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U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 366.

Experiment Station Work, LII.

Compiled from the Publications of the Agricultural Experiment Stations.

TREATMENT OF MUCK SOILS.
MANURES FOR TIMOTHY HAY.
CORN BREEDING.
YELLOW BERRY IN WHEAT.
WEED SEEDS IN FEEDING STUFFS.
HOOK-WORM DISEASE OF CATTLE.
EFFECT OF MACHINE MILKING ON COWS.
MILK SUPPLY OF CITIES.
THE CROW.
LABOR, WAGES, AND COST OF BOARD IN MINNESOTA.

MAY, 1909.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.

A. C. TRUE, Director.

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EXPERIMENT STATION WORK.

Edited by W. H. Beal and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. True, Director, Office of Experiment Stations.

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EXPERIMENT STATION WORK.[a]

TREATMENT OF MUCK SOILS.[b]

Muck soils are widely distributed, in small or large areas, in the United States. When properly drained and handled they are in many cases extremely productive. The amount of muck land reclaimed by drainage and brought under cultivation is rapidly increasing, and it is becoming a matter of considerable importance to know the best methods of utilizing such lands. Extensive areas of muck soils are found in Florida, and in a recent bulletin of the Florida Station, A. W. Blair summarizes the results of his study of these soils and makes suggestions regarding their treatment which are of general interest. He states that "muck soils are formed by the decay, in low wet places, of grasses, weeds, twigs, leaves, and even trees. Being so largely formed from vegetable matter, they are much richer in nitrogen than ordinary soils. They usually also contain small amounts of phosphorus and potassium."

It is recognized, of course, that proper drainage is a necessary prerequisite to the use of muck soils, for "if muck soils are to be cultivated it is obvious that they must first be drained. This is necessary in order that they may become the home of the various kinds of micro-organisms that play an important part in the making of a fertile soil. These micro-organisms need moisture, but they can not develop in mud or standing water."

The method of cultivation requires particular attention.

Cultivation should be deep, especially at first, in order that the air may thoroughly penetrate the soil. Muck soils often contain substances that are injurious and even poisonous to plants. When these poisonous substances are exposed to the air they are probably oxidized to a considerable extent and thus destroyed. A free circulation of the air also improves the conditions for the development of the useful micro-organisms.

Muck soils are generally acid or sour, and this acidity must be corrected before they will be productive.

Suitable materials for this purpose are finely ground limestone, air-slaked lime, wood ashes, and marl. Finely ground limestone (the native rock) is to be

[a] A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

[b] Compiled from Florida Sta. Bul. 93; Press Bul. 109.

preferred to the forms commonly used, since it is effective, is more easily handled, and harm is not likely to result from the use of amounts in excess of what is needed to neutralize the acids.

It will be necessary in most places to use larger quantities [of neutralizing material] on muck soils than on upland soils. If limestone is used, 2 to 6 tons per acre should be applied. If lime is taken, a ton and a half or two tons may be used. The material should be thoroughly worked into the soil one or two months before the crop is planted. This will give time for the lime to neutralize the acid.

The importance of destroying the acids can be better appreciated when we remember that the micro-organisms that convert organic nitrogen into a form that can be used by plants can not develop in a highly acid soil. The limestone and lime also furnish a suitable base with which the nitric acid that is formed may unite, thus producing calcium nitrate which can be taken up by plants.

If muck is to be used [for fertilizing purposes] on upland soils, it is also necessary for the acids to be destroyed. This can be done either by composting it with one of the materials already mentioned, or by applying the latter when the muck is applied, or afterwards, and thoroughly mixing both with the soil by cultivation. Muck may be improved by simply drying and thoroughly airing it. This is especially true of mucks that contain iron compounds. We can not expect a satisfactory yield of such crops as celery and lettuce on muck land until the acids have been largely destroyed.

It occasionally happens that a muck deposit is underlaid with marl, or is in close proximity to a limestone formation. In such cases it is not so likely to be acid, and might not require the treatment with lime.

Muck soils being especially rich in nitrogen should, one would think, require but little, if any, of the nitrogenous fertilizers. Experience, however, has shown that in many cases they do require added nitrogen. This is because they are so strongly impregnated with acids that the bacteria which would otherwise convert the inert nitrogen of the organic matter into soluble nitrates can not live. When this unfavorable condition has been corrected, less nitrogen in the form of commercial fertilizer will be required. If a quick-growing vegetable crop is being produced, nitrate of soda may be used to good advantage, as may also stable manure, since it introduces beneficial bacteria; but sulphate of ammonia and organic forms of nitrogen (such as cotton-seed meal and castor pomace) should not be used; the former because it will aggravate the acid condition and the latter because there is already enough organic nitrogen present. Phosphoric acid and potash may be used liberally if desired. For phosphoric acid, ground bone is an excellent material; while a ton or two of finely ground phosphate rock (floats) would also be helpful; not so much, however, for immediate results as for future crops, since the acids in the muck will very gradually convert the insoluble phosphoric acid into the available form For potash, any of the potash salts will suit. Kainit has been used on the muck soils of Illinois with good results. Hard-wood ashes are an excellent source of potash, if they can be produced on the place or bought at a reasonable price.

MANURES FOR TIMOTHY HAY.[a]

The value of the hay crop of this country is exceeded only by that of corn and cotton, yet it is evident to those who have inquired into the matter that neither in quantity nor in quality is this crop what it

[a] Compiled from New York Cornell Sta. Bul. 261.

might easily and profitably be made. Grass lands do not as a rule receive the care and treatment their importance warrants, and the improvement of hay-producing plants has been given less attention than that of many other farm crops. This Department and several of the experiment stations have, however, realized the importance of the hay crop and are making efforts to bring about improvements in its production.

The New York State and the New Jersey experiment stations have shown that nitrogen is the predominant constituent in a fertilizer for timothy and grasses in general, and have indicated how nitrate of soda may be profitably used for increasing the yield of such plants.[a] The Maine Experiment Station has shown how to prepare home mixtures of fertilizers suited to grass lands.[b] The Rhode Island Experiment Station has very carefully worked out the most suitable methods of top-dressing grass lands in order to maintain a good yield without the use of manure.[c] The West Virginia Station, on the other hand, has shown how grass lands may be improved by the continuous use of manure alone.[d] The Oklahoma Station has done much to improve the hardiness and yield of Bermuda grass as a hay plant and to extend its use in regions of scanty or uncertain rainfall.[e]

Timothy may be taken as the type of hay grasses, and results obtained with it may be considered as in large measure representative of and applicable to such grasses in general. For several years the New York Cornell Experiment Station has been investigating the best means of improving the quality and increasing the yield of timothy hay. A recent report by J. A. Bizzell and J. O. Morgan sums up the results of these investigations, which included more particularly experiments with stable manure (10 to 20 tons per acre) and various combinations of nitrate of soda (160, 320, and 640 pounds per acre), superphosphate (320 and 640 pounds per acre), and muriate of potash (80 pounds per acre) applied in a six-year rotation of corn, oats, wheat, and timothy (three years) on plats of a tenacious clay loam (Dunkirk clay loam). The soil on which these experiments were made is difficult to work except when moisture conditions are most favorable, but is considered a type of soil well adapted to timothy.

The plan was to seed to wheat and timothy in the fall of 1903, so the first application of fertilizers and stable manure that the plats received, was made September 16, 1903. Early fall rains prevented the seeding of wheat, as planned, and in the spring of 1904, on April 15, oats were sown at the rate of

[a] U. S. Dept. Agr., Farmers' Bul. 210, p. 6.
[b] U. S. Dept. Agr., Farmers' Bul. 222, p. 8.
[c] U. S. Dept. Agr., Farmers' Bul. 227, p. 5.
[d] U. S. Dept. Agr., Farmers' Bul. 276, p. 18.
[e] U. S. Dept. Agr., Farmers' Bul. 320, p. 12.

9 pecks per acre together with timothy at the rate of 15 pounds per acre, without the application of any further fertilizers. The second application of fertilizers was made April 5, 1905; the third application, April 17, 1906; and the fourth, May 1, 1907. Stable manure was not added every year as were the fertilizers, the second application being made October 2, 1906.

One-half of each plat was treated with slaked lime at the rate of 1,000 pounds per acre.

In attempting to draw practical suggestions from the results of these experiments attention is especially called to the fact that—

It is difficult to make definite recommendations in regard to the use of fertilizers for grass lands. It is definitely known that chemical fertilizers very often, we may say usually, exert a marked influence on crops, but it is almost impossible to say just what fertilizers or how much of them should be used in a given case with the assurance that the results will be favorable. Every farmer must experiment with his own land, using the experience of other farmers and investigators as suggestions only.

