agent says "fix your road first or we will not do anything for you. Fix your road and then we will talk to you about getting a mail route." In 1891 the National Grange took up the question of free mail delivery, and Mr. Wannamaker who was then, I believe, Postmaster General under President Harrison, suggested that an appropriation of fifty thousand dollars be made for the first experiment. The next appropriation for this work was a hundred thousand dollars—I am not going to take time to tell you how they had to work to get Congress to agree to this; at the start only a few men would listen to words in favor of the movement. The next appropriation was one hundred thousand dollars. The next three appropriations were one hundred and fifty thousand dollars. Up to the time of the one hundred and fifty thousand dollar appropriation only three of the routes that had been established were failures and good and substantial reasons were given for these failures. The next appropriation was five hundred thousand dollars. In 1899 the Committee on Appropriations reported the appropriation bill back to Congress with the appropriation for free mail delivery left off, while the National Grange had asked for an increased appropriation for that purpose. Mr. Hanna was at that time chairman of the Committee on Appropriations. The Executive Committee of the National Grange was telegraphed for to come to Washington at once. They knew that something was wrong and immediately started for Washington but they did not know until they arrived what they were called there for. They were then informed of the action of the Committee on Appropriations. They said to Mr. Hanna: "You have done us a great injustice in cutting out this appropriation for free mail delivery." He answered: "I cannot help you, we thought best to cut the appropriation down somewhere and the thing is done." They answered: "Mr. Hanna, you can get that bill back into the hands of your committee if you wish to do so. We want to say to you that we have petitions from thirty thousand members of the State Grange in Ohio asking that this appropriation be made for free mail delivery." I won't say how many petitions were sent in by citizens all over the United States asking for this appropriation, for I have forgotten the number. They said: "Mr. Hanna, the State of Ohio stands back of us and asks you to give us that appropriation." Mr. Hanna said: "Gentlemen, I will do anything I can to help you." Well, he got that bill back into the hands of the committee and when it came back to Congress it reported in favor of the appropriation for free mail delivery. This is the history of free mail delivery and since that time it has been going on with wonderful results.

SESSION OF

Sheep Breeders' Association

WHY USE A PURE-BRED RAM?

By Prof. F. B. Mumford, Agricultural College, Columbia, Missouri.

The question that has been assigned to me for discussion is certainly one that appeals to the average farmer. It is not necessary to talk to the breeders of improved sheep on this question; it does not apply to them at all, because they would not use any other kind of ram except a pure-bred one; but the question as I interpret it is, why should a common farmer use a pure-bred ram; the man who raises common sheep. I should prefer to state the question a little differently and ask "Why not use a pure-bred ram?" If we look for a moment at the history of the development of sheep even in the past few years, we will see that some remarkable changes have been brought about. In 1812 Col. Humphreys imported some sheep into this country from Spain that sheared three or four pounds of wool per head. In a few years the improved flocks bred in this country sheared from five to eight pounds per head and some rams were produced in the course of fifteen years that sheared from fifteen to twenty pounds per head. Breeders have now brought these sheep to such a state of perfection that there are records of single individuals of the Merino breed shearing as high as fifty pounds of wool per head. These animals have been bred and developed in such a way that they have been able to transmit this improvement to their offspring, and if a man is interested in sheep from the standpoint of wool production, it seems to me very foolish, if wool is his object, not to take advantage of the wool producing quality that is possessed by wool sheep.

But there has been no greater improvement in the wool-bearing of sheep, than in the mutton qualities. We have today almost perfect mutton types of sheep and these sheep are able, when bred to our common stock, to transmit the mutton quality to their offspring. I had occasion yesterday to talk on some breeding questions, and these questions apply very properly to the subject under discussion today. But in this connection I wish to present to you this fact. A great many farmers who have common flocks of sheep say, it will do very well for a man who owns well bred flocks to pay good prices for well bred rams, but a common farmer with common stock cannot afford it, that it is a money-losing proposition to buy pure-bred registered rams at a good price to breed to common stock. I wish to call your attention to the fact that there is far more improvement in breeding common ewes to pure-bred males than in breeding them on the better bred animals. To illustrate what I mean: suppose a man buys a flock of Western ewes at from \$2 to \$2.50 per head, as one can frequently do; these ewes bred to a pure-bred ram of any of the improved breeds will produce a lot of lambs that will be worth a third more, or perhaps a half more than the original ewes from which they were produced; whereas a man who has a fairly well bred flock to start with, in using a ram of the same grade and at the same price, cannot hope to secure so great an improvement. Unquestionably from the standpoint of the amount of money invested, if a man buys a flock of ewes for \$2.50 or \$3 per head and uses a good ram—and I mean by that a well bred registered ram—he might expect more improvement than the man who has a purer bred flock of sheep to start on. There are men not capable of breeding pure-bred registered sheep. There has been a great deal of money lost in this way. I do not attempt to discuss the reasons why that is true. You know it is true and there is some risk attending starting into the business of breeding pure-bred stock. But from long observation and experience, I am satisfied that the process that we call grading is a sure business in the hands of any man, even the most inexperienced, and grading is always attended with success. By grading I mean the use of well bred rams upon common ewes and saving the best female progeny for the establishing of future flocks and breeding these to a ram of the same breed and thus continue building up a flock that for many purposes is as good as a pure-bred flock. A man with a flock of native ewes who wishes to produce mutton, can select a good ram of any of the mutton breeds, Shropshires, Southdowns, Hampshires or Oxfords and by using pure-bred males for four or five generations and saving the best female progeny, can build up a flock that for mutton purposes is as good as the pure-bred animals and will make just as good mutton.

I am discussing this question from the standpoint of a common farmer and not from the standpoint of a pure-bred live stock breeder. We do not breed registered live stock and use them for mutton and beef. All our animals used for mutton are grade animals and I am talking of the production of mutton for the markets, and I speak advisedly when I say four or five generations, for I have had some experience in this particular line of breeding myself, and I am satisfied from experience and observations that I have made on this subject that a man may expect by using common grade ewes (the kind we get from Western ranges) and breeding them to a registered ram of any of the mutton breeds, he can produce a flock possessing most of the desirable qualities of the pure breeds.

I saw at the Live Stock Exposition at Chicago this year a very interesting exhibit from the Wisconsin Experiment Station. In one pen were three Montana ewes, scrubbier than anything I have seen in Missouri this year, small size, bare legs and bellies, poor wool, very coarse and harsh; I doubt if they would shear more than three or four pounds; and in the pen next to these ewes were grade Shropshires that had been produced by breeding these same ewes to a pure-bred Shropshire ram, and these grades so produced, when fattened and fed, were as fine mutton sheep as I saw in the Exposition; they even competed with the pure-bred sheep in the mutton classes. That shows what can be done in one generation only.

Now there is no reason why a man should not use a pure-bred ram. A man must use one if he expects these results that I have been talking about. The greatest mistake one ever makes in breeding any class of live stock, is to use a male of mixed or cross breeding, no matter how good an individual he may be. The best quality an animal can possess is prepotency, the ability to fix his characteristics upon his offspring. No matter what good qualities he may possess, if he has not the power to transmit these good qualities to his offspring, he is of no value as a breeding animal, and we have learned by experience to look for this prepotency in pure-bred registered animals. By a long series of breeding and selection there has become fixed in these pure-bred animals the ability to transmit the desirable qualities that we want in domestic animals, and if we want these desirable qualities, we must look first to the ability of the animal to transmit these qualities to his offspring, and you need never look for this ability in an animal of mixed breed, because experience shows in ninety-nine cases out of a hundred that such animals have no prepotency; they are likely to produce animals inferior to the common ewes you would use in these cases and are also likely to breed back to some former unimproved type. There is a very strong reason, then, for using a pure-bred ram in these cases and for using no other kind.

Now, as I have said before, there is no risk to run in grading animals. A man starting with an inferior herd or flock of females may develop and build up the herd or flock, may grade them in any direction which he chooses. If he is desirous of a flock of the wool type, he can select rams of the wool type, or of the mutton and wool type, so-called. If he is desirous of producing mutton he can grade up his flock in the direction of the mutton type, without risk, because every time he uses a purebred ram he is absolutely certain to make an improvement.

Compare this with what happens when a man goes into the purebred live stock business. He goes to the Chicago show and sees there animals that sell for a thousand dollars and take all the prizes, and he says "that is a pretty good business, I would like to produce a few of these myself. I believe I will go into the pure-bred live stock business." He starts out by selecting that kind of animals for his breeding stock. What has he done? He has selected the rare exceptions, the best individuals of the particular type that he has chosen, that can be produced by the most experienced breeders of the country and he wishes to produce from these animals some more like them. Can he do that, in many cases? No. In the first place he is inexperienced. In the next place, the chances are that when one selects the very best animals for breeding purposes, these exceptional animals are not likely to reproduce themselves in a great number of cases. They are more apt to produce prize winners than cheaper animals are, but it is not a safe proposition that they will produce their equals, and there is a great deal of risk in it, as many men have found out. But when a man of little experience begins with cheaper animals and breeds up his animals, he is certain to produce from the start better animals than he started with, animals worth more money. It is a safe business proposition. It is bound to be so; when one uses a pure-bred ram of the kind selected for his purpose; for such a ram is sure to transmit his characteristics to his offspring. If he does not, it is not properly called grading, but more resembles crossing and the result of using an animal that is not more prepotent than the females in the flock is sure to perpetuate the inferior qualities of the unimproved females.

As to what breed or kind of pure-bred ram to use, that is a question upon which breeders disagree. There is money to be made in various ways of handling sheep. One sure way and quick way to get money out of sheep, in my opinion, is to select common ewes, ranch-bred or native ewes that can be picked up, and breed them to a good mutton ram, and the lambs that are thereby produced, if well fed and placed upon the market from 11 to 15 months old, can be made to weigh eighty or ninety pounds and will then sell at the best prices, if properly fattened. This is being done in many localities and it is a profitable line of work.

Unless you select the best rams and ewes, you are not building up your flock. For the average farmer who wants to build up his flock, it is possible that it is fully as profitable to use the mutton-wool type of

Merino, the National Delaine or some similar type. Save the best ewe lambs and gradually build up a flock, but it must always be remembered that there is no better or quicker way to do this than to use pure-bred rams.

PROFITS ON SHEEP AS COMPARED WITH OTHER STOCK.

By John Morris, Chillicothe, Mo.

Gentlemen.—I have not prepared any paper on this subject and am a very poor talker, but I can say a few words in favor of sheep. I prefer the Cotswolds myself as the most profitable combined wool and mutton sheep for the small or moderate farmer; but for large flocks, probably some other breed would be preferable. The Cotswold is a good wool-producing sheep and generally their wool commands the best prices. They have a combing wool. If I were raising a mutton sheep, I would prefer the Downs and am partial to the Shropshire, they put on flesh faster and make good meat.

As Prof. Mumford said, there are few men who understand the sheep business, only about one farmer in twenty. The sheep of a slovenly farmer are worse neglected than any other stock he handles. Sheep need care and attention and the one who raises them needs common horse sense. A man must understand his business to some extent and watch the progress of his flock. The Bothwells have made a great deal of money by giving their whole attention to sheep raising; they understand their business to perfection. Other men who have handled the same class of sheep have virtually failed, some have even lost their farms buying high-priced sheep, and not taking care of them. I am partial to the Shropshires and Cotswolds, they are the money makers. I think with care they will make as much money as any class of stock.

But I am really partial to cattle. Cattle, hogs and sheep make a good combination.

DISCUSSION.

Mr. Maitland.—How about the profits on sheep as compared with other stock?

Mr. Morris.—There is less investment in sheep. You can buy a flock of sheep for a little money, and you can buy a thoroughbred male to use on them for from \$25 to \$100. Very few farmers need a ram costing over \$50. There is not a great deal invested, and they pay according to the investment about as well as any other stock.

Mr. Maitland.—How would you compare the profits on sheep with that on hogs?

Mr. Morris.—There is this drawback in regard to raising hogs, a man can make money on hogs unless disease gets among them and then he loses them faster than sheep and he has more money at stake. I have made money on hogs, but I think a great deal depends on the class of hogs you are feeding and the faithfulness and care you give them. The hog farmer needs more corn. The sheep farmer uses grass and cheaper feed. Feeding sheep does not require as large an outlay on the feed as feeding hogs. All kinds of stock require good care and with slovenly handling the sheep pays the least. It depends upon the investment, the location and production of the farm. If he has a farm well adapted to raising small grain and is what you call a plain farmer, if he is a sheep man and capable of taking care of them, he can make more money on sheep. But if he has a grain farm, hogs go into market quicker.

I can tell you of one thing I had to learn by experience and my son called my attention to it. The Cotswold sheep do not command as high prices as the Downs. The Down is a good mutton sheep. The Cotswold is a better general purpose sheep. You can get more wool from the Cotswold, but the Downs have better meat.

I compare different breeds of sheep with different breeds of hogs. I have a very particular friend who breeds Poland China hogs, for instance. He raises pure-bred Poland Chinas and keeps them for sale, but he comes to my house and buys Berkshire shoats. I asked him why he did this, and he said he ate the Berkshires and sold the Poland Chinas. It is the same with sheep, the Down has a better mutton flavor but the Cotswold is a better general purpose sheep. If I had to confine myself to one breed or the other, I would prefer the Cotswolds, they are larger sheep and better shearers and their wool commands better prices. But either one is a good mutton sheep. I have tried the Merinos, but they are not a good mutton sheep. Still, you can take a nice, smooth, fat one and it will sell for several cents more per pound than an inferior animal. But fashions change in wool as in cattle, some classes of wool sell better for a few seasons than other classes. I have raised at one time Merinos partially for the wool, but I found that the wool decreased in value, and it took a great many more pounds to bring in the same amount of money for the fleece. For instance, if you get fifteen cents per pound for one kind of wool and twenty-five cents a pound for another class, you need a good many pounds of the former to make the same amount of money.

Mr. Maitland.—Will not the Merinos stand bunching together in larger numbers?

Mr. Morris.—Yes, providing you raise them at the proper time. If exposed to hardships in their infancy, the young die quicker than in other classes of sheep. If a Cotswold lamb once gets up and nurses it will live. It will survive after freezing its tail, its feet or its ears, when such a hardship would kill the Merino lamb. The Merinos have a little more grease and not enough wool and they die quicker. That has been my experience and I have handled sheep ever since I was a boy.

Mr. Mumford.—How do you feed your weathers all winter?

Mr. Morris.—Grain, oats, bran, hay and corn fodder. Sheep need a variety of feed more than any other stock.

Prof. Mumford.—How much do they weigh?

Mr. Morris.—From a hundred pounds up to one hundred and twenty-five pounds. I keep the aged ones and sell the younger ones. With sheep as with beef cattle, the younger class are the highest priced for mutton.

Prof. Mumford.—Do you feed them heavily all winter?

Mr. Morris.—Depends upon the purpose for which I want them. If I have aged ewes or weathers I feed them for two or three months.

Prof. Mumford.—Does the market command a good deal lighter sheep? Does the lighter lamb command a higher price?

Mr. Morris.—Yes, baby mutton. I would prefer to get two crops of wool. It is not everybody that can put in their lambs and feed them right. Sheep need housing. In a storm the wool gets full of snow and the sheep become chilled through, while it would run off from the hair of a hog or cow.

Mr. King.—I was interested in what Prof. Mumford said about starting in the business with cheap sheep. Suppose a man would buy a few cheap ewes, say Western sheep, how many crops of lambs would it pay him to raise, or would it be wise for him to get rid of these ewes the next spring?

Mr. Morris.—I would answer your question in this way: for instance, if I had a farm and wanted to stock it and had not the means to buy thoroughbred sheep, I would buy a bunch of grades, or a little more money will buy half-bloods. I would start that way with a thoroughbred male, because he is half of the flock in production. Then I might try these ewes a couple of years, and as soon as I had sufficient ewes for the farm I would dispose of the poorer ones. Even among thoroughbred sheep some of the flock are more profitable, hardier and better shearers than others.

Mr. ———.—What is the difference in the price of Cotswold and Shropshire wool?

Mr. Morris.—I have sold the Cotswold wool for several cents per pound more. At the present time a mixture of wool is the salable wool. I keep about five hundred to a thousand sheep on my farm, generally. I take a few of the choice of my thoroughbred Cotswold ewes and I use thoroughbred Cotswold males, but I cross my plainer Cotswolds with Shropshires. For instance, if I have a good Shropshire ram and a few Cotswold ewes that are not good shearers, I breed these ewes to the Shropshire ram and get a better class of wool. The Shropshire is not a good combing wool and the combing wool is the highest priced. I sent my son to the Chicago market with a car-load of mixed Cotswolds and Shropshires and grade Merinos, they were fat and nice. There was a gentleman there from way up in Iowa with whom I had some acquaintance who had Shropshires and other sheep with black faces and black feet and his sheep sold for a quarter or half a cent a pound more than mine. They were a more even lot and sold better.

I know of a hotel in Cincinnati where they made a contract with a butcher for Down mutton and preferred to have the head and feet left on the carcass. Their object was to be sure that the sheep were Downs, because it is considered the best mutton sheep. This came to be known to the butcher, who was rather a tricky man, and when he could not get Down sheep enough to fill the contract, he would occasionally sell them Cotswolds or Merinos and paint their faces and feet black, until the hotel found it out and broke the contract. There are tricks in all trades, except mine.

Prof. Mumford.—I have had some experience in picking out sheep in one locality in Missouri and I would rather have the range ewes that can be bought much cheaper than the poor mixed ewes that I was able to buy. It is different in different localities, and in North Missouri there are a good many good grades, half-blood Shropshires, for example; if you can buy them at a reasonable price, you have lost a year's experience and paid more for them than for the grade ewes. These Western ewes do not shear scarcely anything, you need not expect anything from them. When fed and pastured properly, with a good flock of ewes properly selected as to their wool producing qualities, the wool will almost pay for the keeping of the flock of ewes, and the lambs, moreover, are almost clear gain; and I do not know of any business proposition that is a more sure one to pay out any quicker.

There is one question that came up that is of great interest in this connection, the profits coming from different classes of animals. I at one time conducted some experiments in feeding five hundred lambs several different rations. One ration fed for four or five years was screened or shredded corn and clover hay. This was fed to lambs that at the beginning of the experiment weighed from 55 to 65 pounds. It required five pounds of corn to produce a pound of gain. That was the average. That average could be relied upon every year, in conjunction with clover hay. It requires about five pounds of corn to produce one pound of gain. The experiments that have been conducted at Columbia and throughout the United States indicate that it requires on an average ten pounds of corn to produce one pound of gain in cattle, to say nothing about the fodder. In other words, two pounds of mutton can be produced by the same corn that it requires to produce one pound of beef. I am speaking of lambs as compared with two-year-old steers. Comparing baby beef with weathers, the difference is not so great, because the younger the animal, the less feed is required to produce a pound of gain. But feeding sheep, it seems to me cannot fail to be more profitable, with the markets as they have been in the last few years, nevertheless there is money in cattle. You can buy sheep any time for a cent a pound less than you can sell them for when they are finished and when you have clover hay, alfalfa or even cow-pea hay to feed the sheep, in my opinion, there is more profit to be made in feeding sheep than cattle. Now with timothy hay these results do not follow at all. My experience is the best thing not to feed sheep is timothy hay. Cattle will eat more coarse fodder than sheep and sheep will eat more of it than hogs. In the case of hogs, it requires less corn to produce a pound of gain than sheep. Four and one-half pounds of corn will produce a pound of gain with hogs. Hogs are the most economical animals on the farm.

Mr. Maitland.—Is that an average gain for hogs weighing from one hundred to one hundred and twenty-five pounds?

Prof. Mumford.—The figures, as I remember them are for hogs weighing from 50 to 100 pounds it requires about 4¼ pounds of corn to produce a pound of gain, as the hog gets heavier it requires more corn and when a hog weighs from 250 to 300 pounds it requires about 5 pounds of corn to produce a pound of gain.

Mr. ———.—What do you consider the best method of preparing sheep for the show ring?

Mr. Mumford.—That is a pretty hard proposition. Give them good care. The man must study his sheep day and night and if he sees a shower coming up, chase them into the barn and feed them anything they will eat.

I would not compel the sheep to get their feed in the pasture. A little exercise is good for them, but not too much. Do not expose them to the rains, bleaching the wool is a disadvantage. If you are talking of fitting pure-bred sheep, the bleaching of the wool is an objection and you cannot turn them into the sun and compete with other men who keep their sheep blanketed and in the dark. Exercise them at night, however. It is a pretty hard matter to give definite instructions, as any man knows who has had experience in fitting sheep for the show ring. I have had some experience myself. I did not stop with anything. If they wanted cabbages or sugar beets or oil meal or corn meal or oats they got it and it was not a question of what was profitable in such a case, so far as the end was concerned, it was a question of what would produce results, and I have noticed what will produce results with young sheep will not produce results with old ones. When you feed sheep high up to the limit they get very fastidious and want the feed better prepared.

THE MOST ECONOMICAL WAY OF HANDLING SHEEP.

By G. B. Bothwell, Breckenridge, Mo.

Ladies and Gentlemen—I have always studied economy in feeding sheep. It is not economy to have them short of feed at any time, especially in the fall. They must enter winter in fair flesh, but care must be taken not to let them waste feed. It is hard to handle sheep properly without plenty of grass for nine months of the year; a little corn, say a half an ear per head, through most of November and by December 1st a light feed of shock corn once a day and as the cold increases add to the amount of feed.

We find no cheaper or better feed for sheep than shock corn once each day, and add such hay as can be had, timothy, clover and millet to fill out what feed there is lacking of the fodder. Feed even, never gorge and never let them get really hungry. Habitual light feeding makes a light clip of wool and weak lambs, there is no economy in that.

We keep our sheep on blue grass pasture twelve months in the year. We scatter shock corn on this sod. They eat the fodder and corn clean. It is better that way than to feed in small lots. They get some grass every month in the year, which they should have. Sheep need grain and hay only from the middle of November to the fore part of April.

DISCUSSION.

Mr. Morris.—Mr. Bothwell's paper bears me out in my ideas of the care of sheep. He says "never gorge them or let them go hungry."

As I said before, it requires a man adapted to the business to make money. He can make more money on sheep than he can on cattle or hogs. Some men are adapted for one business and some for another. I have two single boys at my home. One would starve to death handling sheep, he does not like to feed them and does not care for the meat. He takes to cattle. But my other son is partial to sheep and likes to handle them.

Prof. Mumford spoke of the comparative profits in raising hogs, cattle and sheep. The droppings of cattle in their feeding will offset to some extent the gain of the sheep. There are no other stock to follow sheep, they require just what they want to eat. You can feed more roughness to cattle, and sheep require more care and attention than any other class of stock.

Mr.——— Do you think it a good idea to keep hay before sheep all of the time?

Mr. Morris.—In the winter, yes. I always aim to keep hay or fodder before them. If I have the fodder, I do not feed much hay.

Mr. Maitland.—Speaking of cattle feeding—When feeding what we call a full feed of corn, what proportion do you charge to the hog?

Mr. Morris.—I have never figured it accurately, but two hogs will live upon the droppings of one steer.

Mr. Maitland.—Is 33½ per cent too much?

Mr. Morris.—Probably it is. It is not a great deal. Prof. Mumford can probably answer that question better than I can. I have not kept a book account. I have just used my own judgment, and never kept an accurate account. I have made good money on cattle as well as sheep. I prefer to use the thoroughbreds all the time, and when you have a thoroughbred that is not a profitable one, put him in the feed lot, either sheep, hogs or cattle. That has been my experience. I have followed this rule all my life and use that plan to dispose of poor individuals. I keep the most profitable of all classes of stock. I believe in using pure bred sheep as well as cattle, hogs or any other class of stock. I believe it is better to use thoroughbred sheep, they pay better in the end. If a man cannot stock his farm with pure bred sheep, he can buy a pure bred ram and bring up his herd in that way. I have sold a great many rams to bring up herds. I think that a farmer had better commence with a few head of good stock than to overstock his farm with common stock. I think a man on a farm, if he has only forty acres, if he will commence right and use good stock, he will come out all right and make a success of the business.

The following officers were elected for the ensuing year:

President, Mr. M. F. Forbis, Chillicothe.

Secretary, L. E. Shattuck, Stanberry.

Vice-President, Prof. F. B. Mumford, Columbia.

Mr. L. E. Shattuck, Jr., was elected the representative of the Sheep Breeders' Association on the Executive Committee of the Industrial Association.

SESSION OF

State Poultry Association.

THE SCIENCE OF INCUBATION AND FERTILIZATION.

By Dr. Casey, Kansas City, Mo.

Ladies and Gentlemen—I am but a novice in the poultry business and cannot even be styled an amateur breeder, but almost daily intercourse with those engaged in raising poultry, has convinced me that by reason of the neglect of many of nature's valuable laws, success has not always crowned the efforts of the poultry fraternity. In dealing with the many different problems which confront the poultry breeders of our land, natural or physiological laws are either lost sight of, or so carelessly investigated that their workings are not understood or their actual bearings fully estimated.

In the past the haphazard methods were principally in vogue, and as a rule, success was rather the exception. Poultry raising from a commercial standpoint was almost unknown, and the fact that it was or could be a science was productive of sneers and ridicule. But the literature of the present certainly shows that the subject is much better understood than it was a decade ago. It has been made an object of scientific research and study by competent persons, with the aim of not only bringing it to perfection, but of so simplifying it, that it may be made of practical benefit to this, one of the great industries. And now, we can point with pride and honor to the result as shown by the United States Government's Statistical Reports of the enormous financial income from the poultry of our land. This gradual, but sure evolution of poultry from almost oblivion to the crowded show room, from the barnyard to the costly poultry buildings, from the hen incubating her eggs in the old manger and trailing her dew-bedraggled broods over the fields, to the well-built incubator and the scientific, expensively-heated brooding houses, marks an epoch, both interesting and commendable.

To make the poultry business a financial success is the aim of all poultry breeders, and to get all from poultry that they are capable of, should be our ambition. It is said with truth, that he who makes two blades of grass grow where but one did before, is a public benefactor. What title of honor should then be bestowed on the poultry fratennity, who, by study and unremitting labor have increased the productive qualities of hens to two hundred eggs per year, and by the improved methods of incubation, have added thousands of chickens to the food supply of the world. I assure you, my friends, this is truly an age of progress, and in no branch of trade or science does this progress show itself to better advantage than in the once ignored, neglected chicken business.

Incubation as conducted today (while it is the same process as of yore in ancient Egypt) has revolutionized the poultry business. Our hillsides are dotted with thousands of the feathered tribes, where but a short time since, the existence of poultry was only known by a visit to some farmyard. Visit any of our large packing houses and see the car loads of poultry being shipped to all parts of the world and you can then realize the enormous growth of the poultry business as a result of the improved methods of incubation. As poultry breeders, you all understand that incubation is the process of the production of a live object from an egg. It is purely a well-known physiological process, depending on certain conditions, and one which nature has ordained for the propagation and continued existence of the feathered tribes of the land.

(I will not include in this, well-known and despised reptiles, who are also styled oviparious). In considering this phenomena from a scientific basis, we accept the dictum of modern science which ignores the ancient theory of spontaneous generation and proclaims that everything takes its origin from a germ, an object, which, under certain natural laws and conditions develops and becomes an animate being.

The germ requires special elements in which to develop, and certain substances from which are to be formed the different parts of the future being ,which in this special case, we style as the chicken. Nature ordains the substance called the egg as the receptacle for the germ for birds and fowls of every species. It is composed of such substances which are appropriated by the germ, necessary for its development. How this is done is not the province of this paper to explain, but rather to state and accept the facts as they exist. We now have a germ, a receptacle for it and some of the material required for its future development. This material is added to by natural laws within the body of the parent bird until there is enough of nutritious substance to meet the demands of nature, when after being invested with its calcareous covering, the egg is extruded, and becomes with the germ enclosed, an object for incubation, commonly called "hatching."

In following the process from this step we will not enter into all the anatomical details of it, but briefly touch upon some of the changes which take place from day to day, both in the natural and artificial methods. On the second day the germ begins to increase in size and changes its shape. If it is now examined with a powerful glass, the first traces of the future bird may be detected in the formation of the spinal cord and small off-shoots from it. By the third and fourth days, the head begins to show as an enlarged projection; the spinal cord bends somewhat on itself and the network of blood vessels, which will carry on an important part of the development, become numerous and enlarged. On the fifth day may be seen the beginning of the liver and other vital organs. From this time on, the embryo chick rapidly develops and the different parts assume their future forms. The head grows (or rather seems to) faster than the other parts of the bird, and by the seventh or eighth day, presents a normal appearance. By the tenth day the rudiments of the feathers can be distinctly seen. The blood vessels appear well distributed within the shell and their mission of carrying off carbonic acid gas and absorbing oxygen for vitalizing the growing bird, is performed in the most perfect manner. From this time, the changes or growth are very marked, and by the 20th or 21st day the now fully-formed chick begins its efforts for an exit from its calcareous prison and soon emerges as a fully-formed, new being.

What are the conditions and forces concerned in this wonderful, but natural process? The answer to this, concerns the breeder and poultry farmer and should be fully investigated and understood if he would be successful in the artificial methods now in vogue. There are certain things always necessary to the formation or maintenance of animal life, viz., oxygen; a proper temperature of the surrounding air; an absence of an excess of carbonic acid gas; and a supply of material which enters into the formation of blood, bone and flesh. These are nature's laws, and he who would use artificial means for incubation, must never ignore these facts. Theories may be interesting to contemplate, but facts must be acknowledged as the basis of success.

From whence is the oxygen derived? The answer is simple: From the surrounding air. You are all well aware that nature provides a reservoir in the egg with a supply of air for the sustenance of the growing chick, which is called the "air cell." She does not stop with this limited supply, but by the process called endosmosis, the oxygen of the air is constantly passing into the egg to replenish said supply. Without this, all efforts at incubation would fail. Oxygen is the chief support of life, and nothing can exist without it in sufficient quantity. I lay great stress on this, as it is generally under-estimated or ignored and few appreciate its importance.

The next requisite is a proper degree of heat in the surrounding air. Different forms of animal life thrive under varied degrees of heat, but by careful observation, it has been found that birds and fowls have a rapid circulation of the blood, and as a consequence, an increased temperature of that fluid which imparts its heat to the incubating germ. Authorities differ as to the exact degree of heat necessary for incubation. But if the temperature of the natural mother is ascertained and the artificial heat maintained at the same degree the result will prove its effectiveness.

The Presence of Carbonic Acid Gas.—The natural question is asked What is the cause of this? There is a natural law, that in the combustion or destruction of anything, one element always present is thrown off. In the growth of the embryo chick there is always a destructive action as well as a development. Elements which have fulfilled their mission by their union with the oxygen received, are converted into carbonic acid gas. If said gas accumulates and is not carried off, it becomes in excess and is then incompatible with life. Ventilation is the remedy par excellence for its removal—a supply of material which enters into the formation of blood, bone and flesh.

Fortunately for man, this is not left for us to provide, but in the formation of the egg, nature has supplied the necessary ingredients in such proportions and conditions that they can be readily taken up and appropriated by the growing chick. How this is done, does not concern us at present. That it is done, an examination of the egg shell after the exit of the chick abudantly proves. The working of nature's laws, although interesting to the searcher after knowledge, is prone to be disappointing, as it is truly said, "The ways of God are past finding out." Man, with all his arrogance and knowledge, must accept facts even though he does not understand them.

Artificial incubation is then, the effort to carry out properly the laws of nature in bringing chickens to life, and the nearer we conform to these laws, the more surely can we expect success. To this end man has devised the machine, called the incubator, and has studied and endeavored by its construction to copy the natural method of hatching, so perfectly that thousands of birds can be brought to life, the ever increasing demand for poultry for food and eggs can be supplied, and success in poultry culture be achieved.

My friends, in bringing these few facts to your notice, it is done with the hope that they may stimulate you to greater efforts to make this science a success, which I think can be done if greater attention is paid to the second subject of this paper, the fertilization of eggs. This, I feel, if properly understood, is the key-note of success. We mean by this, the act or process of making eggs fertile or reproductive. Too much attention is paid to raising stock for show, regardless of their utility. To my mind, there is no subject connected with the poultry business of more practical importance or productive of greater satisfaction than an accurate and positive knowledge of this science. And, although of such vital importance, it is perhaps less understood scientifically, and the required attention to it more neglected than any other. The lack of proper knowledge concerning it causes more failures, more discouragements, and more animosity than can be imagined. The breeder who sells eggs for hatching comes in for his roastings from the buyer, and often his reputation and veracity as a breeder are injured thereby. The amateur poultry-for-market man becomes discouraged by his many failures in hatching and raising chicks, attributing these failures to ill-luck, rather than tc his ignorance of nature's laws, and the strictly poultry farmer is handicapped by his many losses and abandons the business as a fraud and delusion. To every cause but the right one is attributed the failure, and thus, too often the poultry business as a profitable one, is held up to the public as a myth and classed by it as a confidence game.

To illustrate—an enthusiastic poultry man with rose-colored views of the future, fills an incubator with its quota of 200 eggs, recently purchased from a reputable breeder, who has proclaimed to the world the many prizes his birds have captured at the famous shows. He carries out faithfully the directions about the proper management of the incubator, he makes his estimates of the number of chickens he should hatch and raise. Mentally, he sees his efforts crowned with success and his flock increased rapidly by the newly acquired method of hatching. On the 10th day he carefully tests the eggs and finds 30 per cent or 40 per cent of them free from germs. On the 14th day he examines the remainder and throws out 20 per cent more, which have shown but little advance in the embryonic formation. At the end of the 21st day he opens the door of the machine and takes therefrom perhaps 50 small, weak and deformed chicks, which he removes to a brooder. Here they struggle along for a few weeks and finally succumb from some unknown cause. He writes failure; condemns the incubator; anathematizes the party who sold him the eggs, and styles the poultry business a fraud.

Now, to what is all this due? There is no effect without its cause, and to seek and remedy this, should be the aim of poultry breeders and those interested in raising the standard of poultry culture to something higher than luck or haphazard work. That its cause is not found, is because it is not sought for. The analogy between man and fowls is not so far at variance that the knowledge of the one is not to be applied to the other.

First of all, let us look into the matter of breeding. Study heredity carefully, and here we shall meet with much that points to the cause of the failures, or I might say, the diagnosis of the case. Any one who is a student of nature can see the effects of hereditary disease in man, and while looking about, notice the subjects of the following diseases and conditions: Scrofula, syphilis, consumption, inter-marriage, cancer, and other constitutional diseases. Notice the puny, weak, sickly, deformed (mentally and physically) children. Can a good result be expected from the above conditions and diseases? As well expect strong, healthy germs and chicks from roupy, consumptive, poorly-fed, lousy fowls, and yet these conditions are often ignored. Look at the effect of inter-marriage in the human family, and then apply its action (inbreeding) to our poultry. It will surely be productive of degeneration. Is it any wonder that we fail to get strong, healthy germs in the eggs, or strong chickens from such poultry? How much this fact is entirely lost sight of.

Again, take feeding and compare the analogy between man and fowls. See if the poorly nourished man or woman is capable of doing as much work as those who are better fed, and who thereby are more ablebodied. Note the mental and physical strength of well-fed human beings. Note their procreative and reproductive powers. Notice their progeny, and see how they partake of the strong, healthy characteristics of their parents. When I say well-fed, I do not mean overfed or stimulated, for the glutton and *bon vivant* is not, as a rule, physically strong, but fed with the proper food, both in quantity and quality. This holds good equally as well in fowls. The under or over-fed fowl is incapacitated for physical and productive work, and its reproductive organs are affected to a great degree by feeding. The power of reproduction is lessened by fat (as fat is a tissue of weakness), and deprived of strength by lack of proper feeding, both in quantity and quality. Nutrition is injured, proper assimilation is arrested, and the organs concerned in reproduction

I will say right here that the man that raises plums don't want to plant too many of them. You can't handle a large orchard of plums like a large orchard of apples.

Mr. Robnett: My trees are so thick I can't climb up in them. Do you ever prune your Damsons?

Mr. Karnes: No, sir; not much. It does not do well to prune them. I never tried pruning them much. The Wild Goose is a tree that I prune for the first four or five years by cutting it back. Unless you do, your limbs get so long and the foliage so heavy that they will break off, and I practice cutting back, and get better fruit. I practice the same thing on peach trees.

A Question: When do you do that?

Generally in the spring; February or March or April—any time along there before they bloom.

Now the package I market in. The only package that I market in, and the best I have found, is the common berry crate. I can get not quite two crates out of a bushel of plums. They run about fifteen crates to eight bushels.

I have raised Japanese plums that 12 is as many as you could get in a box. I have not used anything but twenty-four quart crates, and they carry better and sell better. For the local trade I use nothing but the eight-pound grape baskets.

Time is getting short and I am going to pass on and notice a few of the Japanese plums. I have tried Willard, Wickson, Red June, Burbank and Abundance. The Willard, Wickson and Red June went during the winter of 1898, and I never tried to replace them. They were all winter killed. Abundance I have tried for 12 years, and have never succeeded in getting anything like a satisfactory crop until last year. A mild winter and the remarkably dry summer, seemed to be the kind of weather that suits them and they did remarkably well. Many of the perfect specimens were two inches in diameter. Burbank the same way; but I would not advise anybody to raise Japanese plums, in order to get any money out of them. If you get any specimens they are remarkably fine, and they are pleasing to the eye, but they are not profitable to raise in this country. Most of them are early bearers, and they are very tender and they rot very easily.

Mr. Augustine: Is that your experience outside of that hard, severe winter?

Mr. Karnes: Yes, sir.

Mr. Augustine: In the same latitude still further north, where

I live, we are growing the Red June, Abundance and Burbank with wonderful success.

Mr. Karnes: As far as I know in this western country, Friend Augustine, the Japanese plums are not a success, although there are some still planting them.

Now, just a short talk on European varieties. They are like the Japanese, too much subject to rot. We have one plum in this country that has given a few crops of remarkably fine plums. They are of good quality and good sellers, and all right in every respect, if you could ripen them, but they rot. If there is any way of spraying them to prevent their rotting, or any way to prevent them rotting, they are all right. I refer to the Lombard plum.

There is another thing I can't see any difference in, in the fruit. It is the Bradshaw and the Lombard, and also one labeled New York State Prune by the nurseries. I can see no difference in them. They may be the same thing. As far as the fruit is concerned, I defy any expert to tell the difference.

A Queston: Have you had any experience with the German Prune plum?

Mr. Karnes: It is not a success in this country. I have seen some grown, but not very many.

This year there are three trees of Green Gage plums in this city, and they had as fine a crop of plums as a man would care to look at. They were large, and the trees were well filled, and of as fine quality as a man could desire, but they are not a success here ordinarily. It was a warm season, and we had dry weather. Californians want dry weather during their fruit ripening season, and if we could have California weather here we could raise California plums. I have tried a number of the European varieties, but none of them have ever succeeded.

Now, just a word or two about one or two other things. I have a small plum orchard, a few hundred trees along the side of the chicken range. I never spray plum trees for plum curculio, or for any other purpose. Early in the spring I sow a little millet and a little rye along through the plum trees, and let the chickens do the scratching, and I have never been troubled with plum curculio.

Another thing, I think is the best scavenger we have, is the pig during the fruiting season. There are always a few bruised plums, and a few not fit to put in the basket for marketing, and a few pigs that can be turned in and let run for an hour or two will pick up everything in the way of a wasted plum in the orchard.

A Question: Do you ever cultivate a Damson plum orchard?

Mr. Karnes: No; I never cultivate a Damson plum orchard. Feed it as much wood ashes as you can and put it as close to the chicken house as you can.

STRAWBERRY PLANTING—RAISING AND HANDLING THE CROP.

(By F. H. Speakman, Neosho, Mo.)

The subject assigned to me by our secretary seems to cover about the whole ground, and I realize that one to do justice to it, must, if he meets the requirements along the lines of extensive production, be a master of the situation from the selection of the ground and its preparation to the placing of the product in the market. This is a wide range, and I hesitate to undertake so complicated a task and the remarks that will follow, will of necessity have more or less of a local application being based upon my experience at Neosho.

In the outset, permit me to say, that of all horticultural work the growing of the strawberry is my favorite. No doubt this partiality is due to the degree of perfection attained by this fruit in Southwest Missouri, which can truly be said to be the home of the strawberry, but I would not say the same for the peach. Of all productions of this region, and they are many and varied, none flourish better, if so well, as the strawberry, and none yield a surer return for labor rightly expended.

As our natural markets are the cities and towns north and northwest of us, most of them being too far away to reach safely by express, our efforts are directed to the production of sufficient quantities of fruit to make daily car lot shipments, and of this degree of production my paper will treat.

Of soils I prefer good timber upland, which has been cleared and cultivated thoroughly one year. This is in a condition to supply all the needs of the strawberry and contains sufficient humus to work easily and resist drouth well. My next choice is naturally good old land, which has produced a crop or two of stock peas. Neither of these soils will be benefited by the application of any kind of fertilizer, and I now avoid their use in every case.

Plow the ground early in the spring as thoroughly and deeply as possible, following in the furrows with the subsoiler that will loosen up the largest amount of clay or whatever happens to be present underneath. Do not fear bad results from this treatment. Such will never appear, I assure you.

Now, harrow enough to smooth the surface, but leave the ground somewhat loose.

About March 20th it is generally safe to begin setting the plants, and it is important in planting a large acreage that no time be lost. Mark the ground out both ways, the wide way three feet ten inches and the other three to three and one-half feet, according to varieties to be set.

In planting, get, if possible, experienced help, and allow them to use nothing but dibbles for the work. This tool should be about three inches wide and eight inches long, and is the only suitable one for the purpose.

Plants, of course, should be the best obtainable, and will be surer to grow and make a stand if they were dug in the winter. Plants taken up after the first sharp freeze, which usually comes in November, carefully cleaned of all runners and leaves and closely root-trimmed, then packed in shallow boxes, or kept in cool, moist cellars until needed, are much better than those dug as wanted in the spring. The greatest advantage these plants have is that they will keep much later than it is practicable to use the spring dug ones. Another advantage of winter digging is the having of that much work out of the way before the rush that is sure to come with the spring.

The planting operations being well under way the cultivators should be started and kept following closely. If the land is not too stumpy use a good two-horse cultivator that is provided with some kind of a scratcher attachment to level the surface and kill weeds that have been loosened by the narrow, deep running shovels, which should for the most part be used in the cultivation of the strawberry.

