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**A HISTORY
OF
THE WISCONSIN AGRICULTURAL
EXPERIMENT STATION**

PART II

**THE DIRECTORSHIP OF
HARRY LUMAN RUSSELL**

1907 - 1930

BY

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DIRECTOR RUSSELL BEGINS WORK (1907-1908)

When Dr. Harry Luman Russell assumed the management of the Agricultural Experiment Station of the University of Wisconsin, in 1907, as Dean and Director, the institution entered upon a new era of utility and efficiency. The new Director brought to his official duties a unique combination of financial acumen and executive ability in addition to his masterful knowledge of bacteriology and of the other basal sciences of agriculture. He possessed in rare measure the faculty of inspiring harmonious and effective teamwork in the staff of eminent research men, he attracted to his assistance, and the clear vision and purpose necessary to the most effective employment of their skill and time in research projects.

Based upon the splendid foundation laid by William Arnon Henry, the Institution quickly expanded under the enterprising management of Director Russell, until it reached the high peak of service envisioned for it from its establishment in 1888. Seven new departments were created and two of the existing ones reorganized in the first few years of the Russell regime, while all of the work in progress and undertaken was carefully supervised and, where necessary, made fully efficient.

STATION PUBLICATIONS

One of the first improvements made by Director Russell was an important change in the character of the station publications. It had been the practice to publish annually a Station Report of 15,000 copies containing the Director's account of changes in the faculty membership, particulars relative to new buildings, financial matters, the projects being undertaken and the prospective ones proposed; together with outlines of the various bulletins published during the year, and sundry articles of an instructive character. In

addition to the Annual Report, which often was bulky and expensive to publish, popular bulletins had been issued at frequent and irregular intervals in editions of varying size, describing in each, a special subject of interest of farmers, and based upon the experimental work of the station. Director Russell, after a careful consideration of the matter, concluded that it would be advisable to restrict the annual publication to the Director's Report in two parts, consisting of (1) a summary of all the activities of the station in its various lines, together with such financial and other statements as are required by law, and (2) The technical Research Bulletins which previously had been issued from time to time during the year. The new Annual Report, composed of the two parts mentioned were to be distributed to libraries, public institutions, etc., and to those especially desirous of maintaining a *file* of the research work of the station. In the popular Bulletins, other than those of strictly scientific character, termed *in* "Research Bulletins," the most emphasis was to be given to the presentation of the practical results obtained from the experimental work of the station in a popular form, and suitably illustrated, for the information and instruction of the farmers of the State.

FINANCIAL RESOURCES

The passage of the Adams and the Nelson acts by Congress, increased the amounts of money granted from the National Treasury for further development of agricultural experimentation under the supervision of Director Russell. In addition to the Hatch Act, which was the original foundation of the Agricultural Experiment Station, the Adams Act provided for use in 1908, \$11,000 extra, this amount of money to be applied solely "in paying the necessary expenses of conducting original researches on experiments bearing directly on the agricultural industry of the United States" and

for the "more complete endowment and maintenance of the experiment stations, presupposing the provision of a working plant and administrative offices".

Under the Nelson Act, passed by Congress on March 4, 1907, there was appropriated to each agricultural college a gradually increasing fund which in 1908, was \$10,000, and was designed to supplement the Morrill Act of 1862, on which all of the land grant colleges were founded. These funds provided by the federal government had been supplemented by the State of Wisconsin by gradually increasing appropriations devoted to the work of the Agricultural College and Experiment Station. The total sum received by the institution from the Treasurer of the United States in appropriations for the year ending June 30, 1908 was \$24,000.

CHANGES IN THE STATION STAFF

Few changes occurred in the personnel of the Station staff during the fiscal year ending June 30, 1908. George A. Olson, of the Agricultural Chemistry Department, resigned and became assistant chemist of the Washington State Experiment Station where in 1910 he was made chief chemist and in 1916, State Chemist. Later he was employed as agricultural director of the Gypsum Industries at Chicago, Illinois. W. A. Brannon took his place as Assistant in Feed and Fertilizer Inspection in the analytical laboratory. Charles Strongman Knight, Assistant in Feed and Fertilizer inspection, resigned in December 1907 to accept a position as assistant agronomist of the Kansas State College. In 1908 he was made instructor in agronomy at the University of Nevada and was assistant professor, 1910-1912; chief agronomist of the Nevada Sugar Company, 1912-13; professor of Agronomy, University of Nevada 1913-20; Dean of the Nevada College of Agriculture 1914-20; director of agricultural extension 1914-15; president of the Reno Chamber of Commerce, 1918-23; managing director 1920-23 and director of the industrial department

of the California Development, San Francisco in 1923. His place in the Wisconsin station was filled by the appointment of George Hine. R. R. Marshall was appointed Assistant in the Soils Department in connection with field experiments.

NEW LANDS AND BUILDINGS

More work land being necessary for the expansion of the work of the Animal Husbandry Department and for the production of pure-bred seeds for dissemination throughout the state, a 70-acre tract adjoining the Hill Farm was leased for a period of 5 years, with the option of purchase, at a fixed price, within that time.

Three new greenhouses were constructed for use by the Soils Department and an 80-ton stone silo erected at the Dairy Barn to hold corn silage for summer use. One other new building was authorized by the Board of Regents and the Great Livestock Pavilion was in course of construction. In the Twenty-Fifth Annual Report of the station for the fiscal year ending June 30, 1908, Director Russell stated that the Stock Pavilion when completed would contain an amphitheatre having a seating capacity of 2,000, thus affording needed facilities for the accommodation of large gatherings. The amphitheatre was to be so adjusted that it could be divided into sections, as required for stock judging purposes, and in addition the building would contain ample quarters for housing the horses belonging to the different departments, hospital and veterinary facilities, offices for the farm superintendent, and several offices for various members of the Animal Husbandry Department.

In 1906, a general color scheme had been adopted for all University buildings by the Regents, at the suggestion of Arthur Peabody the able

architect who designed the Stock Pavilion and most of the other important buildings of the Agricultural group. Madison sandstone, which was selected for the principal group, was too costly for buildings of minor importance. Therefore, a buff vitreous brick, very close to the sandstone in color was selected for buildings located near the principal group, and for those further removed, a brown brick of low cost was chosen. "As to architectural treatment" said architect Peabody, "a return to the Italian Renaissance was fixed upon. The other important change was the use of concrete for floors, and of fireproof materials for the remaining parts of the structure, thus eliminating to a considerable extent, the danger of fire". All principal buildings erected after 1906 were of this character, wood being used very sparingly, except in the barns and other farm buildings of low cost.

RESEARCH WORK IN PROGRESS IN 1908

The Department of Agricultural Chemistry and Animal Husbandry were continuing an important joint investigation which had engaged the attention of its experts for the past two years. They were studying various phases of animal nutrition. Hitherto, scientific nutritional studies had placed emphasis chiefly on the role of organic substances in the animal body. The Wisconsin Experiment Station workers had now decided that equal attention should be paid to the other food constituents, more particularly the inorganic elements. Professors Hart and McCollum, chemists in cooperation with Professors Humphrey, animal husbandmen, had jointly therefore, given this subject this attention and had made important discoveries which were to be reported in a future research bulletin. It was to show that when pigs were fed on a depleted phosphorus ration alone, and also on one supplemented with inorganic phosphates, loss of weight

resulted in the course of a few weeks and the animals at length collapsed. Where the symptoms had not progressed too far, the animals recovered when again supplied with feeds containing the organic phosphorus. Pigs fed from the first on depleted phosphorus rations supplemented with inorganic phosphates, such as ground phosphate rock (floats) made as vigorous growth as animals receiving organic phosphorus compounds.

Other chemical studies proved that the well known laxative effect of wheat bran on the bowels of animals was induced by the organic phosphorus compound phytin, which abounds in bran. The studies had thus far found it impossible to dissect phytin and determine whether the laxative effect is due to the basic substances present or to the compounds of phosphorus.

For nearly two years the Animal Husbandry and Chemical Departments had been studying the nutritional value of chemically balanced rations made from single, versus mixed plant sources. By 1908, it had been determined that the young animals fed a ration composed of mixed grains were more normal than some of those receiving "single" plant rations. The experiments were to be continued long enough to place all of the animals under the strain of reproduction, so that the effect of the nutritive method might be noted throughout a complete cycle.

Investigations of a standard milking machine conducted at the station dairy barn for a period of 18 months, had produced interesting results which would be reported in a future bulletin. It had already been shown that a single careful operator can readily handle three milking machines; but careless handling would be likely to prove unsatisfactory and absolute cleanliness of the apparatus is necessary for satisfactory results. No

appreciable ill effect was noted in the machine-milked cows.

Professors Humphrey and Woll were continuing their nutrition studies. they had been making for several years in the station dairy herd. For the past two years the herd had been fed a medium protein ration and it was expected that another years' feeding would make it possible to decide definitely whether a medium or high protein ration is best for the economic production of butterfat. The improvement of the University herd continued.

During the year, two new methods were devised at the station for the testing of milk under factory conditions. These were the ~~Hart~~ Hart casein test, described in Bulletin 156, and a new moisture test, for the determination of water in butter, described in Bulletin 154.

In the Department of Agronomy, Prof. R. A. Moore's supervision of improved strains of Mansury and Oderboucker barley had been developed, so that limited amounts of seed of these pedigreed types from the crop grown on 50 acres at the Experimental Farm, would be available for distribution in 1909. Work was also in progress for the improvement of other varieties of small grains, and buckwheat, peas and forage crops were being investigated.

Professor Sandsten was working for the selection of improved strains of potatoes, and trying to secure a variety possessed of increased resistance to blight. The Horticultural Department was also continuing the hybridizing experiments on tobacco it had been conducting for several years, and already had succeeded in developing a few new varieties of seemingly special excellence. A small amount of seed of the improved varieties was to be available for distribution for the next years' seeding.

The cooperative work, in cheese making, with the U.S. Department of Agriculture was continued and extended in 1908, under the immediate

supervision of Professor Sammis of the Dairy Department with the assistance of the Bacteriological and Chemistry Departments. The experiments conducted in 1908 pertained particularly to the use of pasteurized milk. The process of pasteurizing cheese had not yet passed the experimental stage.