The experiments, however, make it clear that "of the fertilizing elements usually applied as plant food, nitrogen seems to be the most potent factor in increasing the yield of timothy and related grasses. Unlike the clovers and other leguminous plants, timothy is incapable of acquiring any of its nitrogen from the air, but must depend on that supplied to the soil. The best evidence shows that it requires for its full development a liberal supply of nitrogen throughout the growing period," a fact which has also been clearly demonstrated by the New Jersey, New York, and Rhode Island experiment stations. While nitrogen thus appears to be the dominant fertilizing constituent, it attains its greatest efficiency only when judiciously combined with potash and phosphoric acid.

In the Cornell experiments " the best financial returns were obtained when farm manure was applied at the rate of 20 tons per acre." In the experiments at the West Virginia Station, to which reference has already been made, there was not only a net profit of $33 per acre from applications of 10 to 15 tons per acre of manure for six years, but the soil was in much better condition at the end than at the beginning of the experiment.

The lasting effects or the value of farm manure to later crops should always be considered when comparing it with the value of commercial fertilizers. On the Dunkirk clay loam of New York State the best financial returns may be expected from the use of farm manure when the latter can be purchased for 50 cents a load. This estimate does not include the effect on subsequent crops, to which a value should be assigned.

For the New York farmer who wishes to raise a large proportion of hay on this type of soil an eight-year rotation may be suggested—wheat one year, hay five years, corn one year, and oats one year. The farm manure should be incorporated with the soil previous to seeding with timothy and wheat in the fall. In the following spring a mixture of red and alsike clover should be seeded. Annual applications of farm manure should then be made for the grass crops, the applications being given as top-dressings in the fall and harrowed in the following spring. For the corn crop a similar application may be made. No fertilizer of any kind need be applied for the oats. It might be advisable in some cases to make top-dressings of manure once in two years, in which case larger applications should be made.

When farm manure can be procured in sufficient quantity the use of commercial fertilizers is not necessary. But the farmer often finds it advantageous to reserve a large part of the farm manure for other crops, in which case commercial fertilizers may be substituted wholly or in part if used judiciously. When the supply of farm manure is limited it would be advisable to use smaller applications in the fall than stated above, supplementing this in the early spring by small applications of the commercial fertilizers.

Of the commercial fertilizers, the most satisfactory returns were obtained on Dunkirk clay loam by the use of a complete fertilizer consisting of 320 pounds of nitrate of soda, 320 pounds of acid phosphate, and 80 pounds of muriate of potash per acre.

It is believed, however, that the use of a mixture of 200 pounds of nitrate of soda, 100 pounds of superphosphate, and 50 pounds of muriate of potash per acre would be more economical, but in any case "it would be best for the farmer to determine by actual field tests the quantity most desirable for his land."

As the mixed fertilizers found on the market usually do not contain the elements in the proportion suggested by the above formula, it would be best for the farmer to buy the separate ingredients and mix them himself. The ingredients called for are usually sold under guaranty by the fertilizer companies and vary little from the following composition: Nitrate of soda, 15 to 16 per cent nitrogen; acid phosphate, 12 to 14 per cent available phosphoric acid; muriate of potash, 50 per cent potash.

There are certain advantages in home mixing to which attention is called, but it is pointed out that if home mixing is undertaken it is quite important that it should be carefully done in order that thorough and even mixtures may be obtained.

Commercial fertilizers are well adapted to top-dressing grass lands, since they can be easily applied by hand and since they contain the plant-food elements in an easily soluble form, and are therefore immediately available to the growing crop. Because of their ready availability there is danger of loss by leaching. In view of this fact they should be applied in the early spring, just as the grass is beginning to grow.

In the experiments at the Rhode Island Station referred to above it was found that a mixture of 400 to 500 pounds per acre of superphosphate and 300 to 350 pounds of muriate of potash and nitrate of soda applied as an annual top-dressing from April 15 to 25 would maintain a good yield of timothy without the use of stable manure, which is subject to the objection that the coarser undecomposed material of the manure remaining upon the meadow is likely to be raked up with the hay, and that the manure sometimes has the effect of reducing the quality of the grass by causing a rank growth or by the introduction of weeds.

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In the Cornell experiments the use of lime did not result in an increased yield of hay. It has, however, been demonstrated by the Rhode Island Station that timothy does not thrive on acid or sour soils and that the most effective practical means of correcting the acidity is by the application of lime or wood ashes.

TEN GENERATIONS OF CORN BREEDING.[a]

As the work in corn breeding is carried on from year to year and the accumulation of data increases, knowledge regarding the extent to which certain characters may be influenced becomes more definite. Furthermore, other lines of work suggest themselves. The Illinois Station has recently summarized the results of several lines of its corn-breeding work in progress for a series of years, which indicate clearly how pliable the corn plant may become in the hands of the plant breeder. The work with reference to changing the composition of the grain, more particularly the protein and oil content, and thereby adapting it to certain special purposes, has been described in previous bulletins of this series and the earlier results secured were noted in that connection.[b] This work of selection and breeding is based upon the results of analyses of different ears from a single variety, together with the results of analyses of different parts of single ears, which established the fact that the ear of corn is approximately uniform in the chemical composition of its kernels and that there is a wide variation in the chemical composition of different ears of the same variety. The breeding has now been carried through ten generations, and its effect is indicated by the data compiled from the general averages of each generation as shown in the following table:

Ten generations of breeding corn for increase and decrease of protein and oil.

Year.	High protein.		Low protein.		Difference.	High oil.		Low oil.		Difference.
	Seed.	Crop.	Seed.	Crop.		Seed.	Crop.	Seed.	Crop.	
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1896	....	10.92	....	10.92	....	....	4.70	....	4.70	....
1897	12.54	11.10	8.96	10.55	0.55	5.39	4.73	4.03	4.00	0.67
1898	12.49	11.05	9.06	10.55	.50	5.20	5.15	3.65	3.99	1.16
1899	13.06	11.46	8.45	9.36	1.60	6.15	5.64	3.47	3.82	1.82
1900	13.74	12.32	8.08	9.84	2.98	6.30	6.12	3.33	3.57	2.55
1901	14.78	14.12	7.58	10.04	4.08	6.77	6.09	2.93	3.43	2.66
1902	15.39	12.34	8.15	8.22	4.12	6.95	6.41	3.00	3.02	3.39
1903	14.80	13.04	6.98	8.62	4.42	6.73	6.50	2.62	2.97	3.58
1904	15.39	15.08	7.00	9.27	5.76	7.16	6.97	2.80	2.89	4.08
1905	16.77	14.72	7.09	8.57	6.15	7.88	7.29	2.67	2.58	4.71
1906	16.30	14.26	7.21	8.64	5.62	7.36	7.37	2.20	2.66	4.71

With reference to protein these results show that, starting with a single variety, it has been possible in ten generations of this work

[a] Compiled from Illinois Sta. Buls. 128, 132.

[b] U. S. Dept. Agr., Farmers' Buls. 193, p. 20; 210, p. 11.

to increase the protein content from 10.92 per cent to 14.26 per cent, a gain of 3.34 per cent, while by breeding in the opposite direction it has been possible to reduce the protein content from 10.92 to 8.64 per cent, or a reduction of 2.28 per cent, making a total difference between the two strains of 5.62 per cent. It is further shown that the high-oil corn has increased from 4.70 per cent to 7.37 per cent of oil, while a low-oil corn has decreased from 4.70 to 2.66 per cent, the difference between the two strains in 1906 being 4.71 per cent. Individual ears ranged in protein content from 6.13 per cent in the low-protein strain to 17.79 per cent in the high-protein strain, and in oil content from 1.60 per cent in the low-oil strain to 8.59 per cent in the high-oil strain. In other parts of the plant the proportion of protein is never as high as in the grain. The leaves averaged somewhat higher in protein than the stalks, but this condition was not constant in every year. No regular difference between the upper and lower portions of the stalk with reference to protein was established. The crude fat in other parts of the plant scarcely ever approached the oil content of the kernel, and was generally greater in the lower stalk and leaves than in the upper stalk.

High-protein and low-protein seed were planted together on one plat and high-oil and low-oil seed on another. These plats were continued for three years, and the results secured did not indicate that the soil influences the protein or the oil content. Continued selection has apparently induced a certain correlation between protein and oil content, and has resulted in characteristic types of kernel and perceptible modifications in the type of ear. Selections for high protein is considered as evidently accompanied by a reduction in yield. It is also stated that climatic conditions exert, in certain years, a marked effect upon the composition of the corn crop as regards its protein, oil, and starch content.

The phosphorus content was found always somewhat higher in the stover and the grain from the high-protein plat. On the high-oil and low-oil plats the phosphorus was regularly higher only in the high-oil grain. In general, the grain was decidedly the part richest in phosphorus. The stover carried a much larger proportion of potassium than the grain, but the stalks and leaves did not vary much in this respect. In general, however, aside from the correlation developed between protein and oil in the kernel, the changes in composition due to breeding have not been very marked.