Keep buds and blossoms picked off and cultivate thoroughly both ways until runners come out freely; then, instead of destroying these runners until July, as recommended by some planters, train them carefully along the rows as they will be needed and cultivate but one way. Hoe when necessary, but do not attempt to do it after every rain.

Much of the labor expended by the average strawberry raiser in trying to cultivate and hoe his plants as often as it rains is worse than lost.

As the season advances and runners come out freely, assist them, if necessary, to fill in the spaces evenly, cultivating a little farther from the center of the row each time, and carefully avoiding the windrowing of the runners along the edges of the rows.

By the 1st to the 15th of August the rows, if the weather has been seasonable, and the proper treatment has been given will be 20 to 24 inches in width.

Now, instead of putting the rolling coulters on the cultivator and treating your plants as you would an Osage hedge that was getting too high, stop the cultivator and watch conditions closely. Do not concern yourself about the plants that form in the spaces. There is something more important for you to do just now. This is the time that the average grower makes a vital mistake. This is the time that the writer in the early days of his strawberry experience carefully cultivated between the rows and watched for every little weed to appear, but failed to note that his plants were getting thicker and thicker, now two inches, now an inch, now half an inch apart, now two, no three plants in depth all over those rows. They were beautiful to look upon, but, alas, yielded a very large crop of disappointment only.

I was partly excusable for this mistake as in my search for information on the subject of strawberry growing I think all writings consulted emphasized the importance of watching the weeds to destroy them as they appeared.

Let me emphasize the necessity of watching the plants that they do not pile up too high during the months of September and October. My plan is to watch the plants closely, and as soon as I find a sufficient number of them firmly rooted, go over the rows with light four or five tined potato diggers, scratching across the rows and tearing out all weak plants that are running in profusion in every direction. It will be necessary to pull many of them off with the hand after drawing them out into the spaces. Men, to do this, should have good judgment, and to be valuable, must keep their minds on the work.

One thorough treatment may be enough, but if the weather is very wet, two will be needed.

This brings us along to, say November 1st. Now get the cultivator again and destroy the plants between those rows, cutting them down to the width we left them when cultivation ceased. Finish the treatment of the season by following with hoes carefully, removing all mutilated plants and all of those innocent-looking weeds which come up in the fall, grow all winter and blossom and produce seed at the time the strawberry ripens its crop. Their name is legion, and they sometimes do great injury if not removed.

Now you can leave the strawberry fields for a few months unless you linger to put up the sheds that will be needed in the spring. Mulching for best results should be done in the spring to avoid the strong growth of wheat, cheat, etc., which invariably follows the applications of straw, the only available material for the purpose which we have in any quantity. A very thin covering on the ground around and through the plants is all that will be beneficial, and this is needed simply to keep fruit clean.

So much for the raising. Now, the handling will be a comparatively simple matter. Much thought should be given to the rules governing the picking and other work. Clearly define the duties of the record keepers, field bosses and pickers. Give a premium for satisfactory season work. This will do wonders to hold pickers in line when most needed. The addition of the premium to make the amount per box which you intend to pay. Pay pickers only at the end of the season. I never did, and have no intention of ever using tickets with which to pay pickers. The record system is far better.

Provide a cheap but commodious shed (that can be moved without injury when needed in another place) for every ten or fifteen acres.

The best record keepers will be found to be those persons who are the greatest success in the school room. Give each one the direction of the work in the shed. A field or row boss should not be given over fifty pickers and should be instructed to work in close harmony with the record keeper in seeing that every picker does his work properly. It is possible for the extensive planter to pick, pack and place in cars for shipment 1,000, 2,000, or even many more crates per day of strawberries that have been more carefully handled than the average grower handles the product of his one, two or five-acre patch.

It is a business, however, and one to succeed in it must begin in a small way. The idea that strawberries cannot be grown on a large scale is an unbusinesslike and foolish one. Fifty acres can be grown and cultivated and the product marketed at a much less expense per acre than the patch of two acres. The proper system will do it.

No one without a strong love for the work should attempt extensive production, however, as he will surely fail in many of the almost numberless little details which all come in for a share of attention.

The following were appointed delegates to various State Horticultural meetings:

Arkansas—G. A. Atwood.
Iowa—W. H. Maxwell.
Illinois—M. Butterfield.
Kansas—W. G. Gano.
Nebraska—L. A. Goodman.

THURSDAY—December 5, 8 p. m.

The programme of the evening was varied by songs and recitations, and a very pretty flag drill executed by twelve young ladies of the Todd school.

VARIETIES OF PEARS AND PLUMS.

(By W. L. Howard, Assistant Horticulturist, Columbia, Mo.)

VARIETIES OF PEARS.

In selecting varieties of pears for planting, some important points must be kept in view. One must consider the relative time of ripening of the fruit in order that it may be marketed with reasonable convenience with the facilities at hand, and also questions of pollination, so as to have mutually fertile varieties which bloom at the same time, planted close together. It is impossible to name any certain number of varieties which will succeed in this State, because, apparently, their success or failure is purely a matter of local conditions. The pear growing industry for the United States has been developed fully, only in the Eastern and New England States. There the list of successful varieties is not long, as compared with some of the other fruits like Apples and Plums. All told, but 28 varieties have proved to be reliable, as reported by practical growers, and there are instances where some of this number did not do well in some sections. For Missouri conditions, the following 13 varieties are recommended by growers as being the most reliable for the State at large, although some failures may be expected in some localities from causes not yet understood. Anjou, (called also, Buerre de Anjou); rather large, fine grained, excellent flavor; ripens in late fall, but keeps till far in the winter. Angouleme, (known also as Duchess de Angouleme); very large, buttery, juicy and very good when well grown, but poor and worthless when small; ripens in midautumn. Bartlett; large, flesh nearly white, tender and buttery, and with a moderately rich flavor; the best summer variety. Buffum; size medium, skin yellow, with a broad, reddish-brown cheek, somewhat russeted; flesh sweet, very good but slightly variable; is a good producer; ripens in fall. Clairgeau, (also known as Buerre Clairgeau); large, often with a crimson shade toward the sun, and numerous brown dots; flesh buttery and melting and with a rich flavor, but frequently poor; ripens in winter. Howell; rather large, light yellow, frequently with a handsome cheek; moderately rich flavor and somewhat variable in quality; ripens in early fall. Kieffer; everybody knows the Kieffer and all have condemned it at one time or another, but, like the old Ben Davis Apple, it continues to turn up in the markets to a larger extent than any other sort. Lawrence; size medium, lemon-yellow, with numerous small dots; very good flavor; ripens in early winter. Louise Bonne, (also called Louise Bonne de Jersey); large, flesh yellowish-white, juicy and fine; hardly of the best quality, but very productive; a fall variety. Mt. Vernon; medium, dull brownish russet, with a red cheek; rich flavor; ripens in fall and keeps well. Seckel; small skin brownish-green, becoming rich yellowish-brown, with red cheek; the richest and highest flavored pear known; a summer and fall variety. Seldon; medium, or large, flesh coarse, but juicy and brisk flavored; ripens in fall. Winter Nelis; size small or medium, sweetly aromatic, with excellent flavor; a winter variety. New varieties not generally tested are, Krull, Koonce, Lincoln and Sudduth.

Kieffer and Bartlett are usually classed as self-sterile, but the degree of sterility varies in different places and under different conditions. Probably any variety will fertilize any other variety in case the two bloom at the same time. The safest plan in setting a pear orchard is to plant not more than two rows of one variety together, and to alternate with one or two rows of another variety. The most popular variety in the eastern Pear district is the Bartlett, with the Kieffer holding second place. With these growers the Seckel is a prominent variety, and is the standard of quality.

The Duchess is the best dwarf. It sells on account of its size, for it is of indifferent quality. Other popular dwarfs are, Louise Bonne, Anjou, Clairgeau, Manning Elizabeth, and, to a less extent, Bartlett and Seckel.

VARIETIES OF PLUMS.

At the Station we have 15 varieties of plums that are fruiting. The most of this number are European sorts, but there are a goodly number of American varieties and some of the leading varieties of Japan. This is only a rough way of classifying Plums. The botanical arrangement as adopted by the American Pomological Society is to divide the principal members of the Plum family into five sections as follows:—Prunus Americana,—or those derived from our common wild Plum; Prunus angustifolia,—of American origin, but including only those of the Chicasaw type; Prunus cerasifera, sometimes classed as European, but rightly contains only those like Marianna and De Caradeuc; Prunus domestica, which includes all of those known as Europeans; Prunus hortulana, commonly known as American of the wild Goose type; but also embraces the Miner and Wayland groups; and, Prunus triflora, the Japanese sorts.

Taking them alphabetically, some of the varieties will be discussed. The American Golden and the Golden Beauty are very much alike, flower and fruiting on about the same dates; both are small, round, yellow and hard, ripen late, and too well known to need further mention. Abundance and Botan—names used synonymously, represent the Japanese type at its best. Burbank, Wickson, Yellow Japan and others of this type have their respective merits, but none of them are of finer quality, and certainly none are so sure to set a crop of fruit and ripen it as the Abundance; they are usually large, fine-textured, juicy and of delicious flavor. Chas. Downing makes a fine tree, usually produces a medium crop of average sized fruit which somewhat resembles the Miner in appearance, but is not of so good a quality, and, as these two ripen at about the same time, it would be unwise to use it instead of the Miner. Coe's Golden Drop; this is mentioned because in the East it is reported to be a desirable variety, but I have not seen it amount to anything; a rampant grower, blooms abundantly every season, sets a big crop of fruit, but never holds it; a fine, late, exceedingly large Plum when it ripens—which is so seldom that we have it only in the form of a beautiful memory. Cummunia, is a dark colored Plum, which rots pretty badly, but the tree sets such an enormous crop of fruit that there is a respectable yield left after half have rotted; a desirable European sort. De Caradeuc often has a big crop of very pretty fruit, but is chiefly valuable on account of its earliness, ripening as it does about the 20th of July. De Soto is one of the old standard varieties, yellow in color, prolific bearer and a sure fruiter, but shorter lived than many of the others. Forest Garden can always be relied on to have a crop that will make the housewife smile; size above medium, yellowish, and free from rot. Forest Rose is good for home use, but is too tender to ship well; a desirable American variety. Garfield; along with this might also be classed Moreman, World Beater, Wayland and Missouri Apricot—all of which would make good buck shot, they are so small and hard; however, these have their uses; they are especially desirable for shipping long distances, preserving and spicing. Gold has not done much with us yet, being too young, but is said to be promising. Golden Mammoth has not fruited with us yet, but is given a good reputation by those who have seen it. Goliath; this is rather a weak grower and does not fruit every season, but when it does "hit," it will make you glad; very large, firm of flesh, and does not rot badly. Grand Duke; here is one that has special uses and should have a brilliant future before it; tree vigorous and healthy, of European type; fruit fine large, dark in color, pear-shaped and covered with a heavy grayish bloom and seldom or never rots; it has firm flesh and would make a good shipper. The special use to which Grand Duke could be applied is to place it on the market as a substitute for the expensive California sorts. This is not theory, for we have sold this Plum to retail dealers at fancy prices and I know for a certainty that fastidious customers took them and were well pleased. The fruit is at its best about the second or third week in September. If picked and carefully placed in shallow boxes, about a dozen in each, there is no reason why a few trees of this variety should not yield as good an income as a whole orchard of the kinds that have to be sold for ten cents per gallon. Jefferson, is rather a weak grower, but has fine large fruit; it is somewhat subject to rots, but is promising. Lafayette, is another European, somewhat like Communia, in that it produces very large crops and about half of the fruit rots, but leaving enough for a good harvest. Magnum Bonum; here is a variety that is among the largest of Plums and in some localities appears to do well, but with us it has fruited but scantily; it was a favorite with the late Judge Miller. McLaughlin is fine, delicate and large, but from some cause does not set but a few fruits to the tree. Merunka; this an European variety, which, in its manner of growth and productiveness, resembles the Damsons, but it is not so purplish in color and rather smaller in size; it is valuable for cooking purposes and is liked by some for eating from the tree, when well ripe; the seed is free. This variety is well worth cultivating. Middleburg is an American sort that produces well some seasons, but has too many off years. Milton ripens about the first week in July, and is a desirable sort on that account only, as its quality is not of the best. Miner is too well known to require any description; Moore Arctic is a European sort, probably originated in this country, that is worthy of a place in the orchard; it is very dark in color (almost blue), covered with a heavy grayish bloom, is a little above medium size, and sets a heavy crop almost every year; its principal drawback is its tendency to rot. Newman; probably worth more as a pollinator for the Wild Goose than for anything else. Prince Englebert; one of the largest Plums but does not bear enough. Quaker; here is a native Plum of good size that for delicious eating is hard to beat; valuable for culinary purposes, too.

Reine Claude de Bavay; this one should be included in planting, although it does not fruit heavily every year; ripens middle of September when others are scarce; gets sugary and delicious; it is a white or greenish, European. Robinson; an American and a sure fruiter being loaded down annually; fruit not first class in quality, but fair. Rollingstone, Wyant and Wolf each have their merits. Stanton is an excellent late European variety. Union Purple is fine and large, but nearly always rots. Victoria is a beautiful thing when it chances to ripen, but it is a shining mark for rot. Wild Goose is a leading commercial variety, but needs a pollinator; Newman answers the purpose. Yellow Gage is susceptible to rot but when it escapes is fine.

Many varieties possessing some merits have been omitted for fear of making this report too long. In a test this season to determine what varieties were able to fertilize themselves, it was found that one-third of the total number were more or less self-sterile. This was determined by placing paper bags over several of the twigs on each tree before the flowers open and afterwards noting how many set fruit in the sacks. It has not yet been satisfactorily worked out just what varieties are incapable of fertilizing themselves nor the best trees to plant for pollinators, but it is conceded by all who have investigated the subject, that there should be a mixture of varieties in the plum orchard.

ORNAMENTATION OF HOME GROUNDS.

(By Ruth Jackson, Columbia, Mo.)

There are two destinct types of landscape gardening—the geometrical and the naturalistic. To these Edward Andre adds still another, the composite style, which is a blending of the other two.

According to the geometrical style of landscape gardening, the grounds are laid out in squares, circles or other geometrical designs; the trees are planted in straight rows, the shrubs trained to regular patterns, the walks and drives from definite, and sharp angles. On the other hand the naturalistic style attemps to follow the plans suggested by nature. It cannot be wholly natural, for there must be walks, drives, fences and buildings, but these may be so arranged as to harmonize with the natural features about them.

As to the relative value of these two styles of landscape art, we may say they are of equal merit under certain conditions. The geometrical style may be followed with pleasing effect along public boulevards, around large buildings with steeples and spires and particularily a large building on a small area. It heightens the outline of the building and emphasizes its importance. Many other places might be mentioned where the formal style of gardening would be effective and desirable. But over large estates in rural places and suburban homes where the character of the surrounding landscape retains much of its natural beauty. A formal system would be entirely out of place. The fault, therefore, in much of our home gardening lies not in the system, but in the wrong use of that system. It is true that there are many pretences toward either a formal or informal system, which are complete failures. But again it is not the fault of the system, but the inability of the gardener himself, who is merely a grower of plants and who has not the keen perception of a natural artist.

If we would succeed then in landscape art, we must, first of all, have a special love for the beautiful in nature. We should be familiar with our nature trees, flowers and shrubs and varying effects of form, size and color. We should then begin, first with a careful study of the natural resources of any given place from a landscape point of view. There is no spot either among mountains at the seashore or on the rolling prairies which does not have its own original beauty. There may be massive trees that are impressive from their size and age, which man, by one foolish act, could destroy—thus undoing what it has taken nature years to develop. There will always be something in the contour of the land, in the plant growth or the general outlook of the grounds that will be worthy of our serious consideration. To make or to mar this lies in the province of man.

He who succeeds in preserving the natural charms of a place, its spirit, and sentiment, though he does not attain the highest perfection, is far in advance of the one whose first attempt is to obliterate every thing natural in order that he may substitute some stilted and artificial plan.

Tho the landscape artist has given due respect and reverence to nature, that is not all that remains for him to do. It is only a right beginning.

He has not the artificial features—walks, drives, fences, etc., to blend and harmonize in his landscape. The walks and drives should be as few as convenience will permit; "they should neither be so straight as to lack beauty, nor so meandering as to lack good sense." There should be a legitimate reason for a curve in a drive. Sometimes there will exist naturally a small hill, a clump of brushes, or a tree that will offer sufficient reason for turning aside. Otherwise one can make the curve seem natural by planting shrubs or a tree in those places. Whatever may be his device, it should be something that is permanent and real. Something that could not be destroyed or easily removed. For instance, a flower bed would not be a permanent obstruction. It would offer no resistance to passing wheels. Not only would it be unsuitable on account of its trivial transitory nature, but on grounds which are large enough to require a road, a flower bed would be entirely out of place. The same principal holds true in the construction of paths as in the construction of drives. Paths and drives are for utility and not for beauty. Then with that aim—and only that in view, should they be built.

We have still a more difficult problem to meet than that of walks and drives, and that is what to plant and how to plant it. These are questions that ought to be raised by nearly every one, for there are few places but what could be improved by a judicious planting of ornamental plants. In the words of Mrs. Rensselaer, "two trees and six shrubs, a scrap of lawn and a dozen plants may form either a beautiful little picture or a huddled disarray of forms and colors." Too often instead of a beautiful picture we have a "huddled disarray." But even that is better than no attempt at all. It shows a slight appreciation of the beauiful.

But to return to our ideal garden. In this we would have shade trees, shrubs, hardy climber, annuals, perenials and a well-kept lawn. There must be harmony throughout not only with the individual details, but with the landscape beyond. There must be harmony of color, form and structure. How to obtain these is the work of the artist.

The most valuable plantings from a standpoint of beauty and utility, are the shade trees. Their artistic value is embodied in the three qualities, form, texture, and color. The form of a tree is determined by its outline as described against the sky or other trees. In this it may be eliptical, oval, pearshape or of various other outlines. Structure is another important factor in determining the form of a tree. This includes the manner of branching, which may vary all the way from the drooping habit of the willow to the aspiring branches of the poplar. We can, thus, readily see the inharmonious effect in massing trees of these two extremes as the willow and the poplar. The texture of a tree is determined largely by the form and density of its foliage. Let us compare, if you please, the leaves of the arbor vitae and those of the pine, the great trembling leaves of the cottonwood with those of the weeping willow, the catalpa and cedar—the extreme difference is apparent.

Again the color of the bark and foliage is quite as important an element from an artistic point of view as form and texture. All shades of green, blue, white, red and orange are represented. In this we have equally as great a variation as in form and texture. Then what is the gardener to do with such diversities of color, texture and form. He must know his trees. He must know them as they change with the seasons and with the years. If he is not able nor willing to do this he must take the results of chance.

As time is limited let us pass on to other features of landscape art that deserve our attention.

There are multitudes of hardy climbers and annuals that may be employed over porches, trellises, arbors and against the bare masonry of buildings. Climbing roses and honeysuckles, for example, wisteria, Virginia creeper, clematis, trumpet vine, cypress, maderia, the wild grape and the hop vine must not be forgotten. Not all will look well together nor be suited for all places. Each has a special charm and beauty of its own determined by its habits of growth and the character of its flowers and foliage. Hardy climbers are more effective in uniting the lawn and walls of the house than annuals, which are present for a season and then gone, leaving not only the junction of the soil and walls bare, but the work to be done over again the next year.

Flowering shrubs is another necessary element in the ornamentation of home grounds. Like the climbers there name is legion. We have all gradations, from the little deutzia on the one hand with its low spreading top to the upright honeysuckle, barberry and flowering crab. It is in this profusion of species the danger lies in selecting the proper forms for the proper places.

Here again the gardener should know his plants. He should know those that first put forth their leaves in spring, the time of blooming, the character of the flowers and fruit. In general mass those shrubs with the darker restful colors in the back ground, and those of lighter shades in the foreground.

Select those forms that blossom successively, for it is in this constant change we have one of the principal charms of the garden.

If we attempt the naturalistic style of gardening, let it appear natural. Don't destroy the lawn and the whole effects by dotting here and there pattern beds with bright and variegated foliage that stare at us the summer long like a painted sign.

Pattern beds are not the only monstrosities that appear on our lawns. Equally as bad are the camp kettles, vases, fountains, paint buckets and even sewer tiles are seen promiscously scattered about on the lawn. What could be more unnatural and out of place? Schiller tells us that, "If the art of gardening is at last to turn back from her extravagance and rest with her other sisters, it is, above everything, necessary to have clearly before us what we require. It is certainly tasteless and inconsistent to desire to incompass the world with a garden wall, but very practicable and reasonable to make a garden into a characteristic whole to the eye, heart, and understanding alike."

PEACHES IN NORTH MISSOURI.

(By A. W. Bloomfield, St. Joseph, Mo.)

The origin of the peach is hidden together with the prehistoric life of the Aryan tribes of Central Asia. The primeval home of these early tribes was on or near the 40th degree of north latitude. In fact the Turko-Siberian city of Bokara, for which a well known variety of peaches has been named, is located exactly on the parallel mentioned above.

This 40th parallel north separates our neighboring states of Kansas and Nebraska and running thence east bisects Andrew county this State and the other counties in the second tier from the north line. I have shown that North Missouri is in latitude with the native home of the peach. Next let us see if other physical environments are similar. The altitude of Central Asia in general is high and the surface is drained by several large rivers running in all directions. The soil must be somewhat sandy and the air dry, as the country is dotted with arid deserts.

The altitude of North Missouri ranges from 1,000 to 1,200 feet and the nearness to the more arid regions between us and the Rocky Mountains insures us the proper aridity of atmosphere.

Our upland soil formerly covered with timber, is much of it of loess formation and contains sufficient sand to make it well adapted to the growth of the peach tree.

My effort to prove North Missouri an ideal peach district would be futile, unless substantiated by facts gathered from recent crop results.

In the last ten years eight full crops of peaches have been raised in Northwest Missouri. Can any other section of our State make a better showing.? This year the writer sold the crop from one acre, consisting of Elberta, Champion, Crawford, and Summer Snow peaches, for $352.

Twelve years ago Mr. Hopkins of Springfield in a paper read before this Society at Lebanon, said: "I cannot advise our friends in the northern part of this State to set peaches extensively for commercial purposes. They will not pay." Does eight full crops in ten years of any fruit pay? It surely does. Especially of peaches. Was not Mr. Hopkins surely wrong in his conclusions?

With the proper kind of soil in which the peach does best, the right altitude, and a latitude similar to its indiginous home, we *can*, we *do* and we *will* grow big peaches, not only for home consumption but for commercial purposes also. All the common commercial varieties fruit well here. The Elberta, Champion and Crosby, leading as favorite varieties. Our loess soil does not require cultivation throughout the entire life of the peach tree. I cultivate until the fifth year when I sow to red clover—mowing off the first crop and allowing the second to fall to the ground to reseed and make a winter cover. The only enemies the peach has in North Missouri are an occasional borer and the leaf-curl, neither of which does serious damage.

All hail to the luscious peach. If the apple is the "king of fruits," then has Pomona surely crowned the peach as the "queen of fruits." It vies with the strawberry in delicacy and flavor and defies the art of man to counterfeit it in color.

A PLEA FOR A MORE NATURAL COURSE OF INSTRUCTION IN ELEMENTARY SCHOOLS.

(By John R. Kirk, State Normal, Kirksville, Mo.)

The typical school falls short of its possibilities because it ignores the nature of the children and bends their energies to the acquirement of conventionalities. It represses the natural impulses of childhood instead of directing and utilizing them. It inhibits habits of action and tends to destroy the power of initiative instead of developing that power. It withdraws the child's consciousness from visible and tangible things among which he lives and must live. It fills him with facts remote from his unavoidable sphere of action. It receives children who are fond of serving others, full of willing energy and, by both nature and habit, industrious. It sends them back with distorted ideals and a distaste for doing the world's work.

Let us survey our field of action and get our bearings: Reformers too often magnify their isolated specialties and fail to see things in their relations. We need practical science in elementary schools. This can not come without the contemporaneous organization of several related subjects.

commercial poultry. Mr. Boyer says: "There was a time, and there is yet to a certain extent, when white-skinned fowls did not command the ready sales in the market that the yellow-skinned ones did, but that prejudice is fast dying out where the Langshan fowl has been marketed. The broiler men in Hammonton, N. J., send considerable Langshan meat to the New York market and are commended for shipping such fine stock. The truth of the matter is just this: There is no fowl bred for the table that will give finer or better meat than the Langshan, and the turkey taste of the flesh is what suits the average epicure. Langshans crossed with Plymouth Rocks give the finest roasters, and Langshans in their purity furnish the most excellent broilers."

I recently heard a gentleman say that he did not like the Asiatics, that they were too lazy. I asked him if he had ever tried the Langshan. He said no, but "reckon" they were the same as the rest. No one who has ever tried the Langshan can make this assertion. The Langshan is undoubtedly one of the best of foragers and in this respect excels some of the smaller breeds. Give them unlimited range and they will forage over a small farm. In confinement they are contented and if fed in a deep litter of straw or leaves will work until every morsel of food is found and in return will shell out a fine lot of strongly fertilized eggs. As setters they are faithful and as mothers look carefully after their chicks. If your stock is vigorous and properly fed, you may depend upon a large hatch everytime.

From a fancier's standpoint what is more beautiful than a well bred pen of Langshans, with a proud carriage, with head and tail erect, breasts full and rounding and every movement of military precision, what more can be desired! Can you paint in your mind a more beautiful picture than a lot of Black Langshans, as they stand with tail feathers, neck, hackle and saddle glistening in the sun with their rich sheen that every shade of iridescent green is capable of producing! Or take the white variety, with that proud carriage and clothed in beautiful spotless white, and you cannot help exclaiming "oh how grand; how majestic." Go with me into the show room and hear the crowds always found in front of the Langshan coops and you will hear as I have often heard the exclamations of delight and praise of our black and white beauties.

Before closing I want to call your attention to an article recently written by the veteran judge breeder and writer, I. K. Felch, in which he writes on the Langshan as follows:

"Prejudice more than any other cause has prevented this from becoming one of the most popular of the practicable breeds. Neither the color of its skin nor its dark pin feathers hurts the flavor of the meat. Will any one deny that a thin skin is indicative of tender flesh?

"The only thing that remains is that the Langshan offends the sight of those who have been educated to look upon a yellow skin in poultry as the best. They are early and persistent layers and as winter producers are strictly first class. In these days when merit and prolific egg production are asserting their influence in a marked degree in the increased sales of thoroughbred fowls, I do not see why this breed should not regain its old time popularity. While it is useless to call the attention of the Langshan breeders to these facts—as they are all well known to them—we feel warranted in repeating the above, knowing full well that they will not disappoint any one who may start to breed them. That they are gaining favor mostly on account of their good qualities, as stated above, was satisfactorily proven to the writer while inquiring of exhibitors at several prominent shows last season, as regards to sales made by them, the majority stating that a number of their sales were made to parties who were starting to breed them and in a number of cases they were not able to fill their orders on account of the increasing demand. That this year will be a repetition of last is a certainty, if it will not eclipse it by far."

Now my friends if you are about to start in poultry breeding, either for profit, or pleasure, or both, or if you want to change from the variety that you now breed, we advise you to give our favorites a trial. Test them on their merits and we are sure that you will be as enthusiastic on the subject of Langshans as are nearly all who have given them an honest trial. From a utility standpoint they will meet every requirement and are fast coming to the front. In describing the good points of a Langshan briefly, you will find them large in size, majestic in appearance, hardy in constitution, seldom having diesase, the best of winter layers, good setters, careful mothers and as dressed fowls they have an abundance of tender and delicious flesh.

SESSION OF

Improved Live Stock Breeders' Association.

FUTURE OF CATTLE INDUSTRY

By T. F. B. Sotham, Chillicothe, Mo.

There are two ways to estimate what the future of the cattle business will be. One is by just simply going blindly by the past and saying, what has been will be again; and the other is, to take advantage of what is past and note the signs of the times and the changes that are taking place everywhere, and try from the two together to estimate what may follow. Some people say that because we had a panic in 1893 that we have to have another; these pessimists say there is no possible way out of it, and yet they don't stop to estimate the fact that in 1893 we were considered among the borrowing nations, and in 1901 we are already a loaning nation. We lend our money to England, supposed to be the lending nation of the world. We have a balance of trade in this country amounting to $50,000,000 per month or $600,000,000 per year. After we have paid for everything this nation buys from other countries, we still have $600,000,000 due us from them each year. That is, more money in one year's balance of trade comes to us than came to us during the entire first century of our existence as a government. Now you have a factor to deal with that you did not have before, and it is impossible to estimate the future with this factor in it by the past, because you did not have that factor before. That covers our entire industry—industries of the United States, of which the cattle business is a very large factor, much larger than most people realize.

Back in 1893 and previous to that, particularly in the 80's, we had, as you know, a very extensive demand for young breeding stock. You know that right here in Missouri, western buyers were here to pick up grade heifers—even what we call scrubs—at good prices, to stock the ranges of the west, southwest and northwest, a territory up to that time, that had no cattle to speak of. After awhile the range country filled up and instead of being buyers for our surplus here they had a surplus of their own to sell. Now going back a little farther, you know that our markets absorbed irregularly the supply cattle up to the time the range demand set in for our she stuff. Then there came a shortage because the market had been used to absorb the butcher stock that consisted largely of cows and heifers. When the ranchmen began to buy these cows and heifers to ship them west for breeding purposes, the shortage of butcher stock made high prices for the remaining available beef. The shortage in the butcher stock caused by the demand for the stuff in the west made a shortage; then, later, as a result of stocking the heretofore unoccupied ranges, the time came when those ranges had some cattle to sell instead of having to buy, consequently the glut followed.

You remember how many cattle companies were formed in the west. When I was in Denver in 1883, you could not meet a man—not even a clerk or servant, no matter whether he knew a cow from a saw-buck, but who had some stock in a cattle company. You know that class of men were not practical in their dealings, and that for the unpractical cattle man the business was unprofitable. Thus some of these companies, not well managed, were not satisfied to sell their surplus, but deposited their whole outfits on the market. I heard of one European party that in establishing a ranch company, fell into the hands of cattle sharps, who sold and delivered to these tenderfeet the same herd, three different times, and all the sharpers did was to drive the same herd around a hill three different times repeating the delivery. Could anything but failure be expected from such "chumps?" They met and deserved disaster.

When the surplus of these range breeding herds went onto the market you know what happened. There was a glut and we could not get enough for our Missouri cattle to make ends meet. During this time, I sold registered Hereford cattle at $40 per head, as good as I now sell at $500, for there was no demand for them. People did not want to improve their herds. They said that one animal was as good as another; that there never could be a raise in values; that scrubs were as good as pure breeds; that straight Texans were hardier and more profitable than blooded cattle; that numbers, not quality counted. How often when I predicted the restoration of values and a return to intelligent methods was I laughed at for my pains. Prosperity delayed until, optimist as I was, I despaired its coming. I suffered as deeply as anyone, but in faith and hope. We know it has come now. Here is our situation today. Not only the eastern states, but the entire western range country has been absorbed and stocked with cattle, except the large domain that has been absorbed by the sheep interests, and they are encroaching all the time on cattle interest. We have already drawn on Mexico for all her supply, until Mexico is rather a buyer than a seller today. Same is true of Canada, both eastern provinces and the northwest. We get all the surplus cattle of the provinces of Ontario and Quebec through the Buffalo market and they are distributed through Ohio, Indiana and other states as Canadian feeding cattle. I say we have drawn on the supply of Mexico, Canada, etc., yet the cry is that we have not got cattle enough and hence prices tend higher.

You now see the day when the market has overtaken the supply of cattle. Now I ask you where are you going to increase the source? Where can you go today to increase the supply to overtake this growing demand? Will you go to the range in the west or the northwest? You will find that they have already been overstocked. You will find strife, even to bloodshed, between the sheep and cattle men. Sections of America that were heretofore devoted to cattle have been given over to sheep and they will always stay there. As sheep ruin the range for cattle and can't exist together on the same range, the result is that we have shoved our cattle territory almost exclusively into the state of Texas, where the rangemen own their own lands or can lease them from the state.

Our American cattlemen are purchasing lands and cattle down in old Mexico and Texas, and Mexico is already the centre for large cattle growing plants of this country, and the only place on the North American continent where they can be carried on successfully and permanently. Now the eastern and southern states have wakened up to the fact that they must have beef cattle. They find they have made the mistake of putting all their money into high priced commercial fertilizers when they should have had the cattle and made their own fertilizers at home. There is going to come a day when the south is going to keep cattle (whether the cattle make money directly or not) just to make cheaply and at home the only real and permanent fertilizer. They are tired of having their eggs all in one basket. They are tired of having one industry, cotton alone. But that change is going to be a slow process; the whole southern agricultural system has to undergo a change.

The southerners are going to be slow, because the land is all held by small owners, just as it is going to be slow to have a big supply of cattle in Livingston county, Missouri where you have had a shortage before. The hope of the future is in the young people. They are grasping the situation intelligently where the prejudice of the elders prevents progress.

As I have said before, the sheep have encroached on the range cattle industry, and the result is that the cattle are decreasing, while the demand for beef cattle is constantly increasing. Therefore, I give it as my unhesitating prophecy, that the American cattle industry is on a sound basis, one that it never knew before. Until now, there has always been new territory to occupy, new ranges to stock. Now all the pioneer work is done. Where in America, Mexico, Canada, can you go and stock a range with cattle without first buying out some man that is in the same business? That country does not exist in the United States today; our territory is all occupied, and our markets absorb the entire supply.

For a good many years, cheap politicians have "jumped" on the big packers, calling them the "Big 4," the "Robber Packers," men who were "squeezing the life blood out of the starving agriculturist," or the men who have made "colossal fortunes out of the poor, down-trodden farmer." What are these packers doing today? There is not a butcher in this country who would be willing to kill a bullock for the profit that these packers are satisfied with. These packers will take the offal which the butchers will throw away or pay you to haul away that they may get rid of the stench and extract from that very waste a by-product that they are satisfied to take as their profit for killing the animal and distributing it to the customer. The reason they do it is this: They are satisfied when they make $2.00 net profit per head, while the butcher who only gets three or four head a week, could not live on such profit. But when they kill their thousands a week, you must admit the economy of the methods and on their large transactions they make a fair and lawful profit. These packers have awakened to the fact that when the farmer is prosperous, the packers are prosperous.

The railway companies also see that they can't be prosperous unless the farmer is prosperous. And what is the result? A "condition not a theory," that if a man had prophesied it ten years ago, he would have been called a lunatic. What do we see in the Union Stock Yards owned and controlled by the railway and packing interests? Acts, not words. Money poured out in the interest of farmers; not vain, empty mouthings of platitudes. They say: "Gather all these breed associations together and talk with them, and we will give them a show." They replied: "We will stand by you and make a show, the like of which the world has never seen!" and the first year instead of it costing $10,000 to run the show, it cost to my certain knowledge over $26,000. The result was a champion steer sold for $1.50 per pound; the prize carload selling at 15½c, and large numbers at eight and ten cents, because of the enthusiasm. That was in 1900. Then, this year, what do you see? They have gone and built buildings to house this show for the farmers that have cost over $50,000, and they do not know yet how much more it will cost them. President Spoor insisted that this should be an educational, not a money making scheme.

Go to Kansas City and see what the Stock Yards Company has done. They have built a pavillion for the exclusive purpose of holding pure-bred cattle sales. Forty-five thousand dollars paid for it. Then they built another building to house the Kansas City Royal Cattle Show. They have put thousands upon thousands of dollars to house these shows, and for premiums to draw cattlemen together, to draw rangemen from the west and farmers of the east, and encourage them to improve their herds. It is these monopolistic "octopuses," that in the disordered brains of the demagogue "have eaten up the substance of the farmers," that have been and are continually doing this sort of thing. There is an era of good feeling—what it is attributable to, I will not attempt to define; but there is scripture which says, that "A thousand years is as one day with God." I think the end of this thousand years being so close at hand we are feeling the influence of some of the prophesies of God to be fulfilled in the next millenary (mayhap millenium). But regardless of what I may think we all do know that there is an era of good feeling; that there is growing and fast spreading a different spirit in the world, and the man who looks on the past and says we are going to have a hard time, the pessimist, narrow brained, little hearted man, who has an idea in his head that we are going to the dogs because we have been there before, does not study the signs of the times. Keep your senses together.

GOOD TIMES AHEAD.

Now that the supply has overtaken the demand, there can't be a cessation of demand. It is the one certainty of the future verified by the past, that consumption is bound to grow larger, and as our supply is to be increased by the slow methods of the small farmers of the east and south, demand must increase faster than supply.

So in looking on the future, I see nothing for the intelligent, conservative, sincere, honest business man, but good times. There can't be anything else for this type of cattleman, whatever may be the case with others. Our supply has got to the place it cannot be suddenly enlarged. No avalanche of cattle can fall upon our market from a new and at present unknown source, the sources have all been explored, and drawn upon to their utmost limit.

The demand has overtaken the supply in the United States, and there is no new source of supply other than a gradual or healthy one. I have thought with new railroads connecting us with the extreme south, taking in the province of Rio Grande da Sul of Brazil and the whole country of Argentina, that it might be possible to bring their cattle up this way; but when I think that it takes 35 days to make the trip by a cargo steamer, steaming 10 to 12 miles an hour (that cannot go faster without consuming all transportation profits by an unwarranted use of fuel,) then I can see that that field is hardly worth considering. So that with our demand overtaking and passing our supply, you can all see that the future of the cattle industry in America, is founded upon a rock, and one that will last as long as our government and people last.

SOME RECENT INVESTIGATIONS OF BREEDING PROBLEMS.

By Prof. F. B. Mumford, Agricultural College, Columbia, Mo.

Mr. President, Ladies and Gentlemen—The subject that has been assigned to me is one in which I am sorry that I cannot stick closer to my text.

The Agricultural Experiment Stations of the United States have been interested and active in the study and investigation of a great many questions of practical value to farmers. There have been investigations in the problems connected with the crops of the farm, there have been untold numbers of variety tests in connection with farm crops, there have been fertilizer experiments, there have been experiments with live stock, but up to the present time the Experiment Stations of the United States have paid very little attention indeed to the investigation of the problems that especially interest the breeders of improved live stock. Notwithstanding the fact that at every great agricultural show the interest centers around the pure bred live stock, and more money is hung up in prizes for pure bred animals than any other exhibit, the experiment stations have so far neglected any systematic experiments to settle some of the great problems that confront the ordinary breeder. It is my purpose to call attention to some things more or less well established, and some of the facts more recently investigated in certain parts of the world.

A large number of the experiments that are conducted by the experiment stations are of mere local value; a great many experiments tried in Missouri are only applicable to the conditions that exist in the State of Missouri. This is especially true of all variety tests of farm crops and fruits. The fruits adapted to Missouri conditions are not the ones best adapted to Iowa or Kansas. There are certain experiments of local application. There are other experiments of wide application and an experiment conducted in the State of Missouri or Maine may be applicable to any other part of the United States or the world. This may be said of breeding experiments, any experiment conducted to settle problems that pertain to breeding will be of wide application, and that experiment station that takes up these problems will be perhaps doing more in the way of promoting the general science of agriculture, particularly that phase that relates to live stock husbandry, than in making experiments of mere local value. One reason why the stations have not begun on these problems is because results will be naturally slow, and the experiment stations have often shown a very unfortunate anxiety to try experiments, the results of which could be published the same or the next year, and a great many experiment stations have neglected some very important phases because they could not publish results quickly. Now manifestly experiments on some of the great problems of breeding will require time, and that experiment station that undertakes these problems needs time enough to definitely investigate certain problems. Still this should not be an argument against beginning experiments of this kind and breeders of improved live stock are demanding that the stations pay some attention to this line of work.

It has been said frequently by those connected with the experiment stations that this is the work of the biologist and the embryologist, the man who studies germs, the processes of fertilization; that the problems of heredity must be solved by an examination of the germ plasma and the processes that go on in the germ. I wish to call your attention to the statements of some of the leading biologists and embryologists of the world on this subject, and so far as I am able to observe they are united in the belief that the changes which bring about these phenomena of inherited characteristics are so minute in the embryo and so far beyond the possibility of definite solution by present methods of investigation that the chance for discovering the real causes of many of the phenomena of interest to practical stock breeders, is very slight. This is not saying that many of the investigations of embryologists are not of value, but it is saying that in-breeding or cross-breeding or the influence of a previous impregnation, that these changes, if they do occur in the germ are so minute that we have no means of observing them at present, therefore we cannot look to the biologist or embryologist to settle these questions. All that we know about the process and methods of breeding have been based upon what you may call practical observations. largely the results of practical experience of breeders.

Darwin was the first great authority to use the results secured by practical breeders to support and confirm his great biological theory of evolution and those of you who have paid attention to Darwin's theory of evolution will be impressed most forcibly with the idea that he placed a great deal of dependence upon those facts that he secured from consultation with practical breeders and facts that have been evolved by the practical experience of breeders. All that we know of in and in breeding is based upon the observation of people who have actually tried it, and the results that have come from it have been observed by practical breeders and not by biologists or embryologists. I call your attention to that fact that if we are to arrive at definite results we must rely upon the careful, systematic observations of trained breeders; we must actually breed in a certain way and observe results.

Now this is best accomplished by those who have some knowledge of breeding and the principles of breeding and it is entirely outside of the work of the embryologist. Now as to the necessity of work along this line, I do not know that it is necessary to spend any great amount of time, but certainly there is a great need of work. There has been very little work done anywhere in the world on this subject, and with a few notable exceptions, scientific methods have not been employed in the solution of these questions. There is no work being done in this line in the United States. Notwithstanding the vast amount of money and the great numbers of stations at work on local problems, not one of them is attempting to solve problems connected with these questions that trouble breeders.