Studies on the origin of flavor in cheese were continued by Professors Hastings and Hart with particular attention to the influence of carbohydrates, such as sugar.

Professors Whitson and Stoddart studied the influence of soil treatment on their phosphorus content. Field results already had shown that the combination of phosphorus with humus sometimes renders phosphates unavailable to plants. The Soils Department had also been carrying on experiments on the restoration of worn out light soils at Sparta and on tile drainage upon the heavy red clays at Ashland and Superior. Experimental work on marsh soils at farm stations had shown that they need potash and phosphorus, rather than nitrogen and lime.

Further experience with a new method of cranberry culture, recommended by Prof. Whitson, indicated that the frost problem had been thereby, practically solved.

In cooperation with the U.S. Department of Agriculture, Bureau of Entomology, a study of the insect enemies of the cranberry had been undertaken, with important results. Spraying experiments for the control of insect pests had proved unusually successful.

In the Bacteriological Department, Professor Hastings studied a peculiar acid producing organism capable of forming abnormally large quantities of lactic acid. This class of bacteria seemed to have escaped the notice of other bacteriologists, although found, by Prof. Hastings, widely distributed

in milk. Conrad Hoffman of the same department, had been studying the conditions affecting nitrogen fixation by the type of bacteria, known as Azotobacter, and found that the rate of fixation is closely dependent upon the amount of carbon available for the production of energy, as well as the source of the carbon supply. Karl W. Smith had been engaged, for the past year, in a microscopic study of the cow's udder in different stages of development. The results had given a very instructive idea of the relation of milk secretion to the physiological activity of the cells of the udder.

PUBLICATIONS ISSUED

During the fiscal year ending June 30, 1908, 11 regular and 2 special bulletins, aggregating 920 pages, were issued by the Experiment Station. The regular bulletins were numbered 153-163, inclusive and of these Nos. 157 and 163 pertained to the commercial feeding stuffs and fertilizers licensed in 1908. The special bulletins discussed tuberculosis of domestic stock and its control, and the seeding, growing and curing of alfalfa. Research Bulletins Nos. 1 to 6 inclusive were also published as separates and included as Part II of the Annual Report of the Director.

EXTENSION AND DEMONSTRATION WORK

Much extension and demonstration work was done during 1908 to bring before the farmers the practical results of the research experiments conducted at the Experiment Stations. In addition to such information disseminated at the Farmers Ten Day Course at the Agricultural College and at the Winneconne and Marinette County Agricultural Schools, some 80 lectures were delivered by members of the staff at various meetings held in different districts of the state, and about 30,000 letters of inquiry on agricultural subjects were answered. The demonstration and kindred work included potato and orchard

spraying, Tuberculosis post-mortem demonstrations, dissemination of purebred seeds, selection of tobacco seed, corn growing contests, establishment of cooperative livestock breeding associations, dairy cow tests, butter and ^{cheese} ~~cheese~~ exhibitions, drainage service, soil examinations and soil surveys.

The inspection and control work required by law, and undertaken by members of the Experiment Station staff, included that on stallion licensing, feed and fertilizer inspection, nursing ^{ery} inspection and seed control.

THE RESEARCH BULLETINS

The six research bulletins, already referred to, had the following subjects. No. 1. The role of inorganic phosphorus in the nutrition of animals. No. 2. Factors influencing the phosphate content of soils. No. 3. The efficiency, economy and physiological effect of machine milking. No. 4. The fermentation of pollen. No. 5. The role of the mineral elements in the metabolism of ^hherbivora. No. 6. Studies of the bacterial and leucocyte content of milk.

Brief summaries follow relative to the content and conclusions of these six research bulletins by number.

THE ROLE OF PHOSPHORUS

1. In this bulletin Professors E. B. Hart, E. V. McCallum and J. G. Fuller give the results of two sets of experiments conducted to obtain new facts relative to the comparative value of certain forms of phosphorus-bearing materials for the young, growing animals; the nutritive value of inorganic phosphates, when added to rations low in phosphate; The fundamental processes of organic phosphate building in the body; the influence of the efficiency of phosphorus in the food of the animal; and the minimum phosphorus requirements of young growing pigs. It was found that on a ration low in

phosphorus, pigs of 40 to 50 lbs. weight made gains of 75 to 100 lbs. at first, but then lost weight and finally collapsed. When this deficient ration was supplemented with calcium phosphates, no ill results followed. Animals fed a low phosphorus ration, along with inorganic phosphates, developed as fully as others receiving their phosphorus wholly in organic form. A mixture of di- and tri- calcium phosphates gave ^{no} better results than the crude tri- calcium phosphate "floats". Phytin, as the supplier of phosphorus, gave no better results than inorganic phosphates. A young animal fed a ration lacking inorganic phosphates collapsed in 3 months: whereas one fed a ration containing ⁱⁿorganic phosphates, together with salts supplementary to supply mineral constituents, developed heavy weight and ^{bore} have a litter of fairly vigorous pigs, which proceeded to develop satisfactorily on the same balanced ration. The principal organs and tissues of animals on a low phosphorus ration, maintained the proportion of the elements calcium and phosphorus as well as those fed a normal ration. The ash content in the skeleton of pigs fed a phosphorus deficient ration was reduced nearly one-half compared with pigs receiving a normal ration, or a phosphorus ration supplemented by an inorganic phosphate. It was brought out as probable that an animal possesses a synthetic power enabling it to convert inorganic forms of phosphorus into the organic form demanded by the body and develop ^{a skeleton rich in calcium phosphate when} an abundance of the latter is supplied in inorganic forms. An insufficient supply of calcium phosphates leads to a marked reduction in the quantity of ash of the bones. Animals starving for phosphorus drew the element from their own skeletons, and removed calcium and phosphorus in the proportions found in tri- calcium

phosphate. It was concluded that the daily phosphorus supply for a 50 lb. growing pig should be at least 3 grams, with a supply of 4 to 5 grams probably a safer quantity. The experiments did not furnish positive evidence of the synthesis of nucleo proteids or other organic phosphorus-bearing complex ^{es} as from inorganic phosphates in the animal body.

PHOSPHATE CONTENT OF SOILS

2. Professors A. R. Whitson and C. W. Stoddard in this bulletin gave the results of a study of the phosphate content of soils as affected by methods of farming. They determined that acid soils lack available phosphate and that soil acidity seems to cause a lack of available phosphates; the reason being that such soils contain a higher percentage of their total phosphoric acid in iron and aluminum form and less calcium phosphate, than do non-acid soils, and particularly a greater ratio of iron and aluminum phosphates to calcium phosphate. This does not mean that non-acid soils may not be lacking in available phosphates due to some other cause. The figures they presented on humus and phosphoric *anhydride* in humus showed an interesting variation suggesting that humic phosphorus may be unavailable to plants. If a soil, in Wisconsin at least, falls below 0.015 percent of phosphoric acid soluble in N/5 nitric acid, it will respond to phosphate fertilizer.

EFFECT OF MACHINE MILKING

3. In this research bulletin Professors F. W. Wall and G. C. Humphrey discussed the efficiency, economy and physiological effect of machine milking as a result of a series of experiments and tests they had

made with the Burrell-Lawrence-Kennedy Cow Milker, manufactured by D. H. Burrell and Company, Little Falls, New York. They determined that, under the conditions obtained in their trials, the bacterial content of machine-drawn milk was practically identical with that drawn by hand. That was equally true as to the keeping quality of the milk, and of the qualitative bacterial content. Other conditions, however, might not give similar results. Favorable barn conditions would undoubtedly result in favor of the machine were it kept in a sanitary condition easily managed. It was concluded that the results obtained would depend entirely on the operator and that good milk can be produced with the machine, with no great expenditure of time and labor. A crucial examination of the bodies, udders and teats of the cows tested was made before and after the experiments, by Dr. A. S. Alexander and showed that machine milking had no appreciable effect upon the physical condition of the animals, nor did it in any way affect the udders of a majority of the cows. It was, apparently, responsible for improvement in the udders of 3 of the cows, and in 2 instances possibly caused aggravation of abnormal conditions (previously present). Dr. Alexander therefore concluded that the results from machine milking would seem to warrant the belief that little is to be feared as regards the health or contentment of the cows used, and that no bad effect upon the udders may be looked for, provided the condition of the glands is normal at the outset, and attention is paid to hand stripping in particular cases. Professor Humphrey and his associates also concluded that "properly cared for and handled the milking machine will prove a valuable aid in the solution of the hired-help problem on many dairy farms and will become an important factor in the further development of our dairy industry". The

practical work of the tests was most carefully and efficiently done by W. E. Markey, assistant in the Department of Animal Husbandry.

GERMINATION AND FERTILITY OF POLLEN

4. The mysterious barrenness and unproductiveness of some orchards having perplexed orchardists and been little studied by scientists, Professor Sanstein, Station Horticulturist, gave the matter his attention, with particular reference to the influence of pollen on the problem. He found that, as is the case with grains, germination and subsequent growth of pollen is dependent upon heat, moisture, oxygen, and a suitable medium. No definite ^{ement} ~~statement~~ could be made as to the exact manner of growth of the pollen tube. The vitality of pollen was not seriously affected by temperatures ranging from 25 to 55 degrees C. in dark atmosphere. Temperatures under 25 degrees seriously interfered with germination. A temperature from 70 to 80 degrees C., in a saturated atmosphere, proved fatal to pollen of the peach, apple and plum. Pollen burst open at a temperature of 40 to 50 degrees C., in a saturated atmosphere, and the number of burst pollen increased as the temperature increased. The cause was the rapid ^b ~~in~~hibition of water. This bursting of pollen actually occurs in masses of apple and ^{plum} ~~pear~~ pollen during warm spring rains. Freezing temperatures ranging from -1.5 to -1 degree C. were not seriously injurious to the pollen of the apple, pear and plum. Less than 50 percent of pollen of the peach and apricot were killed by such freezing temperatures. Temperatures ranging from -1.5 to 0 degrees C. killed the pistils. Sunshine had little or no effect on the germination of pollen, or upon the growth of the pollen tubes, in most plants. Cloudy weather retarded growth of the tomato pollen; the anthers required a certain amount of sunshine for

proper development of the pollen, as was true in several species of Lilium. The lack of culture and fertility in orchards greatly injures the production and fertility of pollen-apple pollen can be kept in a dry place in a temperature ranging from 7 to 26 C. for 6 months or longer, but few plum pollen germinated after being kept for 6 months. Pollen may be transported throughout the country without losing viability or fertility. Two or three bright, warm days, at a time of full bloom, is sufficient for the setting of the fruit of apple, pear and plum. Continuous rainy weather for 5 days would be likely to cause a total failure of the crop.