Another line of breeding of more recent origin has also given promising results. In 1902 two sets of ears of Leaming corn, the one representing ears growing high on the stalk and the other those borne low down on the plant, were selected. The following year each set was planted in a breeding plat and the selection for high and low ears continued each year. The results of this work are summarized in the following table:

General averages of crops produced in corn breeding for high ears and for low ears.

Year.	Height of ear.		Height of plant.		Number of internodes below ear.		Total number internodes of stalk.	
	High-ear plat.	Low-ear plat.	High-ear plat.	Low-ear plat.	High-ear plat.	Low-ear plat.	High-ear plat.	Low-ear plat.
	Inches.	*Inches.*	*Inches.*	*Inches.*				
1903	56.4	42.8	113.9	102.5	8.5	7.2	15.4	13.9
1904	50.8	38.3	106.2	97.4	7.5	6.2	14.5	13.0
1905	63.3	41.6	128.4	106.5	8.2	6.5	15.4	13.6
1906	56.6	25.5	116.8	86.0	9.0	5.9	15.1	11.0
1907	72.4	33.2	130.4	99.7	9.2	5.8	16.3	13.0
1908	57.3	23.1	114.0	79.8	8.2	4.7	15.5	11.5

The results show that two strains of corn have been produced, one of which bears the ears about 3 feet higher on the stalk than the other. The high-ear strain has longer stalks, longer internodes, a greater total number of internodes, and a greater number of internodes below the ear than the low-ear strain.

Perhaps the most significant of all, as throwing light upon broader problems of heredity, is the fact brought out by these results that the corn has not only responded to the selection, but there has been a gradual progressive shifting of the types so that even in the fourth generation the average height of ears in the one strain is more than twice that in the other.

The smaller type of plant, or the low-ear strain, has a shorter growing period than the high-ear strain. In yield of grain no great difference is indicated, but the high-ear strain produces the greater yield of fodder.

The experiments to influence the declination of ears was begun in 1903, and the selections were made according to the angle of declination at harvest time from "Illinois High Oil" corn, a strain under selection for seven generations for increase in oil content. The results of this experiment are brought together in the following table:

Average degrees of declination of ears from the perpendicular in breeding for erect ears and for declining ears.

Year.	Average of seed.		Difference between strains.	Average of crop.		Difference between strains.
	Erect-ear strain.	Declining-ear strain.		Erect-ear strain.	Declining-ear strain.	
	°	°	°	°	°	°
1904	20.0	180.0	160.0	42.0	45.0	3.0
1905	16.7	180.0	163.8	62.2	117.1	54.9
1906	15.0	180.0	165.0	49.5	76.2	26.7
1907	12.8	180.0	167.2	42.8	81.6	39.3
1908	7.2	176.0	168.8	46.0	88.5	42.5

The results show that the declination of the ear is a character that can be influenced by breeding. The length of shank is apparently the principal factor in determining the declination. The declining ear is the better protected from rain, and is harvested with greater facility.

YELLOW BERRY IN HARD WINTER WHEATS.[a]

By the term "yellow berry" is meant the appearance of grains of a light yellow color, opaque, soft, and starchy in hard winter wheats which normally produce a hard, flinty, translucent grain of medium size and of a clear, dark, reddish-amber color. Sometimes only part of a kernel will show the yellow berry characteristics, while the remainder has retained the normal translucency and hardness. The region comprising the central and northern part of Kansas and the southern part of Nebraska produces a milling wheat of the best grade, because of a very high content of gluten of excellent quality and texture. As the presence of yellow berry lowers the grade of wheat and reduces its value for milling purposes, the reduction, and preferably the total elimination, of yellow berry is of vital importance to the farmers of the hard winter wheat section and to the millers who grind this grain. The Nebraska and Kansas Experiment stations are at work on the problem, and the reports of progress made in their investigations, published in recent bulletins, form the basis of this article. There are different views regarding the causes of yellow berry. Some consider it the result of degeneration in the variety, others believe it to be due to climatic and soil conditions, or regard it as a consequence of sowing the same seed year after year, while still others attribute it to the condition of the crop at the time of harvesting. The object of the experiment station work is to determine definitely the causes of this trouble, and to find ways and means of reducing or preventing it.

The results of this work, with reference to the physical characters of the yellow berries, call attention to the fact that the difference in color between the flinty and the soft and opaque grains is due to a difference in the structure and contents of the cells of the endosperm; that in weight, as well as in specific gravity, the affected grains fall below the normal kernels of the same variety; and that the yellow berries show a reduced protein content. Lyon and Keyser, of the Nebraska Station, found that in the yellow and opaque kernels the starch grains in the cell were larger in diameter than in the flinty kernels, although not so large as in the typical starchy wheats.

[a] Compiled from Kansas Sta. Bul. 156; Minnesota Sta. Bul. 90; Nebraska Sta. Bul. 89.

In 21 varieties examined by the Kansas Experiment Station the average weight of the yellow berries per hundred was 2.596 grams, and that of the hard, flinty grains 2.740 grams. The average specific gravity of the yellow berries was 1.304, and of the normal grains 1.336. It is believed that the reduction in specific gravity is probably due to the more numerous and larger air cavities within the kernel, and possibly also to a reduced starch content. Data at hand indicate that the ordinary soft and starchy wheats of the Pacific coast and the Middle and Southern States average somewhat higher in weight per bushel than the hard winter and spring wheats, and that the yellow berry in this respect does not resemble the soft wheats, the weight as well as the specific gravity falling below the flinty kernels of the same variety. Analyses made at the Nebraska Station showed that samples of hard winter wheat contained an average of 2.79 per cent of nitrogen, while corresponding samples of yellow berry contained only 2.38 per cent, thus indicating a reduction in the gluten content and a consequent diminution in the flour-making value in the grain due to yellow berry. Regarding the merits of hard and soft wheats for milling purposes, Professor Snyder, of the Minnesota Station, says:

> It is generally considered that the more amber and glutenous wheats yield a higher percentage of the patent flours and less of the clear and lower grades, while the lighter colored or starchy wheats show a tendency to produce a higher percentage of total flour, but less is recovered as patent graded. * * * These physical characteristics are closely associated with, and dependent upon, chemical composition. * * * When two types of seed, light and dark, were selected from the same lot of wheat, the darker seeds in all samples analyzed were found to be richer in protein.

To determine the relation between the amount of yellow berry produced under the climatic conditions of the particular seasons, 128 varieties of wheat were grown by the Kansas Station during 1906–7. The heads were harvested when considered fully ripe and dried under cover, so that the existence of yellow berry could not be attributed to overripeness or exposure to the weather after cutting, but could only be ascribed to the influence of the weather before harvesting the heads or to inherent hereditary tendencies in the varieties themselves, or to both. The results with regard to the relation of temperature, light, air movements, and precipitation to the growth of the wheat plant, and the possible share of each factor in the production of yellow berry, were found to be extremely complex and intricate of interpretation. The influences of the autumn vegetative conditions were studied both years, and the data for the two seasons show the same diminution in the percentage of yellow berry with the shortening of the fall vegetative period and a corresponding decline in the mean temperature for that period. The first year the wheat was sown on six different dates, from September 28 to October 16, inclusive. A general decrease in the amount of yellow berry was observed as the wheat was planted later. The earliest sown plat contained 53.80 per cent of yellow berry, while the latest sown plat contained only 19.58 per cent, these quantities being the highest and lowest in the series, respectively. The second year, when the wheat was sown on September 26, 27, 28, and 29, there was a correspondingly lower range in the average percentage of yellow berry from the different plantings, the highest being 44.33 per cent for the wheat sown on September 26 and the lowest 32.63 per cent for the wheat sown September 29. Apparently the reduction in the total length of the growing period with the later plantings, the consequent lower mean temperature for the period of fall growth, and the necessarily retarded and diminished development of the plants is in direct correspondence with the subsequent development of yellow berry, in so far as these data are concerned.

A study of the vegetative spring conditions in their relation to the production of yellow berry did not give very definite results. For instance, the mean temperature for two weeks before ripening did not show any definite relationship to the yellow-berry problem, but when the possible influence of this factor was traced back to the appearance of the spike, the total averages for the two years indicated that high temperatures are correlated with a minimum of yellow berry. The amount of rainfall from the sixth day before heading to the fourth day before ripening gave no indication of correlation with this difficulty. The complicated and, in many instances, contradictory results secured in this line of investigation lead the authors to conclude that not only climatological conditions but also hereditary tendencies form an important factor in causing the appearance of yellow berry in the grain.

Among the many cultures examined planted side by side on the same day and ripening on the same date the percentages of yellow berry varied widely. Strains and varieties grown in 1906 were grouped into those wheats producing from 1 to 25 per cent, from 25 to 50 per cent, from 51 to 75 per cent, and from 76 to 100 per cent of yellow berry. The crop of 1907 from these groups showed in general that the averages for each had the same relative position that they occupied in 1906. The minimum range in the varieties lay in those groups of 1907 that came from the minimum groups of 1906. The varieties low in yellow berry had progeny in 1907 which averaged 12.25 per cent higher than the average of the corresponding parental groups for 1906, yet on the other hand the varieties high in yellow berry had progeny which averaged 27.41 per cent lower than the average of the corresponding parental groups for 1906. The hard grains planted in 1906 were much heavier than the soft ones and as a rule the yields from the heavy hard grains were the greater.