There are a great many notions about certain problems of breeding that ought to be dispelled. The best way to do that is to prove that they are not true. The greatest trouble with breeders is not that they know too little, but too much—too many things that are not true. Now it is not necessary for me to name over a lot of these notions that have come to be prevalent at this time, because I wish to present another phase of the question that in my opinion is more important; but the result of some systematic experiments along this line would not only dispel some of these notions—facts that are facts—but help to fix the limits of our present knowledge. We say, for instance, breeders are pretty generally agreed that some of the results of in and in-breeding are a loss of fecundity or fertility, and a decrease in the size of the animal, if practiced persistently, and a loss of constitution. These three results from close breeding are generally accepted. Now opposed to these bad results that come from in and in-breeding, we know that some of the best animals that have been produced in times past and some of the best animals of recent times have resulted from very close in and in-breeding. Animals do not always show these bad results from in and in-breeding to which I have called your attention. Why not? What are the limits of in and in-breeding? Can we practice it for the good that is in it without securing the bad? We need some definite experiments along that line. Some experiments conducted seem to indicate, for example, in those breeds of animals that produce litters, in case two of the animals of a certain litter are very much alike in character, that is of the same appearance, the same form, color, nutritive habits and deportment; if these two animals are bred together, the bad results from in and in-breeding are almost sure to follow. But if in the same litter there are two animals not resembling one another, which frequently happens, and they are bred together, the bad results do not follow at all. We certainly need more information to limit our ideas and knowledge, and to know how far we can go and what we can depend upon.

In a similar way do we need more definite knowledge of the results of cross breeding. Crossing, in a general way, tends to disturb whatever prepotency may have been built up by in and in-breeding. Hence experienced breeders practice crossing with caution or not at all.

It seems from what experience we have had that in-breeding is one of the sure ways of establishing prepotency (the power of transmitting character to offspring) in an animal, for after all is said, it seems to be well established that in-bred animals are undoubtedly stronger in fixing their characters upon their offspring, and other things being equal, prepotency is the most desirable quality in any breeding animal. I need not stop here to discuss a good individual, it does not take much of a man to select a good animal or buy one that some judge has pronounced the best animal, but what assurance have we that that animal can fix his qualities upon his offspring? It happens sometimes that an animal is a superior individual, and if we knew how to introduce into that animal the ability to fix his characteristics upon his offspring, it would be an exceedingly valuable piece of information.

It has been found that not only is in-breeding valuable in enabling animals to fix their characteristics upon their offspring, but there are certain other factors involved in connection with heredity that we speak of as prepotency. In a general way we speak of this under three heads, the first is impressiveness, and under this division we place all of those classes where the animal has acquired prepotency because of in-breeding. This is called artificial prepotency. Some animals are born with the power to impress their characteristics upon their offspring, irrespective of their breeding. This we call natural prepotency. There have been numerous examples of this in history. Every breeder knows of male animals that have been exceedingly prepotent. Hamiltonian 10, the great trotting stallion, was an animal naturally prepotent. The great Shorthorn bull, Hubback, was an animal of great prepotency. I remember a trotting stallion of the Nutwood strain, a sorrel, with white legs and a white face. He was so prepotent in this characteristic that it did not matter to what breed or type of mare he was mated, the progeny were always of a sorrel color, with one or more white legs and a white face. This was almost invariably the case in the thousands of colts that this horse produced, so prepotent was he in fixing his color on his offspring. Certain breeds are very prepotent in fixing color on their offspring, the offspring of the Hereford nearly always has a white face, while the offspring of Angus bulls are nearly always black and polled. This is exclusive inheritance. But animals may not only themselves be prepotent, but the offspring of these animals may also be prepotent in fixing their characteristics upon their offspring, and this is the most valuable form of prepotency. This is a form of prepotency not possessed by many animals, it is unfortunately possessed by few or none of the improved breeds; unfortunately, I say but in another sense it may be fortunate for the breeders of improved live stock. What I mean is this, a bull of an improved breed, bred to a common cow impresses himself upon his offspring, that is they have the characteristics of the breed to which he belongs, but the half blood progeny of this bull do not possess the prepotency of their sire, and generally lack the ability to fix upon their offspring the characteristics of that particular breed to which the sire belongs. I say this is unfortunate for some people, but it is very fortunate for the breeders for by reason of this fact we insist on every man using pure bred males, instead of half blood ones, and that is a good thing for the breeders of pure bred live stock.

The controlling of this matter of prepotency is one of the most important questions. Are there factors in prepotency that man can control? Can we develop prepotency in an animal? If we can, it is a thing that we ought to know. We can control it sometimes and under certain conditions and some of the factors concerned in the control of this impressiveness of animals may be named as follows: In the first place age. It is undoubtedly true in general, though there are many exceptions, that the younger the animal, the less prepotent he is. When a young female is bred to an aged male, the offspring of such a mating is very likely to resemble the aged parent. There are a good many careful experiments which seem to indicate that this is true. In some recent experiments conducted by Professor F. C. Ewart of Edinburg University, he has found that if the female is very young, for example, bred as early as possible, the progeny resembles the male; but as the female becomes older, even though bred to the same male, the progeny comes to resemble the female more and more, and he has tried this long enough so that he is willing to verify the belief that age is a controlling factor and that young animals are less prepotent than the same animals will be when older. This fact is of practical value in breeding, it shows that a man will be more likely to secure good results by using older animals, males for example. When we buy valuable pure bred males, if we buy a yearling bull and begin to use him before he is fully developed, he will not be so impressive, as he will later on. The older animals are more likely to fix their characteristics upon their progeny.

Then sex undoubtedly has some influence. I mean this: those of you who have studied Miles Stock Breeding will remember that he believes that there is nothing in sex *per se,* that an animal is prepotent because of its breeding or some natural inherited quality and that the animal is not prepotent because it happens to be a male or female. Recent investigations indicate that Miles is not correct and we are beginning to think now that in those animals that are gregarious in a wild state, that is live in families or herds, having several females and one male, such as horses, cattle, sheep, etc., the male is naturally more prepotent, although his breeding may be the same. This has come about from natural selection. There is ever a contest for leadership of the herd and the result is that only the strongest males are saved and generally an old male and always a strong one heads the herd. All the females, both weak and strong, are saved, and this results in a lower average for the females. It follows then that the male is always fitter for breeding than the most of the females, and as this process has been carried on through a very long period of time, through the workings of natural selection this has probably become a fixed characteristic in the male, just the same as in the case of domestic fowls, the cocks have spurs and the hens have not. Prepotency has become a male characteristic, just as in certain herds of sheep the horns develop on the males, so in some of these breeds in these gregarious types of animals there has been developed this inherent characteristic of the males to be more prepotent. How strong this prepotency is, is another question, but it undoubtedly exists, reduced to a practical basis, other things being equal, the bull is more prepotent than the cow, the stallion is more prepotent than the mare, the ram is more prepotent than the ewe because of, or as a result of sex. We can say with perfect truthfulness that the bull is more than half the herd. We generally say the bull is half the herd, but the bull is more than half the herd, from the standpoint of the practical breeder, owing to that inherent quality of the male to fix his characteristics upon his offspring. So we may say with perfect truthfulness that the superior bull is more than half the herd and the improved live stock breeders have one more argument for using pure bred males.

In connection with the subject of sex as a factor in prepotency, there are some illustrations that will be interesting. When a mare is bred to a jack, the result is a mule that more nearly resembles the jack than the mare, in form at least. If a jennet is bred to a stallion, the result is an animal that is nearer like a horse than a mule. The hinny is more like a horse than a mule. In both cases the male has fixed on his offspring those characteristics that make up the external form. It is true that the mule is sometimes colored like the mare, but the form of the mule will resemble the jack more than the mare, and the form of the hinny will be more like the horse than the jennet.

I want to make a statement, and if it is not true, you may correct me. A Shorthorn cow bred to a prepotent Angus bull will produce generally a black hornless calf, but if you breed an Angus cow to a Shorthorn bull, the result is always a blue-gray calf, and it frequently has horns. Tell me if that is not true. That is the result of my observation. That shows again that the male is more prepotent. When you use the Shorthorn bull, you get horns and color like the Shorthorn, and when you use the Angus bull the calf seldom has horns and is black in color. This shows that the males of certain kinds of animals are more prepotent.

There are certain kinds of animals where the females are equally prepotent with the males. This is true of all those animals that tend to pair, especially all kinds of pigeons and even in domestic fowls the male is possibly not more prepotent than the female, but particularly the pigeon. Experiments indicate that the female is as prepotent as the male where animals do not run in herds, and the male is no fitter for breeding than the female. This is true, of course, with cats, and is also true of wild animals, like the lions and tigers, etc.

Environment is another controlling factor. The nutrition of the animal, amount of exercise and other conditions have something to do with the ability of the animal to fix his characteristics upon his offspring. When an animal is in the best possible condition physically, he is in the best possible condition to fix his characteristics upon his offspring. That is not always true. Certain kinds of feed may have something to do with this matter, or in some cases certain methods of feeding.

There are at the present time, to my knowledge, just two great stations that are conducting experiments along this line, and I wish to call your attention to one of these because I hope to bring out some discussion on this subject. At Halle, in Germany, there is being carried on at the present time the most extended experiments in crossing ever undertaken in the world. Dr. Julius Kuhn, the Director, is crossing domestic animals with wild animals, the swine with the wild boar and the female of the wild hog with the domestic males. He is crossing domestic cattle with the bison. He is crossing the cow with the musk ox and with the Indian cattle or zebus. He is crossing the zebras and the jacks to common mares, and by all these combinations he is attempting to discover some of the questions that have to do with crossing, and his results up to the present time, so far as I am able to judge, prove that what we have believed to be true of crossing is true, that crossing tends to break up the characteristics of the improved breeds of live stock, and that particularly so after the first cross. The first cross is generally successful, but the second is invariably a failure. If you should breed together a prepotent Angus and Shorthorn, the result would probably be a good animal, but the result of that cross used for other breeding would beget a lot of mongrels. That has been Dr. Kuhn's experience all the way through. He has succeeded in producing the most inferior lot of hogs I ever saw; worse than any razor-backs that you can find in the United States, and he has produced them from the best breeds of hogs, simply by crossing.

There is another man that is doing a great deal for live stock breeding, and that is Prof. F. Cossar Ewart of Edinburgh University. You may have read about his famous experiments. He began with a desire to investigate the subject of telegony, or the influence of a previous impregnation. It is claimed by some that if a mare is bred to a jack, the union resulting in a mule, if that same mare is the next time bred to a stallion of her own breed, the result may have some mulish characteristics. This is generallv believed, I think, by most farmers and breeders. If you breed a prepotent Angus cow to a Shorthorn bull, this theory holds that the Angus cow is in some respects forever after a cross, and if you afterwards breed her to an Angus bull, she may drop calves that have some Shorthorn characteristics. This is widely believed by all of the best breeders in England and by many in this country. Many leading scientists like Agazzis, Darwin, Spencer and others believed that this was possible. Prof. Ewart used in his experiments a male Burchell's zebra. He bred several mares to this zebra, producing several hybrids. These mares were then bred to stallions of their own breeds and in these seven or eight years experiments he has not been able to find that the previous sire in any way influenced the progeny. Still one might try thousands of experiments and not find such a case, and then the thousandth might show such an influence. The contention is that such a thing sometimes happens, not that it frequently happens, and it certainly is worthy of investigation.

I hope the Missouri Experiment Station will take up some work of this kind. You can readily see that this kind of work is expensive. When a man uses these animals for experiments, the animals have no commercial value, and it takes money, but it should be done, and the Missouri Experiment Station should take up some work in this line. The Missouri Experiment Station is doing a great work, and should lead also in discovering the truths so important to breeders. I hope the breeders of improved live stock in this State will co-operate with the Missouri Experiment Station in this work and help us to carry it on.

DISCUSSION.

Mr. ——— I would like to ask, in order to secure prepotency and a prepotent type of animal, is in-breeding advisable and necessary?

Prof. Mumford.—I suppose if you would ask a physician if it were advisable to give a certain strong medicine for some disease, he would hesitate in answering, but probably he himself would give it. In my opinion in-breeding is like a powerful medicine, exceedingly valuable and necessary when administered judiciously, but in the hands of the unskilled it may often result in failure. My experience with it has been both favorable and unfavorable. I bred Shropshire ewes to their sires and the results were very satisfactory. Four Shorthorn cows were bred to their sire and one of the calves was extra good, but the other three were weak and inferior. Two of them died at birth and the other died a short time afterwards.

Does anyone know of colts from a stallion-bred mare that had been previously bred to a jack that showed mulish characteristics? If you do, I want to find just such a case, and I would travel a long ways to see one.

Mr. King.—You spoke of prepotency of the male in gregarious animals. You also said the development of spurs and presumably tusks, etc., because the male had to fight for his place at the head of the herd, had by the process of evolution become a sexual characteristic. Does that prove that he and his ancestors begot better chickens or that they had prepotency? Does the fact that the male hog wins his place for the leadership of the herd, because he and his ancestors had big tusks, prove that they also possessed prepotency?

Prof. Mumford.—Not at all. That does not have anything to do with it. I brought that forward as an illustration of the fact that there are certain sexual characteristics developed in certain kinds of animals from some cause. The argument was this: If these characteristics developed as sexual characteristics, if they came to be peculiar to the male sex, and are transmitted to the offspring of that sex, as we know they are, we may also be justified in believing that it is possible that the male sex may also develop the characteristic which we call prepotency, the ability to fix its characteristics upon its offspring. Not that the development of spurs is related necessarily to prepotency at all; but the very fact that there are sexual characteristics, such as these mentioned, leads us to believe that it may be that prepotency may become a sexual characteristic.

Mr. King.—If I recollect rightly, you mentioned these characteristics as belonging to gregarious animals. Are not some of these characteristics also true of animals that pair?

Prof. Mumford.—Secondary sexual characters may belong to animals that pair as well as gregarious animals.

Mr. King.—You spoke of the lion as an animal that pairs. The male lion always has a mane.

Prof. Mumford.—The only point I tried to establish was that prepotency might be a sexual characteristic, that there might be developed in the male that sexual characteristic that we call prepotency. We believe that is true, and because we observe that the male can develop other sexual characteristics and transmit them, we do not see why he could not develop prepotency and transmit it.

Mr. King.—I did not mean to suggest for a moment that he could not, but my suggestion is, the fact that he has developed spurs from one cause does not suggest to me that he may develop prepotency unless the same cause would produce prepotency.

Prof. Mumford.—You see the same cause would not produce this effect. The spur is produced by reason of the necessity of the animal to fight and win his way. Prepotency may be developed from an entirely different cause. Sometimes an animal develops certain characteristics from one cause and other characteristics from an entirely different cause. Prepotency is developed from an entirely different cause from the necessity for fighting. There are innumerable causes producing various results in the great cycle of evolution.

Mr. Hall.—If the necessity of fighting is the cause of these characteristics of spurs, etc., I suppose after a few years sharp horns will go away altogether.

Prof. Mumford.—We do find domestic animals without horns. But you are introducing a very conflicting lot of conditions, such as the artificial condition of domestication and man's selection. Man wants the horns such a size and shape and he selects them then in accordance with his wishes.

Mr. King.—Mr. Hall has stated that question in such a way that I can succeed in conveying my idea now. Where can you find the necessity for prepotency? That is the idea I tried to get at, and Mr. Hall has helped me.

Prof. Mumford.—We have no reason to presume that characteristics are developed only as the result of necessity. They are often developed for other reasons. Necessity is one great and controlling reason why certain characteristics may be brought about, but degeneration is going on, environment, surroundings and disease are also controlling factors. There are nutritive necessities and physiological necessities. It may be necessary for the male to be more prepotent than the female because he fixes his characteristics upon far more individuals than the female. The female only produces a limited number of young while the male produces thousands and that may be the necessity for the male to be more prepotent than the female.

THE TUBERCULIN TEST.

By D. F. Luckey, State Veterinarian, Columbia, Mo.

The fact that tuberculosis is a highly contagious disease among cattle and that it exists to-day to a greater or less extent among some of the herds from which Missouri breeders are accustomed to select animals make some means for diagnosing it almost indispensible. Owing to the apparent fear that the tuberculin test may not be reliable and altogether harmless and that it still might be forced upon them by arbitrary live stock sanitary authorities a great many cattlemen entertain a prejudice against its use. I want to say that in its discussion to-day that I shall attempt to state the truth in regard to it and shall not advocate forcing its use upon the people. I have confidence in the eminent work of the tuberculin test and am sure that when the breeders of Missouri understand and comprehend its value they will use it as their interest demands without any coercion. The main idea I have in view in choosing this subject for this meeting was to discuss it candidly before a Missouri audience with special reference to its use for the benefit of Missouri herds. I do not hesitate to say that I think the tuberculin test will soon be regarded as a boon by Missouri cattle breeders. It is plain to be seen how, by its proper use, the introduction of tuberculosis can be wholly prevented. For that reason I take pleasure in introducing Missouri cattlemen to a friend with whom I am glad to say a great many of them are already well acquainted.

Tuberculin is a glycerine extract from cultures of tubercle bacilli. It was discovered by Koch in his efforts to find a cure for consumption. It is a liquid put up in hermetically sealed bottles and is free from all kinds of germs. Its use consists in injecting small quantities beneath the skin of the animal and taking observations of any change in the temperature that may be caused thereby. A marked rise in the temperature following in from nine to sixteen hours after the injection indicates that the animal injected is tuberculous.

In testing a dairy herd over a year ago I took the temperatures of ninety-four head of cows at 2, 5 and 8 p. m. and injected 2 c. c. tuberculin into each animal at 9 p. m. The next day starting at 6 a. m. I took their temperatures every two hours at 6, 8, 10, 12 and 2. On the first day the temperatures averaged about 101, which is normal. On the second day in forty-eight head they were practically the same and in fifty-six head they were up considerably, varying from 105.5 to 107.3 degrees. These reactions were decided, showing tuberculosis in fifty-six cattle, and the post-mortem in those that were killed showed that the test was accurate. It is worthy of note that the cattle of this same dairy were tested about twelve months before and were found free from tuberculosis. Only a few head of cows were introduced into the herd during the year, some of which were tuberculous. The rapid spread of the disease was due to the fact that the cattle were fed on a plane surface before the row of stalls in which they stood so that they could eat with each other. Besides, in cleaning, the leavings were swept along in front of the stalls from one feeding space over another to the end of the row. The sweeping was always in one direction and the disease spread in the same direction as the sweeping. In one row containing eighteen stalls a tuberculous cow, during the year, was introduced into stall No. 5 and spread tuberculosis to all the others in the same row in the direction in which the sweeping was done. The four head in the other direction were healthy.

This particular test is mentioned in detail to explain the methods used in applying it and to show what might happen in any herd of cattle if tuberculous cattle are introduced. The owner of this herd disposed of his tuberculous cows and now tests all new stock with tuberculin and by its use prevents the further introduction of tuberculosis.

In this test, as in all others I have made, I found that absolutely no harm was done to any of the cows by the injection. The owners of the herds that I have tested all testify to this effect. In careful hands the tuberculin test is almost infallible. In a small per cent of cattle condemned and slaughtered as a result of this test, it is true that no lesions of tuberculosis have been found. It is possible that the lesions were overlooked, but if they were absent, contrary to the indications of the tuberculin test, the number of such cases is so small that the fact remains that the tuberculin test is about as perfect as any work of the human hand, and it is by far the most reliable of all means for the diagnosis of tuberculosis.

It is impossible to give the exact statistics, but a large per cent. of many of the best herds in England are tuberculous. The disease is very common in other European countries. This fact is shown by the official test of imported cattle. In the Eastern states of the United States where tuberculosis was neglected too long it has spread among the cattle to an alarming extent. In Massachusetts, Connecticut and Pennsylvania the strongest possible efforts have been made to eradicate it. In Pennsylvania where the most practical methods and large appropriations are employed in combatting it, a biennial appropriation of $40,000 being used for that purpose, the best report that can be given of the work is "the frequency of tuberculosis in the infected herds in the State has been reduced more than one-half and the number of infected herds have been greatly diminished." In Missouri the examination of herds for tuberculosis has been somewhat limited, but all indications are that very few herds are affected.

Only one dairy herd has been found tuberculous and only two herd bulls of the beef breeds have reacted. The bulls have been isolated and will be re-tested later on. It is safe to say that Missouri herds are now practically free from tuberculosis.

Viewing the situation as we find it today some important questions arise. Without any efforts on our part can we expect our herds always to remain free from tuberculosis? What are the breeders and dairymen going to do about this matter? Are they going to formulate effective plans for preventing tuberculosis and employ, if necessary, the tuberculin test, or are they going to let the purest prejudice close their minds to the facts in regard to these matters?

Only recently I was present at a post-mortem on a bull which had been shipped from England to be placed at the head of a splendid herd of Missouri Shorthorns. This bull reacted to the tuberculin test that was applied by the agent of the Bureau of Animal Industry on his arrival in this country. He was shipped to the herd in Missouri and kept in quarantine for a short while awaiting a re-test. In the meantime he died of blackleg and an opportunity was afforded to test the accuracy of the tuberculin. Four veterinarians present agreed that his lungs were tuberculous and pieces of the diseased tissue are preserved for examination by any one who is interested in the matter. I hope the significance of this incident will be noted by all the breeders and dairymen in the State. Contemplate for awhile the results that may have come from the introduction of this bull into the herd for which he was intended and then decide whether or not you think it will be best for you to take the precaution necessary to prevent the introduction of any tuberculous animal into your own herd.

There are some valid objections to the tuberculin test. One is that it is not reliable when applied to cattle that are excited from any cause. This can easily be avoided, however, by simply having the cattle in their natural surroundings when the test is made. This test should not be applied to cattle en route. Another objection, and the gravest menace to the test, is that one injection prevents a reaction even in tuberculous animals from a subsequent test which is repeated in a short while. This leaves a chance for the preparation of the animal to resist the test and mistakes may be caused in this way. These things must be taken into consideration and if the breeders and dairymen decide to make use of their friend they may also decide to overlook and correct his faults.

DISCUSSION.

Mr. Sotham.—I understand you accept Dr. Koch's idea that tuberculosis cannot be communicated from cattle to the human family and it is all right to use the milk of tuberculous cows.

Dr. Luckey.—That is a matter which is, in the first place, out of my province, belonging to the State Board of Health. It is a subject that has been disputed by the best authorities and I can point you to authorities equal to Dr. Koch, who hold exactly opposite views as to the communication of tuberculosis from cattle to the human family. That is a matter of no particular interest to veterinarians; what we want to do is to keep it from spreading among the herds and let the human family look out for itself. We do not want to overstep our bounds.

Mr. ———.—Give us an idea of how quickly a herd is infected with tuberculosis, how soon it becomes infected after a tuberculous animal is brought into the herd.

Dr. Luckey.—The questions are capable of varied answers, the extremes of rapidity and slowness with which tuberculosis may spread. I know of a herd into which half a dozen cattle were introduced in a dairy barn where the owner thought he had the most perfect sanitary conditions. These few head of cattle were introduced into the barn that at the time I tested them contained 94 cows and they spread tuberculosis among the herd until 56 cows out of the 94 were affected in about nine months. That is an extreme. I would advise against common feeding spaces. Where the animal is kept in a stall where it does not eat with others, it is possible to keep an animal for years without its infecting another animal.

Mr. Sotham.—You object to the common feeding troughs. You want to keep each animal in an individual feeding trough by itself.

Dr. Luckey.—The common feeding trough is about the worst thing you can have for the herd. When we study this matter properly we will quit using the common feeding trough.

Mr. ———.—In the case of the eighteen cows you spoke of in one row of stalls. Were not the thirteen affected on account of sweeping in the direction of the thirteen?

Dr. Luckey.—Yes.

Mr. ———.—How about herds in open pastures?

Dr. Luckey.—It has been found in the ranches of Montana that a few tuberculous bulls have spread the disease to other cattle, but you can see for yourselves that the disease is not so apt to spread in the open range. The cattle shipped from the open country to the markets here do not show the same per cent diseased as the cattle in parts of the country more thickly settled where they are more confined. Reason teaches us that and facts justify that conclusion.

Mr. ———.—Is that caused by the confinement or because of less association?

Dr. Luckey.—The latter altogether.

Mr. ———.—Are watering places as apt to spread contagion as feeding troughs?

Dr. Luckey.—Not so apt to do so. They do not lick the edge of the watering troughs as they do the feeding troughs, nevertheless, I would not want to water my cattle with a tuberculous animal.

Mr. Sotham.—Is not tuberculosis most commonly found in the dairy breeds of cattle?

Dr. Luckey.—It will spread in any herd in which it is introduced. I do not think the breed has anything to do with it. As far as my experience goes, I think one animal in a healthy condition has about as great power of resistance of tuberculosis as another.

Prof. Mumford.—I was going to ask Dr. Luckey one question. At the Michigan Experiment Station some years ago a whole herd became infected with tuberculosis and the infected animals were isolated and treated for a few years and some recovered and were returned to the herd as perfect animals. I want to know if that is possible for animals that were once affected with tuberculosis.

Dr. Luckey.—It is my opinion that these cattle did not recover in the true sense of the word, that is the disease was not entirely removed from their systems. We know that nature has great power of overcoming disease. A study of the pathology of tuberculosis teaches us that in many cases nature throws around the lesions fibrous substance that prevents its contact with other parts of the body almost as perfectly as if the lesions were on the outside of the animal's body. Medical students tell me they often meet with cases of lesions in dissecting that have been surrounded by nature and have lain dormant there for years and the person had lived on until he died of old age. Cases like these we speak of as recoveries from tuberculosis. I think the pathology of the disease thoroughly studied would indicate that there is never any complete recovery of tuberculosis, and at any time nature should withdraw this prevention, the disease is likely to break out again with renewed vigor.

Prof. Mumford.—Will such animals as you speak of show any reaction from the tuberculin test?

Dr. Luckey.—I can see how nature would so separate these lesions from the rest of the body that we could get no reaction from the tuberculin test. I would feel safe in putting them with my herd because I would think that none of the germs would infect other cattle.

Col. Waters.—I would like to ask Prof. Mumford and Dr. Luckey if they are acquainted with the experiment of the Minnesota Experiment Station where they tried the tuberculin test and made a postmortem examination after killing a number of the cattle? I was present the day the killing was done and Dr. Reynolds, the veterinarian in North Dakota, prophesied what their condition would be. He stated that there was no positive recovery, but that the lesions of tuberculosis would still be found in the lungs. Three of these animals were killed and the very statement of the veterinarian as to what we would find came true. In cases of apparent recovery there were plainly found tubercles covered over with tissue so that the disease did not get out into the system, but they were there and would never be absolutely eliminated and the recovery was only an apparent and not an absolute one. That was his idea and I believe it is correct.

Mr. King.—The recovery was temporary and might prove to be permanent.

Col. Waters.—Permanent, so long as the tubercles remained isolated from the rest of the body, but the weakening of the system or the approach of some other ailment might turn the tuberculosis loose again. That was the teaching of this veterinarian. I remember the lecture distinctly, possibly because the veterinarian pointed out before the animal was killed what we would find in his lungs. The animal had been treated on the open prairie and allowed the full benefit of air and sunshine and had apparently recovered so that he had failed to respond to the tuberculin test.

Mr. ———.—At what stage in the progress of this disease is there outward symptom or sign that we can recognize it?

Dr. Luckey.—I could not describe. As a rule when the vital organs become affected to any extent some symptoms begin to develop.

Mr. Abbot.—Is a cough an indication of tuberculous infection? Would you have occasion to suspect on account of a cough that an animal was troubled with tuberculosis rather than something else?

Dr. Luckey.—A cough is, you might say, always present in advanced stages of tuberculosis of the lungs, but at the same time there are numerous causes for coughs and a cough is no certain symptom that we could use in diagnosing the disease.

PURE BRED STOCK ON THE FARM.

By John F. Coulter, Excello, Mo.

The business of breeding pure bred stock is at once remunerative, elevating and fascinating. Let us consider the subject first in its most important light, the remunerative side of the question, which necessarily comes in for first consideration in all avocations. First, because there is nothing more important to man than food, raiment, shelter, home, etc., all of which are but different forms of benefits derived from our avocation. The subject of pure bred stock on the farm is one that can be considered with profit, by the great mass of farmers the entire length and breadth of the land, without respect to locality. With but few exceptions the testimony is unanimous from the fine stock breeders of the country as to the success with pure breds, the entire length and breadth of our country. Many no doubt would be surprised to know the great disposition at the present time of farmers in states not now known as stock breeding states to engage in the business. A single day's mail frequently brings the breeder inquiries and orders from coast to coast of our country and from Canada.

The man of average intelligence needs only to glance at the market reports or a visit to any of the great markets to see the wide difference in price of the well bred animal and the mongrel. Then, the high grade animal being possible only by the use of the pure bred sire, the importance of the pure bred is at once established. Then the question arises: "Who is to be the perpetuator of the pure bred? Must it be only a few specialists?" We answer no not necessarily. Although the specialist will ever be the mainstay to the business and will be the one who will maintain that high standard necessary to the advancement or permanancy of the breed, the mass of the farmers should all breed pure breds. The would-be breeder hesitates to enter the business mainly because he fears his ability to secure the fancy prices being obtained by the well established breeder. I find this to be the hindering cause above all others. There is hardly a man to be found who is not sufficiently posted as to the superior advantages of the *pure bred* over the ill bred, and he becomes more anxious to engage in the breeding of same than the breeder who has the stock to sell him, and he is at once a ready buyer when he sees his way clear to financial gain. I have this argument for the man who has now reached this point: he must not expect to at first be able to sell his output of surplus stock at a price equal to that of the breeder who has given years of toil, study, time and money in advertising and the establishing of his now lucrative business. But the new investor can well afford to sell at prices readily obtainable the country over, of at least twice that of the common stock of same age. He should sell only his males and keep all females that are suitable to build upon until they have entirely supplemented the scrub or graded stock of the farm. In this way a farm can soon be stocked entirely with pure breds from the smallest fowl to the most important animal kept at small expense and from a very small beginning. No one at this day need to be told that uniformity, easy fattening qualities, early maturity are valuable qualities. All know it. Which qualities can be had only by the use of registered or pure bred sires. All, or nearly all, are ready to breed them if they only could believe they would be able to sell their surplus as others are doing, financial gain being assured. The breeder soon finds that this is not all the good to come to the breeder of pure bred stock.

The calling is elevating, mentally and morally. It wields a great influence for good over those who own and handle them, the boys of the farm and those who are hired to care for the pure bred stock feed them better, handle them more quietly, regard them more tenderly, because of their superior qualities and unusual value, and are by this benefited by refining influences and associations of their stock, fatted, well kept charges of which they are justly proud, and thus by the influences wrought upon the men and boys of the farm, and by the increased interest taken in leading stock journals and the congenial associations of fellow breeders of like refinements, the entire household is reached and pervaded with this elevating influence, fascinating also.

The great interest manifest in every breeder of pure bred stock leads to such a deep study of the great breeding problems and to such earnest expectations for the visible evidences of his judgment in the plans and experiments all made with a full determination of improvement on the types at hand and financial gain that it stops at nothing short of fascination.

In view of the many advantages of the *pure bred* animal over the mongrel, who in this age of progress will persist in toiling in the old rut of fogyism? Using scrub, or graded sires, each year depriving themselves and families of the abundant reward in store for the industrious, energetic, progressive, up-to-date breeder of *pure bred stock.*

THE ANGORA GOAT INDUSTRY.

By Wm .T. McIntire, Kansas City, Mo.

The American Angora Goat Breeders' Association was organized at Kansas City in March, 1900, with a membership of a few enterprising Angora Goat owners. The Association at once put out literature pertaining to the Angora Goat industry in this and foreign countries, made up from their own knowledge, from Government reports furnished by Hon. Jas. Wilson, Secretary of Agriculture at Washington, and from information given by the oldest breeders in the country. The information thus secured was put before the breeders and others that could be reached in the United States.

For the benefit of the Association and Angora Goat breeders in general, a paper called the "American Angora," to further collect and disseminate matters of interest pertaining to the Angora Goat industry, was started in Kansas City. The first issue of this paper came out in February, 1901. The paper has done good work in furthering the interests of the industry.

By October, 1900, we had more than one hundred members in the association, which consisted of some of the best breeders in the United States. In that month we held at Kansas City the first annual exhibition and sale, which proved to be the greatest ever held in this country up to that time. The widespread interest manifested spread throughout the country; many thousands of Angoras were purchased by farmers throughout the East and Middle West from Southern and Western breeders. One hundred more new memberships were taken out by those who had embarked in this industry.

Our second annual exhibition and sale came off in October of this year. This brought together nearly all of the principal Angora Goat breeders in the United States, competing in friendly rivalry for the large cash premiums offered by the Association. It is doubtful if any such exhibition of Angoras was ever held in the world. The public sale that followed brought out the true value of Angora Goats as the most profitable of all farm animals. As high as $1,050 was paid for one single animal, one brought as high as $500, many $200, and from these figures down to $5, $10 and $15 per head for large numbers, the total sales being nearly two thousand head. The highest prices were paid by old breeders who knew how to appreciate the true value of fine Angora Goats.

The results of the October show and sale brought many more new members to the Association. The more complete information given to the world through all the various channels since the last show and sale has had a wonderful effect on the industry. New memberships are coming into the Association daily. At this time it numbers over two hundred and fifty of the best breeders in the United States. The industry is on the upward tendency.

Angora Goats produce mohair of which the finest and most durable fabrics are made, consisting of fine plushes used in upholstering palace cars and fine furniture. Also dress goods, fine underwear, hats and many other articles of constant use are made. Many large manufactures are being erected to produce these articles from mohair.

Angora venison is a most delicious meat, second to none, and can now be found on the bill of fare of the best hotels. Angora Goats are farm cleaners and farm reclaimers. They are browsers as well as grazers. They clean the farm of all underbrush and weeds, thereby doubling and thribbling the value of the lands on which they exist. It is known that the Angoras have been put on brush and weedy lands not worth more than a few dollars per acre and in two years, after they had cleaned off the brush and weeds, the same land was worth $15 to $20 per acre for other animals to pasture on or for agricultural purposes.

Angoras are healthy, hardy and prolific, taking care of themselves at all times. The only extra care is to keep them out of cold, sleety rains in winter and early spring. Cold weather does not affect them. They do well in any climate. No other domestic animal can rival the Angora Goat in giving remunerative returns on the investment made. The day is not far distant when their glossy fleece will shine from many thousand hill tops in this country.

DISCUSSION.

Col. Waters.—I would like to ask you if you think the Angora Goat would thrive and do well on a pasture that is entirely covered with brush?

Mr. McIntire.—Yes, sir; they will live and thrive on brush.

Col. Waters.—There are thousands of acres of land in the Ozark region of South Missouri which are covered with White Oak, Post Oak and Black Jack, and it occurred to me that there was a vast waste in that section of the State which might be utilized if the goats would thrive on brush alone.

Mr. McIntire.—They will, no doubt. You can take the southern part of Missouri and the northern half of Arkansas and goats would live and do well there. I have been in the section of the country you have spoken of and have sold a great many goats there, in fact all the farmers bought that could afford to buy goats.

Col. Waters.—What amount of fencing is necessary to turn them?

Mr. McIntire.—A three-foot fence will turn any goat that has been raised on the Western range. They are no harder to turn than sheep.

Mr. Walker.—What is the average weight of a fleece that can be clipped from a goat during the season, what is the average price of it, or in other words, how much money return can you expect from one goat?

Mr. McIntire.—In reply to Mr. Walker I will say that a registered Angora Goat will shear about three or four pounds free from burs and kemp. There are a number of goats that will shear six to seven pounds, but they are not average goats. I have seen several bucks that would shear sixteen to seventeen pounds. I sold one last spring that went over in Illinois that sheared nearly seventeen pounds.

Mr. King.—What is kemp?

Mr. McIntire.—Why, kemp is a second growth hair that will not take the dye from the mill quite as readily as the mohair. In fact a grade Angora Goat has two crops of hair. The first one we call kemp and the second one, mohair. The pure bred Angora is supposed to be free from kemp.

Mr. ———.—When the goat has reached a standard of perfection does it still have kemp?

Mr. McIntire.—There are only two families of goats in the United States that are absolutely free of kemp.

Mr. Maitland.—Is there any market for the meat of the goat?

Mr. McIntire.—We find that the sale of the goat for mutton is just about the same per pound as mutton. We have been selling thousands and thousands of them the past five or six years in Kansas City. We had a banquet in Kansas City on the evening of the 28th of November. We had about two hundred and fifty guests there from all over the United States and everyone that partook of the delicious meat pronounced it very fine.

Mr. Maitland.—Did I understand you to say that the Angora Goat would not do well on good blue grass pasture?

Mr. McIntire.—They attain their highest development from a weed and brush pasture.

Mr. ———.—Are the young kids easily raised?

Mr. McIntire.—They are very tender until they are about six weeks old. They do not suckle as often as lambs.

Mr. ———.—Mr. Chairman to supplement Mr. McIntire's statement in regard to the Angora Goat on brush I wish to emphasize the fact that for the past few years down in Greene county there have been about twenty-five hundred goats turned loose on the range where nothing but brush is raised and they have done well. These goats were shipped from near Chicago down there as an experiment.

THE ADVANTAGE OF CORRECTLY COMPILED CATALOGUES FOR PUBLIC AND PRIVATE SALES.

By J. P. Hall, Breckenridge, Missouri.

Mr. Chairman:—A catalogue is a list of the animals offered for sale. It is a form of introductory from the breeder or the seller to the buyer. It should contain a correctly compiled list of the breeding of the animal offered. In order to present them thoroughly they should contain all of the blood lines contained in the make-up or the breeding of the animal and should show the ancestors both maternal and paternal, also the color, age and the breeder of both the sire and dam. Pedigrees are judged by the information given, in the first place by the knowledge of the breeder, that is the knowledge he has of the herd book and without having a perfect knowledge of the herd book he must have some other way of judging the marks of the pedigree and one that is more permanently impressed on their minds of the reputation of the breeder. In the breeding at least it is necessary to know the strain of blood in order to breed stock for special purposes or in order to mix the blood as it should be mixed to produce the best results. It is just as necessary to have the knowledge of the blood lines of the stock as it is for a druggist to have the proper labels on the bottles in an apothecary shop in order to make the mixtures desired. I don't know of any particular point that I could bring out that would help the matter any, except that the pedigrees should be full and complete and perfectly true to the herd book or the record book. If they are not they are just the same as false labels on apothecary bottles.

THE PURE BRED VS. THE SCRUB SIRE.

By J. C. Hall, Hallsville, Missouri.

Gentlemen:—In beginning the discussion of the subject Pure Bred Sire vs. Scrub, we are met at the outset with the question: Why discuss it at all? Do we not all recognize the need of better blood in all kinds of stock on the farm? This question is like some of the propositions we used to be called upon to demonstrate in school. Such as "A straight line is the shortest path between two points," or that "From one point to another, but one straight line may be drawn." So plain it cannot be proven. Yet with all its seeming self-evident facts and plainness, we find it necessary each year, yes every day in the year, to show and attempt to prove to people the hurtful effects of using scrub, or what is nearly as bad, mixed bred sires. Just here let it be understood that what we shall say applies to all kinds of stock. In cattle, among the beef breeds, whether Angus, Herefords or Shorthorns; in hogs to the Poland Chinas, Berkshires, O. I. C. or Durocs; and in chickens if you have Plymouth Rocks, Buffs, Wyandottes or *what nots,* stand by them, keep them pure and improve them along straight lines.

Understand further that to my mind, cross breeding is but little better than scrub breeding—only requires a little longer to achieve the same evil effects. In most cases the cross breeder soon degenerates into the scrub breeder; when his case is most hopeless, indeed, for having fallen two degrees, it is almost impossible to reinstate him and set him on safe ground.

Now in the chicken world, as in most things else, our mothers and wives are smarter than many of us men. When they wish to purchase new blood they not only want pure bred roosters, but they like to buy the "prize winner." They even go so far as to demand to be shown the "score card." This is the rule at my house and my wife handles *mighty nice chickens.*

Then ascending the scale, the sheep men are coming to recognize that uniform, even, broad-backed flocks, first-class mutton and high-priced wool, are more rapidly and cheaply obtained by the use of pure bred sires, followed by intelligent feeding and at least dry housing.

The improvement in sheep raising among the ordinary farmers, under my observation at least, has been greater than any other branch of live stock husbandry. In my county the call is always for a "full-blood" for a "flockheader," and from this fact the sheep men are to be commended for the long steps they have taken in the right direction.

To use the vernacular of the day, the hog and cattle people are "up against it" to keep pace with these wide-awake and pushing wool and mutton producers. A sheep man's feelings would be wounded should you try to sell him a grade or scrub sire. But perhaps in no department of live stock breeding are the results of using pure blood sires or the opposite so marked as in the case with hogs. Do not think for one moment that any but pure bred sires should be used on the farm at all. Better still, if possible, chickens, hogs, dogs, sheep and cattle, should all be eligible to registry. Such is the case on my place. But with the hogs the use of pure bred sires can so easily be shown. Feed good hogs and scrubs side by side and drive them over the scales now and then. Better put them in different lots, hogs of the same age and weigh or measure out to them the same feed. The results will convince the dullest. Besides the improved hog can be fattened at any age, while the scrub must have all seasons for his own. Then people are so different in mental make-up, in their emotions and feelings. We meet men in every community who will doff their hats to an aristocratic member of the porcine family, whose pulses would scarcely quicken at sight of Lavender, Viscount, Dandy Rex or the most superb mulley that ever wore a black and mossy robe.

Still a few hog raisers persist in using grade sires. This number grows smaller year by year. When they are all dead we can say with the old Boone county negro woman who had lost six children, "The Lord has surely lightened our burden by taking away some of our troubles."

As I said before the sheep men are pretty safe. I have great hopes for the hog people. I believe the day of their deliverance is near at hand when they can strike hands with the sheep growers and by talking, writing, experimenting and in many ways become missionaries. They can forge ahead and not only improve the partner but help to carry the banner of Pure Bred vs. Scrub into the cattle breeding world. For right here it seems to me is the great trouble. As our Eastern friends would say: "Here is the heft of it." To the owner of pure bred cows I need say but little. Allow me to urge that of the pure bred bulls you find for sale, buy the best one you can pay for. Get a good one even if you have to pay $100 more than you had expected to pay. You will like yourself and your cattle more, your fellow breeders will respect you and buyers will come further and oftener and pay more money for your calves. Besides you can have the satisfaction of knowing that you are in line, that you are helping to carry forward the work, and are not being yourself carried as so much dead weight.