THE ROLE OF ASH OF BRAN IN METABOLISM

5. Previous publications of the Experiment Station having shown that wheat bran contains phytic acid in combination with potassium, magnesium and calcium. Professors E. B. Hart, E. V. McCollum and G. C. Humphrey experimented to determine whether it is true that the well known laxative effect of bran on animals is caused by the ^{irritation} ~~irritation~~ induced by the coarse and fibrous matters of this feed, or by the chemical elements it contains. They found that a sudden withdrawal of phytic from the ration caused constipation. This was even manifested when the intake of crude fiber was reduced to that of normal bran. Phytanin also caused a marked increase in the urine passed by test cows. Besides the laxative effect of bran, manifested in all of the feeding experiments, its withdrawal from the ration occasioned more or less disturbance of fat production, a regular reduction in the volume of urine and an increased flow of milk. It also disturbed the occurrence of the heat periods (estrus) in some of the cows.

Valuable facts relative to utilization and elimination of potassium, magnesium, phosphorus and calcium were also learned by the experiments. They concluded that "the laxative action of bran is more easily understood when it is remembered that the channel of excretion of phosphorus, calcium, and magnesium especially, and a part of the potassium, when supplied in wheat bran, is by way of the bowels in the feces ejected.

BACTERIAL CONTENT OF MILK

6. Research bulletin No. 6, on the bacterial and leucocyte content of milk of individual animals, also dealt with the experimental leucocytosis in the cow's udder and the occurrence and ^sdistribution of organisms similar to the Bacillus bulgaricus, of Yogurt. The experiments showed that the same organisms may not only persist in the udder of a cow for long periods, but may be present constantly in large numbers, and that, in sanitary dairies, the normal content of the udders of the individual animals may well be taken into account when judging of the purity and healthfulness of the product. They proved, too, that mixed milk, when incubated at high temperatures, develops a much greater acidity than can be accounted for by the growth of B. lactic acid and that the causal^{al} organism is a bacillus closely related to B. Bulgaricus of Yogurt, and to B. Casei,ⁱⁱ of Freudenberg. The causal organism is widely distributed in milk, butter and cheese. Relative to the occurrence of experimental leucocytosis in the cow's udder it was determined by bacteriologist Conrad Hoffman, of the Station, that a marked leucocytosis occurs when such inert solutions as a physiologic salt solution, boric acid, and distilled water, are

injected into the udder. This is evidence^d by a temporary swelling and fever of the quarters of the udder injected, and by an increased content in the leucocytes of the milk. The experiments^{do} did not find data corroborative of the statement of Esten that "The bacterial content of the udder of a cow is an important factor and one that determines the value of a cow in producing healthful market milk."

REGULAR BULLETINS OF 1908

In Bulletin No. 153 by Professors J. G. Fuller and C. A. Coock, instructions were given for the construction^s of portable hog houses, which were recommended to farmers as sanitary and therefore valuable in keeping swine free from disease and worms. The text was accompanied by many plans and specifications for portable houses of both small and large type. The methods of construction^s advised were simple and economical^a, and such as could readily be followed by farmers. The types described and illustrated were the A-shaped portable house, the small shed-roof house, the large shed-roof house, and the large central hog house. By the use of the portable house, moving it occasionally onto a fresh piece of ground and feeding the hogs at a different place, insanitary conditions are avoided. By the portable^{be} house system the hogs are housed in small numbers--from 4 to 6 mature animals or 10 to 20 sows--keeping them cleaner and more thrifty than when congregated in large numbers.

DETERMINING WATER IN BUTTER

In 1907, the Dairy Department perfected a simple method of determining the amount of moisture in butter and the process was described by Professor Farrington in Bulletin No. 154, of September, of that year. The subject has assumed special importance, as a national pure food law had been enacted, in which butter was pronounced adulterated and therefore taxable, where it contained more than 16 percent of water. The experiments conducted showed that the moisture content is influenced by the manipulations of the butter when working it, and by the temperature of the wash water. Dry butter can be obtained by keeping the cream and the butter cold, by churning to small granules, by washing the butter very little and by allowing it plenty of time to drain. Butter of a high moisture content results from churning for a longer period, at a higher temperature, until the granules are large, and by churning the butter in the wash water. Water adheres to soft butter, but is easily pressed out of cold, hard butter. The bulletin gave instructions relative to sampling, and the best methods of weighing. The process recommended and described instructed the buttermaker how to determine accurately the water content of butter, and make his product more uniform. The Wisconsin high pressure oven employed was described, and full directions given for its use.

ELIMINATING GRADE SIRE

In Bulletins Nos. 155 and 158, Dr. A. S. Alexander, author of the first stallion licensing law in Wisconsin and America, presented a report of the progress made by his Department of Horse Breeding in eliminating grade and scrub stallions and pointed out the strong and weak points of

the law which it was intended to improve by later legislative amendments. The bulletins were profusely illustrated and contained much educational matter relative to soundness of breeding animals and improved methods of breeding and management. Statistics, made available by the enforcement of the law, showed that in 1906, 1067 pure bred stallions were being used for public service, while 1561 of the public service sires were grades. Additional stallions licensed for the first time in 1907, brought the totals to 1286 for pure bred and 1974 for grade stallions. There were also 5 cross-bred stallions in the latter year. Several other states had enacted stallion license laws similar to the initial Wisconsin law, but with some modifications. Iowa was the first to follow Wisconsin's lead; then came Minnesota, Pennsylvania and Utah. In Bulletin No. 153 the astonishing fact was published that of the 75 fairs held in Wisconsin in 1906-7, 39 fairs or 52 percent provided classes for grade stallions or other grade male animals, while 36, or 48 percent did not encourage such animals by providing for them classes and prizes. The result of this announcement, and the work done by Dr. Alexander to effect abolishment of the undesirable classes and premiums for sires other than those of pure breeding at the county fairs was quickly to do away with such classes and so assist materially in the elimination of grade and scrub sires for public service.

THE HART CASEIN TEST

In Bulletin No. 156, of November 1907, Professor E. B. Hart, Chemist of the Experiment Station announced his discovery and perfecting of a new, simple test for casein in milk and explained its relation to the dairy

industry. The method described and illustrated in the bulletin could be used by an unskilled operator with reasonable accuracy, were proper care taken. It involved the use of a special tube, so designed as to permit of the reading of the percentage of casein directly after it had been precipitated by dilute acetic acid and the fat removed by chloroform. A special type of centrifuge was used to mass the casein into one part of the tube for this reading. The author of the bulletin stated that chemical analysis of the milk of individual cows had shown the relation of casein to fat to be variable. For 100 lbs. of fat the casein content might be anywhere from 50 to 70 lbs., with occasionally, even a wider variation. This variation, not confined to anyone breed or to individual cows of the same breed, showed the importance of a casein test to supplement the Babcock butter-fat test. The new Hart test met this need and was deemed, in most respects, as simple as the Babcock test.

Bulletins Nos. 157 and 163, by Professor Wall and George A. Olson presented lists of licensed commercial feeding stuffs, and licensed commercial fertilizers and the analysis of these commodities as required by law.

CRANBERRY INSECTS

For two years the subject of insects praying upon the cranberry had been studied by experts of the station and in Bulletin 159., C. B. Hardinberg presented a report in which detailed information was given regarding the life-history of some of the pests of that crop. Two fine colored plates accompanied the text, giving very clear pictures of the insects discussed for the instruction of cranberry growers. The insects described included:

the blackhead vine worm, yellowhead vine worm, cranberry tip worm, false yellowhead vine worm, oblique-banded roller, yellow cranberry looper, cranberry fruit-worm and cranberry weevil. The bulletin aimed to acquaint growers with the identity of each insect, that control methods might more intelligently be applied.

Bulletin No. 160, by Professor Wall and Roy J. Harris presented an illustrated report of the tests of dairy cows made in 1906-1907. Particular mention was made of the record of the Wisconsin purebred Holstein cow, Colantha 4 lbs. Johanna, champion of her breed in the state, as she had produced 28.176 lbs. of butter fat on a seven-day official test and 110.833 lbs. of fat on a thirty-day official test. The total number of tests made by the experts from 1893 to 1907, inclusive was 969, and the number of tested cows 2,304.

CROPS FOR NORTHERN WISCONSIN

In Bulletin No. 161, of March 1908, Professors R. A. Moore and E. J. Delwicke reported on the merits and demerits of grain and forage crops grown during 1906 and 1907 at the Sub-Experiment Stations, and also called attention to other crops that seemed suitable to the northern counties of the state. They found that certain cereals of the varieties they mentioned could be grown to equally good advantage in the north as in the other sections of Wisconsin. The sandy soils had been found most suitable for the growing of sugar beets, corn, oats, soybeans and clovers, under proper rotation, and manuring of the land. Well worked and drained clay soils were especially adapted for the production of winter wheat, barley, oats, peas, clover, mixed grasses, and clover seed. On heavy clay soil,

alsike clover yielded as high as 8 bushels of seed per acre which sold readily at ten dollars per bushel. Smut nose and Yellow Flint corn matured well in the north and were recommended for growing until dent varieties of corn became acclimated for the production of ear corn in the northern environment. The heavy, bearded, stiff-strawed, six-row varieties of barley were found preferable, especially as nurse crops for clovers and grasses, where old, well subdued clay and loam soils were available for barley growing.

EFFECT OF RUSTY CANS ON MILK

In Bulletin No. 162 George A. Olson of the Bacteriological Department gave the results of an investigation he had made relative to the effect of rusty cans upon milk for cheese making. He found that it required from one to sixteen and one-half minutes longer for milk kept in a rusty pan to coagulate under the action of rennet, than milk kept in a clean glass vessel. Acidity always was greater when milk was not kept in a rusty pan. That in the rusty pan, or in an iron dish^h, acquired a peculiar bluish grey color after standing for several hours. He advised that no milk should be accepted, at a factory, which has been kept in exposed iron pails or cans.