In studying the degree of inheritance of yellow berry in pure-bred or pedigree wheats it was observed that in the first progeny group in 1907 a little over one-third produced no yellow berry at all, while the average of all was 3.9 per cent. In the selections of spikes from common commercial varieties, as well as in the selections of hard and soft grains in these varieties, there were no cases whatever where the offspring was free from yellow berry. The averages for the lowest groups in the case of common commercial varieties and in the selected hard and soft grains were 36.95 and 50.40 per cent, respectively. It appears in general from the results that with the percentage increase of yellow berry in the parents a mean percentage of yellow berry in the offspring was observed, and it is considered as very evident that the pedigree-culture method so far as the elimination of the yellow berry is concerned is superior to the other methods tried. In the common commercial variety lots of parents all contained yellow berry, but there were 61 cases in which the percentage ranged from 1 to 25. The progeny of these in 1907 showed a mean percentage of yellow berry of nearly 37, while among the pedigree cultures there were 38 or 36 per cent which fell in the 1 to 25 per cent class of the parents, but which in 1907 had a mean percentage of only 7.9. The minimum or zero class of parents gave rise also to the minimum class of offspring in the case of pedigree wheats.

The results as a whole indicate that while yellow-berry production may be influenced to the extent that it is possible to control the length of the fall vegetative period, and through this the mean temperature, the solution of the problem seems to lie after all in the hands of the plant breeder, as the tendency to produce yellow berry is found to be more marked in some strains than in others and is heritable. It is believed that from a group of pure-strain pedigree wheats producing no yellow berry for two successive years a race may be derived from which the tendency to deterioration may be entirely eliminated.

WEED SEEDS IN FEEDING STUFFS.[a]

In a recent bulletin of the Connecticut State Station, E. H. Jenkins emphasizes the danger of the introduction of weeds by the use of feeds made up in part or in whole of grain screenings and similar materials, which as a rule contain a large amount of weed seeds.[b] "These screenings vary a good deal in quality. Thus an analysis recently made of wheat screenings showed about 33 per cent of flax and shrunken cereal, 15 per cent of foxtails, 8 per cent of bindweeds

[a] Compiled from Connecticut State Sta. Bul. 161.

[b] See also U. S. Dept. Agr., Farmers' Bul. 334, p. 18.

and pigweeds, 15 per cent of weed seeds of other species, and 21 per cent of dust, broken seed, and sand. Even such a mixture is much better than many others which often contain very little, if any, wheat or flax." Examinations of a large number of feeds in which such materials were used showed that "every pound of each of these mixtures brings to the farm from 5,000 to 86,000 seeds, of which, in some cases, 100, in others more than 22,000, are alive." Among the weeds of which seeds were found in the feeds were false foxtails or bottle grasses, pigweeds or lamb's quarters, knotweed or bindweed, black mustard, charlock, ragweed, Panicums, sorrel, dock, common and Canada thistle, and catchfly.

While it may be granted that the ground seed of certain weeds may have some food value, "it is very doubtful if small whole seeds are broken up and digested by the animal." It is true, as pointed out in a previous article,[a] that fermenting manure kills many weed seeds if they are kept in it long enough, but, as Doctor Jenkins states, "common experience fully justifies the belief that the farm may be stocked with weeds which come along with the manure." Many of the weed seeds in the feeds pass into the manure and thence into the fields with their vitality unimpaired. It would appear that absolute security in this respect can only be attained in all cases by destroying the vitality of the weed seeds before they are mixed with the feed. Some manufacturers claim to do this, but in none of the feeds examined by the Connecticut Station had the seeds been thoroughly killed.

HOOK-WORM DISEASE OF CATTLE.[b]

This disease, also referred to as bovine uncinariasis and salt sickness, has been reported from Texas, Florida, and South Carolina, and is probably widely distributed throughout the Southern States. C. F. Dawson, of the Florida Station, reports it as the most common disease of cattle. Investigations by A. F. Conradi and E. Barnett, at the South Carolina Station, have shown cattle to be seriously infested with the hook worm, which is frequently associated with other intestinal parasites, including the twisted wireworm or stomach worm, the inflated bowel worm, and the hair worm. The disease as described by Doctor Dawson is "an acute or chronic parasitic disease manifested at first by low fever, diarrhea, loss of appetite, soon becoming chronic, with continuance of low fever, constipation, loss of appetite, progressive emaciation, and pronounced anemia, which, in many cases, terminates fatally."

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[a] U. S. Dept. Agr., Farmers' Bul. 334, p. 18.

[b] Compiled from Florida Sta. Bul. 86; South Carolina Sta. Bul. 137; U. S. Dept. Agr., Bur. Anim. Indus. Rpt. 1901, p. 183.

Young animals are more susceptible than older ones, but all ages may be affected. The nematode or round worm (*Monodontus phlebotomus*), formerly described as *Uncinaria radiata*, is the exciting cause of the disease. These worms, found principally in the duodenum or first division of the small intestine, are provided with an armature of sharp teeth, by means of which they pierce the lining of the intestines and suck blood, moving from place to place. Other species of hook worm which affect sheep, dogs, cats, foxes, man, and other animals should not be confounded with the species that affects cattle.

The adult worm is from one-half to five-eighths inch in length and of the thickness of an ordinary pin. The eggs are deposited in the intestinal tract and are discharged in the feces, through an examination of which the extent of infestation can be determined. Conradi and Barnett have observed a gorged female whose oviduct contained more than 1,500 eggs, 17 of which were deposited in one hour. At a temperature ranging from 48° to 60° F. forty-one days are required for the eggs to hatch. The life history and habits of the worm have been studied by Conradi and Barnett.

Upon hatching, the young hook worms are very minute, but can easily be seen with the aid of a hand lens when crawling on the glass walls of the breeding jars. They have a tendency to congregate, and these clusters can be easily recognized with the unaided eye. In this stage, as well as in the egg stage, they are very susceptible to heat or cold, being easily killed. Drought is also fatal, the worms dying in a few minutes. They feed on the fecal matter about them. In the second stage they are but slightly hardier. After several days the body wall becomes thicker and more rigid, and soon they pass to the final larval stage.

The larvæ that were hatched from eggs, gathered from fresh feces on February 26, and hatched February 28, had mostly passed to the final larval stage on March 15. In this stage they are protected by a resistant covering called "sheath." Worms kept in the laboratory during January and February, the temperature varying from 48 to 60° F., passed to the final larval stage in forty-one days. While active they were able to continue feeding through the aperture in the front end of the sheath. They move up and down on any near-by moist object, whether it is earth, grass, leaves, or weeds. They finally become quiescent in some elevated position, discontinue feeding, and are then greatly resistant to heat, cold, and drought. This habit of rising appears to be advantageous, as, we believe, the principal method of host infestation is through the mouth.

That part of the life history from egg to larval stage is very probably completed in a few days during the warm weather of summer.

The eggs and young worms require moisture. It seems quite probable that little development takes place in feces dropped on a hill during the drought of summer. There is said to be little danger from infestation in running water.

At present the outlook for a cure for this disease is not very encouraging. Thymol has given good results in the treatment of the disease in man, and has been recommended by some authorities for the disease in cattle and sheep, but we believe it is far from being a specific. Certainly, in the case above referred to, with a dose of 150 grains, it could not be noticed that the worms had been in the least affected three days later. However, further experiments with this drug will be made as opportunity presents itself. Even if drugs such as thymol were effective in expelling the worms, the animal, if still pasturing on infested land, would continue to reinfest itself, so that the problem resolves itself into a question of prevention rather than treatment, the outlook for which is more encouraging.

When it is remembered that the disease occurs chiefly, or altogether, on low, wet lands, and that in dry seasons it is less severe, it would appear that much could be done by avoiding such places as pastures for at least one year. The land should be thoroughly drained, and it would be well to liberally apply air-slaked lime to accelerate drying. If in hook-worm infested lots the droppings are gathered every day, it will decrease the infestation.

Plowing, undoubtedly, also reduces the dangers of infestation, as heavily infested material buried 3 inches in loose, pulverulent, moist soil in the laboratory showed that a little over one-third as many larvæ ascended on the glass wall of the breeding jar as in the jar used as a check where an equal amount of material from the same droppings was left on the surface of the moist soil.

It is recommended that on hook-worm infested farms annual crop rotation be practiced as far as possible. The manure should be removed from stables occupied by infested animals daily and air-slaked lime used liberally to dry up the floors. The greatest precaution should be exercised to prevent the spread of this parasite into localities where it does not yet occur, either by shipments of infested cattle or otherwise.