To you who own high grade cows, I would say that so far you have done well. Do you want to stop? Ought you not to go higher? Do you not want uniformity in coloring, style, finish and feeding qualities? These can be obtained only by the use of pure and strong bred sires. If you have high grade cows let me beg of you not to ruin your future by the use of some nondescript bull that happens to look well and can be bought for little money—he is never cheap.

You say you just want to raise beef cattle. You want good beef cattle, do you not? Do you not know that a good even lot of nicely colored cattle sell for more money and have been developed and fatted at less cost than the mixed, long legged, sharp-backed sort? Take two car loads of say twenty cattle each. Feed them to same age, give same quantity and quality of feed, one load, say fall after three years old will average sixteen hundred pounds; the other load, scrub cattle, all colors and shapes, will weigh about fourteen hundred pounds. Now what is the difference in value? Any well posted shipper will tell you quickly that $1 per hundred is not enough and when we take into reckoning the two hundred pounds excess in weight we have for the well bred cattle a difference of at least $25 per head or $500, a sufficient sum to have purchased a pretty good pure bred sire. But to the fellow who says he owns scrub cows, what shall I say? Why he is the man who more than all others needs a pure blood bull. If your load is heavy and you are away down in the mud, put on your best team and send your most experienced driver. If you are just a little sick send for the young doctor, but if you are awfully sick send for the most skilled physician and this you will do regardless of cost. Do you own scrub cows, sows or ewes? Buy at once the best pure blood sires you can find and pay for. The best is none too good. You want to build up. Having scrub cows you have a long hill to climb, can you get to the summit too soon? Life is short, do not waste its precious hours in halfway measures. Do not crawl when you can run. I know that some of these cattle people are slow to learn. It is a difficult task to protect a man from his enemies, more difficult still to protect him from his friends, but it sometimes seems that nothing short of Divine intervention in true Calvinistic form will ever be successful in redeeming a man from himself—to lift him out of the ruts into which thick-headed ignorance and unreasoning, mulish, preconceived notions have pushed him. But they will all tell you they want better blood—just better—better than they have but not too good. See! Yes, they say they have been grading up. How do they know? Do they in many cases know what blood they have been using? Can any scrub or his owner be pedigreed? If these people want to know where they "are at," let them purchase a pure bred sire and for once give their good grade cows a decent show to produce some actually good cattle.

But why continue this discussion? If men owning such excuses for cows as were once owned by the Texas and other range people, could by the use of pure bred sires, improve their cattle and build up their herds to their present high state in color, shape, style and fattening qualities—even making prize winners; surely owners of grade cows, whether Galloways, Herefords, Angus or Shorthorns, can in no way more surely benefit their holdings than by buying at once splendid representatives of these several breeds for herd headers.

And now in conclusion allow me to add that whatever you do, never, no never cross breed. If you are an Angus man, be an Angus man. These cattle are worthy your best thought and energy. If you are a breeder of Shorthorns, never lower the banner of the red, white and roan by mixing with any other cattle on earth: If you feel that your money and love should be lavished on the beautiful white faced charmers, never cause them pangs of sorrow and regret that their offsprings are a lot of mongrels and scrubs.

Let these principles and practices obtain with you in hogs, sheep and the chicken world. Everything after its kind was and is the Divine injunction.

DISCUSSION.

Prof. F. B. Mumford.—There are some points brought out in Mr. Hall's paper that it strikes me will be well enough for us to take into consideration and take home with us. Now there are a great many farmers who have derived good effects by the first cross, as Mr. Hall has told us, and have reasoned from that that crossing must be a good thing. There are a great many not only ordinary farmers, but there have been a great many experienced breeders that have undertaken in times past to double the price of animals by means of crossing. Now that is a very taking idea I know. If you can breed together and produce an animal that will have the beef qualities of the Shorthorn and the dairy qualities of the Jersey, that would be a very desirable result if it could be brought about. In the first cross you are more apt to get the beef qualities of the Jersey than the milking qualities of the beef Shorthorn. It is sometimes true that the first cross produces a good result, the second cross, the experience of all those who have tried it proves, is very likely to result in failure. Now crossing breaks up the well fixed characteristic of a breed and it is dangerous, crossing is dangerous. The second crossing results more often in producing mongrels that are even worse than the scrubs that you first bought. There are many cases where this can be shown to be true. You take in the case of the breeding of horses in many states of this Union, and I am sorry to say that it is true in many places of the State of Missouri, breed part of the time to draft horses and part of the time to saddle horses and then again to coach horses, trotting horses and the result has been that in many sections of the State of Missouri the horses are worse than scrubs, they are mongrels. The same is true of cattle in certain states. There are certain states east of us that have bred their beef breeds to Jerseys, Holsteins, Guernseys and so on and have produced grade dairy animals, then when beef cattle came up they have gone back to breeding beef animals and the result is that they have a lot of mongrels and mixed cattle and it is one of the greatest mistakes that a man ever made. Now the crossing of beef breeds is the least dangerous, but it is questionable, very questionable if it is profitable ever, as Mr. Hall says, to change the breeding type of an animal by introducing the blood of some other breed. A good herd of Shorthorn cows is never improved in the long run by breeding to Herefords or Angus or any other breed of stock. I believe that principle cannot be questioned notwithstanding the fact that the first cross is frequently attended with good results, but it is a well known fact that the second cross is frequently attended with failure. I think that the breeders of pure bred live stock cannot bear down on this principle too forcibly.

OF

THE MULE BEST [redacted] ALL.

By L. M. Monsees, Smithton, Mo.

What few words I may say in favor of the mule is from my own experience and observation. In the first place the most essential part is, the mule is a sure money maker. I, one of a large number of men, tried to make money out of the horse and went broke. Then I went back to the mule, and ever since have been making good money. Now do not understand me to say, that there is no money in the horse, for I think that there is good money in the horse, if a man is smart enough to grow and educate the right kind and then smart enough to find a buyer at a good price; and when you grow and educate one and have him ready for the market, you sure are compelled to get a good price for him or you will come out in debt. I have bred, raised and educated a few good horses which I sold at very good prices, but while I was growing these few good ones, I also raised a number which did not bring the price of a second-class mule, and the cheap ones were equally as well bred as the high-priced ones. Please do not understand me to say that there is nothing in pedigrees, for that is one of the most essential things in breeding any kind of stock. You can raise a good mule out of a fairly well bred mare and a well bred jack, but I have never yet seen or heard of a horse breeder that had his herd of brood mares well enough bred to raise all good ones. You may raise two horses—full brothers or full sisters or full brother and sister, as the case may be—one a first-class horse the other very common, not worth the price of a fourteen hand mule. While there have been hundreds of men who failed in handling horses, there have been a very small number who have ever lost any money in handling mules. A fine horse is all right, but if we all had to depend on raising fine horses for a living, there would be a great many poor, hungry men looking for a job. Any of you farmers and stock raisers who have had a little experience along that line can observe two of your neighbor boys or young men start out to do business for themselves and to make money farming and growing stock. One goes into the fine horse business and the other into the mule business; they both come to you for a little favor—in the way of borrowing some money. The chances are that you will gladly let the mule man have the money without any question and inform the other party that you are afraid of the horse business and will not likely grant him the accommodation. If a man had one horse and one mule, and that was all he had on earth, and the man should die the chances are, that the mule would go to pay his funeral expenses and the horse be left on the administrator's hands. And, if he did not dispose of him very soon, he would likely come out in debt and be loser in the transaction. The "Mule best of all," because he does the work that raises the corn, oats and other feed to grow the horse and produces the energy that makes the grain that feeds our cattle, hogs, sheep and other stock, that make our meats. There is nothing but the mule that can go down South and do the work successfully to grow our cotton which makes the bulk of our clothing. It is nothing but the mule that can stand the difficult labor on the sugar plantation. It is nothing but the hardy mule that can go down into our mines and stand the darkness and heavy work in handling the coal that runs our engines and fuel for our use. It is nothing but the mule that can successfully do the railroad work. We will have to have the mule as long as we work hired help, raise cotton and corn, cultivate sugar plantations, build railroads and work the coal and other mines.

The horse I consider all right, the cow is all right, the hog is all right, the sheep is all right and many other animals are all right, but the mule I consider by far the best of all.

Session of State Grange.

A BALANCED EDUCATION.

By W. T. Carrington, State School Superintendent.

The great question with us who feel deep interest in the schools is how to round out properly the common school work so as to prepare the 95 per cent of the children (who attend no other) for the responsible duties that may fall to them in whatever position in life they may be called and at the same time fit and prepare the one in twenty for entrance upon a higher course of school training. Too long did the opinion prevail that the higher education consisted of formal and abstract presentations and conceptions and in the study of the vehicle of thought rather than of thought itself. The demands of these higher institutions were such that the lower grades and preparatory schools, as they were called, had the entrance requirement of the school next above them so in mind that this largely determined what was undertaken as well as the character of the work done.

In more recent years there have been two general conclusions reached having great influence in determining the points involved. The most important is that formal and expressive work of the school are best done when they are outgrowths of the thinking and doing work—that reading is best taught when the child reads to learn something—that the child spells best when the words convey to his mind living, burning ideas—that writing becomes easy for him who practices it as a means of expressing his own conclusions—that correct speech becomes a habit to him whose efforts to convey definite thoughts of his own are well directed.

This has opened the way to the introduction into our school curriculum such subjects as make it worth while to study them for their own sake and the doing of such things as are worth doing if the doing was all there was to it. The introduction of such subjects does not detract from the amount or character of the first work done. This has led to the study of children and principles of education—to the balancing of the curriculum.

This has in turn brought us to the conclusion that what is best for the child that stops his school career at the end of the fourth, the sixth or the eighth grade is also best for that one fortunate enough to have the privilege and inclination to push forward to more advanced fields of learning. So while I would provide shops for manual, industrial and art work and laboratories for original investigation and experiments in the sciences along with libraries for individual research in the humanities in the secondary and higher institutions and thus balance the practical over against, but not in lieu of, the disciplinary work of these schools, I would not forget that something of the same sort of influences and like trends should animate and control the spirit of the lower grades and rural school work. This being true, should not the child's local environments, the natural aspects of life to him and his community, affect very much the subject matter of what is taught, but not in reality change the purposes of the school? We should first establish the purposes of the school and then discover the best means of accomplishing these purposes.

The question of first importance is "What should the schools do for the children?" In answering this question we should not lose sight of the facts that not to exceed 50 per cent of the children of our State remain in school long enough to go through what is known as the "Fourth Grade;" that not to exceed one in ten finish the equivalent of a thorough common school course and not to exceed one in twenty ever enter a secondary school. In discussing the question let us have in mind the children in primary departments more than the college or university students, the grammar grade more than the high school.

In the first place the school should co-operate with the home and other local environments to bring the child into close sympathetic touch with those things, both natural and spiritual, with which it must live and move and upon which its very life depends. In other words, if we first establish what constitutes an ideal home training, we have determined one line of work that the schools must undertake in order that good home training may be properly supplemented, that the bad results from the lack of proper home training and discipline may be counteracted. The time was when the average home in Missouri was more of an industrial school than it is at present, when through the performance of duties imposed for the sake of discipline as well as from the necessities of the situation the children had their perceptive faculties, their powers of observation more systematically trained at home. There seems to be a great dependence on the schools for much of what the home formerly did. Without discussing the evil or good influence arising from this tendency, it is a condition that must be considered when answering the question "How balance the education of the children?"

In the second place, the children must be furnished the key that will unlock to them the store-house of knowledge and inspiration found in literature and history; they must learn how to look into the records of the past and learn practical lessons therein, to commune with master spirits of past ages and draw information therefrom.

In the third place the individuality of the child must be preserved and developed. The school work must be systematized and planned to give every child as complete and as all-round development as possible. This involves the study of each child, of its mental characteristics and the relation and inter-relation of the ever varying mind functions and their special powers of co-ordination. You say this is an impossible task for the average teacher. Grant it. There has been a sufficient amount of experimenting done to enable us to reach some general conclusions upon which we may justly act in the absence of any positive observations or experience to the contrary.

Every one present knows that corn possesses more of the fat producing elements than other grain or food known to us. A stock feeder a few days ago, in giving the results of some experiments, said that he had selected two bunches of pigs as nearly alike as it was possible for him to select them. To one bunch he fed corn, and corn alone. To the other bunch he fed both corn and alfalfa hay. He fed both the same amount of corn and to the one a ton of hay in addition. The ones to which he fed the hay ate the corn with a greater relish than the others. Within the given time, the lot to which the ton of hay had been fed increased 800 pounds more than did the others. This seems a pretty big pig story. The idea that 2,000 pounds of alfalfa hay can be converted into 800 pounds of pork seems out of the question. When we look into the further analysis of the experiment we find that it was not the elements in the alfalfa that made the 800 pounds of pork. There was that in the alfalfa which enabled the pigs to get more out of the corn, and this kept their appetites whetted.

Reasoning by analogy, may we not conclude that certain subjects may serve an excellent purpose in the schools even if their intrinsic worth is not apparent, if we can not easily see any practical lessons in them, if we can not trace some mental or moral culture as a result?

In the fourth place, the work of the schools must inspire children to higher ideals of living and implant in their breasts greater ambitions than their parents have known. In this progressive age each succeeding generation must know more, must do more, must get more out of life than the preceding.

Applying the same principles to our school work that farmers do in balancing the elements of fertility in the soil, as the stock feeder balances the rations for his cattle and hogs, we see the necessity of a balanced curriculum, a balanced course of study—containing not alone subjects for the practical information contained in them, not alone for disciplinary effect, not alone for inspiration, but for each and all of these in due proportion and in addition such subjects as are necessary to whet the mental appetite for some of the essentials to growth and development, and to assist in mental digestion and assimilation.

Within the past six years much progress has been made in organizing and correlating the subject matter taught in the schools and within ten years there has been a revolution almost in some of the work done in the secondary or high schools of our State. Culture, discipline, information, and utility are duly united in the results. They are in mind from the beginning. Isolation of both subjects and purposes has given way to unity in both theory and practice.

These changes have not been brought about by the agitation of specialists or cranks in the educational work. The beginnings may be traced to a former period when the question most frequently discussed at teachers' gatherings was as to whether the sciences or the classic languages were the most important elements in the curriculum of the higher institutions. It had not dawned upon them that both could be accomplished together just as easily as either alone. There has been a more general inquiry into the nature of the child and the world has come to know child nature from an entirely different point of view as a result of these discussions. Everywhere students of pedagogy and supervisors of instruction have gradually seen the necessity of adjusting the work of the school to the child, rather than adjusting the child to a preconceived notion of what the school should be. This question is uppermost in the minds of all who would have schools most economically promote the best interest of each individual child.

Until very recently the schools confined themselves to formal and expressive work, much of it having no substantial basis. When content subjects were introduced for their own worth it was not long until they formed a basis for the best results in the formal and expressive work. At first, however, man and man as a member of society only, was the center around which the world of learning revolved just as it was supposed for ages that the earth was the center of the universe around which the sun, moon and stars all revolved.

United States history, civil government and political geography were introduced to educate for voting and to prepare for social duties.

This view looked upon man as nothing but a citizen. It did not take into consideration that he must be educated to do things—to render service. All instruction touching the common phenomena of nature and their relations to human living were taught as the "ologies" in the high schools and colleges. Today nature study is a new feature in our elementary school work, and it has come mainly as a balancing agent. It has come to connect school work with the living processes, to adjust education to child life in such way as to prepare it for industrial pursuits; it has come to put the child into close sympathetic touch with his natural environments, to give him control of the forces of nature, to minister to his glory and happiness here on earth. It has come into the schools to give meaning and purpose to every other phase of school work; it infuses new life into the spelling, writing, drawing and making or doing work, and modifies all of the school relationships in a most helpful way, offering a better means for the teachers' understanding pupils, and for pupils seeing and knowing the real purposes of teacher.

Nature study is not science in the sense that it is knowledge classified, but it should lead to it. "Nature Study" is just what the two words mean. In the first place it is nature not book work. In the second place it is study, not merely talking and reading about nature. It is the study of plant and animal life, of the earth and its elements and of the physical forces that affect these and the relations one to the other. It culminates in both the theory and practice of agriculture, horticulture, floriculture, stock culture and any other sort of cultivation in the realm of physical being. It may be made to point to and culminate in any of the mechanic or domestic arts.

Nature study is chiefly a study of relations. The commonest phenomenon in nature is related to many other phenomena. The grain of corn is related to the entire corn plant and to each of the essential parts of the plant. To understand the plant one must understand the function of each part; to know its life history one must know the processes of both production and re-production. It is related to, and dependent on soil, rain, sun and wind. It is related to a class of insects that feed upon it and to another class that fertilizes it. There are countless other relations. The investigation of common things about us, arranging and grouping their relations, constitutes the study of nature.

But the aim of nature study does not end here. It seeks the individual development of the child. Nature is many sided and each pupil sees it from a different point of view. The instructor will soon realize that teaching classes is not teaching individuals; as a result nature study becomes more of method than of matter.

As important as is the practical knowledge or facts learned in the study of nature, its aim is still higher. It is a means of securing personal, individual investigation, a means of developing all of the powers of child mind and of training children to see and think and express for themselves. More and more nature study is made the basis for reading, spelling, language, penmanship, drawing and modeling work of the school. Every teacher knows that the acquisition of knowledge and the development of power are dependent on interest aroused. Certainly there is that in nature in some of its manifestations to attract and interest every child. Above all of these, however, is the aim to adjust the child to his environments—physical, intellectual and spiritual; to adjust him to nature; to man, to God.

Nature study deals with the present, with things as they are and directs thought to the future. Literature, in some form at least, deals with the past and thus furnishes a means of interpreting the present and becomes the hand-maid and help-meet of nature study.

These two subjects may be so correlated as to concentrate, to unify the entire work of the school. They may be made to furnish a basis or common ground for the correlation of any and all other subjects taught, to supplement them in as many ways as possible and to enrich the results in each, to provide a means of interesting every child and of holding him in school longer, to touch the child mind at every point and thus secure an all-round development, to inspire to higher ideals and implant new ambitions.

INDUSTRIAL EDUCATION.

By Dr. R. H. Jesse, President Missouri State University.

Every Jew that attempted to educate his son at all taught him a trade. Whether this was the custom of the nation originally or not I cannot say, but such was the universal practice in the century preceding the birth of our Lord. Said one of the most distinguished of the Rabbis: "He that allows his son to reach man's estate without giving him a trade educates him for larceny." It was not a mark of our Lord's humble origin at all that he learned the carpenter's trade, nor should it excite wonder that St. Paul, one of the most profoundly educated men of his generation, learned the tentmaker's craft. Every respectable Jew learned a trade of some sort, and before the Christian era the Jews were God's chosen people. This adds no little historic dignity to manual training. Time fails us to tell to what extent, if any, the idea was adopted by the schoolmasters of the Greeks and Romans, but this at least is sure that the Emperor Augustus, the wisest statesman that Rome ever produced, and one of the wisest that earth has yet beheld, made it a prime feature of his policy to awake in the people of Italy an interest in the pursuits of agriculture. To this policy we owe the Georgies of Virgil that immortal hymn in praise of agriculture. Industrial education in our day is in a measure a return to the wisdom of the ancients.

Many imagine that industrial education is a fad fostered chiefly in Missouri. Without looking up statistics at all we can point easily to the fact that in the province of Ontario, in Canada, agriculture—an important phase of industrial education—is a part of the curriculum in the public schools. If it is a fad at all it has made in one of its forms much greater progress among the Canadians than among the people of the United States. Industrial training in one form or another is a part of the curriculum of all the public schools in Norway, Sweden and Denmark. It is found in all the public schools in France and Belgium, and in many of those of the Netherlands. It is more widely spread in Germany, Austria and Hungary than it is in the United States. In fact, those who oppose industrial education should be called upon to defend themselves from the charge of being behind the times.

There is great confusion in Missouri at least in the use of the term Industrial Education. It is important to determine what we mean by it. It is indeed many sided. Among the Jews it included the learning of a trade. In the United States it includes trades schools. Let me remark in passing that trades schools are excellent institutions which should form a part of the system of public instruction in every center of population. There ought to be one or two at St. Louis, and one at least at Kansas City, and one at St. Joseph. It is possible that there ought to be one at Joplin and another at Springfield. Every one of them should have a day session and a night session, open to young and to old. But when we favor the introduction of industrial training into the public schools of Missouri we do not dream of making them all trades schools. We want the industrial features introduced for their educational value without reference to the future occupations of the pupils. We no more teach handicraft with a view of making mechanics than we aim at the production of sailors in teaching geography. Many Americans consider nature study to be a part of industrial education. No man in this assembly is so strenuous in his advocacy of industrial training as to make it more than a feature of our schools. We prize it and advocate it for the contribution it makes to the training of the pupil. Under no condition would we offer it as a substitute for education or indeed as a chief feature to which other studies should be subsidiary except perhaps in the trades schools, which are admirable institutions in centers of population. I cannot leave this subject without raising my protest against an idea which has found favor with some, viz., that the introduction of industrial features means the exclusion of the classics. Why, because you introduce industrial features into a high school, should you put out the classics or modern languages, or history, or literature, or mathematics, or science or indeed anything else? If it be urged that there is no time for the industrials and the classics, let me point to the apostles of manual training who have claimed that their pupils not only do not lose time thereby, but are so strengthened in body and mind as to make better progress in other studies than other pupils do. I am zealous for introducing industrial training into our high schools and into our grade schools, but my opposition is deadly to making it exclude anything else that is useful. Let us correlate it with everything else that is now valuable in education without setting it in opposition to anything.

What we in Missouri advocate as industrial education may be defined as follows:

1. Its aim is education rather than industry.

2. It includes handicraft in the grades culminating in manual training and cooking in the high schools.

3. It includes nature study in the grades developed in the high schools into the elementary sciences of zoology, botany, entomology, and field geology. Drawing should be a chief feature of the work from beginning to end. The man that struggles for manual training alone is struggling for but a part of the industrial education that I advocate. He that struggles for nature study alone is struggling for but a part. In former days I thought that manual training ought to be the larger part of the subject in the cities, and nature study the larger part in the country. But it seems to me in later years that nature study is not less important for city people than for country people. For the country however, I still think that nature study is more important than handicraft. The fact that nature study is so easily applied to agriculture is the justification if there be any of including it in industrial education.

Perhaps it would be clearer to call it industrial education and nature study.

There is one phase of this subject in which I feel an interest that should be shared by every patriotic teacher. We should develop in Missouri a system of rural high schools in which should be taught languages, literature, history, mathematics, physics, and chemistry with their applications to plants, soil, and climate; manual training and cooking, and nature study developed into the sciences of zoology, botany, entomology and field geology. It might not be possible to teach all these things at the start, but the scope of the school in ultimate development should include them all. In the beginning if anything be excluded let it be foreign languages, and yet I would turn my back upon these schools if the scheme in ultimate development did not provide for them. I am willing, however, to postpone them rather than the other studies. This is not a retraction of my statement that the industrials ought not to be set in opposition to anything.

How shall these schools be established in Missouri? Partly by state aid and partly by increased taxation of the locality. Let me hasten to say that in my opinion the present distribution of the state school fund is not just to the rural districts. It is not right that it should be divided between the country and the city alike. To do so is against sound public policy. Living in the town of Columbia and paying tax upon a certain amount of property I enjoy for my children excellent facilities, because there are fifty-five hundred people who live within a radius of a mile from my house. If I move five miles into the country and pay tax on the same amount of property the educational facilities open to my children in their own school district become inferior. Yet I am paying the same amount of tax on the same amount of property. But even if in the rural districts I and my neighbors doubled the tax levied in Columbia we still could not have half so good a school. If I go to Kansas City and pay the same tax on the same amount of property I get school facilities that are immensely better than those of Columbia because now I have within street car distance of my house a hundred and seventy-five thousand people. It is not sufficient reply to say that I am not bound to live in the country, that if I want better educational facilities for my children I should move into town. The State is vitally interested in having people live in the country. The process by which the country is becoming depopulated and the cities built up is against sound policy in the commonwealth. If, therefore, it is of great public interest that people would stay in the country the commonwealth ought to see that their children be not thereby largely robbed of educational advantages. It will not do to say that a child in Kansas City ought to have as much of State money as a child that lives in the depths of the country. I admit freely that the children in Kansas City should be objects of as great solicitude as those that live in the country, but the State should take some note of the power to help one's self. If you had twenty thousand dollars worth of property and two children, one of whom had received from some relative ten thousand dollars, while the other had received nothing, you would not divide your twenty thousand between the two children equally. One might be as dear to you as the other, but you would so devise your property as to give each child fifteen thousand dollars. A fair method perhaps would be to distribute one-third of the State school fund in proportion to enumeration just as the whole fund is apportioned now, to distribute another third according to actual attendance, and to distribute the remaining third so as to equalize to some extent at least the educational advantages of different parts of the State. Whether the division is correct or not it seems to me beyond dispute that each of these three things should be considered in the distribution of the school fund:

1. The enumeration.
2. The attendance.
3. The power or inability of the locality to have a good school apart from State aid.

In ten years the University has approved about a hundred public high schools scattered over Missouri. Ninety-eight of them are on lines of railway. Very few of them are in towns of less than three thousand inhabitants. It would be safe to say that ninety out of the hundred are in towns of more than three thousand inhabitants. Therefore our much lauded system of approved high schools is an urban system. With its efforts in behalf of secondary education the University has not yet reached the rural districts of Missouri. The general secretary of the Y. M. C. A. of Missouri tells me that there are seventy-three counties in which there is not a town of three thousand inhabitants. I doubt the accuracy of the statement, but have not time to look it up. It is beyond controversy however, that a large number of counties have no city of three thousand inhabitants. We cannot safely count under existing conditions upon establishing an approved high school by local taxation in towns of less than three thousand inhabitants. What shall be done with the numerous counties of Missouri in which the largest town has less than one or two thousand people? I suggest that by State aid we begin a system of rural high schools on the pattern mentioned above in which cooking and manual training and nature study developed into elementary natural sciences shall be taught throughout the four years and shall be compulsory. I hope that a committee will be appointed to formulate a plan for reaching this end. It would be vain to establish any large number of such schools at first. I should be happy if the next Legislature would in some way provide State aid enough to enable us to establish six. Wisconsin made last year an appropriation for the establishment of two such schools as experiments. I have such faith in the idea as to be willing for Missouri to establish half a dozen as experiments. If one of the two Wisconsin schools were to fail the idea would be brought into disrepute; if both schools through accident proved failures the idea would be banished forever. It seems to me to be fair to the idea to try it on a scale large enough to give security against accident. The State aid should be stimulative of local taxation. In the outset at least State aid should be given only where it can be shown that without it a good high school cannot be maintained and that with State aid and heroic local taxation a good high school can be maintained.

If we can devise any means by which money can be raised separately for the inauguration of this system of rural high schools I shall be glad to help, but if no system can be devised then I think that through better distribution of the school fund we ought to provide means for trying this experiment and if it succeeds for enlarging it. We should ultimately have at least one such high school in every county in Missouri. It seems to me that the State University, the three normal schools, and the State Superintendent of public education are alike interested in seeing this experiment fairly tried. The University at least, God helping us, will endeavor to unite country people and city people alike in a demand that the rural districts of Missouri partly by local taxation and partly by stimulative State aid be provided with high schools which, while not eschewing any learning that experience has proved to be good, shall educate the children of farmers in harmony with their environment, emphasizing especially the sciences and the industries that lie closest for farm life such as manual training, cooking, household management, zoology, botany, entomology, local geology, and physics, and chemistry and their applications to soil plants and climate. While these schools should aim primarily at the education of the young in their several localities, they should endeavor also by night session and in other ways to enlighten and indeed so far as possible to educate the adults in their neighborhoods. Having had already some success in strengthening high schools in the towns of Missouri the University is now about to enter upon the far more arduous task of building up rural high schools according to the pattern described above. How long and how difficult the undertaking is no man knows better than the writer, but that is but additional reason for beginning the work promptly. Who will help us? Surely we need help.

ORGANIZATION.

By Hon. R. H. Kern, Macon, Mo.

Ladies and Gentlemen—I am very glad that our Worthy Master does not care to assume the responsibility of what I shall say. If he had been a lawyer for twenty-five years, it would not make very much difference about the responsibility, because a lawyer's mouth is like the toll gate at the turnpike, it opens both ways for pay. A fellow once asked what would a lawyer do when he was dead, and a wag answered, he would "lie still." However, having followed the law pretty faithfully for twenty-five years, by accident I travelled up into Macon county two or three years ago and bought a little farm, returned to view the scenes of a youth that I had passed in another state and concluded that for a few years I would make some study of agriculture.

The great Napoleon, on being asked what was the secret of his marvelous success in battle, replied in one word "Organization." I believe that never before in the history of this country has there been such an opportunity presented to the American people for the fullest realization of all of the possibilities of American life as is being presented now. The recent Spanish War was not a result of the forecast of the statesmanship of America. Two years before it happened—aye, a year before it happened, there was not a statesman in America who foresaw it. It came like swift lightning from the clouds, and it has produced results that, for our people at least, are as far reaching, almost, as any that have ever come upon us, and if the American mind is equal to its opportunity, great possibilities lie before it. I want to say a word to the pessimist who thinks that the best of life, civic, political and personal, is behind us. The next ten years will witness the greatest growth of all the industries of this country that it has ever seen, and I am not a materialist, but no man can ever shut his eyes to the fact that refinement, culture, education and all such advantages go along with success in material things.

If the American people choose to organize, the world will be at its feet before ten years. Today America is better known in the great sisterhood of nations, as the result of the Spanish War than it was ever known in the fifty years of its history preceding that time, and the small tax that the people paid to take the yoke off of the little Island of Cuba, has been more than returned already to our people in the wonderful growth and extension of our trade.

Now, then, I want to say a word to the farmers. I happen to own a little farm—a few thousand acres, down here in Macon county myself, and I am running it myself, too—not asking very much of anybody how I shall conduct it. I never have asked very much of anybody in this life as to how I shall do anything, except my good wife. The farmers of the State need to pull themselves together. Was there ever a time when organization was as paramount a need of our life as it is now? I have lived in a city of half a million of people, and have been in all of the cities of this country and many of the cities of Europe, and all of the business interests of the world —particularly of this country, are pulling themselves together. They are organizing to reap the greatest benefits that may be possible as a result of the concentrated brain of the country. But I think the farmer is lacking. Here we have this week in the beautiful city of Chillicothe, a meeting, representing the great interests of this magnificent State of ours—every department of agriculture has been represented in this hall this week and the farmers are not so largely represented here as they should be. If you people will pull together—if the farmers of America will stand shoulder to shoulder, the great interests that seem to be dominant in American life at this moment, will take off their hats and bow to the farmer. But if the farmers do not organize, they will make a mat of him upon which they will wipe their feet and take his earnings from him in an unjust and undeserved way. Is it possible for you farmers to organize? Why not? It seems to me that the life of the agriculturists should not be such a one as to send everybody to the towns and cities. It seems to me that in this State with its wonderful diversity of soil and products and climate, there can be made a beautiful home life for all the people that choose to live outside of the towns and cities. It seems to me that the farmers are the people that have the right to direct the policy of this country, and I have always thought so. Why not? They are the people whose work never ceases in summer or winter; work must be done on Sunday and on holidays, and if these people who till the soil and take their chances with the elements. have not a right to say what shall be the policy of this country, who has? I am a western man. I believe in western life. I never spend a moment in the East unless I have to, but upon a thousand stumps I have made the statement that it is a great pity that the West never stands united for its own interest. It is a great pity that the laws all favor the people east of the Alleghany Mountains, as they have done for the last fifty years or more. It is time that the people of the West are united and getting some of the favors in this country. Are the farmers going to organize? It seems to me that the Grange of the State of Missouri should have a membership of ninety per cent of the farmers of this State, I am told that less than ten per cent of our farmers are grangers. I do not refer to any co-operative stores. I think the farmer can afford to let everybody live, but he cannot afford to dwarf his own interest in this country. If the farmers were united, there is no reason why there should be a law on the statute books of the State of Missouri or on the statute books of any state in the United States of America that discriminates against you in any way. Here is your opportunity. There are going to come times of depression, of course; but I believe that the dark hours of agriculture are over, and I am showing my faith by my works, and I have made an investment—speaking for myself—in Macon county that I consider one of the best investments I ever made. I did it because I knew this country of ours is to be the granary of the world, and I think that the great four or five interior agricultural states that group themselves around Missouri are to be the states that are to supply not only the food of the United States, but the food of the civilized world to a large extent. Take Illinois, Indiana, Wisconsin, Ohio, Missouri, Kansas, Nebraska and Iowa and you have the great granary of the United States. Even the mule is furnished by Missouri, and the only unholy thing that he ever did in his life was to go down into Africa and help the Englishmen to stamp out the liberty of the noble Boer people, and that was the fault of the laws of trade and the Missouri farmer was not responsible for it. Your cattle are going today across the waters to feed the nations of Europe, and as was said today by Mr. Sotham—and I take my hat off to that citizen of Livingston county for the great work that he has done in the line of the development of the cattle industry of this State—orders are coming in faster than we can fill them. With your wheat going to the foreign markets after the construction of the Nicaragua Canal (and every man who has crossed the ocean favors the construction of that canal, and that speedily), there is going to be a marvelous trade with the Orient, and Missouri must furnish her proportion. If the farmer has had anything to despair of, outside of this unusual wet spell that we have had for the last nine months, drowning everything except the hopes of the people, I do not know what it is.

It seems to me that the agricultural people should unite. There is no reason why the school house should not have a meeting every week in which subjects of interest to the agriculturists should be discussed by the people in the neighborhood. There is no reason why the town should not be moving to the country instead of the country moving to the town. There is no reason why whatever contributes to the comfort of the people should not be found on the farm. I verily believe if the farmers of Missouri would unite, they could get some outside help in their organization, but there does not seem to be any organization among them and so the thing goes on.

I want to say that I am going to make some study of the conditions of agriculture myself. I have not forgotten all that I learned as a boy on a farm many, many years ago; and if my voice from Iowa to the Ozarks, from Kansas City to St. Louis, anywhere in the grand old State of Missouri, can do anything toward upbuilding the great interests of this State, it shall be heard. If my time can help improve the condition of her people, it shall be given. If my money can help along the good cause, that, too, shall be given; and so I am going to these meetings, if the Lord spares me, until we get the thing going, and when we once get it to going, my word for it, the agriculturist will be the man that will not be wandering over the ground where the combined trust interests of the country are going to crush him down. The farmer has been under the heel of the trust a long time. There are three or four great packing houses in this country that fix their own prices, and now the merchant who sat in the city and watched the farmer groaning beneath this load is beginning to take a little of that medicine of having his prices fixed by the combines, as well as the farmer.

I saw in Kentucky the other day where one of the tobacco raisers said: "We are waiting for the tobacco trust to come along and tell us what they will pay for our tobacco, and we will have to take it."

The farmer must send men to the Legislature who have some backbone and that is the prime requisite in life; they should send men to Congress who have backbone. These goody goody fellows that go there and let the other men pull the wool over their eyes and fasten upon the people unjust laws, should be invited to stay at home and raise sweet potatoes and it will be a much better occupation for them. You should pick out men of force and character, wherever they are, and send them to the Legislature.

Why should not the farmer have his rural delivery, for example. Here we find only an occasional route. What do you pay taxes for? You will get free delivery and all the other advantages if you rise in the majesty of your might and demand them and you never will get these advantages unless you do demand them. Other trades will take advantage of their opportunities and it is time for you to take advantage of yours.

My ten minutes are up, and I am very glad to have been here. I hope by co-operation and organization the next meeting will be so large that we will have to rent all the vacant halls in the city where we choose to hold it, and that the farmers may be peaceful and prosperous, and be able to make up for the awful drouth that has cursed us this year.

THE WORLD'S FAIR IN 1903.

By Hon. B. H. Bonfoey, Unionville, Mo.

After thanking your President for the kindly words of recognition that he has so kindly expressed toward the Board which I represent, I wish to say that I will take up but a few moments of your time. I have no set speech to make you gentlemen. I am here to meet you, and have a heart to heart talk on a subject in which we are all interested—the St. Louis World's Fair. As a representative of the Commission from the great State of Missouri, I have been delegated to appear before you, and ask your hearty co-operation in making a display for the grand State of Missouri that will be commensurate with her grandness. Gentlemen, the last Legislature of your State appropriated a magnificent sum for that purpose and your servants, the members of that Board, have the work of the disbursement of that sum. When I say to you that in our preliminary estimate we have appropriated one hundred thousand dollars to make a display of the agricultural interests of this grand old State, and then when I come before you and ask your co-operation, so that Missouri shall stand at the head of all of the states, I believe that I will have that co-operation. We, the members of that Board, realize the position in which we are placed. We realize that we have to have your co-operation to make an exhibit that will do us justice.

On behalf of the horticultural interests of this State we have made an appropriation of fifty thousand dollars. On behalf of education we have set aside fifty thousand dollars. Now, what are we going to do, gentlemen? We have a membership on that Board of nine men, who are at your service.

My friend, Mr. Kern, has struck the key note tonight when he says organization will do wonders. We want you, gentlemen, of the State of Missouri to organize, and you should begin right now, and work from now to the first of May 1903, so when our display is shown at the World's Fair in 1903, you will not be ashamed of it. We have money enough at our command; we only ask for your suggestions; tell that Board what you want; we are your servants; we expect to carry out the ideas of the agriculturists of this State, to carry out the ideas of the horticulturists and educators. The states on all sides of us are organizing. Iowa has appropriated two hundred and fifty thousand dollars; Illinois has appropriated the same. The state of Arkansas has appropriated fifty thousand dollars, and I heard when in the city of Buffalo that Arkansas had appointed four hundred members on her commission, everyone of whom was a committee of one to see that Arkansas was not outdone by any other state. Are you going to stand by and not help the members of your commission? We are here today to ask you to suggest to us and tell us what you want done, and see that we carry out your wishes. We will have organizers throughout the State from now on. We think it is necessary for every farmer, every horticulturist, to begin right now to prepare the articles he wants to exhibit at that Fair. Farmers tell me the last wheat crop was one of the best ever produced. Save your samples of wheat and fruit and put them in cold storage until our collectors can come around and see them, and they will be put where the world can see them.

Do you realize what is before us? We are to be the hosts of the world. The world will be poured into St. Louis in 1903, and we are to be their hosts. We want to display to the world what Missouri will produce. We do not want to be outdone by other states. We know that we have the resources in the mines, the fields, the schoolroom, the orchard and all of the various industries of our State, and we want only organization and co-operation, and that is why I am here tonight, to ask you to co-operate with us and organize and go to work.

I have no set speech to make. I came here to answer any question you wish to ask about the St. Louis World's Fair that it is in my power to answer. We want to co-operate with you, the educators, the horticulturists, the farmers, and we do not expect to cease our work, we expect to follow it up. Do you all recognize what that Fair is going to be? The United States has already appropriated to it the magnificent sum of five millions of dollars, the City of St. Louis appropriated to it ten millions of dollars, and the grand old

State of Missouri appropriated one million dollars. Now we are going to ask two millions more from the general government, because the Fair has spread out so, and is so much larger than we first intended it to be. We can hardly grasp the magnitude of it. Today I saw a statement from Mr. Taylor, the general architect of the St. Louis Exposition, that he needed twelve hundred acres of land for the magnificent displays of the different governments and the different states, and he is asking for additional territory. You see the Fair is outgrowing its original dimensions. We had only four hundred acres in the original plan. The art gallery stretches two hundred feet high, and it is over a thousand feet from length to length in the form of a semi-circle. You will grasp the magnitude of that one building. I think our record in the past bears me out in saying that our display at the Louisiana Purchase Exposition of 1903 will be a world beater. At the Pan-American Exposition in Buffalo, Missouri took more prizes than any other State in the Union. I understand that lately our Missouri cattle have been grasping the first premiums all over this country. I am not a cattleman, but that has been told to me. Our cattle industry is wonderful and reaching from ocean to ocean, and even today I was delighted with your poultry exhibition. Yesterday I picked up a little paper in which it was stated that the poultryman from the Pacific Coast had been sending clear over to Boston for his breeding stock and eggs, but that the time was coming when he would send to Missouri, for the Missouri poultrymen were producing fowls that beat the world. I believe from the looks of the poultry that I saw this afternoon that that must be true. I want to see at the World's Fair in 1903, Missouri's farms, her live stock, her orchards and her every industry represented, and I believe that we will be prepared to take care of them, and we will bid you all a hearty welcome.

In regard to any special feature of this Fair or anything as to our work Brother Stroupe or myself will be pleased to answer any questions.

DISCUSSION.

Mr. Maitland.—I wish to ask what the Missouri Commission would suggest as the best means of collecting Missouri's agricultural display?

Mr. Bonfoey.—The matter has been under discussion at the last two meetings of our Board, and I have been talking wth Mr. Ellis in regard to that matter, and suppose by the co-operation of the State Board of Agriculture and our Commission, the matter will be determined on a near day in the future. Speaking for myself personally, I will say that I would like the co-operation of the counties as counties and of individuals themselves. We will have men in the counties to acquaint you with our desires, and what we expect from each section of the State. I would like for anyone here who has a fine specimen of any product to save it until he can confer with anyone of the Commission direct. Col. Waters has been our representative and has been representing us at the farmers' institutes, but he will now probably be foot-loose and can confer with you direct.

Mr. Ellis.—Let us resolve as individuals to produce something on the farm this coming year to exhibit at that Exposition.

The following resolution, as read by Col. Waters, was adopted:

Resolved, That it is the sense of the several industrial associations of the State, now in annual session, that we heartily approve the offorts of our State Board of World's Fair Commissioners to make the best agricultural and live stock exhibit ever seen, and we hereby pledge our active and earnest support.

Adjourned.

SESSION OF

Swine Breeders' Association.

ALFALFA AS A FEED AND PASTURE.

By Hon. S. F. O'Fallon, Oregon, Mo.

Ladies and Gentlemen: I have been experimenting with alfalfa for some years. I suppose there are some present who think that alfalfa is a plant suitable only for irrigated land or one that is raised principally in the arid regions of the country. That has been true in the past. In Missouri it seems that we have not made much progress in alfalfa culture. In my section of the State, the extreme northwest, it has been cultivated for the past few years. Six or eight years ago we felt about it as most of you now feel, that it was a plant that was not suited or adapted to our State, and where an experiment has been made and failed, it usually deters anyone else from experimenting along that line, but I believe these failures in the culture of alfalfa in our State were due largely to lack of fully understanding the habits of the plant and the care necessary for it, and not giving it proper cultivation.