Bulletin No. 163 contained the Annual Report of Director Russell; No. 164 by Professor Wall, gave the annual report on licensed commercial feeding stuffs, and No. 165 information about new and improved tests for dairy products by Dr. Babcock and Professor Farrington, and the preparation of buttermilk curd by Professor Danne's .[?]

THE LIVE STOCK PAVILION COMPLETED

In the twenty-seventh annual report of the Agricultural Experiment Station, for the fiscal year ending June 30, 1909, Director Russell announced, with satisfaction, that the long desired and looked for Live Stock Pavilion had been completed and put in use. Lectures, live stock demonstrations, veterinary clinics and judging contests, which had proved most popular and instructive features of the ten-day winter course for farmers, had greatly overtaxed the capacity of the comparatively small arena of the Dairy Barn, which would accommodate only some 350 persons thus making the provision of the Pavilion necessary. Influential stockmen had approved the demand for such a building by Director Henry, and the attention of the legislature was attracted to the project at many public meetings. During the demonstrations mentioned, Director Henry often stopped the proceedings to draw attention to the lack of suitable and sufficient accommodation for visitors and students and the animals brought out for examination: Then he made an earnest plea for a commodious ^{live} stock judging arena. As his suggestiona did not at once have the desired effect, Dr. A. S. Alexander tactfully approached the late Hon. Andrew Carnegie on the subject; but at length a curt reply came, through his secretary stating that, "Mr. Carnegie does not consider the University of Wisconsin a fit subject for charity." However, the demands of the Director, professors and leading live stock men and students at length bore print, and the legislature appropriated \$75,000 for erection of the needed structure. It was built in 1907-1908 and given the name of "Live Stock Pavilion"

The building was planned by the state architect, Arthur Peabody, and from an architectural point of view, proved to be one of the most imposing on this campus, besides being one of the most important additions to the agricultural group. The building is 115 feet wide by 212 feet long

2 stories and an attic high covered with green enameled tile which gives a pleasing effect for such extensive roof surface. The main arena is in the form of an ellipse, 66 feet by 164 feet, which is large enough for all kinds of demonstration work including the showing of horses and even for carriage work. The arena is fitted with curtain screens so that it can be divided into compartments, for separate class work. Around the sides of the arena rise amphitheater seats of concrete, accommodating 2,000 people. Beneath the amphitheater seats, on the basement floor, are 15 boxstalls and 22 standing stalls for the farm work horses and those used on the University grounds. Quarters are also provided in the building for the farm foreman and other workers, in addition to a class room pharmacy and veterinary hospital. On an upper floor are ample shower baths and other conveniences for agricultural students who are given athel^etic and gymnastic exercises in the arena during the winter sessions. In the loft are storages places for grain, hay and other forage and considerable space for the storage of machinery and other bulky equipment.

Many predicted that the Stock Pavilion would prove an expensive "White Elephant" on the hands of the Station official^s; but, on the contrary, it has proved one of the most needed, useful and popular structures of the Agricultural group. It has been the scene of many great livestock exhibitions, such as the "Little International", which is managed by the staff of the department of Animal Husbandry and the students of the Long and Short courses, notably those of the College of Agriculture "Saddle and Sirloin Club." On many occasions the seating capacity has been overtaxed and at several Commencement exercises, held therein, the

entire arena has been equipped with chairs, as an auditorium, and they and the fixed seats have been filled. It also housed great patriotic and political meetings during the early days of the World War, and has even been used for great popular concerts. During inclement weather it has also been used many times for the training of university football teams and other athletes, before the great Field House met all needs for these varied purposes. It stands a monument to the clear vision and enterprise of Director, Henry, who was, at length, successful in his appeals to the legislature for funds with which to erect the building he deemed necessary and forwaw would be greatly in demand.

During 1908-1909 a commodious new stock and forage barn, 36 x 106 feet, was erected on the Hill Farm by workmen of the Station. It accomodated 30 head of cattle and horses, and 110 tons of forage. The barn, being of the new "balloon frame" type of structure, attracted the attention of many farmers: therefore, blue-print plans of the building were prepared, and made available to propective builders.

During the year additional land was acquired for Station use. The purchases included two small tracts, aggregating 8 acres, situated on the crest and sides of a knoll, immediately west of the Station farm, to be used for horticultural purposes, and, adjacent to this tract on the north 80 acres additional, of which 25 acres was high land and the remainder marsh, which was to be reclaimed by draining for farm use.

The funds derived from the United States Government for experiment station were again *augmented* by \$2,000 making in the aggregate, on account of the Hatch and Adams funds, \$28,000.

The year also saw the institution of agricultural extension work on a broad basis, under the auspices of the Agricultural College and Experiment Station, the legislature having appropriated \$30,000 annually for the next biennium for this purpose. There was also inaugurated a new line of extension work in the form of a regular press service, prepared by the Station Editor, for distribution to the agricultural journals and newspapers of the state.

NEW DEPARTMENTS AND STAFF CHANGES

An Agricultural Editorial office, and the Department of Home Economics were inaugurated. J. C. Marquis, formerly associate editor of the Orange Judd publications was appointed Agricultural Editor, July 1, 1908, and was to have charge of all station publications and give instruction in Agricultural Journalism.

The Department of Home Economics, transferred, July 1908, from the University College of Letters and Science, to the College of Agriculture was entirely reorganized by its new Dean Professor Abby L. Marlatt, a native of Kansas, who had taken the B.S. degree at the Kansas State Agricultural College, and the M.S. degree in 1890, at the same institution. Before coming to Wisconsin she had been a professor in Utah Agricultural College, 1890-4, and an instructor in the technical high school, Providence, R. I., 1894-1909.

Christian Percival Norgord, a native of Denmark, long resident on a farm in Wisconsin, was appointed, in July 1908, to the position of Instructor in Agronomy. He obtained the B.S. degree from the University of

Wisconsin, in 1905, and the M.S. degree in 1923. He had also graduated from the Whitewater, Wisconsin Normal School in 1899 and was agronomist in the U.S. Department of Agriculture, 1905-6 and agronomist of the University of Arkansas, 1907-9. Later he served as superintendent of Farmer's Institutes for the University of Wisconsin until 1915, when he was appointed Commissioner of Agriculture of Wisconsin. He served in that capacity until 1923, and was then appointed Assistant Commissioner of Farms and Markets, of the State of New York, with headquarters at Albany, where he was still engaged in 1933. Exceedingly active in his line of work, he served as President of the Wisconsin Agricultural Experiment Association 1910-14, and Secretary-Treasurer and President of the National Association of Commissioners and Departments of Agriculture, 1919-23.

Clarence S. Hean, a native of Wisconsin and graduate of the University of Wisconsin, was appointed librarian, at the Wisconsin College of Agriculture, 1908, and B. W. Hammer, assistant in bacteriology there, in the same year.

^{Steenbock}
Harry ~~Stienback~~, a native of Wisconsin who had received the B.S. degree in Agriculture from the University of Wisconsin in 1908, was appointed Assistant in Agricultural Chemistry that year, and in 1910 obtained the M.S. degree and in 1916 the degree of Ph. D. In 1919 he was made full professor of agricultural chemistry, after serving ^{ive} successfully as assistant instructor and assistant and associate professor. He had rounded out his technical education in Berlin (Germany) and Yale University, and was destined to receive international recognition and fame for his research work in animal nutrition, from a chemical stand point.

Harlow Leslie Walster, who was reared on a Sauk County Wisconsin farm, and who had obtained the B.S. in Agriculture degree from the University of Wisconsin, in 1908, was appointed Assistant in the Soils Department of the Wisconsin Experiment Station, that year. He served

in that position until 1909, when he was made instructor and in 1913, assistant professor. In 1913 he obtained the M.^A. degree from Harvard University, and in 1918, the Ph.D. degree from the University of Chicago. In 1919 he joined the faculty of the North Dakota Agricultural College and Experiment Station, at Fargo, where he became agronomist and served as Dean of the School of Agriculture and Director of the North Dakota Soil Survey, for that College. He was still active there at the time of this writing (1933).

Professor E. P. Sanstey who had been in charge of the Horticultural Department since 1903, resigned at the close of the fiscal year to engage in commercial fruit raising work in Montana, where he remained until 1912. Then he was professor of horticulture in Alabama Polytechnic Institute at Auburn until the end of the year, ^W when he was appointed professor of horticulture at the Colorado State Agricultural College, at Fort Collins and state horticulturist, in 1913 where he was still employed at the date of this writing (1933).

NEW DEPARTMENTS ORGANIZED

As there had been a growing demand throughout the state for the organization of a Department of Poultry Husbandry, at the Experiment Station, Professor James G. Halpin was appointed at the close of the fiscal year, to undertake the establishment of such a Department. He was to be provided with an entirely new equipment in the way of buildings and birds. Professor Halpin is a native of New York State where he was reared on a farm. He obtained the Bachelor of Science degree in agriculture from Cornell University in 1905, and, before coming to Wisconsin, was

instructor in poultry husbandry at Rhode Island State College, 1905-6, and at Michigan Agricultural College, 1906-9.

For several years Professor H. C. Taylor of the University had been engaged in economic researches along agricultural lines, and in 1908 this work was transferred to the College of Agriculture and the New Department of Agricultural Economics organized. To it was also assigned Professor D. H. Otis, formerly Associate Professor of Animal Nutrition. He was to devote his attention to the subject of farm management. Professor Taylor was reared on a farm in Iowa, and obtained the Bachelor of Science and Master's Degree from the Iowa State College. Then, in 1902, he earned the degree of Doctor of Philosophy from the University of Wisconsin. Serving as chairman of the Agricultural Economics Department until 1919, he then became chief in the Office of Farm Management, of the U.S. Department of Agriculture, until 1921, when he was made chief of the Bureau of Economics and served in that capacity until 1925. Then he served as Professor of Agricultural Economics in Northwestern University, Evanston, Illinois, until in 1928 he was made Director of the Comprehensive Survey of Rural Vermont. In 1933 he was honored with the L.L.D. degree by the University of Wisconsin.