Where it is desirable to eradicate this pest from a lot previous to putting in animals that are not infested, it may be accomplished by burning. For this purpose one should have a good substantial spray pump fitted with hose, extension rod, and a fine nozzle. Either kerosene or gas oil may be used. After the pump is filled and set in operation the spray is ignited near the nozzle. The present price of kerosene, however, would make this operation too expensive over large areas.

EFFECT OF MACHINE MILKING ON INDIVIDUAL COWS.[a]

Owing to the rapid growth of the dairy industry in recent years and the increasing difficulty of securing competent help, much interest has been aroused in the possibility of securing greater economy in time and labor by the use of mechanical milkers. Several of the experiment stations, as well as the Dairy Division of this Department, have made experiments and published reports dealing with various phases of this subject.[b]

At the Nebraska Station, A. L. Haecker and E. M. Little have been carrying on experiments for several years with a view to ascertaining

[a] Compiled from Nebraska Sta. Bul. 108.

[b] Connecticut Storrs Sta. Bul. 47; Kansas Sta. Bul. 140; Pennsylvania Sta. Bul. 85; Wisconsin Sta. Bul. 173; Ontario Dept. Agr. Bul. 159; U. S. Dept. Agr., Bur. Anim. Indus. Bul. 92.

definitely some of the practical limitations of the milking machine and the conditions under which it may be most successfully used. These experiments have dealt more particularly with the effect of the use of the milking machine upon the production of cows throughout the lactation period and the behavior of individual animals with reference to machine milking.

In the experiments 53 different cows have been milked by machinery. Of these cows some have been milked continually with the mechanical milkers from the time they were first tried, while others have been subjected to this method for only a short time. As a result, twenty practically complete lactation records have been obtained, together with numerous records covering shorter periods of time. * * *

In 1908 an experiment with 10 heifers was begun which will cover a series of years. These animals have never been milked by hand, so their performance, as far as milking is concerned, will be entirely controlled by the milkers. So far, two lactation records by heifers have been obtained by machine milking which compare favorably with other 2-year-old records made in the University dairy. Heifers in their first lactation seem to give down their milk quite freely when milked by machine and are less inclined to hold up milk than are cows which have been accustomed to hand milking for several years before machine milking is begun.

In general it was found that the effect of the machine varied with the individual cows, and that some cows are not adapted to machine milking. Heifers in their first lactation apparently gave better results by machine milking than did aged cows that had been accustomed to hand milking for one or more years.

With animals adapted to the purpose, the use of the milking machine appears, according to the Nebraska Station experiments, to be of very decided advantage, but if there are several animals in the herd which can not be milked in this way to advantage the herd totals may be so lowered, and the resultant losses become so great, that they would not be compensated for by the saving of time and labor in the use of the machine.

The successful application of machine milking can not therefore be assured "until all the members of the herd are known to be adapted to this method of milking."

MILK SUPPLY OF CITIES.[a]

The widespread and constantly growing interest in the subject of a supply of pure milk has led to an investigation of the subject at several of the stations.

There are three classes of persons responsible for the condition of milk as it finally reaches the human stomach, namely, the producers, the dealers, and the consumers. The importance of the first two classes in keeping a milk supply pure and wholesome has been recog-

[a] Compiled from Illinois Sta. Bul. 120; Kentucky Sta. Bul. 134.

nized by all investigators, but that the consumers have a duty to perform seems to have escaped the notice of many observers. This phase of the subject has been discussed by J. M. Trueman, of the Illinois Station, as follows:

Not only the producer and dealer but the consumer has something to do in securing a supply of clean, sanitary milk. He should appreciate the superiority of good milk, should know what such milk is and which dealers are selling it in his city. Every dairyman who tries to meet the modern requirements of good milk should be given trade in preference to the man who is wedded to unsanitary customs. Many a consumer will use the product of poor cows handled in unsanitary buildings, rather than pay a cent or two more per quart for clean, safe milk. This is a direct bid for poor milk.

If the consumer would visit the dairies of his city and find out for himself how the milk is handled it would result in good to all concerned. A number of milkmen have admitted that they would be ashamed to let their customers see how the milk is produced. An intelligent demand for clean milk would go far to improve the situation. It would at least set the dairyman to thinking if a few questions like the following were asked him:

"Are all your cows healthy?" "Do you keep them clean?" "Is your barn light and well ventilated?" "Are your bottles sterilized each time before filling?"

If, in making a round of the dairies, the consumer should find an up-to-date, sanitary place and see the extra care taken to produce good milk, it is very likely he would be willing to pay a little more money for such milk.

The consumer is often to be blamed for the milk souring quickly. First-class milk, left at his home in a clean bottle and at a low temperature, may be sour or off flavor twelve hours later because it was left standing in a warm kitchen for a few minutes, or was poured out into a pan that had been washed in the dish-pan and wiped on a towel that had done service for all kinds of dishes for several days. Milk should not be left standing in the sun a minute after the milkman leaves it. The consumer should have a place for the milk inside the house or in the shade, and should see that the deliveryman puts it there. It should be taken immediately to the coolest place in the house and left in the bottle without removing the cap until wanted for use, or he can not blame the milkman if the milk spoils. The consumer does not deserve good milk unless he discriminates in favor of such milk and takes the proper care to keep it good after it reaches him.

At present prices the cost of milk produced in Illinois in such a manner as has been recommended here should not much exceed 8 cents a quart delivered, and at this price it is cheaper food than meat. It can not be produced and delivered for 5 cents; 6 cents leaves too small a margin of profit for the honest dealer; 7 cents will do in many localities. However, these prices do not apply to special or fancy milk. When the people insist on having good milk and are willing to pay a fair price for it, the milkmen will fall into line quickly and supply the demand.

In one case a dairyman advertised the exact way in which he produced clean milk, and offered it at 2 cents per quart above the regular price. Soon he found more customers than he could supply.

Taking up the question of the methods of the dealers in handling milk and its products, Professor Trueman found in Chicago much to criticise and less to commend.

It was an exception to find a milk depot that was clean and sanitary. A great many of these markets are located in dark, dirty, and ill-ventilated basements where the sunlight never enters. They are never scrubbed out, and many of them could not be scrubbed clean because the floors are of rotten wood or only of earth, and so they are kept foul with sour and decaying milk. These depots would be bad enough if they received only bottled milk and sold it without opening the bottle, but commonly the milk is stored in large cans, dipped into open vessels when sold, and often carried through dusty streets for several blocks. Such conditions are deplorable. Occasionally, but rarely, one of these small depots is found scrupulously clean.

In the better portions of the city much of the milk is delivered from wagons, and a large part of it by big dealers. This milk is uniformly up to grade in butter fat, but the amount of sediment in the bottom of the bottle is occasionally quite large. If all parts of the city were furnished with as good milk as the wealthy people receive, very little cause for criticism would exist. It is not primarily a question of price, as the greater part of the best milk sold in the city retails at from 7 to 8 cents, while the poor milk sold to the working people from open cans brings 6 cents. It is cause for congratulation that an increasing proportion of the working people are being supplied with clean milk in sterilized bottles. The small depot, although it keeps the milk cold for the poor people who have no ice box or cellar and enables them to buy in small quantities, is a doubtful blessing. The best of the big dealers furnish a much better quality of milk at a moderate price, and it may be kept sweet in a cool cellar for the day's consumption.

Of samples of milk collected in a residence district of rich people and well-to-do artisans only 9 per cent of the milk was found below grade, while in the poorer district 50 per cent of the milk was below grade.

The richer district was for the most part served by the wagons of the best large dealers, who always handle a good grade of milk. The fact that 9 per cent was found below grade shows that there is still room for improvement. The amount of sediment found here was much less than in the poorer districts, but it was by no means entirely absent. The noticeable thing revealed * * * is that the poor people who needed the best of nourishment paid almost as much for poor milk as the rich people paid for good milk. * * *

The milk as it comes from the country is almost universally up to grade. It will average 3.5 to 4 per cent of butter fat. The small dealer buys one or more cans at the platform when the train is unloaded, takes the milk to his depot, and sets it in a tank of ice water. The cream rises in the can, and before beginning to sell the milk the dealer removes one or two quarts of cream, which is sold in small quantities at a good price and furnishes the larger part of the profit. The milk remaining in the can is stirred up and sold as whole milk at 6 cents per quart. Frequently water is added to take the place of the cream removed.

The temptation to make profits in this way overcomes any system of inspection that the city has yet established in these districts. By this means the poor are defrauded by people of their own class, and half-nourished children are fed on skimmed and watered milk for which full price has been paid.

That conditions in Louisville are no better is well shown by R. M. Allen in a recent bulletin of the Kentucky Station. He says that "only a small percentage of the milk comes into the city bottled."

He also touches on the question of the unequal distribution of the returns from the sale of milk. The producers have a great deal more invested in proportion to product, and yet they receive on an average probably from one-fourth to one-third of the price paid by the consumer. The balance goes for transportation and distribution.