In Holt county five or six years ago no one thought of raising alfalfa, but we find our land splendidly adapted to it and thousands of acres of our bottom lands have been put in alfalfa and it is one of the most valuable crops we have. It is also sown largely on the upland. We get three crops off of alfalfa, the same as they do in Nebraska and Kansas and it makes splendid hay.

It makes the very best pasture for hogs. I know of nothing that equals alfalfa for hogs. It comes nearer being what a hog needs than any other crop known. The season we have just passed through, and every farmer and breeder knows it was the worst drouth we have had in our State in recent years, at least, we had great success with our alfalfa. There is a time of the year when we cannot depend upon clover or blue grass or anything else raised in our section of the State—we don't raise soy beans or cow peas in our part of the State—and there is nothing for the hog to graze upon and every breeder understands that the hog is a grazing animal and must graze to keep him healthy, therefore we must have alfalfa. We have been growing alfalfa and it keeps green when clover and blue grass are dried up by the hot winds. That has been tried in Kansas, Nebraska and our State, and nothing stays so green during dry weather as alfalfa.

We are growing it on the upland. A gentleman who lives near Forest City, where the Board of Agriculture recently held a very successful farmers' institute meeting, on one of the highest hills on the Missouri river, had last summer a few acres in alfalfa and it remained during all the hot, dry weather as green as could be. Of course the hot weather affects it, but it seems to resist hot winds better than anything else, and it is the most profitable green feed that we can have for hogs. It is not only a fine pasture, but it can be cut and fed to them, and it is as valuable a feed as can be given. It is good not only as a pasture, but as a dry feed, as hay. I have fed it for several years and it is fine. I live on high ground where we have not always made a success of it, but it makes splendid pasture there, and as a dry hay I do not think anything equals it. There is not much waste about it, for the hogs eat all of the rough stems. It made three cuttings this year and good ones.

A friend of mine in Southern Kansas, in talking with me a few days ago told me he had fifteen acres of alfalfa on the creek bottom land this year, and had pastured sixty or seventy hogs on it the entire season, and they did very little damage, and then he cut two crops of hay off of it. Whether or not it could be grown successfully in this section or over the State generally I could not say, as I have not had experience. Alfalfa must be grown on well drained land. In our country it flourishes on alluvial soil, also in gumbo. On the worst sort of gumbo in the Missouri bottom land they raise alfalfa in my county.

One trouble with alfalfa is that it is a little hard to start. That is one reason why it has not occupied the place that it should in our State. It does not start so readily as clover, it is hard to get established. The land must be thoroughly tilled, and it should be where the ground has been shaded, so that it will not be full of weed seeds. When the plant first comes up it is very small and weeds will smother it, unless it is in the right kind of soil.

It must be clipped the first year especially. After that, of course, if it is pastured, it must be clipped to keep the weeds down. While it may make a little start, it is not a good idea to pasture it the first year, possibly not even the second, unless it is growing luxuriantly, as it will in some places.

In Kansas the increase of alfalfa culture is phenomenal. Ten years ago it was like it is in Missouri to-day. There are several counties that now have as many acres in alfalfa as there was in the entire State ten years ago. Almost every county in Kansas is growing alfalfa, and it is the same way in Nebraska. Alfalfa will produce more hay to the acre than any other plant. Not only that, but it is drouth resisting when it once gets firmly established in the soil, and it is very nutritious. It is good for all kinds of animals as hay.

There is nothing better for feeding brood sows in the winter than alfalfa hay. It takes the place of green feed on the pasture. I understand that in Kansas and other experiment stations they expect that an acre of alfalfa will keep ten or fifteen shoats and make from six hundred to a thousand pounds of pork to the acre with grain. You can keep hogs and rough them through the winter entirely on alfalfa, and not give them any grain at all. They may not come out as well without any grain, but the alfalfa is nutritious and invaluable for the hog and just what he needs.

There is one other crop which I might mention, with which I have experimented more than with alfalfa. In places in this State where we have hard pan, while alfalfa cannot be raised, there is nothing more valuable for the swine grower or farmer than sorghum. For several years I have been raising it and using it as hay, and hogs do well on it. Raise it as you would raise sorghum for syrup. Plant it early, cut it up and feed it to your hogs in July and August when the pastures are burned up, and it is worth more than anything else. One-half or one-fourth of an acre will feed them, and they will do well on it. Cut it up and shock it like corn and feed it to your hogs in the winter and they will do well on it.

DISCUSSION.

Mr.—: What time in the spring do you sow alfalfa?

Mr. O'Fallon: We sow it late in the spring, later than clover for it is harder to start than clover and the plants are small and weak and frost kills them. We plant it real late in April or May.

Mr. —: How much do you sow to the acre?

Mr. O'Fallon: Fifteen or twenty pounds to the acre. We have not been growing it in the bottom lands as much as clover. The ground should be pulverized very carefully, more so than for any crop I ever grew. I have failed utterly on alfalfa because my ground was not in the right condition.

Mr. Ellis: Do you think fall sowing is better than spring sowing?

Mr. O'Fallon: They do sow it in the fall, but spring sowing is better with us.

Mr. Ward: Will it grow well on clay subsoil?

Mr. O'Fallon: It seems to flourish about Forest City and that is clay subsoil.

Mr. Anderson: Will it make permanent pasture, or will it die like clover?

Mr. O'Fallon: It will be permanent if you can make it permanent. It has died some in this State in some places, but it does not die in other states, nor does it with us. We have had it for four or five years in my county, that is all the personal knowledge I have of it. Six years is about as long as we have been growing it, but we are shipping it out by the car load.

Mr. Abbott: Do you notice any difference in the variety of alfalfa you have and that which comes from Kansas? I am using part of a car load of alfalfa that came from Holt county, and it does not look like any I ever saw. I have given it study, but have never noticed any special varieties of that grown here. I noticed they found varieties where they have been experimenting with it.

Mr. O'Fallon: I think the alfalfa in Holt county is the same as that in Kansas and Nebraska. I do not know where the seed came from, but I believe it is better to get the seed from Kansas and Nebraska than it is from Colorado or New York.

Mr. —: Is it not a stomach producer instead of a ham and shoulder producer? That has been my experience. I lived nine years in Colorado and I harvested quite a number of crops of alfalfa, and I have grazed a few hogs on it, but I found unless you fed grain with it the hog would be all stomach.

Mr. O'Fallon: Of course there is no one thing that is a perfect ration for a hog or for any other animal. You must feed some grain with both clover and alfalfa to get best results. The Kansas Experiment Station answers that question in this way. They have been fattening hogs with alfalfa hay and corn, and they figure that hogs fed on alfalfa hay and corn in a certain time gain ninety pounds, while the same kind of hogs, taken good care of and fed on corn alone, gain only 52 pounds, of course this extra forty pounds gain does not all come from the alfalfa, but because you are feeding two kinds of feed, a bulky feed and a grain. It does not all come from the fattening qualities of the alfalfa, although alfalfa is as rich as any plant you have, it is the principle of feeding a balanced ration.

In Atchison county, the northwest corner county of the State, they are beginning to raise quite a good deal of alfalfa and it was very much of a success this season, dry as it was, as you heard them say at the Farmer's Institute and as you would judge from samples of the hay. Here lately the farmers on the Missouri and Nishna Botna bottom land are bringing in alfalfa for sale, and they claim that it makes fine feed. I have not had experience with it, but it looks fine. They tell me while it is a fine hog pasture and produces a great hay crop, especially fine for cattle, that it is not a good pasture for cattle, as it produces bloat like clover, and our farmers do not advise sowing it for cattle pasture. They say it is good to sow it and use it for a hog pasture, then harvest the hay crop and feed it to cattle during the winter.

I was talking recently to a breeder of Percheron horses and he told me of his experience with alfalfa. He said he raised a good deal of it; that it was dangerous for a cattle pasture. He said you could produce a good hay crop and at the same time go right along and pasture it to your hogs.

Mr. Ellis: I wanted Mr. O'Fallon to bring out two other points before he closed, but he did not, in reference to the time and manner of sowing. I think these are two important things to consider. If it is sown in the spring there is danger of the weeds smothering it out, but if you will clip it when it is only a few inches high and clip three or four times the first summer, you may save it. Mr. Bryant of Independence, a member of our Board told me he secured a good stand by sowing with flax in the spring. I have found flax an excellent nurse crop for red clover. It branches at the top and does not grow so thickly at the bottom as oats or wheat. I believe in this State, however, we will do well to try fall seeding, August 10th to September 10th. Prepare the land just as you would for a bed of onion seeds, make it as fine and compact as you can get it, work the land down some time before you want to sow, and then sow shallow with a press drill or sow broadcast and cover with a harrow. As to kinds of soil adapted to its cultivation, I will say it is now being grown in a small way in fifteen or twenty counties in the State, and it will be perfectly safe to try it on any well drained soil that will produce corn.

Mr. Abbott: There is another point I wish to be brought out, and that is the time to cut alfalfa for hay. Half of the hay that comes to the city markets is worthless for feed and alfalfa hay can be spoiled quicker than any other kind of hay. The experiment stations recommend cutting it just as it begins to bloom. We bee people do not like that because it is the best honey plant in the world—but to make good hay it wants to be cut the minute it begins to show bloom. The longer it is left standing after it begins to bloom, the less feeding value there is in it. If left standing till full bloom, the stems will be worthless. I have been feeding alfalfa in St. Joseph for a long time, although I do not grow it. Sometimes I get alfalfa that is absolutely worthless. The alfalfa that I have now seems to be all leaves, there is no bloom on it and my horse will eat any amount of it. She will almost leave her corn for it. She pushes the stems aside and gets the leaves. After she has eaten all the leaves she will eat the stem, for the stem that has leaves along with it is good, but where the leaves shatter off, as they do when the plant is in full bloom, the stem is perfectly worthless.

Dr. Peters: How long have you been feeding alfalfa to your horse?

Mr. Abbott: A number of years.

Dr. Peters: Is he all right?

Mr. Abbott: Yes.

Dr. Peters: I will say that alfalfa is not considered as a rule a successful feed for horses. I do not know just how it would be in this State, but in our State it becomes easily affected with a fungus, and if it is not cut at the right time and it should happen to be a moist time when it is cut, the fungus grows very readily and this is injurious to horses. It is not injurious to any other animals and it makes a good feed. On the other hand, it makes a good pasture for horses. I wish to emphasize the fact that anyone who has had any experience with alfalfa for pasturing cattle knows it is not a success. You may try putting a big bit in their mouth or any other device, but you are liable to lose from ten to fifteen per cent. of your cattle. It is a great forage plant, we have tried it in Nebraska and have had great success. At our Farmers' Institutes I hear them advising the securing of seeds from the home market, as near as I can gather it, they seem to think if they secure seed from their own locality it is better than if they secured them from the eastern market. Alfalfa is certainly the king of all the forage plants that can be fed to hogs, but do not let anyone make you think that you can feed and fatten hogs on alfalfa alone. I have known some alfalfa enthusiasts to leave that impression, but it is not true. I would rather grow alfalfa on my farm than possibly any other forage crop if I were raising hogs. Though I am not personally in the hog business, I have probably as good a herd to maintain as can be found on the market to-day, and I know of what I speak when I say I would not exchange alfalfa for any other feed for hogs.

Mr. O'Fallon has given you some very practical suggestions on sorghum as a feed for hogs. Sorghum is a wonderful feed for hogs, and I wonder why our farmers in the eastern states as well as in the western states have not availed themselves of this forage plant. I know it is in very bad repute, owing to the fact that we find it is sometimes dangerous as a cattle pasture, and I shall speak of that later, but it certainly is one of the very best feeds for hogs, if we cannot have alfalfa, and it seems that sorghum will grow anywhere; and because most every farmer can grow it I think everyone engaged in the hog business should certainly have a little patch of it.

Mr. Johnson.—I would like to speak in regard to the difference in the quality of alfafa, of which Mr. Abbott spoke. The first crop of alfalfa—Mr. O'Fallon will bear me out in this—the first crop is more of a stem crop, the second crop is a leafy crop. It is a seed crop like clover, and the time of cutting has a good deal to do with it. I have seen alfalfa cut and by the time it would reach the stack there would be very few leaves on it. If rain comes it will shed its leaves as quickly as any grain when the frost strikes it and it is difficult to secure it when the stalk is in proper condition. Heavy dews will affect it. It is more easily affected than clover and everybody has had experience with clover. As a hog pasture it is a great crop.

In regard to horses, as Mr. Abbott has said, it is a good feed for horses; it will fatten a horse as long as you are not working him, but do not work a horse that you are feeding on alfalfa. Alfalfa is a grand feed, but there are two sides to the question. This is my experience with it after nine years residence in an alfalfa country where I saw a great deal of it and helped to handle a great deal of it.

Mr. Abbott.—What affect does it have on horses?

Dr. Peters.—It will heave them; it will produce asthma in horses. This is one of the objections to it. I have brought this out because, if you should go away from here very enthusiastic on alfalfa, as you no doubt have a right to be, you might feed it to your horses and then you are apt to ruin some valuable horses and you would condemn alfalfa ever afterwards. I believe in telling people the truth and they can govern themselves accordingly. Alfalfa is a valuable feed, there is no question about that, but on the other hand you cannot work horses on it as a full feed on account of a tendency to produce inflammation of the kidneys. There is no question about that; it is dangerous to feed it to horses that are working hard, either in the cities or on the farm. Those that have had experience with it will condemn it for working horses.

Mr. O'Fallon.—I omitted to speak of one thing in regard to cutting alfalfa and Mr. Abbott called my attention to it. It should be cut sooner as a hog feed, as soon as the bloom begins to appear. That is what the hog eats. It ought to be cut green with all the leaves on it. I use the third cutting for hogs, as I believe that is the best; possibly the second cutting may be just as good, but I do not believe the first cutting is good for hogs at all.

A FEW DISEASES OF THE HOG.

By Dr. A. T. Peters, Animal Pathologist, Agricultural Experiment Station, Lincoln, Nebraska.

DISEASES OF THE RESPIRATORY ORGANS.

I shall try and classify three diseases which have caused very heavy losses in the last few years.

The first disease manifests itself in the respiratory organs of small pigs and shoats. The animal usually coughs, especially during feeding time; the coat is rough, the hair loses its lustre and the animal's entire make-up is a picture of unthriftiness. As the disease progresses the animal becomes weaker, more gaunted, and the cough more severe. These symptoms may be applied to three different diseases of the respiratory organs: The first, caused by feeding too heavy a grain ration, such as corn, without any regard for a balanced ration or providing any of the mineral salts that are necessary to build up the system. Second, by mechanical substances. Under this heading we have first, mechanical pneumonia, caused by compelling animals to inhabit quarters where they are obliged to continually inhale a great quantity of dust. This dust naturally adheres to the mucous membranes of the breathing organs, such as the bronchial tubes, which when completely filled up, causes mechanical pneumonia. This disease alone has taken away many thousand hogs in this State last year. In many instances, during a very dry spell, the hog lot becomes very dusty, so that the hogs moving around freely in the corral stir up a cloud of dust; and it is this dust that causes these heavy losses.

Mechanical Pneumonia Produced by Parasites.—The symptoms in this case are almost the same. The animal coughs at the least provocation, loses flesh rapidly, and becomes emaciated. It is caused by very small threadworms lodging in the bronchial tubes, which if not removed, will finally completely obstruct the air passages, causing heavy losses.

In order to administer the proper remedy it is necessary to first determine which of the three above mentioned diseases is causing the loss. The first two can very easily be ascertained by taking an inventory of the conditions. The latter is more accurately diagnosed by holding a post-mortem on one that seems to have been very much affected. If lung-worms are present, then a treatment is indicated.

The treatment for the overfeeding is a balanced ration. Use some slacked lime with the feed; also charcoal, and allow the animals to root. By thus changing the feed and removing the cause they are certain to soon recuperate. The same is true for hogs which are shut up in dusty places; when this cause is removed, and with a light tonic, such as tincture of iron in water, the animals will soon be on the road to recovery.

When affected with parasites—small thread-worms—it is wise to feed something to drive off these worms. The most efficient is turpentine or gasoline, which should be administered in the swill, and the best on an empty stomach. The proper way to feed this medicine is to omit the morning feed and give a teaspoonful in the feed for an average hog. Two or three applications usually suffice. The breeder must not rely upon the use of chemicals alone to be given to the animal, but he must also inaugurate immediately through disinfection; because the eggs of these parasites are laid in the feeding and watering troughs, and for this reason they must be thoroughly cleansed, or the hogs will be reinfected in a short time. Too much cannot be said for the liberal use of disinfectants and hot water in the feeding and watering troughs.

DISEASES OF THE MOUTH.

A disease affects small pigs in which the lower or upper jaw and the snout become affected. It commences with a small sore on either of these parts, which rapidly spreads, and in a very short time involves the entire mouth, gums and tongue. This disease has been described by many writers as being caused by black teeth or due to the tusks that are seen on the side of the jaws. Many writers claim that it is due to an injury caused by animals fighting or biting each other; but the latest theory advanced is that it is due to a lack of phosphate of lime in the bone. The bones of the jaw, being in need of these ingredients, become brittle and the least injury will produce aggravating ulcers. It is essential, therefore, for the prevention of this disease, that the sow should be fed enough of lime ingredients that when the small pigs are born the milk will contain a sufficient amount of lime ingredients.

Treatment.—The affected parts should be well washed once or twice a day if possible with a five per cent. solution of zenoleum or carbolic acid, and after being thoroughly cleansed they should be anointed once or twice a day with a zenoleum salve made with two parts of zenoleum to five parts of common lard not salted. A small amount of slacked lime should be given in the drinking water or milk. With these remedies the greater number of animals affected can be cured.

A similar disease is described in some farm journals and by most breeders as rheumatism. The animals show the following symptoms: They lie around and it is quite difficult to make them move; the joints usually become swollen, and if no treatment is followed they finally become hard; the animals seem to walk on their toes, and the joints of the fetlock seem to be "knuckled" (enlarged.) When made to stand or move they show symptoms of excruciating pain, and stiffness in every limb, as though foundered. The latest investigations have shown that this disease is not true rheumatism, but that the animals so affected are lacking earthy salts, such as phosphoric acid and phosphate of lime. To prevent the occurrence of this disease the herd should be supplied with plenty of minerals, such as slacked lime, and allowed to root in the ground, where they can secure the natural minerals they require to maintain their balanced ration.

Animals affected should be given about a quart of slacked lime mixed with a gallon of food, which should be prepared at least six or eight hours previous to feeding, so that the food is thoroughly saturated with slacked lime. A little slacked lime water should be administered in the drinking water each day, and if the animal is not too far gone, recoveries with this treatment are certain. If the joints are very much swollen, a liniment made of ammonia one part and water three parts, applied once a day to the affected parts, is very beneficial.

INTESTINAL PARASITES.

Intestinal parasites are at times very troublesome to the hog raiser, and at certain times of the year they take a great per cent. of the hogs. Hogs affected with parasites cough occasionally, do not take up their feed as readily as usual, are languid and unthrifty; the coat is rough and the hair not smooth and glossy. As the disease progresses the animals become emaciated and pass parasites. At times these parasites are so abundant in the colon and stomach that while vomiting some of them become lodged in the throat and nose. Whether or not hogs are affected with parasites can best be determined by a post-mortem; or when worms are noticed in the feces it is best to commence treatment. The following is a powder for hogs affected with worms:

Copper sulphate, one-half pound.
Gentian root, one-half pound.
Licorice root, one-half pound.
Wood charcoal, one-half pound.
Hyposulphate of soda, two pounds.

Give a teaspoonful to each hog once a day; or in very bad cases about five grains of calomel should be given to each hog, either in the feed or by dropping a five-grain tablet into the mouth. This is a very easy and simple method of administering this drug.

PARALYSIS OF THE HIND LIMBS OF HOGS.

One of the diseases of the hog which has been quite an annoyance and has caused heavy losses, usually manifests itself in mature animals, but very often in small pigs, by paralysis of the hind limbs. The animal at first shows a weakness by walking on its toes, some days previous to the final collapse. It also shows symptoms of pain and restlessness, by lying down, getting up again, moving around, and symptoms of colic. In some, symptoms of rheumatic pains are noticed. In the later stages of the disease the hind limbs become weak. The animal knuckles in the ankles and finally drags its hind parts. The limbs are cold to the touch and the animal has no fever. Appetite is usually good. As the disease progresses, the animal becomes weaker and the constant dragging of the lumbar region (hind parts) causes abrasions, as the animal will try in the early stages of the disease to move along with the other animals if possible. As stated above, the appetite does not seem to be impaired. The animals, however, do not as a rule make any rapid recovery. Very often when tonics are administered they finally get up on their feet again; but as a rule the animals seem to be weak and do not thrive well, and a recurrence of the disease may appear at any time. The disease usually appears in well fed hogs. I have noticed that this disease attacks some of the best and fattest animals in the herd, either old animals or young shoats. I have found it occasionally in sows that had just farrowed and that were not in very best of flesh.

The cause of this disease has been largely attributed to the kidney worm. Whether it is due to this parasite or not I shall not definitely state, but the observations made by the department certainly contradict that theory, for we have held hundreds of post-mortems in the last six years on subjects affected with this disease and yet we have failed to find in a single instance a kidney worm in animals so affected. On the contrary, I have known of instances in which animals manifesting no symptoms of disease whatever and apparently sound in their feet have been shipped to the packing houses and the kidneys found to be very much diseased (degenerated—containing large cysts); and therefore I believe that it cannot be the kidney worm that causes this trouble, for if it were the kidney or the kidney worm we would certainly expect to see one or more kidneys partly destroyed in advanced stages of the disease; and yet these animals during life showed no trouble of this kind. This has often been demonstrated by post-mortems on animals for other diseases, such as hog cholera, which revealed diseased kindneys, the owner having never noticed symptoms of this peculiar lameness. I think that the seat of the trouble is in the nerves of the spinal column, and we have therefore inaugurated the following treatment with very good success, judging from the reports received.

The operation we recommend is to produce active inflammation by using the actual cautery. To produce this cauterization, take some baling wire, about eight inches long, and taper this at one end. Cut about eight wires of this length; secure your animal away from the buildings, and build a small fire; place the wires therein, and when they are at a white heat secure them with pinchers and insert them through the fat, down to the lumbar muscle, making eight punctures on each side of the spinal column. Be sure to penetrate the fat so as to reach the muscular tissue. With this treatment we have been very successful. The reports of some two hundred cases have been favorable, and we therefore venture to give our experience with this trouble and advise anyone who has cases of this kind to try this simple operation.

I wish to say that while it may seem barbarous to use the heated wire, yet it is not painful to the animals, as they do not seem to feel the white heated wire inserted in the fat, and it is not nearly as painful as some of the treatments I have seen where a large incision is made in the back and turpentine or Spanish fly applied, causing a very severe blister and intense pain. The wounds caused by the remedy I recommend in this article heal readily and in most cases leave no scars whatever. The animal should be kept on light food in a cool, shady place in the summer. It should be borne in mind that animals in this condition must not be subjected to a great deal of disturbance, which, causing excitement, is not beneficial to their recovery. Rest with proper diet is one of the essential features for this disease.

VALUE OF DIPPING HOGS.

It has long been known to the intelligent hog breeder and grower that the presence of insects on the hog is a very serious matter. It is a fact that very few hogs are free from lice and that breeders have been accustomed to use various remedies for the destruction of the pest. The favorite seats of lice on the hog are back of the ears, along the neck and under the breast. These vermin are bloodsuckers and they produce in a short time a very weak, debilitated condition of the animal, making him far more susceptible to other diseases that the animal is heir to. The louse has not been credited with occasioning serious loss, but of late years more and more attention has been given to this little insect by the Department of Animal Pathology. We have found that the hog louse becomes all the more a serious question when hogs are out of condition. As above stated it is a bloodsucking insect and if the accompanying conditions are bad, especially if the pens are excessively dusty and through the inhalation of an excessive amount of dust there should be a slight pneumonia of the lungs, the animals being affected with a large quantity of lice will be all the more apt to die.

We have also found that where animals affected with cholera were free from lice there was, in the great majority of cases, a far smaller percentage of loss sustained than where the herds were largely affected with lice. This has been brought to our attention after examining numerous herds in various parts of the State during the last five years, and so now the first rule that we insist upon when we visit an outbreak of cholera is to examine for lice and if present the hogs are immediately thoroughly relieved of these insects. The breeding pens and hog houses are also thoroughly disinfected. All the bedding that is found in pens and hog houses at time of disinfection is burned. The method that we have for disinfecting the hog pens and hog houses is as follows: For the stables we prefer to use hot water and any of the coal tar, such as chloro-naptholeum, zenoleum and other similar preparations. This is done by making a one per cent. solution of either of these preparations and using it liberally with broom and brush and also with a spray pump. If you have any of the spray pumps used for spraying trees it will answer the purpose admirably.

After the stables and pens are thoroughly disinfected the animals should be disinfected also. This can be done by dipping them, which is a far easier method than any other. Of course, it necessitates a dipping tank. These dipping tanks can be bought on the market very reasonably. If one is not in favor of using the dipping tank, or does not feel warranted in spending the amount that it would cost to purchase one, a spray pump will do the work, but I wish to state that in spraying hogs one should have them on the floor and must have quite a large and forcible sprayer, so that they can be thoroughly saturated with the liquid. If sprayed they should also be rubbed with a broom immediately so that the fluid will soak well into the skin. The solution that we recommend is from 5 to 6 per cent. for grown hogs and about 3 to 4 per cent. for small pigs. In our experience we have not found any harm resulting from dipping very young pigs.

Spraying and dipping for lice can be highly recommended, as it is the only safe, rational thing to do if hogs are in any way infested with lice, and, as stated above, there is not a breeder of hogs who has not been troubled with this insect and the remedy is to dip, and dip often. It aids the very best balanced ration that can be given to a hog, by enabling him to thrive and assimilate the food administered. Breeders who have begun to dip their hogs find it very economical and a very beneficial method of ridding the animals of these insects, and the coal tar preparations which have been mentioned, chloro-naptholeum, zenoleum and Lincoln dip, leave the skin in a very soft, pliable condition and I believe that it is a very economical and sensible way out of this difficulty.

In conclusion I desire to say that I do not wish to convey the idea that it is absolutely necessary to procure a dipping tank. I have known instances where our American farmer with his genius for making the most of his surroundings has soon improvised a proper dipping tank with very little cost, but it is the purpose of the writer to urge every grower of swine to dip his hogs at least every two or three weeks to have the very best success and also to use liberally any of these dips in a spray in his hog pens. And he will attain the very best results and in a great measure prevent infectious diseases from gaining any foothold on his premises.

DISCUSSION.

Mr. ———.—What causes these praying hogs that go around on their knees and do not stand up?

Dr. Peters.—Do you mean young or old hogs?

Mr. ———.—Both kinds. The ones that weigh one hundred or one hundred and fifty pounds. I call them praying hogs because they kneel all of the time.

Dr. Peters.—That term describes the symptoms very well. My treatment for that trouble is this, for young animals I advise a liniment made of equal parts of strong ammonia and oil. Rub it along the tendons. I also give a tonic, Fowler's solution. Give the doses in accordance with the size of the animal, twenty drops to a hog weighing two hundred pounds and ten drops to a hog weighing one hundred pounds. Drop it on a piece of bread and throw it to the animal and they will pick it up readily and eat it. I increase this dose five drops every day. If you start in with twenty drops increase the dose until you have given eighty drops. If you start in with ten drops, then increase the dose five drops a day until you reach sixty. By that time you will notice a great improvement. Also mix lime water in your feed and within a fortnight you will have your hog pretty well on the road of recovery.

Mr. Schooler.—I wish to ask in regard to that treatment for paralysis. For instance I have noticed as a rule the hogs affected with this disease are often very fine ones. I have one on my place now that was paralyzed that way last spring and she just drags herself around into the pasture. She raised three of the nicest pigs I ever had on my farm. She is still dragging her hind legs around. Do you insert this hot wire into the loin?

Dr. Peters.—Yes, perpendicularly down for about two inches, according to the size of the hog. Put eight punctures on each side.

Mr. ———.—I tried that. I came in a little late and do not understand your theory fully. I tried that remedy on a hog of mine six weeks ago and it failed. I made the incisions with No. 16-inch wire (I think it was); eight punctures on a side and added three incisions immediately over the back-bone itself—whether that was going astray or not I cannot say—but my animal still drags her hind feet. She is in good condition, has a good appetite and I see no trouble with the brain—although I have always had the impression that this trouble was paralysis instead of kidney worm as has been said.

Dr. Peters.—The reason you failed may be due to the fact that you did not insert the wires deep enough. The wires must penetrate through the fat and into the muscles.

Mr. ———.—My animal would probably weigh two hundred and twenty-five pounds. I inserted the wire, as near as I can recollect, two inches.

Dr. Peters.—That is about the average. I cannot explain why you did not have good results. I would suggest that you try it again.

Mr. ———.—Just insert the wire and draw it right out?

Dr. Peters.—Perhaps the wire was not hot enough. You should get it to a white heat. You want to get the same results that you want to receive from a blister.

Mr. ———.—What would be the result if you would run the wire too deep?

Dr. Peters.—I never heard of anyone having any bad results from the operation.

Mr. ———.—What spaces would you use in probing in up and down the backbone?

Dr. Peters.—Half an inch.

Mr. ———.—I mean lenghtwise on the backbone?

Mr. Schooler.—You make these incisions eight on a side, lengthwise.

Dr. Peters.—Yes.

Mr. Schooler.—That would make four inches you would go up and down.

Dr. Peters.—Yes. Use good strong wire, heated to a white heat.

Mr. ———.—What causes lumps on pigs?

Dr. Peters.—Lack of phosphate of lime.

In Europe it was found that on very wealthy ranches and estates they could not raise hogs and little pigs because they were raised in what you may call palaces. The extremist had been there and the man who said that hog cholera could be cured in that country by having fine stables so that they could furnish them with hot and cold water, cement floors and all that kind of thing. They found they could not raise hogs in that way, while the hog of the poor peasant that had none of these advantages grew and flourished, simply because the peasant was raising hogs as nature intended them to live. We cannot raise hogs on cement or even hard wooden floors. Give me good earth floors and I will grow the very best of hogs. To-day if you go through that country, the southern part of France and southern part of Germany you will see that on those rich estates cement floors are a thing of the past.

Mr. Schooler.—Then you do not advocate wooden floors?

Dr. Peters.—No; I would not grow hogs on them. I like a good floor in the feed yard where they can go and take up their feed. A good feeding floor is economical because you do not lose the feed. If you have a good feeding floor you can feed any kind of feed at any time.

DUROC-JERSEY HOG FOR THE PRODUCTION OF PORK.

By W. L. Addy, Parnell City, Mo.

With a careful regard for all breeds of swine, I do not hesitate to assert that the Duroc is second to no other hog for the production of raw material for the great packing houses of the world, in which are prepared the most thoroughly marbled bacon, the finest of tenderloin, the largest cuts of pork-steak, the most satisfactory class of pickled pigs' feet, the smallest proportion of head cheese, and the largest proportion of leaf lard. At this point I desire to diverge a little and offer a point in defense of the Duroc; as we are unfortunate in having a color which is of a similar tinge to the seriously objectionable and out croppings belonging to other breeds, we are occasionally referred to as mongrels, which are but the result of indifferent methods in breeding operations; the effect is inclined to be the outcroppings of the objectionable characteristics of the conglomeration of which the animal is composed, which is sure to appear in a sandy hog, too often credited to the Red hog. To this class we do not wish to be understood as referring in our remarks favorable to the Duroc Red hog. To the carefully bred Duroc I aim to confine this paper, which, for want of time, will necessarily be short. In the carefully bred Duroc may be found a hog ready for an early finish, yet one which may be profitably fed until a very heavy weight is obtained; a hog of extra length, splendid breadth and depth, strong bone (most generally very heavy bone) and the best of feet, a good jowl well attached, assisting to form a properly finished neck upon which is generally found a handsome head and ear, a hog of mellow skin and a smooth (no long stiff bristles) coat of glossy texture; such hogs are the result of careful breeding operations, along well established lines of idealities, the mixing of different strains of blood lines with brains; the careful consideration of blood lines as well as individuality in the selection of breeding stock. These results may be acquired without destroying the valuable traits which are said to belong to the less improved hogs. In the Duroc we have a hog of feeding quality, to which we have in part already referred, and to which we further desire to call your attention in the fact that at different experimental tests made at experimental stations, with swine of different breeds the result has not been unfavorable to this breed. Also to the fact that where parties, in the way of a trial, have placed one or more litters with a more favored breed, where all have the same care, the result has been almost invariably favorable to the Duroc. Hence, largely the rapid favor into which the breed has merged. With reference to their propensities to grazing I have been criticised for claiming this a superior quality in a feeding hog. It has been said that a roaming hog is necessarily a rough, uneasy scavenger. This we deny. Among Durocs of large scale, with coats as smooth as pigs, with backs as broad and bodies as deep, with heads and ears as neat as can be found on any breed, hogs not hunting trouble, hogs easily restrained, hogs well shaped for the commercial market, they may be found regularly taking daily tours of the pastures upon which they are permitted to range. With reference to their power to produce large litters and rear them, we claim this breed combined with other qualities mentioned, has no superior, and I doubt their having an equal. We have often known sows to farrow fifteen to seventeen pigs. We do not claim that sows are generally able to sustain to a weaning age litters of this number, yet with such a beginning we have favorable hopes of a satisfactory ending. We know of sows, some of which were gilts, which raised eleven to thirteen pigs, every one of which has gone out in crates as breeding stock. We know of a breeder who weaned 120 thrifty pigs from 15 sows. To one man last spring I sold two gilts which farrowed in April and he told me about November 1st that from those two gilts he now had twenty-six head of hogs, the spring litters then weighing, as he said, on an average of 275 pounds each. This party is living in town and has no range for his stock, these hogs getting only such food as are given them by hand. We have a party in our town who operates a slaughter house on a small scale; he butchers for everybody within a radius of two miles. He dresses representatives of every class of hogs. Unsolicited, he has told me that the Duroc hog invariably showed a larger per cent. of leaf lard than any other hog he opened. It is also generally conceded they are equal to any in the matter of superior bacon, that they are invariably a deceiving weigher. All of which is readily explained upon the theories above referred to.

Finally.—With a smooth hog of handsome style, of a disposition to take plenty of exercise upon pasture, put on finish at any age, able to mature very large profitably, produce large litters and sustain them carefully, turn out an excessive proportion of leaf lard, take no back seat on the bacon question, we ask is not the Duroc-Jersey breed of hogs the mortgage lifter indeed?

DIPPING HOGS—MODE AND ADVANTAGES.

By. E. E. Axline, Oak Grove, Mo.

Mr. President and Gentlemen, Fellow Breeders and Feeders of Swine:

When I received the communication from your honorable Secretary that he had assigned to me as part of the programme, the thoughts and suggestions I am about to offer on the mode, experience and results of dipping hogs, I felt he had made a great mistake and placed me in a disappointing position to those who might expect words of wisdom from one of many years' experience in hog culture, but, like the boy whom his father commanded to perform a certain task, right or wrong, I will do it because father is right, and will not ask me to do anything but what is right.

Ten years ago I consulted a gentleman in reference to the mode and plan of dipping hogs, or rather he consulted me by advocating the plan that I afterward adopted, that I had pondered in my mind for years, believing it to be the common sense, practical and only certain way of preventing what people call Hog Cholera from penetrating and devastating our herds, whether they be thoroughbreds or grades fattening in feed lots.

By observation, investigation, research and experience, I learned partially how to develop a certain type of hog, and while I believe after long years of breeding, the Poland-China hog is superior in some respects to any of his rivals, yet I am frank to admit that all the strains of thoroughbreds have their good points—but to my subject and the question before us.

The hog being constituted more like the man than any other animal that has brought wealth, satisfaction and pleasure to the American farmer and the American home, particularly in the great states of Missouri, Illinois, Iowa, Kansas, Nebraska, Indiana, Michigan and Ohio, it behooves us, as men engaged in this industry to work on intelligent lines protecting our herds from the ravages of disease as well as the bringing of the hog to the highest state of perfection by the cross and interchange of blood in both the male and female, developing the proper bone, muscle, head and symmetry of form, which is or should be a joy to every thoroughbred breeder. These being facts beyond any questionable debate, how shall we protect the ideal hog by dipping and feeding a remedy that will rid the hog of all lice, mange, parasites, fever germs, filth, and at the same time keep the pores open, thereby assisting nature in throwing off the dead matter that continues to accumulate during the natural life of the hog, feeding the same remedy to rid the hog of worms, one of his worst enemies, and keeping his digestive organs in perfect order.

I do not believe it necessary to have Hog Cholera, nor do I believe in administering these nostrums, powders, foods, sure cures or certain decoctions to a hog, and forcing the hog to partake of poisons more destructive and deadly than the disease that is propagated and developed in our own feed lots, breeding pens and among our own droves that carries off thousands of valuable animals yearly, but years of successful breeding, dipping and feeding, a remedy that has kept my herd in almost perfect condition, permit me to advise all my fellow breeders to adopt this simple common sense mode and plan at a cost of a few cents per hog per year.

My tank for dipping is about ten feet long, four feet deep, and it is larger at the top than at the bottom. I have it set in the ground in a box, and my chute is about twenty feet long, the last four or six feet slopes to the end of tank, where hog enters at an angle of about twenty-five degrees, so whenever the front hogs pass on incline, the rear hogs crowd them forward, and they slide into the tank, going entirely under in the solution, passing out on a cleated board at the other end of the tank. With this plan and mode I can dip 200 to 300 hogs in an hour, and after the drove is dipped, I cover up the solution to prevent dirt, rain or snow from getting into it, and this solution lasts indefinitely, or as long as an ounce remains. I add the necessary amount of liquid and water whenever I want to dip, keeping the tank a little over half full of the solution, and I dip as often as I think it necessary to keep my herd in perfect condition. Whenever I bring any hogs on my farm I think it a good idea to dip them twice and feed the remedy before I turn them in lots with my other hogs.

I have tried to the best of my ability, knowledge and experience to place before this intelligent body the mode, plan and results of dipping hogs, and in conclusion, I advise you to beware of many things or solutions that are advocated for this purpose, as there is never a genuine without a counterfeit, and both will find favor, just as the words of a man in authority will advocate "hog cholera cannot be prevented." I advise every man engaged in the hog business to adopt this simple common sense plan of dipping and feeding, and I believe it is only a short time until the fears and uncertainties of this destroyer, call it what you may, will not be feared and this mode of treatment will be adopted generally.

ARE WE BREEDING OUR POLAND CHINAS LARGE ENOUGH?

By J. R. Young, Richards, Missouri.

Your Association has assigned to me the very important subject, "Are We Breeding Our Poland Chinas Large Enough?" I hardly feel able to intelligently present this question, not having had a very wide experience in breeding or particularly observing the very large Poland Chinas. From some cause I became early in life most favorably impressed with the medium sized hog and am of that impression still.

The very large hog never, as a rule, seemed to me to present that captivating finish that expert judges almost invariably tie to. A question here arises, what is a large hog? As I will present it a hog that weighs from 750 pounds up is a large hog; from 600 to 750 pounds the medium hog, and a matured hog under 600 pounds may be considered the small hog. Few breeders, if any, are *sticklers* for the small hog for the practical hog, because they do not get large enough at the usual marketing age—from 7 to 10 months—to be profitable. My experience with the large hog evidences the same fault; the large hog is by nature longer in arriving at maturity and necessarily does not finish up with the medium sized hog at an early age.

On several occasions I have fed the large specimen with the medium kind, giving them identical care and invariably the medium sized pigs would, at from 7 to 10 months of age, be plump, fat and well finished, while those of the larger kind were long, lean and usually lank and growing. I believe it is generally conceded by the practical hog man that the medium sized hog gives the quickest and best results from the present methods of feeding and usual age of marketing.

Let us see, for instance, what the weight of some of the State Fair winners of recent years might suggest. We will begin with Corrector, champion of Illinois State Fair this year, of whom the "American Swineherd" has said in substance: "No better boar was ever produced and long will it be until his equal will again be produced." I understand from Col. Lail, his breeder, that Corrector would likely not over-reach 750 pounds which puts him in the medium class.

Chief Perfection 2nd, the pride of Iowa, his illustrious brothers, I Am Perfection and King Perfection, three of the most phenomenal boars living, the product of one sow and one boar, can neither of them be classed as large hogs.

Proud Perfection, Perfect I Know, M's Black Chief and Missouri's Black Chief are none of them hogs of any great size and can hardly be placed out of the medium class, yet who doubts but that they, with many others of similar scale, are first in the hearts of most breeders of Poland Chinas?

You would infer from this paper my answer to the query. I think we *are* breeding Poland Chinas large enough.

Mr. Schooler.—While attending the Nebraska State Fair last fall and mixing up with the Nebraska breeders I found that they were finding fault with the Missouri breeders for not breeding our hogs large enough. For instance, Mr. John Blaine of Pawnee City has a hog, Logan Chief, that when in show condition weighs from 950 to 1,000 pounds and a number of hogs on exhibition at that fair from Nebraska were very large, much larger than our Missouri hogs, but these extra large hogs do not show the finish that the medium sized hogs do, and I think as Mr. Young says, we find greater finish and better quality in the medium sized hogs than we do in the larger ones, and as the Nebraska people were rather finding fault with us, I thought we would let Brother Young defend us.

FEEDS AND FEEDING.

By J. M. Ketchum, Love Lake, Mo.

Gentlemen:—The subject assigned me by our worthy Secretary is "Feeds and Feeding." This subject is susceptible of a wide range and difference of opinions. I will give you a few items on the feed question, with a view of carrying on the business and growing pigs profitably. My idea of raising hogs is to grow them as cheaply as you can so that you will get all the gain with as little cost as possible. As a successful raiser of hogs you must use judgment in raising your own feed to bring good profits. All swine breeders or pork producers should have a large range for their hogs such as woods, blue grass, clover or rye pasture, with plenty of fresh running water or a large pond so the hogs can wallow at will and which will keep them free of lice and skin diseases. Through the heat of the day they retreat to the thick brush and undergrowth to get away from the flies, but beware of small, filthy, stagnant mud holes, they breed disease.