The Department of Agricultural Education was also organized, with Professor K. L. Hatch in charge, in addition to his work as secretary of the Agricultural Extension Service.

Ravages of plant disease's having greatly injured the plant growing industry, the Department of Plant Pathology was established in 1908, with Professor Lewis Ralph Jones in charge. He was reared on a farm near Brandon, Wisconsin. In 1889 he took the Ph.B. degree at the University of Michigan and, in 1904 the Ph.D. degree from that institution. In 1910,

the University of Vermont conferred upon him the honorary degree of Doctor of Science and in 1930 Cambridge University, England honored him with the like degree. This honor was conferred upon him at the conclusion of his services as chairman of the section of mycology and plant pathology of the International Botanical Congress, where he was also the speaker on "The Relationship of Environment to Plant Disease." From 1890 to 1910 he was professor of botany in the University of Vermont, and botanist of the Experiment Station. He was destined to become famous, in Wisconsin, by the development of strains of cabbage that were capable of resisting the disease known as "Yellows" caused by the soil parasite Fusarium conglutinans, and also for his notable services in training experts in his line for positions of trust and responsibility.

Up to 1908, the entomological work carried on by the station had been done by experts of the Horticultural Department; then a separate Department of Economic Entomology was established. James G. Sanders, a native of Ohio, where he was reared on a farm, was placed in charge and was to begin *given* work the following year. He obtained the M.A. degree from the Ohio State University, in 1903, and was a fellow and assistant in science there until 1905 when he was made assistant in the U.S. Bureau of Entomology and served until 1910. From 1910 to 1915 he was professor of entomology at the Wisconsin Station, and from 1915 to 1916 State entomologist; then he served as a state zoologist of Pennsylvania, from 1916 to 1919, and Director of the Pennsylvania Bureau of Plant Industry from the latter date, until 1923, when he engaged in commercial work relating to spraying.

FACTS FOR FARMERS

During the fiscal year ending June, 30, 1909, thirteen bulletins of the regular series for farmers, aggregating 415 pages, were issued and distributed by the Station. They were numbered from 164 to 176, inclusive, and of these No. 170 gave the usual annual report on licensed commercial feeding stuffs, and No. 172 the report on tests of dairy cows for 1907-1908 along with portraits of some of the best producing cows.

KING SYSTEM OF VENTILATION

One of the most notable bulletins was No. 164 of December 1908, relative to the King System of Ventilation. In it Professor C. A. Ocock presented plans for the first time, which would enable the farmer to instal such a system of ventilation in his barn. The introductory matter of the bulletin explained that the King system consists of two sets of flues. One set provides the fresh air, while the other furnishes an escape for the vitiated air. The inlets ^{or} of flues for fresh air should be placed not more than 10 feet apart and located in the exterior walls of the barn. The greater the number of these flues, the more effective will be the ventilation since they enable the fresh air to displace the foul air more rapidly. The outlet consists of one or more large flues, so placed as to provide the quickest means of removing the foul air from near the ground level. The fresh air is introduced at the level of the ceiling of the stable. A cross-section of the University barn, some 40 feet wide, by 72 feet long with the cows facing the central alley, was shown in Fig. 1. Plans and specifications for construction accompanied the text. The author

advised builders that stable walls and ceilings should be practically air-tight and non-conductors of heat and cold, while doors and windows should fit snugly. The outside opening of each fresh air inlet should be at least 3 feet below the inside opening, and the inside opening, at the ceiling, should be provided with a valve or shutter. The foul air flues should be air tight and non-conductors of heat and cold, with their lower opening about 1 foot above the floor level. The outlet flues should have as few bends as possible, pass upward to a height of at least 25 feet, and always extend 2 or 3 feet above the ridge of the roof or of any near-by roof. These flues should be enlarged, where built around a girt or plate, in proportion to the size of the obstruction passed.

Bulletin No. 165 of November 1908 by Professor H. L. Russell and Conrad Hoffman, presented facts relative to the vaccination of cattle with Bovo vaccine (Von Bering) against bovine tuberculosis. It described the experiments conducted by the authors with the vaccine mentioned, and discussed the results with relation to the practical value of the method. They stated that the method might be considered of doubtful value for use by Wisconsin farmers, on account of the expense it entailed, the time involved in immunizing animals, and the fact that only young stock could be treated and they had to be kept separate from sources of infective^{ion} during the immunizing process.

DISINFECTION AND DISINFECTANTS

The campaign in progress for the eradication of tuberculosis in the state had led to the disinfection of all contaminated stables and r.

desire, on the part of cattlemen and others, for definite information on the subject, and instructions for the choice and proper application of effective disinfecting agents. This information was well presented by Dr. M. P. Ravinel and Karl W. Smith, in their illustrated Bulletin No. 166, of February, 1908. They explained the general principles of efficient disinfection and gave instructions for the selecting of disinfectants, and their proper application. The value of sunlight, heat, and burning, and steam as physical disinfecting agents was explained. Data relative to the following chemical disinfectants followed: Bichlorid of mercury, carbolic acid, the cresols, lime, chlorid of lime, formaldehyde, formalin-permanganate of potash, paraform, sulphur and sulphate of iron. The results of comparative tests of several commercial disinfectants were also given.

POTATO SPRAYING EXPERIMENTS

The Experiment Station had been conducting experiments in spraying potatoes against blight, and the potato beetle, and gave the results of the work in Bulletin No. 168 of November, 1908, by Professors E. P. Sandsten and J. G. Milward. They had been seeking to determine first whether early potato blight could be controlled by the application s of Bordeaux mixture, and, second, whether spraying should be recommended as a profitable investment and insurance against blight. The experiments indicated that marked increases in the potato crop can be obtained from one application of Bordeaux mixture late in the season, if the development of the blight disease is carefully observed. In Wisconsin, early potato blight is usually most destructive between August 15 and September 25. The numbers and dates of application should depend upon the season, three

thorough sprayings generally being needed between the dates just mentioned. Failures in spraying against blight often result from impoverished soil, weakened potato seed, injury from the potato beetle and carelessness and inattention to essential details. Failures in spraying potatoes against the potato beetle in Wisconsin usually result from postponing the treatment until the beetles have had a good start on the vines. Failures in the use of poisons, such as Paris green and arsenate of lead, against the beetles, are usually due to mistakes in the method of applying, rather than to any inferiority of the product. Care should be taken to buy and properly use a superior spraying machine, as there are inferior ones on the market. The bulletin gave the formulae for many different spray compounds and directions for their effective use.

PROGRESS IN HORSE BREEDING

In Bulletin No. 169 of December 1908, Dr. A. S. Alexander reported that 35.2 percent of the 1,561 grade stallions licensed for public service in 1906 had already been retired. Of the 553 stallions retired, 95 had been castrated, or their licenses revoked on account of unsoundness, while 54 had died, 36 had been shipped out of the state, and the licenses of 368 had not been renewed, their owners having decided not to use them for public service. The bulletin presented a directory of the owners of stallions and jacks licensed in 1908. Several additional states had enacted stallion license laws similar to the one first enacted by the legislature of Wisconsin.

Bulletin No. 173, of February 1909, by Professors F. W. Woll and G. C. Humphrey, presented, in condensed form, the results of the tests

they had been making with milking machines of the Burrell-Lawrence Kennedy firm. Two types of machines had been tested, viz., one operated by pressure on the teats and lower part of the udder, and the other operated by suction, in imitation of the sucking of the calf. The machines in the market at that time were of the latter type. The conclusions reached were those reported in Research Bulletin No. 3 of which a summary was given in a previous section of this history.

Conservation of phosphates on Wisconsin farms was discussed by Professor Whitson and C. W. Stoddart, in Bulletin No. 174 of April 1909. The matter presented was the same as that given in Research Bulletin No. 2, by the Professors just mentioned, but in more simple language for the benefit of farmers.

In Bulletin No. 175 of May 1909, Professor H. L. Russell and Conrad Hoffman gave the results of a three year campaign against bovine tuberculosis in Wisconsin. The educational campaign had been conducted by means of addresses, printed bulletins and postmortem demonstrations. Since tuberculin testing was begun in 1892, a total of 72,638 animals had been tested in Wisconsin. There had been a decline in the percent of the animals reacting to the test from 17.7 in 1906, to 5.6 in 1908. In 1906 about 12 percent of the animals were found infected, while in 1908, less than 4 percent were found diseased of 363 herds found infected in 1908, 263 or over 72 percent were infected through purchase. In the south, over 10 percent of animals were infected while that could be said of only about 3 percent in the north. The authors advised the enactment of a law requiring a clean bill of health to go with each sale of cattle, and of a law requiring the pasteurizing of factory milk products.

The improvement of Wisconsin tobacco, through seed selection, was discussed by Professor E. P. Sandsten, in Bulletin No. 176, of May 1909. Work for such improvement had begun in 1903 with the selection of a good type of Wisconsin-grown Connecticut-Havana seed. In 1908, over 700 lbs. of this seed was distributed among growers. The best methods of selecting plants for seed production, and of raising the tobacco seeds, were advised in the bulletin. The harvesting and testing of tobacco seed was also discussed. It was advised, as most important, thoroughly to test the seed to be sown, by the method suggested by the authors. A low germination test would indicate weak seeds from which strong plants could not be raised. Growers were advised to select their own seed from the best plants, or some one grower in the neighborhood might become the seed grower for that district.

THE TWENTY EIGHTH ANNUAL REPORT

In the twenty-seventh annual report of the Experiment Station, for the fiscal year ending June 30, 1910, Director H. L. Russell stated that the entire staff of the College of Agriculture and Experiment Station consisted of 69 persons, 13 of whom were professors, 18 associate and assistant professors, 14 instructors and 24 assistants.

Activity in increasing the facilities of the College and Station, to make them fully efficient, had continued during the past year. Hiram Dairy Hall having become too small to accommodate the Department of Dairying a two story and basement building, 46 x 84 feet had been erected in the rear of the main building. The newly organized Department of Poultry

Husbandry had been furnished with a two story and basement general utility house 36 x 56 feet. Twelve movable Colony houses and 3 permanent laying houses, 12 x 24 feet had been constructed during the summer of 1909, and in the summer of 1910 a large laying house, 12 x 100 feet, was being constructed. A main connecting tunnel had been completed, permitting the transfer of the heating system of the Agricultural College buildings from the old heating plant to the new central heating station of the University.