The following [is a report of] an inspection of the principal milk depots, and in addition some clean and unclean places selected from the grocery and fruit stores where the milk is kept "to accommodate the customer." It has been the experience not only in this milk inspection, but in all pure-food work that many of the grocery stores are very unsanitary places. This inspection shows in the majority of instances unclean refrigerators, or milk kept in refrigerators with vegetables and other products, and often the situation of the refrigerator near oil tanks and so on, in the midst of general dirt and rubbish. There were, however, a number of clean stores. The retail grocery store by reason of its ice boxes and other conveniences is a necessary adjunct to the community, else many of them would not be tolerated in their present filthy state. It should not take much argument to convince anyone that the retail grocery store would become more necessary and profitable if cleaned up and kept cleaned, and provided with all of the systems and means necessary for keeping and protecting perishable food.

The general milk depots may be grouped into five classes: (1) The depots owned and operated by the dairymen themselves; (2) the depots which are supplied by dairymen under contract to maintain sanitary barns, to use covered pails, and to cool the milk before shipping; (3) depots in which the milk is pasteurized and which are supplied from sources with a less regard for sanitary conditions; (4) depots supplied with an inferior milk from any source possible, and with which the patrons have no steady contract; (5) the ice-cream plants which sell milk. The milk is shipped or delivered to these depots in cans holding from 2 to 10 gallons. Some of the dealers empty these cans at once, wash and steam them, and return promptly to the dairymen. Others return the cans unwashed, and still others use the dairymen's property for further handling of the milk among their trade, and the can, after a week's use or delay, is finally returned to the owner foul and filthy. The dairymen as a rule have not the facilities for steaming and sterilizing cans which a milk depot by reason of its volume of business should maintain. Attempt is made by the dairymen, however, to wash the foul cans on the farms, but such a can is not fit for use again unless it has been aired for several days, and it is frequently necessary to use it at once because the dairymen's full supply of cans have either not been returned promptly or have been misplaced in shipping. The only way to remedy this problem is to require the milk dealer under the penalty of an ordinance or a law to return the cans promptly, and to return them clean and sterilized.

The system of distributing milk out of wagon cans from house to house can not be too strongly condemned. It matters not how cleanly the milk may be produced or with how much care it is delivered to the city, if finally distributed to the consumer in this way. The can top is opened to dip out the consumer's amount. This is put into the open top or bucket, which is again emptied into the consumer's pitcher or crock. All [this is] done in the open dusty street. Among all sources of contamination there is none from which comes more opportunity for dirt and disease than the distribution of milk in open cans from the street. And among the regulations most needed is one to compel all milk to be delivered to the consumer in the original package. This would mean the bottling of all milk for retail trade on the farm, or delivered in cans to consumers purchasing a gallon or more, and in cans to ice-cream factories, bakeries, and other places where milk is used in wholesale quantities.

It will be seen from this that much improvement is to be made in the milk depots as well as in the dairies if the city is to have pure milk. There is too much handling of the milk in the city depots, and the mixing of milk from good and bad herds together is another objectionable feature. The cost of distribution is also excessive, in fact, is from two to three times the price paid the dairyman for milk, while the investment in farm, equipment, herd, feed, labor, and shipping in 100 dairies is many times the investment necessitated in the one city depot which distributes the milk. The city plants should really be nothing more than a distributing point for the handling of milk in the original bottles or cans as it comes from the farm. And if such were the case, and if cooperative distributing plants were organized, there would be more profit to assist the dairymen in maintaining cleaner and better barns and milk houses, and this profit would come without much advance to consumers in the price of milk, besides the protection from city contamination. In addition to this, depots established under city or some charitable aid are necessary to distribute pure milk to the poorer classes of customers, and thus by eliminating a large part of the cost of distribution make it possible for such customers to have pure milk at a price within their reach. Rochester's system of depots maintained in this way has proven not only in every way practicable but has had a direct effect in decreasing the rate of infant mortality.

It would seem that in smaller places conditions should be better, inasmuch as producer and consumer are in closer touch with each other, but the contrary seems to be the case. Perhaps one reason is that the milk reaches the consumer in so much shorter time, and therefore the effect of careless and unsanitary methods has not had as great opportunity to develop. On this point Professor Trueman says:

The milk conditions in the 26 smaller cities visited were found less satisfactory than in Chicago. Much more formaldehyde was discovered and a larger proportion of samples contained sediment. A great deal of criticism is always heard of the food supplies of large cities. But the chances of getting good milk, by anyone who knows the requirements of such milk, are better in Chicago than in any of the 26 cities of 10,000 to 60,000 population in Illinois. Here again is shown the good that may be accomplished by inspection. The majority of the smaller cities have little or no inspection, and the dairymen and dealers have failed to bring the milk up to a high standard. The percentage of butter fat averages higher than it does in some districts of Chicago, but the amount of sediment is very large.

From all the foregoing facts it appears very evident that all the blame for poor milk is not properly charged to the farmer. While it is true that good milk can not be produced except by strictly sanitary dairy methods, it is equally true that milk which leaves the dairy in the best possible condition may become contaminated and unfit for food before it is used. This does not, however, relieve the farmer of any responsibility for his part in the production of pure milk, but rather makes it incumbent upon him for the sake of his own reputation to see to it that he disposes of his product to dealers who will use equal care to keep it pure.

While it costs more to produce clean milk the returns will in the long run more than repay the added expense, and, besides, it is not so much a question of an expensive outfit as it is one of being careful and cleanly. The requirements for clean, healthful milk are stated by Professor Trueman as follows:

All cows that are weak, extremely thin, and coughing must be removed from the herd. Milk from unhealthy cows is not safe to use, and only cows in good health can make profitable use of the food given them. The herd should be inspected at regular intervals by a competent veterinarian.

It is necessary to have healthful buildings and to keep them clean, but such buildings need not be expensive. The four essentials are light, ventilation, a proper floor, and a comfortable tie. Window glass is almost as cheap as lumber. The King system of ventilation can be installed by any carpenter or by the farmer himself at the cost of a few feet of lumber and a few days' work. A cement floor is but little more expensive than a good wood floor, and is many times more durable. Planks laid over the cement where the cows stand will prevent injury to the animals. A comfortable tie is only a little more expensive than an awkward rigid stanchion. A good swing stanchion is not uncomfortable to the cow. All of these things could be put into the ordinary Illinois barn with but little trouble, and would pay for themselves in less than a year in the increased efficiency of the herd.

Much of the dirt in milk comes from the barnyard. The cows wade knee deep in mud and manure and carry this filth into the barn on their legs, tails, and udders. It is difficult to clean off, and the careless milker makes little attempt to prevent the constant shower of dirt falling into the pail. The yard should be well drained and graded up with cinders or gravel. If drainage can not be obtained in any other way, the rule should be, raise the barn and grade up to it.

Before milking, the cows should be gone over with a brush and all loose particles of dirt removed. This need not take more than thirty seconds per cow. The cow's udder comes in contact with the floor and can not be cleaned by simply brushing. It is very important that the udder should be washed with a damp sponge or cloth, and this may take thirty seconds more. The sponging will be doubly effective if the long hairs around the teat and lower part of the udder are cut short. Each man who is to milk twelve or fifteen cows will need to spend twelve or fifteen minutes in cleaning them. This cleaning is very simple and inexpensive, and yet nine out of ten farmers scout the idea as preposterous. Every farmer will spend hours cleaning his horses, because he is ashamed to have the public see them dirty. It would be much more reasonable to spend less time cleaning his horses and more time cleaning the animals that produce the milk his children are to drink. It is time for the consumer to demand that every individual dairyman supplying milk for city consumption shall use at least common decency in its production.

Clean cows, clean clothes, and clean dry hands for the milker should be the unvarying rule of every dairy. Special milking suits should be worn and frequently washed.

A small-topped pail would prevent a large amount of dirt from falling into the milk. Pails, cans, strainers, coolers, and every other utensil that comes in contact with the milk should be washed clean and sterilized. Sterilizing means heating to 212° F. It may be done by boiling water or by steam. It can not be done by starting with boiling water in one can and pouring it from can to can to clean half a dozen. The easiest way to do thorough work is to use steam.

The ideal method for preparing the milk for delivery is that it shall be cooled to 45° F. immediately after milking in a clean dairy room separated from the stable, and then bottled in sterilized bottles and the bottles sealed with paraffined paper caps. This method, however, involves quite an outfit, and would usually require a supply of ice. In case of small dairies too far away from their market to retail their own product the next best method would be to take the milk immediately to a bottling plant, where it is cooled and bottled as noted above, and then shipped to the city either packed in ice or in refrigerator cars.