My mode of feeding for pork is to feed shelled corn soaked ten or twelve hours, feed in troughs or on a plank floor and avoid feeding in the mud as much as possible. Feed so the hogs will clean up all feed and come up squealing for next feed. Soaked corn is worth about one-fourth more for hogs than corn not soaked. This feed with the range of clover or rye is a good mixed ration. In pushing hogs for show ring and quick and large advertisements, I feed shipstuff mixed with ground corn and oats of equal parts, mixing in about one-fifth part of oil meal and a small amount of bone meal, mix into a thick slop, feed three times a day and also some dry shelled oats. Hogs should have free access to wood ashes, charcoal, salt mixed with copperas. This treatment, with correct breeding of good constitution, good heart girth, good medium bone, well upon feet, will, as a rule, bring the practical farmer a reasonable profit.

The State Dairy Association.

Abstract of Addresses at Annual Meeting.

THE DAIRY COMMUNITY.

By Mr. Rudolph Miller, Proprietor of the Macon (Mo.) Creamery.

A few days ago I received a letter stating that they had put me down to say something about the Dairy Community. I was somewhat perplexed about it, I did not just like that idea, and had a good mind to refuse, but the thought came to me that the Bible says you must not be hearers only, but doers. I, therefore, resolved to say what I could and do my best here, because if we all refuse to do what we can, to do our best, the meeting would be a failure. Therefore, I will tell you what I think about an Ideal Dairy Community, and also about a dairy community that is not an ideal dairy community. From my talk you will soon learn that I am not a full-blooded Missourian. But I believe I will tell you what I have seen here in Missouri first.

I was very, very much discouraged, I have only been here a year and a half. I came here to Macon, Mo., on the recommendation of the Burlington Railroad Co., came here in January a year ago and saw something I had never seen before. First thing, I had never seen as much mud. I saw green grass in January, and I had never seen that before, and I learned that where there is mud there is grass. Don't you know that I never saw a calf suck before I came to Missouri? The cow came in in the spring; summer time came and I expected an increase of milk, but there was no increase—the matter was, the calf sucked and I sucked my finger. I do not call that an ideal dairy community. I asked my dairymen: Are you going to let the calf suck all the time? I want to get a little milk for the creamery. When you get your check you look at it and think the creamery is a failure; when you look at the calf it is thin, that is a failure. Let one or the other be a failure, but not both. When the cow comes in in the springtime and you let the calf suck, by the time it is springtime again the cow has eaten the calf up.

My ideal of a dairy community is one I have in mind in Illinois in the Elgin district; it is at Hebron. I went there to visit a friend of mine; he had nineteen patrons in his creamery. This was in October, and they had 14,000 pounds of milk.

As a rule the farmer has not much to do in the winter time; he works hard for six or seven months, and what he makes in the summer he eats up in the winter. If you have your cows come in in the fall, you have all kinds of time to raise your calves. Give them the skimmed milk; you can keep it sweet in winter. In summer you give a calf sweet milk to-day, and sour milk tomorrow. When you feed regularly sweet skimmed milk, I guarantee you can raise just as good calves with that and a little other food as when allowed to suck. Corn and oats cost money; do not give the calf a bushel a day, but a handful. When the calves get that they will do well. When a calf sucks it gets all that butter fat that is not necessary for it. When the farmer learns that he can raise calves on skimmed milk, then it will pay the dairyman to raise calves in Missouri.

What does a good dairy community consist of? If you take the train and go through a good dairy community, you will see fine houses, fine barns and good roads. When you go out of that section you wonder at the difference.

In a dairy community there is a steady income right along; you don't have to go to the storekeeper and ask for things on trust. As a rule there are good schools, because people have money and hire good teachers, and have good buildings. The roads are half the battle; I never saw as poor roads as we have here. When we have to fix a road, we get together and talk and then go to dinner; after dinner we talk again, and the road stays as it was. There is better education among the dairy farmers than there is among those who do not dairy, because as a rule they take several good papers. There is more money among them, because there is always something coming in. Of course, it is not the cows alone. You must figure out in proportion to the cows you have and the amount of milk you have, the number of hogs you can keep.

When a man has money he can build stables, but if he cannot do any better he can make sheds. A man came to me and said, "I have seven cows and they are giving a good deal of milk, and I would like to patronize you, but have not any cans." By and by prices will be a good deal better than they are now, I said, and you bring in your milk, but he has not been there yet. He has no shelter to keep his cows in. I think that to make money out of your cows you must have good shelter for them, they must be taken care of. I think the great difficulty here in Missouri (I have not found it so out in Wisconsin), is that the farmers will not milk the cows here. If they want milk, they just take a little and the calf gets the rest. It cannot be so in an ideal dairy community.

I am not talking creamery, but take good care of your milk whether you take it to a creamery or not. Patrons of a creamery get together at the creamery in the morning and talk together and advise one another. We should all come together and talk over what is best. We organized what we called the Macon County Creamery Association. We talk over what to feed, how to feed, and where to get it. That I think is a very good thing among all of us, that we come together and talk those matters over, and, if you have anything better than I, let me know about it. Help one another, it brings a better understanding. I think that if anybody expects to have what we call an ideal dairy community, he ought to take one or more good dairy papers and read them. When you get through with them and find something good, mark it or cut it out, or hand it to your neighbor. By so doing you will see that it will not take long before you will get together, talk the matter over and derive profit in the long run.

If you have cows, whether five or fifty, it makes no difference how few or many, take care of them. Do not overstock yourself. But if you have five or fifty cows and neglect them for outside business and do not milk them, then I say sell them, get rid of them as soon as you can.

I am much disappointed in Missouri as a dairy State. I do not believe there is a state in the Union that can produce as cheap milk as Missouri. Up near Macon it does not pay to raise grain. They cannot begin to compete with Iowa in raising grain. But I have seen them clear off the brush here in Missouri and have nice blue grass without sowing the grass seed. Why is it that the people do not take hold of it better than they do when they do not have to raise grass? In lots of places in Missouri there are creameries, but they are locked up. There was one in Macon and I bought it, but it is up-hill business.

When the day comes when the farmers learn to feed the calves skimmed milk, the whole problem will be solved. They must know the value of the skimmed milk. If they figure on just what butter they get out of it they will not be satisfied; they must figure on the value of the skimmed milk and use it right.

MILK AS A HUMAN FOOD.

By Miss Jane Zabriskie, Professor of Domestic Economy in the Missouri Agricultural College.

We have a saying in Columbia that it takes a freshman to know how to run a university. It really seems impertinent for a school teacher to come to tell dairymen about milk. However, when we think of the importance of milk in its relation to the human body, we all agree that the subject cannot be emphasized too much. And although I shall go over much ground with which you are familiar, I trust you will be interested.

To begin with, we will take up the subject of the human body. It is composed of water, of fat, of muscle or proteid matter, and in the bones we find lime and other mineral salts. Now, a stove needs fuel. In the same way our body needs food, else it would soon exhaust itself. We find that food is made up of the same compounds of which the body is composed, viz.: Proteids, which we find in meat, fish, etc., and which would build tissue, fats and oils, mineral salts, water and starches, the latter not forming starch in the body, but going to make heat to maintain the continuous warmth of the body.

But the body requires these compounds in a definite proportion. You dairymen make your cows fat or muscular by regulating the proportion of foods in their diet. Did it ever occur to you that a balanced ration is as good for man as beast? We need in the human adult body about 118 ounces proteid, 500 ounces of starch and 56 ounces fat. Milk, although containing all these compounds, does not contain them in this proportion. The proportion of water is so large that great quantities would have to be consumed per day in order to obtain the necessary nutriments. Then, too, the proteid is in large quantities compared with the fats and carbo-hydrates. So that milk for an adult is not a perfect food, and one could starve to death on it.

In a seed of wheat we find the food necessary for the young plant. You all know how the seed germinates, and how the germ feeds on the starch surrounding it, until all the starch cells are exhausted. Then it utilizes the outside circle or layer of proteid matter and mineral salts, and by this time we find the plant really sprouted and ready to get nourishment from the soil.

In the same way an egg contains all the nourishment for the little chick. Even the shell after hatching is found to be worn thin, as much of its mineral matter has been used in forming the chicken's bones. Now milk is often called a "perfect food." It is, for calves, but not for cows. For invalids and children's use the value of milk cannot be over-estimated, owing to its rapid and easy process of assimilation.

The methods of altering milk to suit the taste and digestive requirements are so numerous that we will group them under four general headings:

First—Methods of altering the taste of milk.

Second—Methods of improving the digestibility of milk.

Third—Methods of predigestion.

Fourth—Methods of sterilization and preservation.

The first, that of altering the taste, is done to beguile the patient into taking larger quantities of milk without tiring of it. Black coffee or weak tea, a little caramel, or cocoa, salt, liquors, wines or spices, if added in very minute quantity will not affect the dietetic value of milk and will relieve the painful monotony of a regular milk diet.

The second method, that of improving the digestibility, aims at preventing the formation in the stomach of dense tough curds, so difficult of solution by an enfeebled gastric juice. It is done by skimming, or diluting with water, or adding alkaline or aerated waters, such as lime water or Vichy; or it can be done by adding a little cooked starchy food, like flour or corn starch. If milk is sipped, rather than taken in large quantities at a time, the curds are not formed so large.

The third method of altering milk, by predigestion, relieves a weak stomach of much labor. It is done by adding pepsin or pancreatin obtained from an animal's stomach to the milk, and thus partially digesting it.

The fourth method of altering milk, by sterilization, is made necessary because it is generally impossible to procure cow's milk sufficiently free from harmful bacteria, so it becomes necessary to kill these germs with heat. In sterilization the important thing is, first, to kill all germs in the milk, and, second, prevent other germs from entering it later. For sterilized milk do not use lime water. A bit of baking soda will give the desired alkalinity. Although there are many ways of sterilizing milk, it is by all means, best to procure at the outset, special apparatus.

Pastuerization was devised by the celebrated French chemist, Pasteur. It has the advantage of killing the germs at a sufficiently low temperature not to coagulate the albumen at all and render the milk indigestible. It is much preferred to sterilization. It, however, unlike sterilization, cannot be done without a thermometer. The method consists in heating the bottles containing the milk mixture, to a temperature of 150 Fahrenheit or 167 degrees, instead of 212 degrees as in ordinary sterilization, and in then removing them to a refrigerator just as soon as they will stand the cold. It has been found that this process destroys the germs sufficiently for practical purposes and that it does not alter the digestibility of the milk or affect its taste.

Every hospital has its milk diet. An exclusive milk diet is desirable in all acute diseases of young children, in typhoid fever, in acute Bright's disease, and in many other sicknesses. And milk in combination with other foods form the general convalescent diet, although an active person would require, if taking milk alone, several quarts per day; in illness five or seven pints are usually enough. Many invalids have been starved to death by being kept on a milk diet, and fed only a glass or two a day. If we have nothing but milk, let us have plenty of it.

Regarding the cookery of milk, there is little to be said. The scum which rises to the top upon boiling is proteid, and is not so hygienic as when raw. In scalding milk it is better to place the pan in an outside vessel filled with water. We call this contrivance a double boiler. When the water in the outside kettle begins to boil, the milk is sufficiently scalded, yet there is no scum on top. There are other advantages in using the double boiler for heating milk. First, owing to the large amount of sugar contained, milk burns easily. Was any drink ever concocted by Macbeth's witches more odious to a normal palate than scorched milk? It is impossible to scorch milk in a double boiler. Another plea for the double boiler lies in the fact that in it milk does not boil over.

The reason water boils is this: The particles of water at the bottom of the sauce pan, nearest the fire, become heated and are turned to steam. This steam, being light and gaseous, rises to the top and endeavors to escape. The force of the steam pushes the surface of the water up in a so-called bubble, because the surface of the water is elastic. These bubbles break in quick succession, and we term this boiling. Milk, however, owing to the casein and albumen contained, is even more elastic and these bubbles instead of breaking, stretch over each other, and finally stretch over on the stove. The next best thing to a double boiler for heating milk is a thick granite sauce pan perviously rinsed out with cold water. The water fills the pores, and helps to keep the milk from sticking.

Skim Milk.—Possibly you have heard of the economical milk maid who would skim the cream off the top of the pan, and then, looking first to see that no one was watching, quickly turn the milk over and skim it on the bottom.

Really it was not so bad, however, for skim milk has a value which is not appreciated. A quart of skim milk contains more proteid—that is, more casein and albumen than a quart of whole milk; and proteid is the most expensive part of our food. Two quarts of skim milk has a greater value than a quart of oysters. Oat meal and skim milk form a well proportioned diet, and if generally adopted by the poor in our cities, would do much to improve the health of the people. The hardiness of the Scotch and Irish are largely attributed to their daily ration of oat meal or potatoes combined with skim milk. In some recent experiments in Maryland skim milk was found to be just as digestible for calves or babies, as the whole milk. Housewives, particularly, in the city, do not realize that there are numberless nutritious and delicious soups and puddings which can be satisfactorily made with the skim milk which is often thrown away.

Cheese.—And now we come to cheese, which is composed so largely of proteid and is therefore such a valuable food product. According to Matthew Williams there is in every pound of cheese twice as much nutriment as in a pound of the best meat. There is much difference of opinion as to the digestibility of cheese, but the fact remains that to the average person it is as digestible as it is nutritious. The Scotch and the Swiss who eat it in the place of meat, experience no trouble in digesting it, nor would any one who ate it rationally, as they do. But it is too heavy to be eaten in large quantity, combined with other heavy foods as we Americans use it.

Contrary to general belief, cheese is considered more digestible when cooked, especially if a tiny pinch of baking soda be added to the preparation. Cheese custard and omelettes, cheese and macaroni, cheese and rice, cheese and potato, are combinations we would do well to introduce oftener into our menus.

Butter is one of the most digestible forms of fat when eaten raw. It can be given to young children when other fats would be harmful. When taken alone it will not support life for any length of time, but in combination with other foods, it is highly digestible and nutritious, and often fattening. It has been said that if bread is the staff of life, then butter is its golden head. When heated, however, it, like other fats, becomes chemically changed. It decomposes and sends off little particles of smoke, which are irritating not only to our eyes and throat, as we who have fried chicken and crullers, know only too well; but it is even more irritating to the tender membranes lining the digestive organs. This is why fried food is so injurious. A fried beefsteak takes twice as long to digest as one which is broiled over hot coals. Raw butter, however, is very hygienic, as you, of course, know.

Buttermilk, strained, contains less fat than ordinary milk, and is digestible and refreshing. It should be drunk fresh, as it decomposes quickly.

Surely the dairy is about the most important food institution which the country possesses. The household economic people as a class, are exceedingly grateful to the dairymen for their praiseworthy efforts in securing clean, pure milk products. A gigantic stride has been taken within the past ten years. Think of the dainty brick of butter, covered with its waxed paper, or the clean glass bottles of separated cream and compare it with the crude products and methods of twenty years ago. There is much to be done, however. Frauds are even yet perpetrated in many of our milk stores and butter packing houses. Butter of all grades and containing all degrees of dirt and adulterations, is melted down, re-colored and sent out as "best creamery." Such frauds are the worst enemies with which the legitimate dairy business has to contend. But, on the whole, a public sentiment has arisen, which bespeaks better things. Science, too, has aided the dairyman, and probably it is safe to say that at present dairy products are the cleanest of all food stuffs with which the housekeeper has to deal.

It used to be said that the stream in Montana, called the Milk river, was so named because—because it contained water. The time has come when we call it the Milk river, because it is so pure.

BUSINESS DAIRY PRINCIPLES.

By Prof. D. H. Otis, Professor of Dairying, Kansas Agricultural College.

Before a man embarks in the dairy business he should stop and consider the cost. Dairying, like any other pursuit, is a business proposition and should be established with the same care and judgment that is exercised when a bank is started, or a dry goods company is incorporated. To succeed in any pursuit a man must be in love with his business. While attending a farmers' institute in Kansas a farmer made the remark that he wanted his son to be a doctor, and said he was willing to send him to a medical college, but did not feel like sending him to an agricultural college. The son, on the other hand, preferred farm pursuits. Another farmer in the same neighborhood remarked that he wanted his son to become a farmer, although the boy had inclinations toward the law. Both of these men had wrong ideas. Give that young man a chance to develop along the line that suits him best. He may make mistakes, but rest assured he will find them out before it is too late and he will be all the stronger for the experiment.

While the inclinations of a man are to be considered, those inclinations are greatly influenced by environment. While assisting at a farmers' institute in Marshall county, Kansas, your speaker was invited to remain over night with Mr. L. Scott, a farmer who lives two miles out of town. Mr. Scott is a former school teacher, and ex-county superintendent of Marshall county, but for the last five years has been working and improving a 90-acre farm. Mr. Scott is working on the theory that the farm should, as far as possible, produce all his family needs on the farm, and accordingly has a fine apple, peach, pear and plum orchard, together with an abundance of small fruits and strawberries. A garden near by contains all the fresh vegetables that the housewife could possibly use, even to a large patch of peanuts for the children. Both the orchard and the garden are planned with a view of producing more than is needed by a family, thus furnishing a little ready cash from the sale of extra products. A little patch each of alfalfa, clover, corn, sorghum and millet completes the list of crops grown. A few hogs, some chickens, and a small herd of cows, with a few horses, completes the list of live stock that converts his crops into ready cash.

Mr. Scott believes in getting all the comfort and enjoyment that it is possible to get out of life. He does not overwork and for this reason has time to spend with his family. When a holiday comes he sees that the chores are done and then he celebrates. Mr. Scott says he is not getting immensely rich, but he is getting lots of satisfaction out of his farm. He has plenty to eat, plenty to wear, and plenty of time to read and enjoy himself with his family. What more does a man need? Such a life is worth living. We need more such spirits among our farmers.

There is another feature connected with this farm that should commend itself to every intelligent farmer. Mr. Scott has adopted four bright boys from the orphan asylum. When these boys come to the farm each one is given a pig, a chicken or a calf, as his own property, which he is expected to care for, and when sold to invest the proceeds into something else. In this way the boys learn how to conduct business transactions. Once in a while an object lesson is given. For instance, two years ago Mr. Scott had cholera among his hogs. One day he asked one of the boys if he would trade his rooster for a hog that he saw at a distance in the yard. "Oh, I will trade," replied the boy eagerly. "All right, we will call it an even trade," replied Mr. Scott. A moment later the boy went out to look at his hog and found it dead. The boy's experience was a hard one and although the rooster was returned three or four days later, he never will forget the lesson.

These boys have twenty-five holidays during the year—one on each of their birthdays, on legal holidays, and a few extras thrown in. On these occasions the family hitch up the team and go off for a fishing expedition or in some other way, to enjoy themselves. The boys look forward to these excursions with a great deal of interest. In the meanwhile they are expected to work, and do work with a vim.

When leaving the farm the speaker went out to tell the boys good-bye. He remarked to one of them that he would expect to see him at the agricultural college some of these days. The little fellow pointed to a calf out near a tree, and said, "Do you see that calf? I think that calf will send me to college."

How many boys on our farms are encouraged to take an interest in farm work like these boys are taking? It is one of the leading secrets of keeping the boys on the farm. It adds interest to their work and helps them to realize that farming is not all drudgery. It was surprising what interest, what enthusiasm the boys put in their work. Give the boys a chance, let them handle some of the income, buy their own clothes, shoes, hats, etc., and it will not be long until the boys will be inclined toward the farm instead of away from it.

Much complaint is raised that the hired men do not like to milk. Frequently that is the result of asking them to do a full day's work in the field in addition to the milking and other chores. Allow the milkers to finish the chores by the time the regular field men quit work and their attitude toward milking will be modified considerably. At the Kansas Agricultural College the position of the milker is in demand by our students, not so much for the money they can get out of it as for the skill and knowledge gained by keeping the records in connection with actual experience. All our boys are trying to make records with their cows, and of course are very careful to milk them clean. They compete with each other to see who can get the most milk and at times they get so interested in special cows that they can hardly wait until they are through milking in order to weigh the amount, and it is amusing to watch the pleased expression when a high yielding cow goes up a few tenths of a pound in her yield or her test. It is such intelligent interest as this that makes the milking hour a pleasure and not a time to be dreaded and scorned as is too frequently the case.

From what has been said it will be seen that a poor man will not make a dairyman; an average man will scarcely make a living; only the best men make a success of dairying in the truest sense of the word. What is true of the man is likewise true of the cow. It frequently happens that farmers, hearing of the profits to be derived from private dairying or from a newly established creamery, become intoxicated over the prospects, and as a result every cow that can be bought in the neighborhood, regardless of quality, is drafted to contribute her mite at the milk pail. A partial record is kept for a few months or perhaps a year, and, after estimating the cost of labor and the cost of feed and subtracting this total cost from the total income, the profit is either a minus quantity or so small that the conclusion is reached that dairying doesn't pay. This dissatisfaction is frequently contagious, and a number of farmers in a single community have been known to quit milking their cows because they have found by experience that there is no money in the business.

A man might with just as much propriety go to Arkansas, buy up all the razorback hogs he could find, and after a year's experience declare that there is no money in raising pork, as to say that there is no money in milking cows. Undoubtedly there are far too many "razorback" cows in Kansas and Missouri as elsewhere; cows that are actually "eating their heads off," to say nothing about the expense of labor or interest on the money invested.

Unless a cow gives considerably more milk than is needed by the calf, it will not pay to milk her. If a man's time is worth 12½ cents per hour (and every dairyman's time ought to be) it will cost $8 a year to pay for milking a cow; and it will cost from $8 to $9 to raise a calf by hand on skim milk. This indicates that a cow must produce, to be a profitable milker, at least $16 worth of butter fat. This leaves the skim milk to pay for the hauling. With four-per-cent tests and 15½ cents butter fat, this would mean 2600 pounds of milk per annum. This does not mean that cows giving this amount of milk are really profitable dairy animals, for usually a dairy cow will consume more grain than one nursing a calf, but it indicates to the man who has the dual purpose animals what his beefy cows must yield in order to pay for the expense of milking and raising the calf by hand.

If poor or average cows are not a success in the dairy, how are we to get the choice cows so much desired? Not by buying, for such cows are seldom for sale. In nearly every herd there are at least a few good cows. It is only by persistent selecting, feeding and crossing these with a No. 1 dairy bull, that the average farmer can hope to possess a herd of choice dairy cows. How can a man tell his best cow? The only way yet invented is through the record of the scale and the Babcock test. A man often thinks he knows his paying cow without having kept a record, but usually when his judgment is placed alongside the scales and Babcock test, a big discrepancy appears. Mr. Chas. C. Lewis, of Kansas, a close student of the dairy cow, and one who is in the dairy business for the money he can get out of it, has the following to say on this point: "I thought I knew our cows quite as well when I began keeping our record, and I numbered them in the order I thought they would stand at the close of the year. I got the first one right and the last one; the other eight were all wrong."

"But I cannot spend the time to keep records," is the sentiment of a large number of cow owners. Upon the point, as to whether it pays to keep records, Mr. Lewis says: "We think it does. It adds interest to the milking and is one of the best things I know to get the boys to do their work well and to milk the cows dry, each one being anxious to have his cow do the best. It forms the only basis upon which to weed out the poor cows and keep the best. By carefully studying the records you learn the individuality of each cow and know how to handle her to the best advantage.

"The effect of care and feed are easily noted, and improvements along these lines may thus be inaugurated. When the milk flow of an individual cow, or of the herd, decreases, we know it at once, immediately look for the cause and try to find a remedy.

"The time required to weigh and record the milk is very small. The scales and milk sheet are placed in a convenient location, and it takes but a few seconds to make the record. A new sheet is placed on the board each week, the old one being taken to the house and recorded. The weekly sheet furnishes an instructive study for one who is interested in his herd, and it is a pleasure to see what interest the boys take in the performance of the cows for the week.

"I see no reason why the dairyman should not know whether he is conducting his business at a profit or a loss, just the same as any other up-to-date business man. If there is a loss, he should have some system that will enable him to detect the source of the loss. The individual record furnishes the only means."

Mr. T. A. Borman, a Kansas creamery patron who realized an income of $81 from each cow in his herd, has the following to say about keeping individual records: "Years ago we began weighing through idle curiosity, but this demanded regular weighing, and the spring balance demanded the Babcock test. The one without the other is a delusion and a snare, and the two brought about tabulated records. Dairying without these simple means of ascertaining the real value of the cow is not conducive to the best results. I know that a pair of spring balances hung in a convenient place in the barn, will actually make a cow give more milk. They induce clean milking, and if a good yield is shown one day and a low one the next, he is a shiftless milker, indeed, who will not give the same feed, or place the cow in the same condition as nearly as possible as that of the day of the high yield. The scales in the barn are a good thing for us and will do much good for any one else. No farm work is so instructive, or will yield so great a return for a bit of intelligence, as does dairying."

At the same time we are choosing we must be improving. The criticism is sometimes raised that the experiments carried on at our agricultural experiment stations are of but little value to the average farmer, for the reason that the stock used are either pure-blood or high grades and are not the kind with which the average farmer has to deal.

On the contrary, considerable criticism has been expressed by farmers and agricultural writers about the Kansas Agricultural College spending its time experimenting with scrub cattle, when it might be spending its time to much better advantage in testing blooded cows. Undoubtedly both criticisms are well taken. With most of our farmers it would be impracticable, as well as unwise, for them to sell off their common and grade cows and buy pure-bloods. The problem that confronts them today is, how best to make the most of what they have.

Records of a number of herds in Kansas and Missouri show that some of the dairymen are succeeding. But while a few of our best cows are yielding from 200 to 300 pounds of butter fat per annum, the general average is far below. The average annual capacity per cow of the herds of 82 patrons investigated by the Kansas Experiment Station was 104 pounds of butter-fat. Where the cow machine has been the object of prolonged and deep study we find whole herds that average over 350 pounds of butter-fat and individual cows that yield from 400 to 500 pounds. This, and the good records with which we are already familiar, give us an idea of what we may expect from good dairy cows, and show very plainly that there are great opportunities for improvement. The dairy interests of these western states are demanding a dairy cow that has the capacity to transform cheap raw feeds into milk and do it with such a degree of efficiency that there will no longer be any doubt about the unprofitableness of trying to squeeze milk out of a beef animal. If this great need of western dairying is to be met, it will necessitate the use of better sires in grading up common herds.

A good grade cow may yield as much milk and butter as a pure-blood, but a grade of any kind has not the power to transmit its qualities to its offspring as has the pure-blood, for the reason that the latter has received the qualities for which the breed is noted through a long series of years of careful breeding and selection and these qualities have become fixed or permanent.

Out of the 82 patrons mentioned, there were only 19, or 23 per cent., that were using pure-blood sires, and two of these had Herefords and one had Aberdeen Angus—animals that, as breeds, are unfit for profitable production of milk. This leaves 77 per cent. that bred to grades or common bulls of no particular breed. Some of these are bred to any kind of a bull that they could find to get fresh cows. One man bred to a Red Poll bull because he was working for a red color. Another man did not know what kind of a bull he had last year, but said he had a fine one this year. When asked the breed, he replied, "Don't know, but guess he is a Red Polled." Right here lies the secret of many of the low yields of our cows. Many of our farmers little realize how extravagant they are in using a common or ordinary bull. Their short sighted policy leads them to believe that because a good animal costs $100 it would be money thrown away to invest, when, in reality, it would be money in their pockets. A dairyman can much better afford to pay $100 for a good bull than to accept a poor one as a gift. Mr. T. A. Borman says: "An old red cow dropped two heifer calves in succession, one a half-breed Holstein, and the other from a Shorthorn bull. The Holstein heifer with third calf produced an average of 52 pounds of 3.8 per cent. milk per day for seven days, and at the same time, the red heifer with second calf gave 27 pounds of four per cent. milk per day. The cows were half sisters, one producing 2.3 pounds of butter per day and the other 1.2 pounds; the first milking eleven months of the year, the second dry at five months." "This instance," says Mr. Borman, "only serves to demonstrate the value of a sire bred for milk and butter when the farmer is rearing a dairy herd."

The question very naturally arises in this connection, "What is the best breed to grade up cows along dairy lines?" Unfortunately we have no definite or extensive experiments to throw light upon this point. But in the absence of experimental data as to crossing with different breeds the dairy interests must not lag. Any of the dairy breeds can furnish sires that are vastly superior to those from grade or common cows, and our dairymen should become acquainted with this fact. The dairy interests demand that the breeder of the coming dairy cow shall be a sire that will stamp his qualities in a way that they will show at the milk scale and Babcock test, and the improved stock breeders along dairy lines need to agitate and educate until our dairy farmers feel that they are committing a crime against their own welfare to use anything but a pure-bred sire. Life is too short in which to grade up a herd of common cows with a common bull. Time was when we could afford to harvest grain with a scythe, and the time was when we could afford to keep an ordinary cow for her calf, but that time is past; we must now have the modern improved self-binder, and likewise we must have the modern, improved, up-to-date cow machine.

The right kind of a man in possession of the right kind of a cow will not be able to accomplish much without the right kind of feed. This feed must be rich in milk producing elements, must be appetizing and at the same time be economical. The latter point is usually the best accomplished where as much of the feed as possible is produced on the farm. In the spring the blue grass and in some localities the orchard grass and clover furnish abundant and nutritious pasture, and in favorable seasons will continue through the summer. Frequently and especially during the last season, there comes a dry spell through June and July, or July and August. This dry spell may be tided over by the use of soiling crops, preferably green alfalfa, clover or corn, although oats, sorghum and Kaffir corn may be used to advantage. During the past summer the Kansas Experiment Station tested the value of sorghum pasture for dairy cows with the following results:

During the month of July we realized $8.20 per acre from pasturing sorghum, besides having the field left to produce a second crop. On July 1, 27 cows were given all the alfalfa hay they would eat and then turned on a sorghum field of 6.7 acres for 15 minutes. The sorghum was from 18 to 24 inches high. The next day they remained 30 minutes, the third day 45 minutes and so on increasing 15 minutes daily until they reached an hour and thirty minutes when they were left to run at will. During this transitional period the cows were given all the alfalfa hay needed to keep up the normal flow of milk. For the first nine days this amount was nearly 24 pounds daily per head. After 12 days the cows were allowed to pasture the sorghum at night as well as during the day. For the rest of the month these cows consumed less than 5 pounds of alfalfa hay daily per head.

If it had not been for the sorghum pasture it would have required at least 24 pounds of alfalfa hay daily per head to keep these cows up to a good flow of milk. This would have amounted to 10 tons. As it was, the cows consumed only 4½ tons, making a saving of 5½ tons. At $10 per ton (a low price for this year) this would have amounted to $55 which divided between 6.7 acres would amount to a saving in alfalfa consumed of $8.20 per acre.

On August 1 the cows were turned into a fresh field of sorghum, from three and a half to five feet high, but with the same precautions that were exercised July 1. This time it did not take so long to get them on full feed, and after the first week had free access to the sorghum day and night. The two fields of sorghum were connected with each other and the cows not only had access to both fields but in getting to the second field were obliged to pass through the first, where second growth sorghum was making a vigorous start after the recent rains. The herd has not experienced the least trouble from poisoning or even bloating.

During the time the Kansas Station has been pasturing sorghum several reports have been received of cattle dying from ten to fifteen minutes from the time they entered the sorghum patch, but in every case where we have been able to get the details, the cattle have eaten the sorghum on empty or nearly empty stomachs. Cattle should have their stomachs so well filled that they feel completely satisfied before touching the green sorghum, and then allowed to eat only a few minutes at a time until they are accustomed to it. If sorghum can be pastured successfully, as has been done at the Kansas Experiment Station, it means that the dairymen and stockmen can get an immense amount of pasture from a small area, which is available at a time when their other pastures are getting short and dry. Pasturing will also be the most economical way of utilizing sorghum. The man that turns his cattle in a sorghum field, however, must realize that he may be taking risks. He must weigh the evidence for and against its use and then decide for himself whether the benefits will outweigh the risks.

With blue grass, orchard grass, red clover and sorghum for pasture supplemented if necessary with soiling crops will enable the dairyman to get through the summer in first class shape. The next problem is to provide grain and roughness for winter use. Corn, Kaffir corn and oats can usually be grown in abundance; bran can generally be had at reasonable prices and supply houses for concentrated meals are not far away.

For roughness you have already heard of and some of you have used silage. It is one of the best and cheapest feeds for the dairyman.

Red clover grows luxuriantly in Missouri and is a most desirable hay. Without detracting one word from the credits of red clover there is one crop which greatly outranks it both in yield and percentage of digestible nutrients. I regret to say that Missouri farmers have not yet taken hold of this crop as they ought. Alfalfa is becoming more and more the wonder crop of the world. This last season's dry spell has established its superiority beyond the shadow of a doubt. In eastern Kansas, on soil similar to that found in Missouri, the first cutting (about May 10) yielded from one and a half to two tons per acre. There was from four to five cuttings during the season, making the aggregate yield from three to nine tons per acre. In good seasons two tons of red clover is considered a good yield. Alfalfa produced that much of a yield before there was any sign of a dry season. Alfalfa is nearly fifty per cent. better feed than red clover pound for pound. Alfalfa being a perennial does not have to-be reseeded every two years. It sends its roots down to a great depth to gather plant food and water from the lower portions of the soil. Perhaps a few examples will better impress us with the importance of alfalfa. Mr. A. Scott, of Pottawatomie county, Kansas, had 12 acres of alfalfa. The third cutting was saved for seed and yielded 105 bushels. This sold for $5.50 per bushel. The seed and hay combined brought an income of $82 per acre. Another farmer, C. W. Peckham, of Reno county, Kansas, realized $52 per acre from his alfalfa land. Mr. M. O'Brien, of Montgomery county, Kansas, measured his alfalfa by adding the height of one cutting above another and during the season found that his alfalfa had made a growth of 13 feet and a yield of 7.4 tons per acre. Is any farther testimony needed to show the Missouri dairymen the value of alfalfa? Missouri has excellent natural advantages but her dairymen will not make the most of them until they get their farms well seeded to alfalfa. It will be impossible here to go into a discussion of preparing the ground, sowing, care of young plants, care of old plants, harvesting and feeding alfalfa.

Pasture grass, ensilage, Indian corn, sorghum or Kaffir corn and alfalfa make a combination of feeds that are exceedingly economical and hard to excel in quality in Missouri or anywhere else. It rests with the dairymen of today whether they will lay hold of the opportunities offered and make the most of them in advancing the dairy interests of this great commonwealth.

HOW I FEED MY DAIRY COWS.

Paper by J. L. Erwin, Steedman, Mo., to Whom Was Awarded the First Premium.

Dollars and cents to the credit side of the balance sheet is the ultimate object of every dairyman. Large yields per cow at large expense and risk, may mean, after all, little profit in the business. My pastures of blue grass, timothy, red and white clover, orchard grass and red top supply the feed in general from May till November.

It may interest this audience to know how I have managed my cows during the past year. A year ago we had a fine crop of pumpkins, which we sliced with a corn knife and fed to the cows, adding also a few nubbins of corn twice a day to the grass ration. I have ground no corn for the past eight years because corn was too cheap to grind. When corn was worth 25 cents per bushel, it cost one-fifth to get it ground; this one-fifth added to the ration, was all saved by the pigs and the chickens. I fed my best cows a peck of nubbin corn, chopped fine with the shuck on, at a meal, with all the corn fodder (and at times a small ration of clover and timothy hay) they would eat. I shredded my fodder last year and my cows did well on it.

About April 20 I turned on grass, and by the first of May had ceased to feed corn. July 25, 1901, found the pastures so dried that I began hauling green corn from the field and running it through a feed cutter and supplementing this with about two pounds of bran and two pounds of ground wheat per day. This I kept up till October 18, when I began grazing on wheat, which I sowed, commencing on September 7, since which time I have fed nothing. Whilst others were sowing cow peas, sorghum, Kaffir corn, Hungarian millet, etc., I was at work on my wheat ground. I plowed shallow and rolled and harrowed and rolled till when the drill started it was one great field of dust, which made such a cloud of dust you could hardly see the team. My neighbors were all against me; "Will lose your seed. It will sprout and die," they said. "Why didn't the wheat sprout and die that shattered off last June," said I. Wheat is a plant that grows in cool weather. Fine earth will hold the moisture the longest; wheat is the best drouth resisting plant we have; old fashioned red clover and common field corn—the Missouri article—with its thick, tough blade, next. Had we understood this thing fully and thinned our corn to the old way of four feet apart each way, and two stalks to the hill, and made a dust mulch of the surface, we would have made a good half crop. I intended to say that by feeding I held my cows up in condition, though I lost nearly half in yield, till I reached the wheat pasture and I am now getting as good a yield as I did last June when the grass was good.

I am going to grind my corn this winter, because it is old corn and the cob is too hard for the cows to crush, and the corn is too high in price to allow any considerable portion to go to the cheaper hog. I ran nearly my whole crop of corn this year through the feed cutter, corn and stalk, and blew it into the mow over the cows. I took the cyclone stacker off my shredder and put it on the feed cutter. It worked to perfection.

I am shredding fodder for my neighbors and baling the shredded fodder like hay. A good shock of sixteen hills each way will make about two bales. Care must be taken to see that the fodder is dry, or it will mould and heat. I am also baling my wheat straw and may cut some of it if the corn gives out.

As soon as it gets cold and frosty I shall begin a grain ration at full feed; will give a peck of ground corn and cob with a couple of pounds of bran or ground wheat mixed with it.

Now, as to the income. All the stuff fed is raised on the farm; the milking and churning is done by the family. Twenty-five cows and heifers have turned in about $1,000 during the year, the butter selling at 15 cents for the six summer months, and 20 the six winter months. It is about all sold at the nearest town, four miles away, on a cash basis. The calves brought $300 of that sum.

DAIRY SANITATION.

By Dr. D. F. Lucky, State Veterinarian.

The subject of sanitation about the dairy is entirely too comprehensive to be treated in full in any one paper. It would probably require a paper longer than this Association would desire to hear to go into the details of how to keep the dairy and dairy utensils clean. It would require another to explain the proper ventilation and lighting of the dairy building. Material for another would be furnished by the plans for the proper drainage for the dairy building and its surroundings.

It seems almost useless for me to suggest here that it is important and necessary for dairymen to practice the utmost cleanliness in connection with the milk vessels, the water and feed troughs and the floor of the dairy barn. Cows, as well as other animals, require plenty of fresh air, and besides lending a wholesomeness to the surroundings, plenty of sunlight destroys many germs of disease.

I will not stop to consider these matters in detail, but pass on to call attention to two things which are of the utmost importance in connection with the subject of sanitation. The first is the use of due care to avoid the introduction into the herd of diseased cattle. The second is the proper arrangement of stalls in the dairy barn to prevent the rapid spread of the disease should it once gain a foothold.

Spreading Disease.—The promised development of the dairy industry in this State in the near future will require the bringing together of new herds, the addition of new blood to those already formed, and the interchange of stock among the dairymen. In the ordinary trading of stock, especially of herd bulls, with a view to improving their herds, dairymen necessarily open the way for the introduction of disease. The extra traffic that we may expect as a result of the impetus that the dairy industry is receiving will increase the chances for the spread of the disease, and unless the greatest possible care is exercised by those who are undertaking the dairy business, disease will increase faster in proportion than the number and size of the dairy herds. It is to this matter that I wish to call the special attention of the dairymen present today. I wish to urge that the greatest possible care be taken in the selection of dairy stock, to avoid getting disease. I should like very much to have the co-operation of the dairymen and breeders in an effort to prevent the introduction of disease among Missouri herds, so that these herds may be kept in the future, as they have been found in the past, practically free from all contagious diseases.

I do not mean to infer that either dairymen or breeders are careless in this matter now, or that anyone would purchase an animal of any kind knowing it to be diseased. The point I want to bring out is, that now and then a diseased animal is added to a Missouri dairy herd and considerable damage is done in spite of the fact that the owner used what he considered reasonable care. I want to call attention to two diseases in particular, either of which will ruin a dairy herd and either of which is liable to be overlooked in purchasing stock by the ordinary dairyman. I know of only a few dairymen in the State today who use precaution enough to prevent the introduction of these diseases. The ones I have in mind are contagious abortion and tuberculosis. Just now at the very dawn of the dairy industry in this State, I wish I could stamp on the mind of every man who is interested in the business a deep impression of the damaging nature of these plagues. To say the least a cure for either is not practical. We will therefore have to prevent them as far as possible and I shall discuss their prevention alone.

Contagious Abortion.—I can call to mind some ten herds of dairy and breeding cattle in this State which from time to time have become affected with contagious abortion. One was a herd of registered Jerseys, one of pure bred Herefords, one of grade and pure bred Aberdeen-Angus and one of mixed dairy cattle of good milking qualities. More or less despair was caused by an effort to proceed with the breeding of these infected herds. The disease could be held in apparent check for awhile and would then blaze out afresh. Its ravages were to the extent that at least the profits of the several herds were lost. The Jerseys eventually were sold for beef, the Herefords were sold at a sacrifice of some $8,000 on their value and the mixed cattle were put on the market for what they would bring for beef. The best advice that I could give in regard to handling an ordinary bunch of dairy cattle which were affected with contagious abortion would be to prepare them for beef and put every animal in the herd on the market. The barn can then be disinfected and a new herd purchased, but I fear that at this point many dairymen would quit. Let us hope to prevent this plague and spare our dairymen the loss and worry caused by it.

I cannot discuss contagious abortion here any further than to point out the necessity of its prevention. It is enough to say that it is practically incurable and may be introduced into a herd by an infected animal. It is spread most by the bull. The cow is not apt to spread it any further than to the adjoining stall, and on pasture I think cases are rare where she spreads it directly to the other cows. The infected bull, however, infects the entire number that are bred to him with the result that, as a rule, about three-fourths of that number abort.

It is to be regretted that there is no way to tell by any kind of an examination whether or not a bull is infected with contagious abortion. The purchaser must therefore avoid the disease in one of two ways. He must either rely upon the representations of the seller or buy stock that has never been bred. I think that the bull always gets the infection by serving an infected cow. Therefore a purchase of a bull which has never served a cow is the thing to do; I believe that such a bull will not spread contagious abortion even if he is selected from an infected herd. I can not, in this connection, advise too strongly against the breeding of a cow that has aborted from any cause whatever to a good herd bull. I should treat every cow that aborts as though she had the contagious form, and if I wanted her to milk again I should keep her isolated and breed her to some bull of little value. A good herd bull is often ruined by allowing his use in breeding outside cows, and this is bad practice as far as the owner of the bull is concerned. The herd bull at the Missouri State Farm was infected in this way and has spread the abortion to nearly all of the cows. Those in the dairy business doubtless have cares enough without soliciting by carelessness the extra burden which this disease will cause them. I only wish that those who have had no experience with it could comprehend all the facts about it as well as those who have worried with infected herds.