The new Stock Pavilion, erected during the previous year, had been equipped with additional quarters for the newly organized departments of Veterinary Science and Experimental Breeding and gymnasium facilities for the Short Course and Dairy students provided in the attic of the building.

So great had been the development of the Soils and Horticultural work that it had been found necessary to remodel the interior of the Soils Building, so that it might accommodate the Soils Department alone. Meanwhile the research work of the Horticultural Department had been seriously handicapped by lack of space, but it was hoped that an entirely new building for Horticulture would be completed by the autumn of 1911. To permit experimental and teaching work in Horticulture to proceed until the new building became available, there had been built, during the year 4 greenhouses 20 x 90 feet, connected by a one story basement brick structure, 30 x 60 feet, to be used for potting and general utility purposes. In addition a small pathological laboratory, 20 x 30 had been erected for the Department of Plant Pathology, immediately adjacent to a section of the greenhouses assigned to that Department. The cost of this new equipment for Plant Pathology and Horticulture aggregated over \$16,000, furnished by surplus funds accumulated from maintenance during the last biennium.

On the University Farm had been built a two story ^{er} little shed, 40 x 60 feet, sufficiently large to house 300 tons of manure. The upper story was to be used for the storage of coarse forage, to be fed to the stock below. A wagon shed, 30 x 90 feet had also been erected near the Stock Pavilion, and additional out-buildings provided for the housing of machinery in both the University Farm and the Hill Farm.

Eighty acres of land immediately adjacent to the city of Spooner, Washburn county, had been acquired as authorized by the legislature of 1909, for the purposes of a permanent ^{branch} ~~trench~~ experiment station, and preliminary work for its establishment was in progress. A demonstration sub-station had also been started at Ellin^s Junction, in Marinette county.

RECLAMATION OF UNIVERSITY FARM MARSH LANDS

During the year a comprehensive plan for the drainage of the large marsh, forming a part of the University Farm was prepared by the Soils Department and the supervision of the work entrusted to the able hands of Professor E. R. Jones. The well constructed driveway of the Madison Park and Pleasure Drive Association, skirting the lake shore line of the marsh, formed a permanent dyke as a basis of reclamation work, to make the marsh land lying in some places below the level of the lake, available for farming purposes. Roadways, forming division dykes, were quickly constructed and division ditches dug to keep ^{our} ~~out~~ face water from the surrounding hills out of the marsh so far as that might be found possible. During the season 27,000 feet of tile were laid, and 926 feet of open ditch constructed. The next step was to install ^{our} ~~wind~~ ^{power} power for

lifting the dryweather flow of water from the drains over the dykes, and gasoline power for use after heavy rains and spring floods. Later, electric power was to be installed, for day and night service. The work, which eventually proved a gratifying success and reclaimed a large area of marsh land for profitable farming, also served as a valuable demonstration to visiting farmers of what might be accomplished in like manner for hundreds of thousands of acres of swamp ^{lands} in the southern part of the state. The new arable areas, reclaimed by the admirable work of Professor Jones and his assistants proved of inestimable value to the Experiment Station as its land resources had been seriously encroached upon by the utilization of large areas ^{as} for sites for new buildings and other University purposes.

NEW DEPARTMENTS AND STAFF MEMBERS

Pending the erection of the Pathological Laboratory for the Department of Plant Pathology, Professor L. R. Jones had been able to organize only the preliminary stages of his research work which, temporarily, was being housed in Agricultural Hall. The Agricultural Hall was also accommodating Professor J. G. Sander's new department of Economic Entomology until space in the old Dairy Building would become available for him in the quarters to be vacated by the Horticultural Department on completion of their new building.

Professor E. P. Sandsten having resigned as head of the Horticultural Department, Professor J. G. Moore was promoted to his position.

The Department of Experimental Breeding was organized during the year and placed in charge of Associate Professor Leon Jacob Cole, who was to

undertake chiefly the study of the most fundamental problems associated with inheritance, as applied more particularly to domestic animals.

Professor Cole, a native of New York state, had obtained the degree of A. B. at the Michigan Agricultural College in 1901, and the Ph.D. degree at Harvard University in 1906. From 1906 to 1907, he was chief of the Division of Animal Pathology and Breeding at the Rhode Island Experiment Station, and acting chief there from 1907 to 1908; then he was instructor in zoology at the Sheffield Science School of Yale University before coming to Wisconsin. Professor Cole was a member of the Harriman Alaska Expedition in 1899 and Bermuda, 1903. He was with the Yucatan Zoological Expedition in 1904, and in the summers of 1901 and 1906 made investigations for the U.S. Bureau of Fisheries, and in 1911 and 1924 traveled in Europe and in 1927 in Puerto Rico. On leave of absence from Wisconsin University he acted as chief of the Animal Division of the Bureau of Animal Industry, of the U.S. Department of Agriculture, at Washington, D.C. from 1923 to 1924 and from 1926 to 1927, he served as Chairman of the Division of Biology and Agriculture of the National Research Council. The Department of Experimental Breeding, organized by Professor Cole in 1910 was so far as he was aware the first department of genetics to be established in America. In 1918 its title was changed to Genetics with Professor Cole as chief.

In July 1909, Carl Emil Lee, who was reared on a farm near Edgerton, Wisconsin and had obtained the B. S. degree from the North Dakota Agricultural College in 1897 and the M.S. from Wisconsin University in 1909 was appointed assistant professor in the Dairy Department to specialize in dairy manufacture. From 1903 to 1909, he had served as assistant professor of dairy manufacture at the University of Illinois and did like work at the University

Wisconsin Station, until 1915, when he was made assistant dairy and food commissioner and dairy specialist of the Wisconsin State Department of Agriculture.

RESEARCH WORK IN PROGRESS 1909-1910

Among the important lines of research work in progress during the fiscal year ending June 30, 1910, may be mentioned the manufacture of cheddar cheese from pasteurized milk; investigations as to the origin of flavor in ripening cheddar cheese; the purification of creamery sewage; balanced rations from various grains; the influence of sulphur on wool production; the mineral requirements of growing animals; the loss of phosphorus in heavy manuring, and the condition of phosphorus in the soil; investigations in soil management; the needs of sandy soils; the relation of metabolic water produced in tissues to growth of plants and animals; development of pedigreed grains; crop rotation for northern Wisconsin; selection of seedling apples; new varieties of apples; rhubarb ^{forcing} ~~forcing~~; tomato breeding investigations; methods of tobacco culture; fruit and potato trials and tests at the northern sub-stations: A plant disease survey, by Professor L. R. Jones: an economic entomology survey relative to the San Jose Scale; cranberry investigations; various investigations in agricultural economics; historical and geographical studies and one of farm tenures; farm surveys; and weed control. In cooperation with the government and state organizations, cheese work was conducted by the Dairy Department and the subjects of cranberry insects, stump removal, state soil survey, farm accounting and farm tenures in-

vestigated. The Dairy and Agricultural Economics Departments also cooperated with the Wisconsin State Dairy and Food Commission in the preparation of a new dairy map showing the location of creameries and cheese factories in 1910.

AGRICULTURAL EXTENSION SERVICE

Carrying the work of the Experiment Station directly to the farmers of the state in 1909-1910 new community breeders' associations were organized by Professor ^{George} C. Humphrey, making in all 37 of these cooperative enterprises in 27 counties. Testing of dairy cows had been more active than *ever*, 872 cows, or more than 61 percent, more than the previous year having been tested. Many post-mortem demonstrations of tuberculosis-affected cattle were held in cooperation with the Live Stock Sanitary Board at the farmer's courses at the different county agricultural schools, the State Fair, and various county fairs. Butter and cheese scoring exhibitions were head by Professor Lee of the Dairy Department with the cooperation of inspectors from the State Dairy and Food Commission and the U. S. Department of Agriculture. During four years of this work monthly entries had been received from 618 creameries and 458 cheese factories in the state. About 150 creameries and cheese factories had been supplied with pure starters by the Department of Agriculture/ Bacteriology, cooperating with the Dairy Department. The work of revolutionizing the type of seed grains throughout the state was being forwarded by the Department of Agronomy, with the cooperation of the Wisconsin Experiment Association, an organization comprising over 1,500 paid-up members. Fifty grain growing contests were held for young people during the year, through the cooperation of the Agronomy Department, the county superintendants of schools and county fair secretaries. Enough seed was sent out to furnish about 20,000 tests, and over 6,000 exhibits were made at the county fairs. Thirteen all-day meetings and demonstrations were held by Professor Korford at the state and county farms, with a total attendance of 4,150 farmers. A number of

potato spraying demonstrations were conducted by J. G. Milward of the Horticultural Department, and the Horticultural Department also, through him, did demonstration work in the spraying of orchards with Bordeaux mixture against the codling moth and apple scab. The department likewise furnished plants to several schools, for the planting of the grounds around their buildings, and distributed improved selections of Connecticut Havana tobacco seed to 1,322 growers in 58 counties of the state. Professor E. J. Delwicks actively continued his experimental work at the Ashland, Iron River and Superior sub-stations under his management. He reports^d that cooperative tests with 400 farmers had been in progress during the past year in the Northern half of the state. Among other valuable results of his work had been the development of 3 types of corn adapted to Northern Wisconsin conditions and which already were being grown with success. Many clover hulling demonstrations had also been conducted.

Professor E. R. Jones, of the Department of Soils, had continued his important work in drainage of marsh lands. During the past 5 years aid had been given by the Soils Department to the reclamation of 116,000 acres for which plans had been prepared and perfected. The improvement of 33,000 acres had been accomplished or was in progress. Nearly 200 cooperative tests with fertilization^{ers} adopted^a for use on clay, marsh, and sand soils were conducted during the year. The Department of Agricultural Chemistry had instituted field tests for manure conservation in 15 different counties in the southern and eastern districts of the state.

A collective exhibit representing all departments of the Wisconsin College of Agriculture was made at the State Fair in the old dairy building and attracted wide attention.