In recent years milk commissions organized by county medical societies have made it possible to secure for the use of invalids and for the artificial feeding of infants a supply of milk that is extremely pure and wholesome. The milk produced under such supervision is called certified milk, and the name is protected by registry in the United States Patent Office. However, this does not prevent its use by duly organized commissions. The work of such commissions and the production of certified milk have been discussed in considerable detail in a recent bulletin of the Dairy Division of this Department.[a]

The following statement is made of the composition, bacterial content, and value of certified milk as compared with ordinary market milk:

As far as the chemical composition is concerned, certified milk does not differ materially from ordinary market milk. The milk commissions require that the fat and total solids shall come within certain limits, and for this reason there is but little variation in the chemical composition of certified milk. The standards are not high, for the reason that milk containing about 4 per cent of fat is considered to be the best for immediate consumption. As stated elsewhere, many of the herds in certified-milk dairies are composed of grade cows and do not produce milk of more than the average richness.

When we compare the bacterial content of certified and market milk we find a very striking difference. The bacteria in the average milk supply of our large cities exceed 500,000 to the cubic centimeter, while the bacteria in certified milk seldom exceed 30,000 to the cubic centimeter and in most instances average less than 10,000. There have been some cases where commissions have reported that no bacteria were shown to be present by the ordinary methods used for their detection. Liquefying, putrefactive, and pus-forming bacteria are seldom present in large numbers; in fact, the contracts of some commissions with the producers specify that the milk shall not contain pathogenic bacteria or more than a limited number of pus cells to the cubic centimeter. * * *

Certified milk, produced under the direction of a reliable milk commission, is worth more than ordinary market milk for several reasons: (1) It is free from disease-producing bacteria, and all other germs are reduced to a minimum. (2) It is free from high acidity and pathogenic germs which lead to stomach derangements and kindred troubles. (3) The customer can always depend upon his milk coming from the same farm, the same herd of cows, subjected to the same treatment, and having the same quality. The fat content is guaranteed not to vary outside of narrow limits; hence the milk is always of good

[a] U. S. Dept. Agr., Bur. Anim. Indus. Bul. 104.

quality. (4) Cleanliness and cold are the only preservatives used. (5) It is a safe food for infants and people with delicate digestion. (6) It is the natural product of the cow, and has not been subjected to any treatment which affects its digestibility or changes its character. (7) It is reasonably free from foreign odors and objectionable flavors.

The extent to which milk and its products are used as food and the influence which the purity of milk has on the health of the consumers have led to an extensive investigation of the relation of milk to the public health. This investigation was carried on by the United States Public Health and Marine-Hospital Service in cooperation with the Bureaus of Animal Industry and Chemistry of this Department. The results have recently been published in a very comprehensive report.[a]

The purpose of the investigation was to secure "all available data showing the influence of milk as a carrier of infection, its chemical composition, the contaminations found therein, their influence upon it as an article of food, and the measures necessary in its production and handling to prevent such contamination."

As regards milk supply, the conclusion was reached that "it is evident, from a broad view of the subject, that a pure and wholesome milk supply is possible," and it is stated that the report contains all the necessary information to attain that end, as well as the existing standards of purity to which it should conform.

"The three cardinal requirements—cleanliness, cold, and speedy transportation from the cow to the consumer—must be observed, and the cow herself must be free from disease. For their observance, intelligence and care on the part of the dairyman and milk dealer are absolutely essential."

In the report of a previous conference appointed by the Commissioners of the District of Columbia,[b] a classification of commercial milk was proposed by A. D. Melvin, chief of the Bureau of Animal Industry of this Department, which seems applicable to the milk supply of any city. Doctor Melvin recommends "that the milk supply of the city be divided into three classes." Class 1 is to be certified milk, essentially as previously specified (p. 26).

Class 2 to be clean, raw milk from healthy cows, as determined by the tuberculin test and veterinary physical examination; the cows to be housed, fed, and milked under good conditions, but not necessarily equal to the conditions provided for class 1; pure water, as determined by chemical and bacteriological examination, to be provided; the bacteriological count of the milk not to exceed 100,000 bacteria per cubic centimeter at the time the milk reaches the city at any season of the year, as determined by the health department at frequent intervals; milk to be delivered to the customer in sterilized containers, and the temperature of the milk not to exceed 50° F. until delivered to the consumer.

Class 3 to be milk from all other dairies not able to comply with the requirements for classes 1 and 2, this milk to be clarified and pasteurized at central

[a] Pub. Health and Mar. Hosp. Serv. U. S., Hyg. Lab. Bul. 41.

[b] U. S. Dept. Agr., Bur. Anim. Indus. Circ. 114.

pasteurizing plants, which shall be under the personal supervision of an officer of the health department. These pasteurizing plants may be provided either by private enterprise or by the District government, and should be located within the city of Washington. Class 3 milk should not be permitted to exceed 60° F. on delivery from the dairy to the pasteurizing plants. The milk from these pasteurizing plants, placed in sterilized containers, should be delivered to the consumer at a temperature not exceeding 50° F. All milk of unknown origin should be placed under class 3 and subjected to clarification and pasteurization. It should also be provided that no cows suffering from any communicable disease or any unfit condition, to be determined upon physical examination by an authorized veterinarian, shall be permitted in any dairies; and, further, that cows which do not show any physical signs of tuberculosis upon veterinary examination, but which may have reacted to the tuberculin test, may be included in dairies supplying milk of this class.

No dairy farm should be permitted to supply milk of a higher class than that for which the permit has been issued, and each dairy farm supplying milk of a specified class should be separate and distinct from any dairy farm of a different class; the same owner, however, might supply different classes of milk, providing the dairy farms are separate and distinct, as above indicated.

All milk to be of good composition, free from adulterants and artificial coloring matter.

The term "milk" to include both milk and cream.

It seems evident from a consideration of the foregoing that what is especially needed is a better knowledge on the part of producer, distributer, and consumer of milk of the necessity for intelligent care and absolute cleanliness in producing and marketing this valuable product.

THE CROW AS A MENACE TO POULTRY RAISING.[a]

Discussing this subject in a report of the Rhode Island Station, L. J. Cole says:

That the common crow (*Corvus brachyrhynchos*) is a not infrequent despoiler of the nests of other birds has long been known, while his attacks upon poultry and eggs were among the grievances held against him by the early settlers. It is, perhaps, not generally appreciated that the crow is distinctly omnivorous, and that under natural conditions a large proportion of its food consists of animal matter. According to Barrows and Schwarz, roughly speaking one-third of the food of crows consists of animal matter; during certain months, especially April and May, the proportion of animal food consumed is nearly double, while in the fall and winter it is correspondingly less.

The crow's depredations upon poultry consist almost entirely in the destruction of eggs and the killing of the young. Adult fowls are probably seldom attacked, unless sick and weakened. The eggs of the turkey, which is commonly allowed to roam and select its nesting site far removed from the house or poultry yard, are especially liable to destruction by crows. They do frequently, however, attack chicks, young turkeys, and even goslings. * * *

Serious depredations of crows upon poultry and eggs appear to occur only in certain localities, while in other places, though the crow may have an unsavory reputation, as he generally does in farming communities, he is at least free of this opprobrium. The reasons for this are probably twofold, depending,

[a] Compiled from Rhode Island Sta. Rpt. 1908, pp. 312–316.

first, upon the abundance of other food, and, in the second place, upon the accessibility of poultry. As poultry raising is now generally conducted, when any special attention is given to it, the eggs are no longer exposed to the danger from crows, since the hens lay in regularly appointed houses. Furthermore, the young chicks are, as a rule, much better protected, being confined in yards and runs near the house, instead of being allowed to roam at large with their mothers. Nevertheless, * * * the crows may become very daring in their attacks when other food is scarce. The necessity of an abundant supply of food is especially great during the months of April and May, when the crows are rearing their young. * * * Since young chicks are usually raised at about the same time, it is evident why they often furnish a very acceptable addition to the crow's larder.

Attention is called to two cases of persistent depredations by crows, which caused serious losses to poultrymen in Rhode Island. In one case, 25 per cent of the chickens hatched were destroyed by crows between April 1 and July 10.

All sizes were taken, from the time they were just hatched until they were a pound in weight. The larger chicks the crows killed and ate where they caught them, but the smaller ones they carried away in their beaks. Various efforts were made to keep the crows away, most of which were ineffectual. The first was a scarecrow, but this had little or no effect. In the second place, corn soaked in strychnin solution was scattered on a field of planted corn at a little distance from the chicken yard. This may have killed some crows, but no dead ones were found. No corn was pulled, but there was no appreciable decrease in the number of chickens taken. Third, a steel trap was set on a pole near the chicken yard, but without success. Fourth, white twine was run on stakes around and across the chicken yard; this kept the crows from the yard, but the small chicks would get out, and would then still fall a prey to the crows. Finally, a crow was shot and hung on a pole near the chicken yard, after which there was no further trouble.

In the other case cited, 87 per cent of ducklings hatched were destroyed by crows. In this case, also, a scarecrow was ineffectual in keeping the crows away.