Tuberculosis stands as a constant menace to our dairy herds. There are no symptoms by which this disease can be detected except in the most advanced stages. However, the tuberculin test affords a means of detecting it in the early stages. In order to allay any prejudice that may exist against the tuberculin test, let me say that tuberculin is a glycerine extract from the cultures of the tubercule bacilli containing neither live nor dead germs. It is injected beneath the skin of the animal and I have never noticed any harm coming from its injection any more than would be done by the injection of the same amount of distilled water. The marked rise in the temperature of the animal following in from nine to sixteen hours after the injection indicates that the animal is affected with tuberculosis. I have examined herds of breeding and dairy cattle over the State, applying the tuberculin test to ascertain whether or not Missouri cattle are affected to any extent. I have found tuberculosis in connection with two herd bulls and in one lot of dairy cows.

In order to explain the contagious nature, the absence of symptoms in the early stages and the use of tuberculin to detect tuberculous animals—things which are necessary to carry out my original purpose of telling how to prevent tuberculosis—I shall relate briefly the facts in connection with the test of a dairy in which 56 out of 94 cows were found to be tuberculous. In this particular dairy the sanitary conditions were supposed to be the best. The lighting and ventilation were just about perfect; and the floor was made of cement and kept scrupulously clean. To avoid any cracks or crevices for the accumulation of filth and germs of the disease, the cattle had no feed boxes. Their feed was poured on the plain surface of the floor just in front of the row of stalls and here is where a fatal mistake was made, that of allowing the cattle to eat together. In cleaning up, trash was swept along in front of the stall from the feeding space of one cow over that of another. There were four rows in one department of this barn each containing 18 cows. In one of these rows a tuberculous cow was introduced into stall No. 5 and when the test was made all of the others were found to be tuberculous in the same row in the direction in which the feeding surface was swept. The four cows on the other hand still remained healthy. In 1899 the cows of this dairy were found upon examination by the State Veterinarian to be free from tuberculosis. A few head of tuberculous cows were introduced during the year and the disease spread from them inside of twelve months until 56 out of 94 head were tuberculous. This example shows three things. First, it shows the importance of avoiding the purchase of tuberculous animals; second, the contagious nature of tuberculosis; and third, the danger that comes from the feeding together in a common trough, of cattle that are to be housed and kept for breeding and dairy purposes.

All experience has shown and reason teaches that where cattle are to be housed the stalls should be so constructed that each animal has an entirely separate trough and manger and each animal should always be required to occupy the same stall. This alone is of more importance than the whole question of lighting and ventilation of the dairy barn and I may safely include the drainage and cleanliness of the floor. Numerous cases are on record where a tuberculous cow, always occupying her individual stall has remained in a dairy for years without spreading the disease to other cattle. I therefore suggest the use of individual stalls and feeding apparatus.

I am sure that those who have had any experience with contagious abortion or tuberculosis do not need to be reminded of the necessity of the prevention of these diseases. What is true of them is true of lumpy jaw and other diseases. Let us hope that all dairymen will use reasonable diligence in preventing the introduction of the disease into their herds and that none will try any experiments with feeding cattle in a common trough.

MAKING PRIZE BUTTER.

By A. M. Larsen, Kansas City, Mo.

If I should be asked to give any definite rules for making prize butter, I could not. I know of no rules that would apply in all cases. The rules for making a uniform, high grade of butter will all depend upon the conditions the buttermaker is laboring under, condition of milk and cream, and the season of the year.

There are those who seem to know how to make a fine article of butter, but for some reason, lack of vigilance and a lack of application to their work, result in failure to produce a uniform article.

There are those who depend upon theory alone and do not combine with it the knowledge of actual experience, and utterly fail. Theory and practice must go hand in hand. The production of a fine article of butter under conditions where everything is favorable, offers no criterion by which to pass judgment on a man as a buttermaker. First of all, a buttermaker must be an excellent judge of milk and cream. It is impossible to make prize butter from tainted milk or cream. It must have a clean flavor. Certain bad odors can be overcome in the process of ripening, but it is best not to have them. My highest scores were received on butter made from milk two or three days old. Of course it would undoubtedly have been better had I have had milk only one day old, but the principal thing seems to be to have clean, sweet milk even if it is a few days old.

I favor ripening at a high temperature if conditions are favorable, but a buttermaker must adapt himself to conditions under which he is working. He must take the practical side into consideration in his daily routine of work, more than the theoretical side, or he will not make a success.

If I had a creamery where I could take in the milk myself or where I could treat the milk direct from the weigh can to the cream vat, I would skim at such a temperature that the cream would be 75 degrees in the vat and ripen at that temperature. As to how long I would keep it at that temperature, would depend upon facilities at hand for cooling and the condition of the cream during the ripening process. If everything was favorable and I could control temperature, I would not let the temperature go below 70 until it had reached its proper acidity, and then cool down at once to churning temperature, but if I had to cool cream with water and ice surrounding the vat, then I would begin cooling before the cream had reached its full ripening stage, so that it would be about right when cooling process was completed. We receive our cream from the numerous skimming stations at the Brady-Meriden factory in Kansas City from 6 to 10 o'clock in the evening. The cream is immediately graded and that of the same quality and temperature put in same vat. A starter of 10 to 15 per cent is added and temperature is raised or lowered as required so as to have cream ready for churning at 5 o'clock next morning.

I never make any special selection or rejection of milk or cream when making butter for contest, nor do I change my way of making from my every day method.

The tub of butter that secured sweepstakes at the St. Louis Fair recently, on a score of 97½, and pronounced by the superintendent, Mr. Chubbuck, as being one of the best tubs of butter ever exhibited at the St. Louis Fair, was made from cream from four different skimming stations, about 300 gallons in all. The cream arrived at the factory at a temperature of 70 degrees, slightly sour, but of clean flavor. I used 10 per cent of skim milk starter on account of my commercial starter being "off" and a new bottle of culture failed to arrive in time to get a new starter made from it that day. The cream was kept at a temperature of 70 degrees until it had reached its proper acidity, when it was cooled to 52 degrees by putting ice into the cream. I do not recommend this method as the proper one for cooling cream, but it is the way we have cooled our cream all summer and I have noticed no bad effects from it. Of course we used pure manufactured ice made from distilled water.

The butter which we sent to the Pan-American Exposition for October contest was made the same way as the St. Louis tub, except that a commercial starter was used. We had 46 packages exhibited there, of which the highest scored 97¾ and the average was over 96 points.

The cream was churned until the granules were the size of wheat kernels, when the buttermilk was drawn and the butter washed in water at 52 degrees by revolving the churn once in slow gear. I used half the amount of water that I had cream. The water was quickly drawn and the butter salted with Worcester salt, one ounce to the pound of butter; churn revolved twice before put into working gear. Working was finished in 30 minutes and was made in a Disbrow churn and colored with "Alderny" butter color, of which I used one-half ounce per thousand pounds of milk.

City Forestry.

By L. A. Goodman, Secretary State Horticultural Society.

A quarter of a century ago it would have been easy to have settled this matter in many parts of Kansas City, and especially so on these rocky hills and deep ravines. All these hills and valleys were covered with some of the most beautiful forests known to this western land. The elms and oaks, in a dozen varieties, the walnut and hickory as fruit producers, the linden and willows giving honey to the wild bees, the maples, hard and soft, sugar, and white, growing beautifully everywhere, the sycamore, ash, wild cherry, cottonwood, hackberry, coffee bean, the thorn and crab apple with their beautiful flowers and delightful, pungent fruit, the box elder, and in some places the tulip tree. All these magnificent trees interspersed with an endless variety of shrubs and vines and plants and wild flowers would have made it easy for one to settle this matter of City Forestry with the greatest of satisfaction in the olden time.

It does seem a pity that these western Americans have so little regard for the trees in, and about, our large cities. Beyond this, it is still more deplorable to see how quick our city fathers have been to destroy every tree that stood anywhere near a street or sidewalk, no matter if it be a forest tree planted by nature and grown for hundreds of years, or if it be one planted by the owner of the lot and cared for until it becomes like one of the family, if it only stands one foot in the way of a street or sidewalk, out it must come. What has been done cannot be helped now, but what we may do by carefully guarding our treasures, "the priceless trees," and by preserving religiously every one of them is a matter in which we are all deeply interested. There are many of these beautiful hillsides and valleys and creek bottoms in and about our city, which are still worthy of our attention and preservation. Trees as old as this nation, yes trees which were in these valleys when the Pilgrim Fathers landed at Plymouth Rock, or perhaps when the foot of the first white man stepped upon this land, are of such wonderful beauty and size that we must surely revere and protect them. There are elms in the Brush Creek valley which measure twelve to fifteen feet in circumference and the spread of the branches over one hundred feet. There are beautiful dells and vales, rocky knolls and steep hillsides, high bluffs and glorious hills, grand springs and lovely creeks which are still covered with the native forests that are of untold value for future beauty and they must be preserved.

I have but to point you to the beautiful Fairmount Park, and the Wissahickon river out of Philadelphia, where you may revel in the beauty of nature's forests in which has never been the ax of the woodman. Within a few miles of the capitol of our nation there are hundreds of acres of the native woods in all of their wild beauty and those places are being preserved with a religious zeal and determination.

How much more should we reserve and preserve some of the grandest spots about our new city. Then there are noted trees on some of these old homesteads and on some of these hills which should always be cherished for their age and beauty.

A society for the preservation and improvement of our natural beauty spots and waste places is something to be desired right here in this city. But the probability that this will hardly be accomplished soon shows the greater necessity of something being done now, ere we lose more of our natural beauty. There is nothing more delightful than this study of tree growth and nature's beauty; nothing so productive of good for the future, I plead with you, therefore, for your assistance, for your influence, for your authority, to help create a love for trees and awaken such an enthusiasm for the preservation of what we have and the planting of more, that no one will dare to deface, injure or destroy any of them in the future.

Forestry in its true sense means to get the most trees in number per acre that the land can grow, with the idea of getting body growth and as few branches as possible. But City Forestry means to get all the leaf growth, all the shade, all the broad branches, all the spreading top that we can secure on the ground with the least number of trees. Twenty-five years ago the greatest landscape gardener of the West, M. G. Kern, who laid out Lafayette Park and Forest Park in St. Louis, went with me over the hills in and about Kansas City and outlined a most beautiful landscape and park effect. Such a plan might be put in working order and the preservation of these grand monarchs of the forest be accomplished.

Let us then at this late day begin to protect every tree we can and plant every tree we can, with this idea in view, the covering of our city with a leafy growth of trees.

Tree Growth.—What then can we make our city by planting? We know that it takes years to develop these forest trees and we must always keep in mind, therefore, what the trees will be in twenty, forty, or one hundred years hence. We must remember, also, that we do not want tall bodies as the trees get old, with the leaf surface forty feet from the ground, as in real forests, but we want this leaf protection as close to the ground as possible, so we can walk or drive under.

First—By street planting. All street planting should be of one variety on the street for permanent trees, some other varieties may be planted between with the idea of removing as soon as they get too close or the branches interfere. The permanent trees should not be planted closer than fifty or sixty feet. Of course this will necessitate one between them for at least ten or fifteen years, especially if the permanent tree is to be a hard or soft maple. These extra trees are to be used as fillers only, and are to be cut out as soon as they begin to crowd the others. The only danger lies in the failure of the party to thin out. If you can cut out when the time comes, then so plant.

Second—Planting in the waste places, hollows, ravines, corners, or nooks. Many of these may be secured by the city for the asking. Some of them have had the taxes accrue against them and they have been forfeited to the city. In some of our cities these waste places are planted with a clump of forest trees simply for the covering or hiding of undesirable objects and the giving of leaf surface instead of the barren spots.

On many of our waste places nature soon plants a young forest of her own if you will just let her alone and protect the young seedlings as they come up. Note an instance of this on the east side of Grand Avenue south of Twenty-fourth street in the old quarry, where is a wonderful growth of young elms which make us think of the words of the poet.

> The elm a lovely lady is,
> In shimmering robes of gold,
> They catch the sunlight when she moves,
> And glisten fold on fold.

These trees in a few years, if protected, will entirely cover the old barren, unsightly places with a young forest that will be a thing of beauty.

Third—The plan will be to do a lot of group planting at corners or in large lawns or back yards so as to break the monotony of the regular lines of street trees. In the City of Washington we find this plan utilized to its best advantage. Whenever there is a little three-cornered plot at the intersection of streets it is covered with a group of forest or ornamental trees, and it becomes a wonderful relief to the long rows of street trees. We have many large lawns or back or side yards where such grouping can be most profitable and advantageously done without a dollar of expense to the city, if we will but call the attention of the owner to its beauty and value.

What do we plant when we plant the tree?
A thousand things that we daily see.
We plant the spire that out towers the craig,
We plant the staff of our country's flag.
We plant the shade from the hot sun free,
We plant all these when we plant the tree.

In this planting, therefore, we want to understand the nature of the tree. What it is, how it grows, what are its working parts, how it eats and drinks and sleeps. First of all, then, we must ever remember that the tree is alive. It is alive, and because it cannot move, like our dumb animals, and cannot talk like our children, yet it is none the less alive, and it will bend in obedience like our dogs and respond in answering our questions like our children if we can only understand its talk.

The working parts of the tree are the roots, branches and leaves and we should follow nature in the treatment of these. The roots need to be in the ground and the tree needs all of its roots, and so when we take up a tree we must take up all the roots we can get, and we must keep them in as near the condition as they are while in the ground as can possibly be done. You might just as well expect a fish to live out of water as a tree to live with its roots lying in the full sunlight on a hot day or out of the ground during a frosty night.

The tree begins to suffer, in fact, it begins to die just as soon as the roots are out of the ground, and it is only a question of how long it will be before it is dead. More than nine-tenths of our trees are lost by this exposure of the roots, and the trees are really dead before planting, although they may not show it until months after. It is not like Rome, which took 700 years to die, but it does sometimes take the tree seven months to show it.

The tops, body and branches begin to suffer in just the same way, but not so quickly. The branches are evaporating moisture all the time, and if the roots are not able to supply it they at once begin to shrivel up and it is only a question of how long before the tree will be ruined. Again, in the handling of these trees the bark is often bruised and broken from the bodies and branches, and if the trees could cry out they would do so just as quickly as you would when the skin is torn from your hand or arm or face. Then in order to cover these various injuries the "tree butcher" will cut off all of the tops of the trees and leave nothing but the poles. The trees need good roots and branches and young twigs to begin the foundation of the other working part, the leaves which are the pumping force of the tree, the transformer of the sap from the roots into twig growth and the producer of a layer of wood on the outside of the tree. How can the tree do this if there are no leaves until midsummer, as is too often the case when there are nothing but poles, instead of tree tops. These branches and leaves are like you, they love pure air. Trees cannot thrive well otherwise. The scraggy appearance of so many of our trees in the city is due to the soft coal smoke and you may as well expect to keep healthy and rosy cheeked in a dungeon, as for a tree to be healthy and vigorous with soft coal smoke in the air.

Trees love society, they do better in groups, grow more vigorous when they protect each other from the hot winds of the summer, and cold of the winter. They love attention and respond in their own way to every care and attention given them. Do you love trees? Then they will grow for you, they will live better if you plant them, they will answer you with increased loveliness for every particle of food you give them to eat and every drop of water you give them to drink, and every washing or cleansing you give their bodies, just as much and just as certainly and just as intelligently as does any horse or dog or cat.

Do you love trees? Then try them and see and you will get a thousand times the pleasure out of them, you can talk with them more intelligently and receive a hundred times the reward for the love expended upon them in return, than you or any living man or woman can get from a pet poodle dog, fox hound or pug dog in a thousand years and those who live after you will call you blessed.

Set some trees on the commons—
Ashes, linden, poplars, birch;
Set them out around the schoolhouse,
Plant them thick about the church.
Have the childrens' playground shaded,
And the public walks as well,
And the joys from these arising,
Coming ages glad will tell.

This tree planting means much more to all of us than what pleasure we get out of them or those who come after us will get. These trees are a plan of nature to modify the heat of summer and the cold of winter. Our delight on a hot summer day is under the shade of the trees and the modifying of the winter blasts by the forest is just as perceptible to you if you seek their shelter. The trees help to regulate our rainfalls and our moisture and every city and town and village should be a city forest just so far as it is possible. We should have leaf growth of any and every and all kinds for our pleasure and profit and health, and for its influence on the climate and rainfall. Without these forests we should have the desert wastes described by the poet.

The forest trees that in the olden times,
The peoples' glory and the poet's pride,
Tempered the air and guarded well the earth,
And under spreading boughs for ages kept
Great reservoirs to hold the snow and rain,
From which the moisture through the teeming year
Flowed equably but freely—all were gone,
Their priceless leaves exchanged for petty cash.
The cash has melted and had left no sign,
The logger and the lumberman are dead,
The ax had rusted out for lack of use,
But all the eudless evil they had done
Was manifest upon the desert waste.

The Home of the Birds.—I was at Marshall, Mo., the other day in the campus of the college grounds among the beautiful trees and the President said to me that the trees were becoming a birds' paradise and his whole trouble during the summer was to keep the boys and men from killing the birds and destroying the nests. Not the least, therefore, of the many benefits of the tree planting is the place we give the birds for their homes, plenty of beautiful forest trees in which to make their nests, after having destroyed their native habitat, the natural forests.

The farmers and fruit growers realize more and more each day the need of birds as assistants in keeping the insects in check.

This tree planting in all of our cities will thus be of untold value to the agriculturist. Birds are one of the plans of nature to give us sweet songs and also protect us from our enemies.

I plead therefore in this matter for protection to our birds. They are beautiful in our trees but not on hats. They are valuable in our forests but not on our tables. They are happy when on their nests but not when the nests are in the boys' hats. They are industrious after insects if we give them the trees for homes, but they flee far away when there are no forests or city trees to protect them. They are our best friends in the woods and fields but not when murdered by the ruthless hand of the man with the gun. Let us plant trees for the birds.

Nature Study has no more delightful phase of pleasure or profit or investigation than has this same tree planting or "City Forestry."

1. It creates a love for the trees so that we can talk or commune with them to our heart's content. You know how much more you enjoy society when you are well acquainted with every person present, do you not? Well just so do I plead for a knowledge of our trees, know them, get acquainted with them, see their characteristics in summer, in winter, know the leaves, the twigs, the bark, the roots, know them by name just as you know your friends by name and call them such.

Our Friends the Trees.—"The book for every one to read is the open book of nature. There was none ever written that contains one-half of the information, none other half so fascinating, none so perfect and so pure."

A FEW PRACTICAL THOUGHTS IN THE LINE OF GROWING AND PLANTING AND HANDLING TREES.

First—The best tree is grown in the nursery from seeds, and there well cared far, headed at the proper height and where necessary transplanted once or twice or thrice before planting out in its permanent home; all trees are much more valuable when thus transplanted.

Second—Trees must be taken up with plenty of roots, about one foot in diameter for every inch the tree is in diameter at the crown of roots.

Third—Handle so that they will not be exposed to the air more than absolutely necessary, cover all roots with wet straw or wet sacks as soon as dug. Do not bruise root or top.

Fourth—Pruning so that there will always be some of the one year old wood left on the tree. Cut back the tops so that they will compensate for the roots cut off.

Fifth—In lawn planting always plant in clumps or groups. The beauties of the tree are much more prominent when broad patches of green grass intervene between the clumps of trees. It makes a setting for the trees, a frame work for the picture. This is always a safe, sure, and satisfactory plan.

Another great mistake is in thinking that trees are not beautiful until they become large. There is just as much beauty and sometimes I think more, too, in a small, shapely, thrifty, vigorous growing tree, be it apple, pear, peach, maple, elm, evergreen or shrub, than there is in the full grown specimens. To a lover of trees, the beauty and pleasure they give is a continual one, for the first of spring, the middle of summer, the autumn or the winter, all have their attraction.

Sixth—The plan of pruning is to have an ideal tree always in mind. What is an ideal? I think it is one with a central trunk with all the branches coming out of the main trunk at as near right angles as possible, and scattered all along the entire trunk.

Keep the main center stem longer than any of the others and prune in a rather pyramidal form. All trees thus pruned will make a symmetrical growth, and you will hardly have a fork to split or break down by heavy winds or snow or ice. Something in the shape of a Norway spruce is near the plant I like to carry in my mind. I know it is hard to realize this ideal in many of our trees, but if we will have it in mind all the time we will gradually bring the tree to its ideal in a few years. I have a soft maple in my back yard that is thirty years old, now six feet around, fifty feet high, and spread of branches seventy feet, that has never been injured by snow or storm, and sugar maples that at one-third of a century are perfect marvels of beauty.

Seventh—Plant thickly so as to get immediate effect, and then chop out when they are too thick, and do not be afraid to do it in time.

I fear to recommend this rule, because so many will fail to do the cutting out in time.

Eighth—In street trees plant them so that they will occupy the middle of the grass plot between the sidewalk and the curb. These granitoid men will come and cut the roots from a lot of trees that have been planted twenty years, to within one foot of the tree, taking off all the roots for a depth of twelve to fifteen inches.

A perfect outrage and a barbarous practice sanctioned by our city fathers; it should be prohibited by every person with the least bit of sense.

Ninth—Planting should be made in holes large enough and deep enough to hold the roots in a natural position. Do not plant any deeper than the tree stood in the nursery. Put well pulverized soil around the roots, so that every root will be in contact with the soil, and then tramp the soil well.

Tenth—When shall we plant? Whenever we can find the ground in good condition, spring or fall.

Eleventh—The care during the first and second years is to hoe the trees well and often, or mulch them well with rotten straw or old manure. Pruning with the only ideal tree in mind, taking off only such twigs or branches as are destroying the symmetry on tree.

Twelfth—Protect the bodies of the trees, especially in large trees, by wrapping them with old gunny sacking or hay rope. This will prevent sun scald and keep out the flat-headed borer, and insure a good growth the first year.

Thirteenth—Pruning in after years need be only such as will preserve the beauty and the symmetry of the tree keeping the same ideal in mind, and cutting back about one-half of the year's growth in the case of soft maple and elm, and that class of tree. For a lawn tree of peculiar beauty it is often desirable to have the trees branch at the ground like the spruces. This is true of some birches and beeches, and it makes a very striking feature in the landscape.

Fourteenth—It is always desirable to preserve the individuality of our trees. It is just as distinct as is the individuality of each person in this room, and we lose one-half of our attractiveness when we lose this characteristic, just so with the trees, no two are just alike, and it is always well to preserve these distinctions, and so it is necessary often to cut out surplus trees in order that we may retain this individuality of each variety. One tree well shaped and covering 50 or 100 feet of ground with its branches, is much more grand than the same space covered by a clump of a half dozen. On my home place I have cut out more than three times as many trees as I have left and have thus retained the individuality of the trees.

The elm, for instance, varies greatly from the tall upright to the low crooked, scraggly, drooping branches, and it is absurd to try and modify them by a variety of treatment, but treat them so as to induce this peculiarity in each.

Can you go into the woods and name one-half the varieties of forest trees? Then is it any wonder that you do not love the trees? Can you love people and not know them? Know the different members of one family, not one member only. Such, for instance, as the family of Oaks, Black, White, Red, Brown, Spanish, and so on, or the family of Elms.

If you do not know them thus, then you lose half, if not all, the pleasure of the study of our forests. Nature study in this direction is a delight, a recreation, as well as a good lesson, to all of us if we will but make use of it. We can see beauty in every leaf and bud and branch and variety, and when the leaves have fallen, then in the twigs and branches and bark and lichens that grow thereon.

Nature in and among our trees and the growth of these trees is a valuable, delightful, interesting and profitable study as is any science. What is science? I know not what you think, but in my humble opinion science is "seeing things that you look at and drawing conclusions from what you see." Can you apply this to our trees and tree planting? Then you will become a scientific forester. If you thus love nature study and follow it you will always be ready to protect the trees, young and old, planted or being planted.

Protect them:

First—From our city authorities, shame to them be it said.

Second—From our tree butchers, who cut them to pieces.

Third—From our telephone and electric light companies, when they want to run a wire over or among them.

Fourth—From the man who hitches horses to them and lets the bark be pealed off.

Fifth—From the careless boys.

Sixth—From the ignorant owner.

Seventh—From the horses and cattle that run at large.

In conclusion many a man would find a most healthful and delightful recreation if he will but give some of his spare time from his office or his business, to the plainting of some ornamental or fruit trees, and to the care of them. He would lose every thought of business care, and would enjoy the most complete rest and relief that any occupation could possibly bring him, add years to his life and take wrinkles from his brow. Love trees, protect trees, care for them, plant them, water them, train them, feed them, talk with them, and you may be sure they will repay you a thousand fold.

Economic Notes on Some of the Grasses of Southwest Missouri.

By S. A. Hoover, Professor of Agriculture, State Normal School, Warrensburg, Missouri.

(The result of the study of the grasses and forage plants of Taney, Stone, Ozark and Greene counties.)

Southwest Missouri is old geologically. It was not subjected to glacial action. Its streams all lie far below the general level of the country. The creek and river bottoms are usually narrow, and the bluffs abrupt. Sometimes cliffs several hundred feet high may be found, notably, the one at Forsyth, in Taney county. In some places there are bald knobs, or mounds, nearly devoid of vegetation. Flint hills abound which are difficult of cultivation, but which will produce fairly good crops of grain and excellent fruit. Grass, however, does not succeed on this quality of land. The smaller valleys and creek bottoms are frequently gravelly, and the soil is poor. Some of them, like the Sac and Osage river bottoms, and valleys, such as the one at West Plains, in Howell county, are very productive. These, with the Burlington limestone land are by far the best agricultural lands in this part of the State. The latter, when forested, has a natural growth of white hickory, black walnut, hackberry, mulberry, linden, redbud, red elm and sometimes scaly-bark hickory. On this quality of land I have seen exceedingly heavy crops of timothy cut from a field which had been in continuous cultivation for sixty years without fertilizers of any kind having been added to it.

The subsoil in some of the prairies and in the post-oak flats is very stiff, and it will hold water like an earthen vessel. When heavy rains fall the water reaches this subsoil, and remains there until it evaporates. This quality of land is not well adapted for the cultivation of most grains or grasses.

The flora of Southwest Missouri is very rich in species. Perhaps no other portion of the United States equals it. Some plants whose habitat is further south are found here now.

Nature, wherever possible, puts a covering of some kind of herbage on the land. In the extreme southern counties, such as Stone, Taney, etc., leguminous plants predominate. In the open woods of the north part of Dallas county, in Camden county and in Stone county there are beautiful, park like expanses, mostly covered with little blue stem (Andropogon scoparius); in other places big blue stem (Andropogon provincialis) and bushy blue stem (Andropogon nutans) are found. All these grasses grow and thrive until so closely pastured that the ground cannot be burned over in the spring. When such a condition comes about the under-brush soon smothers out the grass, and the pasture is destroyed.

GRASSES.

Importance of the Grass Crop.—All our cultivated grains, except buckwheat, belong to the grass family. Grasses vary in height from a few inches to more than seventy feet, as in the case of the giant bamboo. While the useful grains belong to the grass family, yet we always speak of them as wheat, corn, etc., and never as grasses. On the other hand, timothy, red top, blue grass and many others are always called grasses. Many of the grasses are of great economic interest, because of the fact that they furnish both hay and pasture. While we could raise stock without grass, by substituting for it some one of the leguminous crops, such as clover, alfalfa or cow peas, yet stock-raising would be much more difficult, and, certainly not so profitable.

On the prairies of Missouri, nature was many centuries in preparing a number of grasses adapted both to the soil and the climate. It is a matter of regret that so many of these natural meadows and pastures have been destroyed by the plow. Where the prairies have been used as pasture, in many instances, the grass has been killed by over-pasturing, and weeds have taken its place.

While some grasses are useful, others are very bad weeds.

What a Grass Is.—Both clovers and sedges are popularly called grasses, but it is a mistake to designate either of them by a name which does not belong to them. A grass has a jointed hollow stem, or *culm,* while the stem of a sedge is neither jointed nor hollow. There are other differences, but these two characteristics are sufficient to distinguish a grass from a sedge. The sedges of Missouri are of no economic value, as stock will not eat them.

Some grasses start from the seed, make their growth and mature seed all in one season. Such grasses are called *annuals.* Others again live an indefinite number of years. These are *perennial.* Kentucky blue grass is a perennial, while June grass, belonging to the same genus as the blue grass, is an annual.

The parts of a grass are:

1. The stem, or culm.

2. The leaf—divided into two parts. One part clasps the stem, and is called the sheath; the second or free portion is the blade.

3. The membranous part of the sheath which extends above the blade is the ligule.

4. The fruiting part may be either a spike or a panicle. Timothy is an example of the spike and oats of the panicle.

5. The panicle and spike are each divided into spikelets.

6. Each spikelet has upon it one or more fruits.

7. The fruit is made up of several parts: The chaff or *glume,* and the *palea,* which is opposite to the glume and partly enclosed by the latter. The spikelet has at its lower part two empty glumes. In some cases, as in the panic grasses, the spikelet is jointed below the empty glumes. In oats, and in most of the grasses, it is jointed above the empty glumes. In the latter case, when the spikelet is removed or drops off, the empty glumes remain as chaff. Each glume may have upon it a beard or *awn.*

The writer has found more than sixty species of grasses which are growing wild in Southwest Missouri. One of these, red top, has escaped from cultivation. The others are either natives or else they have been carried into the State by various means from other places. The first grass which blossoms in the spring is the June grass, or *poa annua.* In the spring of 1901 it was in blossom before the last snow. The latest one to blossom is the *Sporobolus minor.* It seldom blooms before the last of August or the first of September. Others which have bloomed earlier may continue to bloom until killed by frost.

THE CULTIVATED GRASSES.

Phleum pratense L. (timothy). This is easily the king of meadow grasses. It is a delicate feeder, however, and only succeeds on good land. The probabilities are that the wire grass will not injure it, if the ground is very fertile. The timothy, not being a gross feeder, is not able to make a living in the impoverished soil, while the wire grass is a weed, and can live in any soil. If the timothy is well fed, it will in most cases be strong enough to keep the wire grass out.

Dactylis glomerata L. (orchard grass) is cultivated to some extent as a pasture grass. It starts very early in the spring and remains green until late in the fall, and is, therefore, of value as a pasture grass. It is inclined to grow in bunches, and cattle do not relish it as much as they do other grasses. They will not eat it so long as they can get other grasses or forage plants, which they like better. According to the writer's observation, it only succeeds on rich land.

Agrostis alba. L. (Red-top.) This well known grass is a fairly good hay and pasture grass, though somewhat difficult to cure as hay. It succeeds in any soil, except the poorest. It will make a good crop of hay on the post oak flats, where other grasses would fail. It is also a good pasture grass, and will stand very close pasturing.

Wild grasses. The most important of the native grasses are the *Andropogous,* to which the blue stems belong. They are quite variable. One of them, in Stone county, shows at least eleven variations. Although they are variable, yet the general characteristics are so well marked that there is no difficulty in identifying any one of the species.

Poa pratensis. L. (Kentucky Blue Grass.) When other native grasses are killed by close pasturing, blue grass makes its appearance. It does best on the Burlington limestone lands, although it does fairly well on any porous, well drained soil. It does not succeed on cold, spouty land. In the early part of the season it is by far the best pasture grass that we have. When the summer drouth comes it dries up, but upon the advent of the fall rains, if it has not been injured by close pasturing, in a few days it forms a beautiful green sward. In many pastures during the intense heat of the past summer it was entirely killed. This was caused by over-stocking. If not pastured during the autumn, on the limestone land, it would make excellent winter pasture.

Tripsacum dactyloides. L. (Gama or sesame grass.) Grows on rich uplands and in well drained creek and river bottoms. Prof. F. Lamson-Scribner says of it in his "Grasses of Tennessee:" "It grows in large tufts, producing a great mass of broad leaves, which, when young and succulent, are eaten with great avidity by stock. When abundant Gama affords a large amount of natural forage, and is valuable to this extent."

Triodia cuprea. Jacq. (False or tall Red-top.) Succeeds best in low, rich land, but may be found growing on poor upland. It has been considered valueless from an agricultural standpoint, yet, when young and tender, the leaves are eaten quite readily by stock. During very dry weather it remains green when most other grasses have dried up.

Uniola latifolia. Michx. (Broad leaved Uniola.) This is one of the most beautiful grasses found in the West. It might be cultivated for ornamental purposes, and for winter bouquets. It is found along the margins of creeks. Not very plentiful.

Boutelona recemosa. Lag. (Side oats ———.) This grass grows on the dry uplands of Stone county, where it forms a dense sod, resists drouth and tramping of stock, and is greedily eaten by stock. These characteristics make it a valuable pasture grass. It would certainly pay to experiment with it in cultivation.

Panicum sanguinale. L. (Crab grass.) Abundant in cultivated fields, door-yards, lawns and waste places; makes good pasture or hay, but is, nevertheless, a pest in corn fields and gardens.

Panicum proliferum. Lam. Common everywhere. It grows in wet places and in small ponds on the dry uplands. It blooms from early summer until late fall. Its economic value is that it tends to drain wet lands and fit them for other plants.

Panicum crus-galli. L. In rich grounds, barnyards, and in the edges of ponds. Common and variable. A coarse grass, but eaten by stock when other grass is scarce.

Andropogon provincialis. Lam. (Big Blue Stem.) Throughout Southwest Missouri, Usually it grows on dry uplands, in open woods, by waysides, etc. It affords excellent pasturage, but is easily killed by the tramping of stock. It would make fine grass for hay if it could be grown in sufficient quantities. The stems are large, and when matured they become woody. For hay it should, therefore, be cut before it ripens.

Aristida oligantha. Michx. This grass is locally known as Wire, Dog-hair grass, or Poverty grass. When young, the blades form a thick mat, which is exceedingly difficult to cut. Usually the sickle glides over it unless the machine is set very low. When set low enough to cut this dense mat, it is almost impossible for the ordinary team to pull the mower. Wire grass ruins the meadows by smothering out the meadow grass. In a few years after this grass gets a start the meadow will not be worth cutting. As it does not mature its seed until long after the cutting of the other grass, it thoroughly seeds the ground for the next year's crop.

Andropogon scoparius. Michx. (Little Blue Stem.) Found in open woods. Stock will not eat it readily when other pasture is plentiful.

Andropogon halepense. Scribner. (Johnson grass.) Has made its appearance in Greene and other counties in Missouri. It varies somewhat from the form occurring elsewhere—noticeably in the absence of the awn. I look upon it as the most dangerous weed that can enter the State. I believe that when it once gets a foot-hold on a farm, it is utterly impossible to get rid of it. It spreads by means of its many jointed root-stocks as well as by seeds. Plowing only helps it to spread by breaking up these root-stocks and scattering the pieces. S. M. Tracy, in Farmers' Bulletin No. 18, of 1894, says: "We have never seen it permanently cleared from a field where it has become established." It is simply impossible to grow any crop with Johnson grass. The immense number and size of its root-stocks prevent the growth or cultivation of other plants with this pest. On a farm, eight miles south of Springfield, an attempt was made to grow a crop of potatoes in a field overrun with Johnson grass. About the first of September the field looked as though covered with a heavy crop of sorghum, which had been sown broadcast. A gentleman, who owns an extensive farm in northern Arkansas, purchased the seed of this grass from an enterprising firm in California. It was advertised under the name of "Ever-green millet." He has never been able to eradicate it from the orchard in which he sowed it. He has kept it from spreading by preventing the ripening of the seed, and by turning hogs on it. The hogs will eat the root-stocks, but enough pieces are always left in the ground to start another crop. To give an idea of how others regard the Johnson grass, I quote from Dr. J. B. Killebrew in his "Grasses and Forage Plants of Tennessee": "While it makes excellent hay and furnishes a large amount of grazing, it is at the same time one of the most troublesome weeds that can be introduced upon a farm. If one wishes to raise nothing but hay; if he has no regard for the rights of his neighbors; if he expects never again to grow tillage crops on his farm, then the wisdom of sowing Johnson grass may be commended. Otherwise it should be left severely alone, for no time will completely eradicate it when once well set upon good land. It has a thick, fleshy root-stock that penetrates the soil in every direction and throws up a culm from every joint. If a single joint of it an inch long is left in the ground it will be the prolific mother of a numerous progeny of stalks and roots within a year. It is possessed of a strange and extraordinary vitality. A barrel of salt poured upon a bed of it eight feet square did not destroy the roots. Within a month the salt disappeared, leaving a briny surface, but the invincible roots sent up an army of numerous stalks that waved their flags in victory over the bed that was intended to be their grave."

It grows entirely too coarse in this part of the country for hay. In Western Texas, where the rain-fall is light, and other forage plants do not succeed it is worth raising, because the land may be completely given up to it. In this State, and in Arkansas, where much better forage plants may be grown successfully it is very foolish to attempt its cultivation. In fact, farmers ought to be on the lookout for it, and destroy every stalk that makes its appearance.

Andropogon virginicus. L. (Broom-sedge.) In some respects this is a bad weed, while in others it is of benefit to the farmer. It injures meadows and pasture, yet when young it furnishes good pasture. It is generally supposed that stock will not eat hay which is made from it, but I noticed that mules belonging to a street railway company ate it quite readily last winter. The hay had been made from grass fully matured, yet the mules ate it up clean. During one of the driest summers ever known in Southwest Missouri most grasses showed not a green blade, but in spite of the intense heat and drouth, broom-sedge remained green. In one pasture I noticed that it was the only plant which furnished feed for the cattle, and it was kept eaten down quite close to the ground. Another thing that may be said in its favor is that it will grow on the very poorest, wornout land. An old field whose fertility has been exhausted for years will still yield a large crop of Broom-sedge. By pasturing this, or by turning it under before it matures its seed, one might possibly be enabled to restore this wornout land.

It is an annual, and if it can be kept from producing seed there will be no trouble in getting rid of it. Pasturing the meadow after the hay is taken off is recommended by some farmers. Cattle do not like it, but will eat it when other grass is scarce. After it gets a good start the best remedy is to plow the meadow up.

Muhlenbergia diffusa. Schreber. (Nimble Will.) Stock will not eat this grass at all. Under shade trees, if permitted to grow, it kills blue grass. It is almost impossible to mow it, and the best way to get rid of it is to pull it up by the roots.

Panicum capillare. Everywhere. A somewhat troublesome weed.

Hordeum jubatum. L. Waste places.

Eragrostis pectinacea. Gray. Common. Specimens of this grass found in Greene county seem to differ from the typical plant in having (to quote the language of F. Lamson-Scribner) "remarkably long and lax panicles." A very beautiful grass, but of no economic value.

Eleusine indica. Gaertn. Common in door-yards, barnyards, cultivated fields, etc. Stock will eat it in the absence of other grasses.

Setaria glauca. Beauv. (Fox-tail.) Found abundantly in all cultivated fields. As a weed it is very troublesome. It makes fairly good pasture, and is sometimes cut for hay. If used for hay it should be cut before it ripens its seeds, as the beards are a very unpleasant thing for stock.

Bromus secalinus. L. (Cheat or Chess.) This grass is so well known that it needs no description. There have been more disputes about it than about any other plant. It is popularly supposed that wheat turns to cheat. Such a thing is an utter impossibility. Wheat always produces wheat, and cheat only comes from the seed of a plant like itself. No matter what the appearances are, the seeds of cheat were in the ground before the plants could come. It is a very bad weed. Only seed free from it should be used.

The writer hopes in the future to make at least a check list of all Missouri grasses, and to this end he asks farmers, teachers and everybody else interested in the subject to send specimens from different parts of the State. In sending them, be sure to send root, stem, blades and the fruiting parts.

MISSOURI WEIGHTS AND MEASURES.

Secton 10576, Revised Statutes, provides that the standard weight in this State for a bushel shall be the number of pounds indicated in the following table:

Name.	Pounds.	Name.	Pounds.
Grains.		*Grass Seeds.*	
Wheat	60	Clover	60
Rye	56	Hungarian	48
Shelled corn	56	Sorghum	42
Corn meal	50	Blue grass	14
Ear corn	70	Red top	14
Flax seed	56	Orchard grass	14
Barley	48	Timothy	45
Oats	32	Millet	50
Buckwheat	52	Hemp	44
Castor beans	46		
Cotton seed	33	*Fruits.*	
Bran	20		
		Apples	48
Vegetables.		Apples, dried	24
		Peaches, dried	33
Beans	60	Pears	48
Beans, green, unshelled	56		
Peas	60	*Miscellaneous.*	
Peas, green, unshelled	56		
Sweet potatoes	56	Salt	50
Irish potatoes	60	Coal, mineral	80
Cucumbers	48	Malt	38
Turnips	42	Osage orange	36
Top onion sets	28	Flour, bbl	196
Onions	57	Flour, sack	98
Tomatoes	45	Flour, ½ sack	48
Carrots	50	Flour, ¼ sack	24
Rutabagas	50		
Parsnips	44		

Apples when sold by the barrel and no special agreement is made, the barrels should be of the following dimensions: Length of barrel 28½ inches with chimes of ¾ inch at the ends; the diameter of the heads shall be 17½ inches, and the diameter of the center of the barrel inside shall be 20½ inches.

MISSOURI COUNTIES.

Table giving area, population, taxable wealth, etc.