ANTHRAX ATTACKS UNIVERSITY HERD

About daybreak, on the morning of August 15, 1909, and following a violent thunder storm and heavy downfall of rain, a herdsman telephoned Dr. A. S. Alexander, Station Veterinarian, that he had found a cow dead on the marsh pasture at the University farm. Asked whether blood had issued from the natural openings of the animal's body--which usually occurs after death from anthrax--the man replied that he had not seen any blood. The natural inference, therefore, was that lightning had killed the cow; but later that morning investigation showed that there had been an issue of blood. Anthrax was then suspected as the probable cause of death and a microscopic examination of the animal's blood corroborated that suspicion. The carcass was immediately destroyed by burning and an unofficial quarantine placed upon the herd and farm. Later an official quarantine was ordered by the State Veterinarian, and signs posted announcing the nature of the disease. Sale of milk from the University Dairy was, at the same time, discontinued.

On the morning following discovery of the cow's carcass, a young goat was found dead in a paddock near the marsh pasture and laboratory tests conducted by Professor E. G. Hastings, showed that it had also been killed by Anthrax. Dr. Alexander, who had at once established headquarters in the Dairy Barn, then instituted vigorous measures for control of the outbreak. Dr. S. M. Babcock, acting Director of the station in the temporary absence of Director H. L. Russell, took a keen interest in the proceedings, and Professor George E. Humphrey took charge of the workman^e who carried into effect the measures of control, ably assisted by George

Hutton, Farm Foreman, and W. E. Markey, assistant in Animal Husbandry.

One of the first steps was the taking of the bodily temperature of each cow in the dairy herd, at intervals of two hours. The clinical thermometer readings were recorded on a special chart showing the names of the animals, and the moment a rise in temperature above normal 101.5 F. was noted, the animal was taken to a picket line on the marsh pasture, where a crematory had been prepared for the burning of the carcass. The chart readings showed that the temperatures of the affected animals quickly rose, in the most severe cases as high as 107° F. and then fall below normal just before death. Twenty-one cows went to the picket line, and 5 succumbed to the disease. Practically all of the animals, excepting those most violently attacked were given internal treatment with various drugs, including quinine, salol, eucalyptus, etc. and it seemed possible that the treatment lessened the fatalities. In the worst cases, considerable swellings formed on the neck or other parts of the body of the affected animals, but these were less evident in the animals that recovered. The deaths occurred among the Ayrshire and Jersey cows, while other breeds escaped, or survived comparatively mild attacks. Later, 3 heifers and 4 calves died from the disease; then a few hogs succumbed. The latter animals had been frequenting a muddy ditch running to the infected pasture. It was noted that, in swine, swelling of the glands of the throat was the chief symptom of the disease apart from a marked rise in temperature. In April, 1910, after an absence of the disease during the winter months, 4 small pigs succumbed to anthrax. From the outset of the disease, cleansing, disinfecting and whitewashing of all stables where cases of anthrax occurred, was most thoroughly done, and, so far as possible, these measures were also

adopted in all places where infection might have occurred. Vaccinating of susceptible animals against the disease was also carried out. Later, test animals, allowed to graze where the original case of anthrax occurred, failed to contract the disease.

An inquiry made by Director Russell to discuss, if possible, the source of the outbreak led him to publish the following conclusions in his Annual Report for 1910: "The refuse from the various laboratories of the University is disposed of by depositing it in the sand pit which is located in the middle of the marsh pasture, but separated from it by a fence. Accidental access to this pit was had through gates being left open when sand was hauled. The custom of thorough disinfection of all refuse from the bacteriological laboratories, it was found later, had been unknowingly discontinued by a laboratory subordinate. It appears that material was received at the Hygienic Laboratory in July, 1909, which was suspected of anthrax. Animal inoculations made at that time confirmed this diagnosis, and the refuse from these animal cages was not disinfected upon its removal. This material was probably deposited with the general garbage, and so made possible the origin of the disease in the single animal which was supposed to have died of lightning. The manner of the disposal of this carcass gave opportunity for the further spread of the disease. This history accounts for the chain of circumstances which developed, and shows how, in an indirect way, it may be possible for such a violently contagious disease as anthrax to establish itself in a new locality.

RESEARCH BULLETINS OF 1910

Seven research bulletins, numbered 7 to 13 inclusive, were published by the Experiment Station during the fiscal year ending June 30, 1910,

and contained much scientific information of interest and instruction to farmers as well as scientists. Brief summaries of these bulletins follow.

MOISTURE CONTENT OF CHEESE CURDS

Research Bulletin No. 7 by Professor J. L. Sammis, F. W. Laabs and S. K. Surguki discussed the factors controlling the moisture content of cheese curds, as based upon experiments conducted by the authors. The moisture content was deemed by these as no less important than acidity in its effect on the quality of the finished cheese. He concluded that variations in the proportion of rennet between 2 and 6 ounces per 1,000 lbs. of milk do not influence the rate at which whey separates from curd in the cheese vat; nor is it influenced by longer or shorter action of the rennet before cutting, or by the relative softness or hardness of the curd when cut. Whey gains most of its acidity by transfer from the curd. Whey rises more rapidly in acidity when part of it is withdrawn from the vat, soon after cutting, but this does not affect the rate of separation of whey from curd. A larger proportion of moisture is retained by curds made from very sweet or overripe milk than from those from milk of medium ripeness. Great differences of moisture content in curds are caused by using different sized cutting knives. Higher temperatures facilitate the separation of whey. High acidity and high temperature induce rapid separation of the whey immediately after cutting of the curds. Pressure applied to curd in the press, on the rack, or under the whey hastens the separation of whey. Stirring curds on the rack prevents matting. After thorough stirring the final moisture content of curds depends to a great extent in its acidity. Richness in fat content of milk tends to retard at rate at which whey

separates from the curd. Variations in the percentage of casein and water in milk have a like tendency. The addition of water to milk does not increase the moisture content of the finished cheese as the curd as the curd from watered milk gives up moisture more rapidly after cutting. The loss of moisture, immediately after cutting, is rapid but decreases in speed as time passes. The rate increases when the curd is removed from the whey and piled, then is rapidly decreased but again increases when the curd is salted.

NUCLEIN SYNTHESIS IN THE ANIMAL BODY

Experiments by Professor E. V. McCollum reported in Research Bulletin No. 8, led him to conclude that the palatability of the animal's ration is an important factor in its nutrition. Although it contains the necessary food ingredients, a ration lacking in palatability may fail properly to nourish the animal. An appreciate amount of growth may be induced by changing the character and flavor of the feed supplied. Very young animals are least affected by low palatability of these rations. Other things being satisfactory all phosphates needed by an animal, for skeleton, nuclein or phosphated formation can be drawn from inorganic phosphate. Finally, the animal "has the power to synthesize the purine basis necessary for its nuclein formation, from some complexes contained in the protein molecule, and does not necessarily use purine bases of exogenous origin for this purpose".

ACID-SOLUBLE PHOSPHORUS COMPOUNDS OF FEED

Professors E. B. Hart and W. E. ^T Nottingham, in Research Bulletin No. 9, furnished feeds with valuable data relative to phytic acid, as a complex

salt of potassium, magnesium and calcium in certain feeding materials. They had confined the experiments reported on to a continuation of their study of the nature of phosphorus bearing bodies in a dilute hydrochloric acid extract of a few natural feeding materials, and found that phytin is present in the seeds of the corn, oat and barley plants, as well as in wheat kernels where it had previously been discovered. It could not be isolated from alfalfa hay or from rutabagas, but appeared to be distributed throughout the entire seed of the cereals investigated. In wheat, it is largely localized in the outer layers, being, therefore, abundant in wheat bran. The approximate proportion of phytin phosphorus in the seeds mentioned was estimated as 38 to 48 percent of the total phosphorus content. In rutabagas, 64 percent of the contained contained phosphorus was inorganic, along with 24 percent of an unknown organic phosphorus complex that was soluble in dilute acids and nitrogen free. In freshly cut, in-bloom alfalfa, 63 percent of the phosphorus was inorganic with 17 percent of the total phosphorus of the plant of an organic phosphorus complex. The authors considered it possible that a reducing substance, separated by dilute acids from the alfalfa hay preparation, was dextrose, but further work would be necessary to fully decide that point. They were unable to separate pentose sugar from the same alfalfa preparation.

CHEMICAL ANALYSIS OF MILK

Some improved methods of dairy chemistry analysis were explained in Research Bulletin No. 10, by Professors E. B. Hart and Semmis and S. Suzuki. The methods tested in their experiments were: A Volumetric method for the estimation of casein in milk; the quantitative estimation of lactic acid in cheddar cheese and the relation of different acids to

the precipitation of casein and to the solubility of cheese curds in salt solutions. The volumetric method is rapid, and when properly conducted, would give results in less than two hours. In this method, casein itself is first separated and then volumetrically estimated, thus affording sharp titrations. Professor Hart explained the determination of the alkali constant of milk of the cows of the various breeds: how to prepare the casein ^{and details} charts of the volumetric method. The results obtained by Professor Sammis with the test were given in a table, as well as those of Professor Hart, with which they closely agreed. The tests, made by S. Suzuki, chemist of the Dairy Division of the U. S. Department of Agriculture cooperating with the Wisconsin Station on investigations, and Professor Hart included those on the Palm method, the Partheil method, and the zinc-lactate method of estimating lactic acid in cheddar cheese. The conclusions arrived at by the various tests were that the Palm method, based upon the formation of the basic lead salt of inactive lactic acid, gave low results and could not be used as a quantitative method for the estimation of lactic acid in cheese. The Partheil method was not found applicable to the quantitative separation of lactic acid from a mixture in which may occur such acids as malic, citric, tartaric, oxalic, and succinic acids. The authors advised that, in cheese analysis, the usual method of lactic acid estimation--extraction with ether after solidifying and separation of the zinc salt--gives fairly satisfactory results, when carefully manipulated. They found, too, that the phenomena of milk coagulation and salt solubility of cheese curds are affected by conditions of temperature and concentration, and by the presence of many substances in solution. With the discovery of new facts, the older explanations of these phenomena become increasingly inadequate and incomplete.