The question of whether the crow is on the whole beneficial to agricultural interests or whether he does more harm than good, is one that will probably have to receive a different answer in accordance with different conditions. That he does a great deal of good at times by the destruction of noxious insects can not be denied, though it would probably be difficult to convince the average farmer that he is anything but a thief and a rascal. The problem is in reality an extremely complex one, depending upon a great many variable factors, especially the absolute and relative abundance of various kinds of food. When other food is scarce the crow turns to poultry, but when certain insects (such, for example, as the beetles commonly known as "June bugs") are abundant, the crow feeds largely upon them. * * *

Whatever may be the crow's good points in particular cases, it is not likely that the poultryman who is suffering serious losses by his depredations will be inclined to look upon him with favor. * * *

It should, perhaps, be mentioned that it is the opinion of many observers that the egg and poultry stealing habit is not common to all of the crows of even a single locality, but that the habit is acquired by certain individuals only, and that if these can be shot the trouble will be stopped.

HOURS OF LABOR, WAGES, AND COST OF BOARD ON MINNESOTA FARMS.[a]

In connection with an exhaustive study of the cost of producing farm crops and of feeding and caring for live stock on Minnesota farms, statistical data have been collected regarding the hours of labor, the cost of farm labor, and the value of the food of the family, including both the articles purchased and the articles produced on the farm. These statistics are of interest in themselves and are also an essential part of the discussion of the cost of producing farm crops and stock.

Farms were selected first in three, then in five, counties in western, northwestern, southeastern, and southwestern Minnesota, and data were systematically gathered in a number of farm homes in these counties. The investigations were instituted by Assistant Secretary Willet M. Hays (then professor of agriculture at the Minnesota College of Agriculture) and have been carried on by the Minnesota Experiment Station cooperating with the Bureau of Statistics of this Department.

According to E. C. Parker and T. P. Cooper, who reported the latest of these investigations, the average monthly cash wages of farm laborers on the selected farms for the years 1904–1907, during the eight "crop-season" months, April 1 to November 30, were approximately as follows: Northfield, Rice County (1905–1907), $26.16; Marshall, Lyon County, $26.64; Halstad, Norman County, $25.56, and a large farm in northwestern Minnesota, Norman County, $26.77. During the months of December, January, February, and March the average monthly wage at Northfield was $15.80; Marshall, $14.20; Halstad, $11.69, and the large farm in northwestern Minnesota, $14.36.

The average cash value per hour of farm labor on all the farms, for the three years 1905–1907, was 11.2 cents for December, January, February, and March, and 12.7 cents for the "crop-season" months, April to November, inclusive. While wages are lower in the winter months, the number of hours of labor is much less than in the summer, thus there is little difference between summer and winter in the cost per hour for farm labor. This cost is based upon the wages paid to men plus the cost for board.

The average number of hours worked per day by men (1902–1907) on the farms at Northfield, southeastern Minnesota, was 8.94 hours, with 3.64 hours for Sunday work. At Marshall, in southwestern Minnesota, 8.66 hours for week days and 3.05 hours for Sundays, and at Halstad, in northwestern Minnesota, 8.10 hours for week days and 2.76 hours for Sundays. No estimate is given of the average length of the working day of the women on these farms.

The statistics summarized show that on an average the total value of the farm produce used per family was $222.97; of groceries and

[a] Compiled from Minnesota Sta. Bul. 97; U. S. Dept. Agr., Bur. Statis. Buls. 48, 73; Jour. Home Econ., 1 (1909), No. 1, pp. 43–51.

fuel, $170.89; of man and horse labor, $57.74; of women's labor, $216.66, and of house furnishings, $32.46 per year, women's labor representing 30.91 per cent of the total cost, the largest single item with the exception of farm produce, which was 31.81 per cent of the total.

In estimating the cost of board per man per month record was kept of the food, including groceries, meat, farm products, etc., fuel, garden produce, including cash cost of seeds, labor, rent of land, etc., the labor of men in the household, and labor of women in the household. Record was also kept of the number of persons who were boarded and the number of days each was boarded.

Assistant Secretary Hays and E. C. Parker make the following statements regarding this part of the work:

> In determining the cost of board on farms per day and per month, it is necessary to figure the total cost of the table board each year, and then divide this sum by the total number of days' board in terms of one man. It is impossible to figure this cost of board month by month during the year, because the purchase of supplies may be great one month and very small the next month. Inventoried supplies of flour, sugar, farm produce, etc., are consumed during a number of months, and the exact amount consumed each month can not be determined. Cost of board per month per man is, therefore, figured from a yearly average, and the data secured * * * are used in determining the rate of wages per hour. * * *
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> Wages for household work are not actually paid on a majority of farms, but a yearly cash value is placed upon the household work on each farm, so that the cost of board may be reduced to cost per month per man and be used in determining rates of wages for man labor. The amount of wages * * * [assigned] in each case is determined by the standard of living, the size of the family, and the prevailing wages for housekeepers and hired women.

The average cost of farm board per month of one laborer for the three years 1905–1907 was, according to the figures summarized, $14.36 at Northfield, $12.73 at Marshall, $11.58 at Halstad, and $10.02 on the large grain farm in northwestern Minnesota. "The average cost per day was 47.9 cents at Northfield, 42.4 cents at Marshall, 38.6 cents at Halstad, and 33.4 cents for the large farm in northwestern Minnesota; the average cost of board per month on all farms was $12.65, and per day 42 cents."

An important factor in determining the cost of board on farms is the proportion of home-grown material and purchased foods which is used. The table which follows shows the average quantity of farm produce other than vegetables used on the various farms.

Average annual consumption of farm produce per man on certain Minnesota farms.

Location of farms.	Whole milk.	Skim milk.	Butter.	Cream.	Eggs.	Pork.	Poultry.	Beef.	Mutton.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Dozen.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Northfield	333.2	....	19.1	16.3	61.8	94.4	22.6	....	....
Marshall	241	298.9	68.5	90.1	46	77.5	24.9	28.4	4.1
Halstad	48.2	718.1	52.2	84.7	26.3	60.1	6.8	118.2	2.2

According to T. P. Cooper's discussion of this subject—

The values given in the table afford a good illustration of the quantity * * * of the farm products used per man, and show the great difference in the dietary of the farmers in the southeastern part of the State and those in the northwestern. At Marshall a larger amount of butter was made and consumed on the farm than at Northfield and a considerably larger amount of cream, meats, etc., were used, while the quantity of eggs and pork used was smaller. At Halstad as at Marshall there was a tendency to make a greater use of products produced at home. The saving shown in the amount of butter and eggs used per man is possibly due to the fact that they have a ready cash sale, but is more likely due to the use of certain substitutes which are cheaper or more easily secured.

No skim milk (that is, milk from which the greater part of butter fat has been separated, but which still contains about one-tenth per cent fat) was used on the Northfield route, but a large quantity was used on the Halstad route and but very little whole milk. The quantity of cream used on the Marshall route is large compared with Northfield, 90 pounds against 16 pounds, but the quantity of whole milk consumed was less. In 1907 only two farms on the Halstad route used whole milk. However, the loss of fat in the whole milk was made good by the use of cream and the skim milk. The cream commonly used on these farms contains from 20 per cent to 30 per cent butter fat.

It is of interest to note the great dependence placed upon dairy products on the Marshall and Halstad farms. There, the milk, cream, and butter used assume a prominent place in the family diet. As no milk or cream is purchased, the quantities of milk used indicate in a way the dependence of the farm family on the different routes upon these products. At Northfield 349 pounds of milk and cream are consumed per man per year, while at Marshall and Halstad the amounts are 630 pounds and 851 pounds, respectively. The farm at Halstad, then, provides almost two and a half times more milk and cream per man per year than the farm at Northfield.

The farms at Halstad furnish annually 187 pounds of meat per man per year, those at Marshall 134 pounds, and at Northfield 117 pounds, the housewife at Northfield being more dependent upon the butcher than are those of Marshall and Halstad. The smaller quantity of meat from the farm used at Northfield is probably due in part to the fact that the average number of persons boarded is insufficient to consume fresh meat during the warm months and in part to a distaste for the preserved products. The value of the farm produce used at Halstad and Marshall is about one-third of the total cost of board, which illustrates the old saying that the farmer obtains one-half his living from the farm. If labor and furnishings are not considered, the farm, as determined by cost, furnishes 44 per cent of the living at Northfield, 53 per cent at Marshall, and 56 per cent at Halstad. If food values are taken into consideration, a much higher proportion would be furnished from the farm. A large proportion of the expenditures for groceries is for items having a slight food value best used for condimental purposes and for furnishing pleasant changes.

If a people are known by their dietary, we may look upon the farmer of Minnesota as being an exceptionally well-fed individual and consequently having a high labor efficiency. This view is undoubtedly correct, for while the average number of hours of labor by the farmer is not excessive, yet a visitor is usually impressed with the amount of work accomplished.

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