County.	County seat.	Area in square miles........	Population of county in 1900......	Population of county seat in 1900......	Total taxable wealth......	Acres of government land
Adair	Kirksville	570	21,728	5,966	$5,586,556	....
Andrew	Savannah	420	17,332	1,886	5,793,682	....
Atchison	Rockport	560	16,501	1,080	8,471,948	....
Audrain	Mexico	680	21,160	5,099	9,628,389	....
Barry	Cassville	810	25,532	702	3,871,126	9,884
Barton	Lamar	612	18,253	2,737	5,713,796	....
Bates	Butler	874	30,141	3,158	9,352,943	....
Benton	Warsaw	744	16,556	743	3,410,829	2,280
Bollinger	Marble Hill	616	14,650	295	2,240,260	1,202
Boone	Columbia	680	28,642	5,651	8,974,495	....
Buchanan	St. Joseph	420	121,838	102,979	26,852,172	....
Butler	Poplar Bluff	716	16,769	4,321	3,403,543	673
Caldwell	Kingston	430	16,656	655	5,689,327	....
Callaway	Fulton	760	25,984	4,883	6,633,687	160
Camden	Linn Creek	692	13,113	340	1,819,513	19,840
Cape Girardeau	Jackson	540	24,315	1,658	5,547,196	40
Carroll	Carrollton	690	26,455	3,854	9,196,094	....
Carter	Van Buren	500	6,706	....	1,370,254	80
Cass	Harrisonville	688	23,636	1,844	8,890,737	....
Cedar	Stockton	496	16,923	555	3,448,873	....
Chariton	Keytesville	740	26,826	1,127	6,906,547	....
Christian	Ozark	556	16,939	830	2,851,527	420
Clark	Kahoka	510	15,383	1,818	4,570,145	....
Clay	Liberty	415	18,903	2,407	7,253,520	....
Clinton	Plattsburg	440	17,363	1,878	7,369,732	....
Cole	Jefferson City	390	20,578	9,664	4,790,311	....
Cooper	Boonville	562	22,532	4,377	7,618,234	....
Crawford	Steelville	710	12,959	686	2,932,949	3,219
Dade	Greenfield	500	18,125	1,406	3,921,381	....
Dallas	Buffalo	530	13,903	757	1,796,436	15,667
Daviess	Gallatin	576	21,325	1,780	7,966,392	....
DeKalb	Maysville	440	14,418	925	5,232,860	....
Dent	Salem	720	12,986	1,481	2,080,761	3,501
Douglas	Ava	792	16,802	....	2,389,244	7,240
Dunklin	Kennett	500	21,706	1,509	3,118,237	....
Franklin	Union	866	30,581	744	7,597,650	....
Gasconade	Hermann	510	12,298	1,575	3,657,264	80
Gentry	Albany	450	20,554	2,025	6,359,915	....
Greene	Springfield	688	52,713	23,267	13,627,564	....
Grundy	Trenton	460	17,832	5,396	5,690,136	....
Harrison	Bethany	730	24,398	2,093	$7,791,143	....
Henry	Clinton	740	28,054	5,061	8,450,621	....
Hickory	Hermitage	415	9,985	....	2,034,403	4,100
Holt	Oregon	462	17,083	1,032	6,758,313	....
Howard	Fayette	450	18,337	2,717	6,165,380	....
Howell	West Plains	920	21,834	2,902	3,730,451	2,317
Iron	Ironton	550	8,716	797	2,430,988	9,696
Jackson	Independence	630	195,193	6,974	88,248,891	....
Jasper	Carthage	672	84,018	9,416	14,788,965	....
Jefferson	Hillsboro	640	25,712	254	5,574,532	....
Johnson	Warrensburg	800	27,843	4,724	10,533,646	....
Knox	Edina	510	13,479	1,605	4,282,732	....
Laclede	Lebanon	740	16,523	2,125	2,829,812	14,424
Lafayette	Lexington	622	31,679	4,190	10,478,437	....
Lawrence	Mount Vernon	606	31,662	1,206	6,035,716	....
Lewis	Monticello	510	16,724	287	5,197,069	....
Lincoln	Troy	598	18,352	1,153	5,323,598	....
Linn	Linneus	620	25,503	878	6,828,308	....
Livingston	Chillicothe	520	22,302	6,905	6,426,228	....
McDonald	Pineville	580	13,574	....	1,736,704	8,894

MISSOURI COUNTIES—Continued.

County.	County seat.	Area in square miles....	Population of county in 1900........	Population of county seat in 1900.......	Total taxable wealth........	Acres of government land.
Macon	Macon	820	33,018	4,068	$8,660,498	....
Madison	Fredericktown	492	9,975	1,577	1,827,870	6,332
Maries	Vienna	515	9,616	....	1,645,136	2,100
Marion	Palmyra	420	26,331	2,323	8,914,806	....
Mercer	Princeton	484	14,706	1,575	4,551,717	....
Miller	Tuscumbia	590	15,187	225	2,438,910	3,800
Mississippi	Charleston	430	11,837	1,893	2,770,128	....
Moniteau	California	420	15,931	2,181	4,348,058	....
Monroe	Paris	644	19,716	1,397	6,493,651	....
Montgomery	Danville	546	16,571	174	4,832,417	....
Morgan	Versailles	638	12,175	1,240	2,640,344	340
New Madrid	New Madrid	620	11,280	1,489	2,246,160	....
Newton	Neosho	648	27,001	2,725	5,216,718	....
Nodaway	Maryville	848	32,938	4,577	12,007,345	....
Oregon	Alton	780	13,906	468	2,068,017	5,297
Osage	Linn	586	14,096	491	3,894,724	....
Ozark	Gainesville	780	12,145	222	1,080,346	54,566
Pemiscot	Caruthersville	480	12,115	2,315	2,150,407	....
Perry	Perryville	436	15,134	848	2,935,766	303
Pettis	Sedalia	688	32,438	15,231	11,330,333	....
Phelps	Rolla	640	14,194	1,600	2,653,031	11,779
Pike	Bowling Green	620	25,744	1,902	8,316,188	....
Platte	Platte City	410	16,193	744	5,887,721	....
Polk	Bolivar	640	23,255	1,869	4,189,179	80
Pulaski	Waynesville	520	10,394	....	1,747,210	22,108
Putnam	Unionville	542	16,688	2,050	4,072,828	....
Ralls	New London	490	12,287	881	4,532,127	....
Randolph	Huntsville	470	24,442	1,805	7,169,957	....
Ray	Richmond	584	24,805	3,478	8,631,501	....
Reynolds	Centerville	830	8,161	....	1,696,635	6,498
Ripley	Doniphan	640	13,186	1,508	2,036,227	3,194
St. Charles	St. Charles	520	24,474	7,982	10,794,530	....
St. Clair	Osceola	690	17,907	1,037	4,002,276	2,300
St. Francois	Farmington	410	24,051	1,778	4,027,797	270
Ste. Genevieve	Ste. Genevieve	450	10,359	1,707	1,982,842	1,458
St. Louis	Clayton	492	50,040	....	31,622,130	....
Saline	Marshall	760	33,703	5,086	12,207,842	....
Schuyler	Lancaster	336	10,840	980	2,930,376	....
Scotland	Memphis	440	13,232	2,195	4,057,922	....
Scott	Benton	434	13,092	234	3,596,511	....
Shannon	Eminence	960	11,247	....	2,086,251	2,254
Shelby	Shelbyville	514	16,167	777	5,722,654	....
Stoddard	Bloomfield	840	24,669	1,475	4,222,380	....
Stone	Galena	516	9,892	....	1,175,739	14,250
Sullivan	Milan	656	20,282	1,757	5,258,928	....
Taney	Forsyth	660	10,127	204	1,023,602	13,474
Texas	Houston	1,145	22,192	514	3,221,743	14,678
Vernon	Nevada	850	31,619	7,461	9,212,060	....
Warren	Warrenton	435	9,919	770	3,497,288	....
Washington	Potosi	780	14,263	638	2,770,081	2,203
Wayne	Greenville	800	15,309	1,051	2,681,622	4,692
Webster	Marshfield	630	16,640	964	3,067,836	268
Worth	Grant City	270	9,832	1,406	3,055,698	....
Wright	Hartville	700	17,519	445	2,707,397	2,540

MISSOURI LIVE STOCK.

Table showing number of horses, mules, asses and jennets, neat cattle, and the assessed valuation on June 1, 1901, in the State.

(Compiled by Hon. Albert O. Allen, State Auditor.)

Counties.	Horses.			Mules.			Asses and jennets.			Neat cattle.		
	Number.	Average value.	Valuation.	Number	Average value.	Valuation.	Number	Average value.	Valuation.	Number.	Average value.	Valuation.
Adair	8,401	$19 89	$167,130	842	$17 80	$14,990	84	$30 18	$2,545	26,279	$11 78	$309,590
Andrew	6,250	24 12	150,765	1,415	29 19	41,315	104	45 76	4,760	31,016	15 96	495,195
Atchison	8,289	28 04	232,460	2,785	31 67	88,205	39	66 90	2,610	39,044	16 50	644,390
Audrain	8,651	27 81	240,612	2,998	31 03	93,028	163	53 40	8,705	21.384	17 56	375,667
Barry	8,135	24 43	198,801	2,336	25 54	59,671	68	43 82	2,970	18,141	11 04	200,390
Barton	8,879	19 68	174,800	2,000	23 99	47,974	92	40 92	3,765	27,356	10 02	274,252
Bates	13,943	23 87	332,708	2,741	24 25	66,452	152	44 04	6,694	36,313	11 25	408,639
Benton	6,853	27 56	188,870	1,733	29 48	51,092	78	51 03	3,980	21,209	13 81	292,966
Bollinger	4,408	26 17	125,454	1,794	33 58	60,245	31	89 04	2,760	12,462	9 08	122,505
Boone	8,040	27 69	223,675	3,292	34 49	113,535	175	52 20	9,135	18,764	16 19	303,800
Buchanan	9,165	28 22	258,720	2,317	31 46	72,905	80	40 50	3,240	19,148	16 63	318,495
Butler	3,141	25 18	79,114	1,091	29 27	31,940	9	39 55	356	10,024	7 62	76,379
Caldwell	7,200	23 45	168,856	1,134	23 76	26,945	49	54 89	2,690	27,086	14 76	400,056
Callaway	8,090	21 90	177,185	3,911	25 10	98,165	211	46 85	9,885	17,667	11 83	209,090
Camden	4,599	30 39	139,786	1,016	36 00	36,575	42	42 50	1,785	15,309	15 93	244,016
Cape Girardeau	6,199	24 09	149,370	2,534	26 87	67,930	88	39 65	3,490	13,395	8 37	112,210
Carroll	10,687	23 24	248,399	3,750	25 76	96,630	137	44 29	6,068	29,765	13 30	399,021
Carter	1,060	32 32	34,262	756	35 84	27,102	11	48 18	530	4,629	11 01	50,982
Cass	10,623	22 32	237,134	2,439	25 07	61,149	96	57 53	5,523	32,683	13 00	424,928
Cedar	7,214	30 38	219,215	1,401	34 54	48,392	60	63 66	3,820	15,496	16 68	258,571
Chariton*	11,457	19 31	221,215	2,671	20 75	55,440	103	33 95	3,497	28,387	15 20	431,729
Christian	6,083	27 24	165,727	1,557	29 60	46,099	82	43 62	3,577	15,684	11 54	181,004
Clark	7,031	22 61	159,000	815	28 90	23,560	31	46 77	1,450	20,331	15 07	306,445
Clay	6,888	27 00	186,030	1,334	28 07	37,455	48	135 20	6,490	21,750	13 79	299,985
Clinton	7,981	27 36	218,400	2,153	30 99	66,740	51	60 00	3,060	30,698	18 40	565,031
Cole	3,455	24 54	84,805	1,068	24 11	25,750	11	25 45	280	9,283	9 63	89,452
Cooper	6,784	22 85	155,045	3,723	36 89	137,370	114	45 78	5,250	18,519	14 26	264,115
Crawford	3,252	27 29	88,757	1,403	28 18	39,543	40	29 37	1,175	11,401	13 68	156,074
Dade	6,853	22 22	152,249	1,802	30 05	54,160	94	59 25	5,570	17,789	11 93	212,283
Dallas	5,884	23 75	139,767	1,415	24 59	34,901	77	29 18	2,247	14,567	13 44	195,893
Daviess	11,571	21 98	254,414	2,189	25 20	55,166	108	46 21	4,991	34,748	14 07	498,787
DeKalb	7,028	23 88	167,830	1,135	24 87	28,237	54	39 44	2,130	29,433	16 45	484,253

*This is for the year 1900. Returns for this year not in yet.

Dent	3,670	27 40	100,534	1,531	30 77	47,111	71	41 68	2,959	13,091	11 50	150,418
Douglas	5,128	26 68	136,852	968	29 58	28,639	34	34 41	1,170	10,773	12 43	133,955
Dunklin	5,287	29 77	157,405	3,157	36 05	113,825	22	73 40	1,613	15,080	9 22	139,075
Franklin	5,889	24 54	144,540	2,740	25 15	68,933	38	37 10	1,410	14,131	11 36	160,620
Gasconade	3,141	29 02	91,151	1,996	30 61	61,116	27	43 70	1,180	9,791	11 65	114,082
Gentry	10,346	23 03	238,285	1,191	24 37	29,025	109	50 27	5,480	36,286	13 30	482,540
Grenee	12,724	23 45	295,391	3,996	23 82	95,175	102	38 11	3,888	27,242	10 10	275,170
Grundy	7,124	23 00	163,871	942	25 54	24,064	83	32 53	2,700	27,496	12 87	353,706
Harrison	14,047	23 23	326,442	1,607	25 13	40,393	90	60 94	5,485	49,046	17 63	865,030
Henry	9,446	25 42	240,205	2,393	31 84	76,205	64	52 52	3,370	29,742	12 35	357,390
Hickory	4,977	27 99	139,341	1,052	31 15	32,773	39	67 89	2,648	13,862	15 79	219,017
Holt	7,239	22 30	161,485	1,928	24 33	46,910	37	64 05	2,370	21,361	15 11	322,835
Howard	6,629	24 57	162,900	3,016	30 17	91,010	97	56 13	5,445	19,595	17 01	333,430
Howell	4,758	23 77	113,005	1,558	27 35	42,620	37	37 43	1,385	12,495	10 65	133,090
Iron	1,594	28 80	45,909	846	31 62	26,758	17	39 06	664	6,730	10 38	69,853
Jackson	17,029	29 23	497,765	3,191	34 53	110,110	....	....	....	29,250	14 12	413,229
Jasper	16,456	25 55	420,478	1,954	28 81	56,302	78	45 79	3,572	22,406	15 55	348,602
Jefferson	5,477	24 45	133,919	2,341	27 46	62,287	81	32 00	2,592	16,627	10 59	176,105
Johnson	10,979	26 53	291,320	3,450	30 90	106,600	133	57 85	7,695	33,277	13 57	451,935
Knox	5,024	23 13	116,227	1,000	23 98	23,979	49	44 80	2,195	22,833	13 70	312,789
Laclede	5,501	23 72	130,516	1,212	26 97	32,695	117	24 06	2,815	13,451	13 62	183,221
Lafayette	10,612	30 55	324,210	3,889	37 22	144,765	88	80 96	7,125	25,554	19 66	502,635
Lawrence	9,162	24 41	223,727	2,939	24 86	73,071	60	42 00	2,520	15,852	13 02	206,470
Lewis	6,585	23 06	151,855	1,282	21 46	27,520	66	75 30	4,970	19,704	13 19	260,025
Lincoln	7,429	23 88	176,950	1,151	28 88	33,255	32	71 97	2,280	17,539	14 15	248,150
Linn	9,066	20 76	188,191	1,149	22 25	25,568	35	51 46	1,801	37,838	11 65	440,919
Livingston	9,245	19 71	182,228	1,146	21 76	24,834	37	49 70	1,839	25,006	11 94	298,731
McDonald	4,384	33 37	146,326	1,090	37 00	40,480	20	65 15	1,303	10,147	14 08	142,963
Macon	12,826	26 02	333,820	2,821	25 64	72,240	228	32 17	7,335	35,369	17 40	515,670
Madison	2,346	28 41	58,200	1,169	31 65	37,000	46	41 85	1,925	9,202	9 82	90,410
Maries	3,392	23 14	78,494	1,726	28 66	49,482	40	50 90	2,036	12,321	11 02	135,832
Marion	6,408	24 82	159,060	1,068	28 64	30,595	38	50 79	1,930	12,699	14 78	187,695
Mercer	7,845	26 48	207,784	746	28 69	21,408	37	53 37	1,975	32,519	16 52	537,456
Miller	5,246	21 30	111,765	1,441	23 29	33,570	35	34 71	1,215	18,006	9 63	173,530
Mississippi	2,139	27 23	58,260	3,139	34 11	107,075	21	64 28	1,350	8,704	8 66	75,410
Moniteau	5,367	22 25	119,465	2,023	25 39	51,377	69	44 56	3,175	15,188	10 78	163,867
Monroe	8,444	21 97	185,630	2,909	25 79	75,050	127	71 88	9,130	22,045	14 34	316,160
Montgomery	5,473	26 44	144,750	1,808	30 17	54,555	97	37 55	3,445	17,013	14 40	245,650
Morgan	4,530	25 27	114,485	1,868	26 60	49,700	75	43 26	3,245	15,671	13 02	204,143
New Madrid	2,240	20 34	45,582	2,715	23 50	63,811	9	52 77	475	8,289	5 88	48,813
Newton	8,904	21 75	193,086	1,434	24 65	35,365	55	33 00	1,810	14,712	13 62	200,188
Nodaway	17,364	18 33	318,325	2,067	21 26	44,016	74	44 60	3,300	65,010	9 77	634,642
Oregon	3,648	19 61	70,552	1,501	21 87	32,828	22	23 22	511	10,267	9 83	101,965
Osage	3,305	26 23	86,695	2,532	31 13	78,845	29	59 18	1,715	13,833	10 13	140,686
Ozark	3,310	23 90	79,421	783	27 16	21,271	37	42 57	1,575	14,985	9 19	137,800

MISSOURI LIVE STOCK—Continued.

Counties.	Horses.			Mules.			Asses and Jennets.			Neat Cattle.		
	Number.	Average value.	Valuation.	Number.	Average value.	Valuation.	Number.	Average value.	Valuation.	Number.	Average value.	Valuation.
Pemiscot	2,410	$36 08	$86,962	3,038	$50 41	$153,163	25	$69 00	$1,725	11,148	$9 49	$105,819
Perry	4,531	25 12	113,850	2,404	27 45	65,990	44	50 11	2,205	10,017	10 02	100,449
Pettis	10,560	23 00	242,343	3,066	30 00	93,130	164	45 00	7,475	30,480	18 00	432,833
Phelps	3,733	21 90	81,789	1,159	25 76	29,862	81	26 11	2,120	12,554	12 78	160,318
Pike	9,308	24 70	230,970	1,995	28 86	57,580	118	48 05	5,670	19,100	14 42	275,580
Platte	6,097	27 38	166,980	2,249	32 78	73,755	85	58 00	4,855	16,562	16 53	273,910
Polk	8,592	26 31	226,126	2,054	31 14	63,965	122	47 50	5,795	18,948	14 67	278,000
Pulaski	3,516	23 46	82,515	862	24 00	20,690	45	26 44	1,190	12,600	11 20	141,165
Putnam	9,524	20 49	195,150	924	19 53	18,050	49	38 55	1,927	35,270	12 53	442,982
Ralls	4,685	26 07	122,160	1,140	28 05	31,985	79	44 49	3,415	16,472	12 64	208,310
Randolph	7,458	30 40	226,790	1,530	33 82	51,750	100	77 05	7,705	16,761	16 53	277,135
Ray	10,285	28 30	291,140	3,633	31 51	114,494	147	48 84	7,180	32,981	16 50	534,232
Reynolds	2,109	34 18	72,094	1,182	39 27	46,420	11	71 73	789	11,903	11 25	133,850
Ripley	3,188	27 49	87,666	1,462	31 33	45,813	33	40 30	1,321	10,397	9 90	103,003
Saline	10,840	27 59	299,170	4,948	40 49	200,355	131	48 77	6,390	39,185	15 82	620,070
Schuyler	6,563	30 63	201,032	887	34 00	30,091	20	82 75	1,655	17,061	14 68	250,458
Scotland	6,531	25 08	158,815	866	26 73	23,155	66	40 45	2,670	23,802	13 21	314,635
Scott	2,905	26 42	76,759	3,172	34 31	108,835	20	37 30	747	10,001	9 30	93,018
Shannon	2,454	31 62	77,604	985	28 41	27,980	29	32 06	930	10,345	8 75	90,551
Shelby	7,871	25 75	202,676	2,302	23 50	54,104	163	38 65	6,300	20,415	14 43	294,687
Stoddard	6,382	24 12	153,948	2,879	28 08	80,855	58	38 96	2,260	15,196	8 18	124,414
Stone	3,398	31 90	108,409	900	38 44	34,597	46	35 43	1,630	10,397	10 49	140,296
St. Charles	7,377	32 29	238,229	2,364	34 40	81,338	26	70 00	1,820	13,927	14 49	201,918
St. Clair	8,308	22 63	188,055	1,140	26 92	30,695	50	46 30	2,315	21,565	11 60	250,155
St. Francois	3,158	24 09	76,095	960	28 26	27,135	8	40 62	325	8,188	10 22	83,695
Ste. Genevieve	2,647	29 63	78,442	853	35 79	30,530	20	82 25	1,645	7,489	11 90	89,127
St. Louis	7,870	29 11	229,135	3,433	34 06	116,930	....	....	....	10,266	15 38	157,925
St. Louis City	11,210	29 64	332,310	580	23 27	13,500	....	....	....	6,000	15 38	92,300
Sullivan	10,458	22 60	236,356	1,113	21 82	24,291	86	38 66	3,325	46,019	13 22	608,611
Taney	3,455	21 83	75,459	857	27 00	23,184	53	16 73	887	14,274	10 85	154,902
Texas	6,679	27 91	186,467	1,747	32 25	56,336	71	53 23	3,780	17,951	11 26	206,202
Vernon	13,303	20 97	278,982	2,700	26 64	71,934	274	19 48	5,240	34,067	11 42	389,349
Warren	3,249	22 44	72,915	1,240	26 00	32,250	21	42 39	890	9,052	10 28	93,090
Washington	3,332	19 14	62,776	1,392	21 46	29,885	32	46 71	1,495	12,094	8 26	99,955
Wayne	3,491	33 41	117,655	1,794	37 23	66,803	37	45 13	1,670	16,055	10 12	162,535

Webster	5,870	27 22	159,818	1,700	31 96	54,370	115	34 20	3,934	13,242	10 46	138,580
Worth	6,311	25 04	158,066	400	27 50	11,000	31	36 22	1,123	18,407	16 49	303,345
Wright	5,169	27 65	142,967	1,307	29 64	38,741	69	40 49	2,794	12,502	12 48	156,107
Total in State	720,356	....	$19,745,632	217,232	....	$6.388,313	7,813	....	$360,816	2,274,491	....	$30,495,001

MISSOURI LIVE STOCK.

Table showing number of sheep, hogs and "all other live stock," and the assessed valuation on June 1, 1901, in the State.

(*Compiled by Hon. Albert O. Allen, State Audtior.*)

Counties.	Sheep.			Hogs.			And all other live stock.		
	Number.	Average value.	Valuation.	Number.	Average value.	Valuation.	Number.	Average value.	Valuation.
Adair	4,403	$1 05	$4,650	11,031	$3 00	$33,125			$865
Andrew	3,121	97	3,055	27,268	3 21	87,735			
Atchison	1,446	1 98	2,875	44,421	2 78	123,895			
Audrain	15,627	1 48	23,244	18,926	4 29	81,157			
Barry	8,709	1 15	10,008	21,550	1 41	31,460			
Barton	3,092	1 00	3,016	17,500	2 20	38,587	104	$1 00	$104
Bates	3,597	1 04	3,727	37,623	2 63	98,990	382	8 87	3,771
Benton	6,370	1 35	8,619	15,691	2 61	40,992	179	1 06	190
Bollinger	7,840	1 38	10,790	20,372	1 30	26,513	55	1 00	55
Boone	8,674	2 11	18,425	17,614	2 38	41,995			
Buchanan	2,114	1 82	3,860	20,035	2 87	57,695			
Butler	1,059	1 00	1,058	11,456	1 00	11,943	10	1 00	10
Caldwell	13,357	1 12	15,006	27,894	2 51	70,275	60	6 00	360
Callaway	16,706	1 39	23,325	14,302	2 60	38,315			
Camden	9,283	2 02	18,831	18,373	1 17	21,616	297	1 78	529
Cape Girardeau	7,684	1 39	10,680	26,058	1 50	39,345			
Carroll	3,858	1 34	5,184	35,648	2 13	76,144	178	9 59	1,708
Carter	629	1 24	780	5,065	1 14	5,808			25
Cass	5,480	1 18	6,454	40,398	2 45	98,950			
Cedar	3,823	1 35	5,166	25,982	2 10	54,750	1,160	1 21	1,404
*Chariton	5,313	1 22	6,474	24,433	1 76	42,935	7	3 56	25
Christian	5,785	1 35	7,911	22,610	1 65	37,415	228	1 43	427
Clark	5,291	1 44	7,650	10,222	3 82	39,100			
Clay	6,787	1 39	9,490	23,692	2 81	66,650			
Clinton	4,392	2 05	9.037	26,349	3 31	87,217	213	13 07	2,784
Cole	2,779	1 15	3,217	12,663	1 30	16,496			517
Cooper	6,259	1 89	11,850	26,698	2 40	64,300			
Crawford	6.494	1 50	9,797	12,524	1 52	19,117			
Dade	3,120	1 82	5,691	16,105	2 26	36,445	124	2 68	333
Dallas	10,181	1 55	15,868	19,624	1 56	30,766			
Daviess	11,328	1 46	16,539	35,226	2 53	89,165			4,647
DeKalb	2.962	1 78	5,284	22,710	4 07	92,562			
Dent	6,768	1 47	9,964	16,400	1 23	20,137			
Douglas	11,343	1 33	15,133	20,916	1 09	22,917	188	1 26	237
Dunklin	212	1 36	290	26,928	1 22	33,020	12	2 08	25
Franklin	3.261	1 26	4,114	18,748	2 10	39,529			
Gasconade	3,649	1 06	3,884	10,584	2 17	22,966			
Gentry	8,987	1 31	11,785	26,819	2 77	74,430	69	1 08	75
Greene	5.471	1 26	6,901	32,196	1 59	50,444	42	3 05	1,281
Grundy	7,363	1 00	7,340	15,967	2 78	44,489			
Harrison	10,262	1 93	19,853	35,247	3 19	112,558	28	7 05	1,975
Henry	1,955	1 81	3,542	23,969	3 25	77,946			
Hickory	5,268	1 75	9,233	17,224	1 91	32,698	826	2 44	2,022
Holt	1,724	1 35	2,325	31,286	4 08	127,750			
Howard	5,677	2 02	11,480	15,992	2 74	43,830			
Howell	7,652	1 33	10,200	16,397	1 02	17,820			
Iron	2,792	1 04	2,907	5,099	1 18	6,045	33	2 55	84
Jackson	7,421	1 53	11,385	36,509	3 38	122,382			
Jasper	2,284	1 20	2,758	16,307	2 56	41,790			510
Jefferson	2,919	1 13	3,326	16,837	1 43	24,230	21	6 00	126
Johnson	7,157	1 00	7,245	29,368	3 19	93,750	381	2 16	825
Knox	5,951	1 34	7,957	18,347	2 23	41,043			
Laclede	8,748	1 23	10,751	21,013	1 22	25,674	119	1 86	222
Lafayette	4,588	1 83	8,415	28,080	3 67	103,200			
Lawrence	3,532	1 28	4,551	16,211	2 36	38,328	36	3 58	129
Lewis	9,018	1 05	9,510	14,091	2 52	35,515	10	1 50	15
Lincoln	5,569	1 55	8,680	18,202	2 58	47.065			
Linn	8,009	1 38	11,026	13,291	2 28	30,263	15	36 20	543
Livingston	6,416	1 29	8,322	20,481	2 34	47,935	111	5 82	646
McDonald	4,551	1 00	4,551	14,568	1 68	24,556	79	85	67
Macon	10,044	1 46	14,720	19,231	2 61	50,370			
Madison	3,128	1 13	3.543	9,508	1 14	10,821	64	97	62
Maries	7,379	1 48	10,964	18,429	1 00	18,429	165	91	151
Marion	7,459	1 72	12,870	11,795	3 27	38,575			
Mercer	3,917	2 53	9,932	16,119	3 42	55,137			
Miller	10,188	1 20	12,270	22 446	1 18	26,534			127

MISSOURI LIVE STOCK—Continued.

Counties.	Sheep.			Hogs.			And all other live stock.		
	Number.	Average value.	Valuation.	Number.	Average value.	Valuation	Number.	Average value.	Valuation.
Mississippi	70	1 21	85	13,608	1 34	18,334	1	25 00	25
Moniteau	3,304	1 71	5,657	16,023	2 34	37,592	....	....	....
Monroe	23,529	1 15	27,210	14,339	2 96	42,530	....	....	....
Montgomery	42	2 17	13,885	17,699	3 01	53,480	42	3 00	125
Morgan	5,826	1 12	6,539	9,950	2 37	23,598	270	1 09	295
New Madrid	323	1 36	440	11,862	1 17	13,945	....	....	....
Newton	645	1 18	764	11,436	2 42	27,702	160	4 00	635
Nodaway	3,600	1 04	3,751	61,476	2 04	125,776	524	1 00	501
Oregon	4,925	1 00	4,925	17,332	1 00	17,332	9	1 00	9
Osage	4,415	1 02	4,510	17,905	1 21	21,774	....	....	7,143
Ozark	6,798	1 15	7,833	16,964	89	14,802	....	....	....
Pemiscot	409	1 39	572	15,108	1 64	24,845	165	96	159
Perry	6,509	1 25	8,169	25,741	1 27	32,800	....	....	6,984
Pettis	4,448	1 80	8,248	34,645	2 10	72,778	144	8 50	1,220
Phelps	7,189	1 04	7,460	14,783	1 15	16,952	212	1 00	212
Pike	9,682	1 77	17,140	17,855	3 02	53,960	....	....	....
Platte	3,689	1 31	4,852	18,093	2 69	48,678	266	1 33	355
Polk	9,362	1 55	14,520	31,574	1 78	56,236	....	....	....
Pulaski	7,560	1 32	9,985	15,120	1 22	18,680	....	....	....
Putnam	8,636	1 20	10,438	14,269	1 68	23,970	54	1 44	78
Ralls	8,012	1 49	11,950	9,322	2 73	25,490	....	....	....
Randolph	8,286	1 96	16,310	10,354	3 27	33,870	....	....	....
Ray	5,069	1 55	7,894	47,600	2 73	130,173	....	....	....
Reynolds	5,189	1 02	5,328	12,367	1 04	12,838	479	70	336
Ripley	3,636	1 23	4,501	15,761	1 24	16,152	....	....	....
Saline	3,113	1 48	4,610	36,970	3 30	122,210	....	....	....
Schuyler	20,837	1 04	21,784	17,534	1 65	29,090	....	....	....
Scotland	6,482	1 47	9,580	11,499	2 71	31,215	....	....	....
Scott	523	1 25	655	18,276	1 31	23,978	53	1 58	84
Shannon	2,127	1 07	2,288	11,301	1 04	11,765	....	....	....
Shelby	10,791	1 49	16,129	13,719	2 72	37,279	....	....	....
Stoddard	2,574	1 03	2,655	29,362	1 00	29,497	104	1.39	145
Stone	3,592	1 69	6,076	14,401	1 56	22,541	143	2 76	396
St. Charles	3,130	2 06	6,461	23,543	2 62	61,751	....	....	....
St. Clair	4,277	1 08	4,630	18,659	2 17	40,555	....	....	355
St. Francois	1,549	1 34	2,080	4,290	1 88	8,075	....	....	....
Ste. Genevieve	2,907	1 27	3,699	12,665	1 30	17,516	....	....	....
St. Louis	913	1 82	1,665	13,974	2 87	40,180	....	....	....
St. Louis City	....	....	....	....	....	....	....	....	....
Sullivan	10,348	1 21	12,602	14,317	2 27	32,449	88	1 17	103
Taney	5,988	1 28	7,675	13,614	1 07	14,644	....	....	....
Texas	17,343	1 51	26,191	27,778	1 07	29,827	1,038	1 00	1,038
Vernon	2,851	1 23	3,528	23,422	2 64	61,906	125	5 40	676
Warren	2,695	1 08	2,915	13,293	1 52	20,225	....	....	6,185
Washington	3,920	1 03	4,066	11,169	1 06	11,841	....	....	....
Wayne	3,417	1 45	4,961	14,332	1 43	20,579	88	1 11	98
Webster	12,859	1 30	16,763	19,772	1 29	25,453	....	....	....
Worth	3,596	1 48	5,325	13,825	4 38	60,805	232	1 28	296
Wright	16,907	1 85	31,406	18,819	1 31	24,702	100	1 76	176
Total in State.	661,456	....	$969,998	2,372,488	....	$5,046,273	9,493	....	$54,105

*This is for the year 1900. Returns for this year not in yet. (1) stock not listed in other classes.

REPORT OF DR. D. F. LUCKY, STATE VETERINARIAN, FOR 1901.

Date.	How called.	Kind of stock.	Owner.	Postoffice.	Disease.	How disposed of.
Jan. 24	Letter	1 horse	J. M. Carpenter	Poplar Bluff	Chronic Glanders	Quarantined
25	Request	"	C. A. Russell	"	"	"
26	"	"	G. S. Sisney	"	"	"
27	"	2 mares	Nathan O. Farrell	"	"	"
27	"	1 horse	J. W. Freer	"	"	"
31	Letter	225 sheep	W. J. Robinson	Cleopatra	Scabies	"
Feb. 7	Petition	1 horse	R. S. Belshe	Richland	Chronic Glanders	"
16	Letter	"	John T. Edwards	Wallace	"	"
26	Petition	2 horses	Jas. A. McLueny	Modena	Ulcerated tooth	Advised extraction
29	Telegram	1 horse	S. A. Mahaffey	St. Joseph	Glanders	Dead
Mch 3	Petition	200 Angora gts.	J. M. Thompson	Stockton		
11	Telegram	3 cows	J. E. Woods	Hardin	Ptomaine poisoning	
19	Petition	1 mule	W. A. McCain	Almon	Chronic Glanders	Quarantined
19	"	1 mule, 1 mare	S. W. Baines	Elixer	"	"
19	"	1 mare	S. J. Odenbaugh	"	"	"
22	Letter	12 cattle	David Arnold	Nevada	Chorea	Advised treatment
28	Petition	1 dog	Willie Runyan	Stockton	Rabies	Quarantined
28	"	"	J. E. Sharp	Jerico	"	"
28	"	"	W. M. Mead	"	"	"
28	"	"	H. H. Collins	"	"	"
28	"	3 dogs	Robt. Usher	"	"	"
28	"	1 dog	Mrs. M. E. Ruth	"	"	"
28	"	"	W. R. Williams	Stockton	"	"
28	"	"	W. H. Jones	"	"	"
28	"	3 dogs	C. M. Wagoner	Wagoner	"	"
30	Letter	7 cattle	D. C. Byram	Shawnee Mouud	Ptomaine poisoning	Dead
Apr. 3	"	1 horse	G. V. Hardeman	Gray's Summit	Ulcerated tooth	"
4	"	"	R. S. Duncan	Turney	Glanders	"
6	"	212 sheep	Geo. Widmier	Braymer	Scabies	Quarantine
10	Letter	2,000 sheep	L. D. Proper and Joseph Davenport	Guilford	"	"
12	Petition	12 calves	Henry Springman	Vandalia	Blackleg	Advised vaccination
16	Letter	1 horse	W. F. Isreal	Chillicothe	Chronic Glanders	Quarantined
18	Petition	Cattle	F. L. Sweeney	Sturgeon	Pneumonia	Dead
21	Letter	1 horse	John Callahan	St. Louis	Chronic Glanders	Quarantined
29	Telegram	3 horses	Wm. Fitzgerald	"	"	"
30	Petition	1 horse	James Hudson	Dexter	Glanders	Dead
May 2	Letter	50 calves	Jas. F. Pleeker	Deepwater	Malignant Catarrh	
June 6	Petition	1 horse	Geo. Bower	Independence	Chronic Glanders	Quarantined
15	Telegram	2 cows	Mike Murphee	Silex		Dead
21	Letter	1 horse	J. B. Barry	Chillicothe	Glanders	Quarantined
25	Petition	2 horses	Ben. J. F. Farr	Alanthas	Mange	"
July 11	Letter	1 mule	Rothwell Bros.	St. Louis	Chronic Glanders	"
19	"	2 horses	Henry Staats	"	"	"
24	"	1 horse	R. P. Wilson	Gridley	"	"
25	"	2 mules	Wm. Donovan	Kansas City	"	"
25	"	1 horse	F. A. Williamson	"	"	"

Aug. 4	Telegram	51 cattle	Matthews Stock Co.	Oran	Texas fever	"
16	Letter	1 horse	W. I. Branberger	Kansas City	Chronic Glanders	"
16	"	"	P. W. Carleton	"	"	"
16	"	"	Erizel Goodman	"	"	"
24	"	"	Geo. H. Castle	"	"	"
24	"	"	J. H. Dye	"	"	"
24	"	"	G. B. Roberts	"	"	"
Sept. 8.	Petition	2 cows	C. A. Turner	Brown		
9	Telegram	1 horse	John Shapter	Kansas City	"	"
9	"	"	Wm. Stewart	"	"	"
Oct. 10	Letter	45 sheep	A. A. Rose	Holden	Scabies	"
10	Petition	3 calves	D. S. Child	"	Blackleg	
15	"	1 mule	J. M. Marshall	Charleston	Pneumonia	Dead
Dec. 12	Letter	1 horse	J. S. Richardson	Kansas City	Chronic Glanders	Quarantined
Oct. 3, 4, 5.	Telegram	Cattle	Star Ranch Co.	Neeleyville	Blackleg	Advised vaccination
9.		Mare	Pat Hayer and H. B. McDonald	Springfield	Glanders	Quarantined
17, 18, 19	Letter	"	W. E. German	Louisburg	"	"
25, 26, 27	Telegram	Cattle	Deal & Bro.	Charleston	Indigestion	Advised treatment
21		Horse	Abe Jenkins	Springfield	Glanders	Quarantined

REPORT OF E. J. NETHERTON FOR 1901.

Date.	How called.	Kind of stock.	Owner.	Postoffice.	Disease.	How disposed of.
June 28	Petition	1 horse	J. F. G. Kilburn	Laredo	Influenza	Quarantined
Sept. 21	Letter	1 "	Wm. Swilley	Kansas City	Chronic glanders	Ordered carcass burned
26	"	1 "	J. L. Williams	"	"	Ordered killed
Oct. 1	Telegram	1 mule	G. W. Neusing	"	"	"
18	Letter	3 horses	W. F. Hardesty & Geo. H. Castle	"	"	"
22	"	1 horse	Richard Hill	"	"	"
22	"	2 horses	L. A. Farley	"	"	"

REPORT OF DR. E. BRAINERD FOR 1901.

Date.	How called.	Kind of stock.	Owner.	Postoffice.	Disease.	How disposed of.
June 14	Telegram	1 horse	A. G. Strohmier	Kahoka	Glanders	Quarantined
14	"	80 cattle	W. A. Clem	Reger	Indigestion	Gave treatment
Aug. 30	Letter	1 jack	Wm. Rhodes & Wm. Davis	Greentop	Chronic catarrh	"
Nov. 16	"	1 horse	A. F. Reed	Louisiana	Chronic glanders	Quarantined

REPORT OF DR. E. M. HENDY FOR 1901.

Date.	How called	Kind of stock.	Owner.	Postoffice.	Disease.	How disposed of.
Jan. 2	Telegram	1 mare	David Lambert	Craig, Holt county	Nasal Gleet	Gave treatment
7	"	"	L. Anderson	Troy, Lincoln county	Chronic Glanders	Condemned
10	Letter	1 gelding	Gillis Bros	Euclid ave., St. Louis	" "	"
10	"	1 mule	Dr. Dye	Blodgett, Scott county	" "	"
12	Telegram	6 horses	John Smith	Schell City, Vernon Co.	Euaphalitis	Gave treatment
12	Letter	3 horses	S. A. Mahaffey	St. Joseph	Chronic Glanders	Condemned
Apr. 6	"	1 horse	Wm. Boilliott	Bonnots Mill	" "	"
15	"	"	J. L. Bregenzen	Elmont, Franklin Co.	Distemper	Gave treatment
22	Telegram	Horses & mules	E. N. Harris	Pilot Grove	Euaphalitis	" "
June 5	"	1 horse	J. H. Danes	St. Louis	Chronic Glanders	Condemned
Sept. 18	Letter	"	Wm. Bassett	Pilot Grove		Dead
Oct. 31	Telegram	5 horses	Mr. Harned	Bunceton, Cooper Co.	Euaphalitis	Gave treatment
Nov. 13	Letter	2 horses	Frank Hardesty	K. C., 20th & Hardesty ave	Chronic Glanders	Condemned
13	"	3 horses	Gustave Holenbeck	Linn, Osage Co.		Dead
Dec. 2	Telegram	Cattle	Haywood Spurlock	Versailles	Blackleg	Advised vaccination

REPORT OF DR. F. W. O'BRIEN FOR 1901.

Date.	How called.	Kind of stock.	Owner.	Postoffice.	Disease.	How disposed of.
Nov. 22	Letter	Cattle	Jacob Smith	Carrollton		Dead
Dec. 28	"	Horse and colt	Adolph Prack	St. Louis	Chronic Glanders	Quarantined
28	"	Sheep	James Hohman	Frankford	Scabies, Sheep sold	Pens disinfected

REPORT OF DR. R. B. LOVE for 1901.

Date.	How called.	Kind of stock.	Owner.	Postoffice.	Disease.	How disposed of.
Feb. 14	Telegram	Horses	H. C. Wetmore	Lamar	Glanders	Quarantined and destroyed.
Apr. 8	Letter	"	H. C. Wetmore	"	Exposed to glanders	Released
July 22	Petition	Horse	J. B. Oliver	Sarcoxie	Lymphangitis	
25	Letter	Mule	James M. Smith	Conway	Glanders	Destroyed
30	"	Mules	A. S. Killingsworth	Harold	"	"
30	"	Horse	H. J. Carter	"	"	"
30	"	"	E. Jerdon	"	"	"
Aug. 5, 6, 7	"	Horses	F. E. Bridges	Luck	"	Quarantined
15	"	Cattle	L. L. Romey & Neighbors	Springfield	Southern fever	"
Sept. 19	"	Mare	King Hartley	Marshfield	Glanders	"

INDEX.

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