FATTY ACIDS AND ESTERS IN CHEESE

Investigations relative to the production of volatile fatty acids and esters in cheddar cheese, and their relation to the development of flavor, were reported by S. K. Suzuki, E. G. Hastings and E. B. Hart in Research Bulletin No. 11. Previously, investigations of the chemical changes taking place in the process of cheese ripening, had involved wholly the nitrogenous side. The investigation mentioned therefore studied the non-nitrogenous products formed during the normal curing process, of cheddar cheese. They found that lactose disappears from such cheese in from 3 to 6 days, depending upon the condition of the milk and temperature of curing. Lactic acid does not decrease during the ripening process, and may even increase. The increase, after lactose disappears, is probably of protein origin. Racemic acid was the form usually found in cheddar cheese; but solutions of lactose, inoculated with *B. lactis acidii*, or a starter, produced active acid. When inoculated with a bit of cheese, a mixture of active and inactive acids was produced. No enzymes capable of producing lactic acid or volatile fatty acids from lactose, could be isolated from cheese. Increasing amounts of lactic acid formed during the ripening process, and after lactose had disappeared. Acetic and propionic acids reached a maximum at 3 months, and then decreased. Butyric and caproic acids continually increased during the test period. Formic acid was only detected in whole milk cheese at the 5½ months stage. No valerianic acid was found. Lactates were the probable source of the acetic and propionic acids. Fats and protein were the principle sources of the butyric and caproic acids. A distillate produced and designated "flavor solution by the investigations and having

a cheese aroma, contained alcohols and esters. The esters of mild whole milk cheese were made up largely of alcohol and acetic acid; those from more pungent skim milk cheese were largely compounds of ethyl alcohol and caproic and butyric acids. The alcohol probably had its origin in the lactose ^efermentation and ^{saved} appended to be an important factor in flavor production. The source of the volatile acids and synthesis of esters remained to be discovered. Succinic acid was isolated from curing cheddar cheese, and identified from its silver salts.

FIXATION OF NITROGEN BY AZOTOBACTER

Two types of bacteria were known to possess the power to fix nitrogen in the soil without the aid of any host plant, viz: ⁽¹⁾ the anaerobic type and ⁽²⁾ the aerobic type. In Research Bulletin No. 12 C. Hoffman and B. W. Hammer reported that the results of their work with the latter type of bacteria. The name Azotobacter had been given to the group of bacteria mentioned. The experimenters concluded that different soils vary widely in their power to fix atmospheric nitrogen. Mannite and lactose proved the best sugars for maximum fixation in impure cultures, while sucrose gave a high degree with pure cultures. The activity of Azobacter was enhanced by the use of smaller quantities of carbohydrates in the culture solution. Di- and tri- calcium phosphates, in impure cultures at last, gave better results as regards fixation than the mono-salt. The period of incubation of impure cultures should range from 14 to 28 days. For fixation purposes, but a small quantity of calcium carbonate need be used in the culture solution. A quartz sand slope was described and recommended as efficient for the abundant

development in a pure culture. When grown in liquid media, the use of large Petri dish cultures, described in the Bulletin, was recommended for the securing of an abundant supply of the dry *Azotobacter* cells for chemical analysis. The percentage of the protein content of *Azotobacter* cells obtained ranged from 8.31 to 19.13. The age of the culture apparently influenced the percentage of the protein content. The phosphorus content of the cells was influenced in the same way. Calculated as P_2O_5 it ranged from 2.51 to 2.97 per cent.

PROTEIN REQUIREMENTS OF COWS

In Research Bulletin No. 13 Professors F. W. Wall and G. C. Humphrey reported the results of their extended investigations to determine the amount of protein required by dairy cows in their daily rations. They stated that studies of feeding problems with dairy cows, conducted during late years, and practical feeding experience accumulated during the last two decades, had established the practicability of furnishing smaller amounts of protein in their rations than had formerly been considered necessary. There had been a growing tendency on the part of dairymen to feed rations containing larger quantities of non-nitrogenous digestible components, carbohydrates and fat, than called for by the German standards, and with apparently satisfactory results. The establishment of the University dairy herd in 1898 had offered exceptional opportunities for studying the protein problems, and soon after the herd was fully established and accustomed to their quarters, an investigation of the subject was undertaken. It had been continued for 9 years, or until November, 1909, and it had resulted in the conclusions

prevented by text and tables in the bulletin mentioned. All things considered, it was determined that the production of cows on a high protein ration was, in general, lower than that of cows fed a medium protein ration. Although the higher protein rations cost somewhat more, on the average for the herd, than those medium in protein, ^{more} ~~more~~ milk and more butter fat were produced on the latter, and about 18 per cent larger net profit per cow was obtained on the average for the respective periods of the investigation. The rations containing highly nitrogenous grain feeds, like distillers' grains and cotton seed meal, not only did not equal those made up largely of farm-grown grains in nutritive effect, but produced less milk and butter fat and yielded a considerably lower net profit than did the latter rations. It was noticed, however, that the high-protein rations tended slightly to increase the fat content of milk during the winter periods of the tests. The average nutritive ratio of the high-protein rations was 1:62, and those of the two medium proteins periods averaged 1:74. As regards the effect of the two systems of feeding on the body weights of the cows, no marked differences were observed. It was concluded, however, ^{as} that certain that a liberal supply of protein is necessary for ^b the production of large amounts of milk and butter fat. Malt sprouts, barley feed, hominy feed, gluten feed, rye feed, and dried distillers' grains were stated as being especially reasonable in price, during the periods of the tests, and lower than the mill feeds, cereals and mixed dairy feeds tested. It was concluded, relative to choice of feeds, that, other conditions being equal, the former feeds should be preferred, from the feeders' standpoint of view, unless the feeds on hand

are very low in protein. It was advised, as important, to supply high-protein feeds in the rations in order to bring these up to a fair standard, when low as regards the amounts of proteins they contain and their nutritive ratios.

REGULAR BULLETINS OF 1910

During the fiscal year ending June 30, 1910, 19 regular bulletins containing practical information for farmers, based, upon the experimental work of the Station were issued. They were numbered 177 to 195, of which No. 18 reported tests of the University dairy herd for 1908-1909; No. 191, a decade of official tests of dairy cows for 1899-1909; No. 193; The annual report of the Director, and No. 194, the list of licensed feeding stuffs in 1909. Brief summaries of the remaining regular bulletins follow:

POTATO GROWING EXPERIMENTS

Potato culture in Northern Wisconsin had been carried on experimentally at the Iron River sub-station during the past three years. The results obtained, together with conclusions based upon personal study and observation of potato growing in that section, were presented by Professors E. P. Sandsten and E. J. Delwicks, in Bulletin No. 177, of July 1910.

The potato crop had proved most important for the sandy and sandy loam soils of northern Wisconsin, and under proper culture had proved uniformly profitable. Better methods of soil preparation and fertilization of the potato crop were advised as necessary, along with correct methods of planting, cultivation, spraying and harvesting. The experiments had shown the advantages of such improved culture. As to soil preparation, the turning under of green crops, such as clover, rye or barley, and the application of farmyard manure, were recommended to increase the humus content. Potato raising might well be combined with dairying, and the use of commercial feeding stuffs, to improve the quality of manure for the production of greater yields of potatoes. Potatoes on clover sod

usually produced the best crops of tubers. Planting of large, selected tubers was advocated, rather than the continuous planting of small seed potatoes. They should be kept entirely dormant for planting. Shallow planting, at a depth of 4 inches, was advised for sandy soils. Bordeaux mixture was recommended for combating early and late potato blight, and Paris green for control of the potato beetle. On sandy soils, the turning under of a heavy crop of green clover had given better results than the application of either stable manure or commercial fertilisers. Variety tests had shown little difference between Noroton Beauty, Early Rose and Stray Beauty for early crop, and Carman No. 3 Burbank, Sir Walter Raleigh and Rural New Yorker of the late sorts.

PEAS FOR NORTHERN WISCONSIN

In Bulletin No. 178 of July, 1910, Professors R. A. Moore and E. J. Delwicke discussed the subject of pea raising, from a practical stand point for the information of farmers. It was stated that thousands of acres of land in Northern Wisconsin would, when cleared, prove admirably adapted for the growing of field and canning peas. The best yields might be expected on clay or clay loam soils which are not very rich. The land should be fall plowed, well manured for a previous crop, and to be deeply worked with a disc harrow in spring. Drainage was advised as necessary where the land was wet. Early seeding gives the best results. A hay mower, equipped with a pea lifting attachment, may be economically used for harvesting the crop, which should be thoroughly cured, in small covered heaps before housing. The crop is a rich source of digestible protein elements for stock feeding and yields more than wheat. The crop is relished by swine, provides excellent forage for sheep, and can be grown profitably in rotation for soil improvement as a nitrogen provider. The

crop should be raised two years in succession, on new land, to enrich the soil with nitrogen-gathering bacteria.

KILLING FARM WEEDS

The eradication of farm weeds with iron sulphate was advised in Bulletin No. 179 of July, 1909, by Professor R. A. Moore and A. L. Stone. Wild mustard has become a serious pest in many Wisconsin districts, while Quack-grass, Canada thistle, Sew thistle, star thistle, English plantain, Oxeye daisy, toadflax, dodder and velvet leaf, were also troublesome. Proper application of iron sulphate in solution had been found effective for the eradication of wild mustard, and partially so for the control of other weed pests. The solution recommended was to be made by dissolving 100 lbs. of granulated iron sulphate in 50 gallons of water. That amount would serve for the treatment of 1 acre of land infested with wild mustard. A special sprayer available for the purpose can spray 15 to 25 acres daily, and a single application of the iron sulphate solution will kill all of the mustard, if applied at the right time. It acts best on plants in the bud or not beyond the third leaf stage of growth. It failed to kill Canada thistle. The cost of spraying with iron solution was, at that time, about \$1.25 per acre.

CHOICE AND USE OF FERTILIZERS

As continued cropping of land sooner or later depletes its plant-growing constituents Professor F. W. Wall, and his associates had been giving the subject their earnest attention and in Bulletin No. 180 of August, 1909, furnished farmers of the state with practical information on the choice and use of fertilizers. The analytical work reported in the bulletin was done by W. A. Brannon and the inspection work by Roy F. Harris and George S. Hine. Conservation of soil fertility might be

accomplished by feeding crops and purchased concentrates to livestock and then applying the stable manure to the land; and by the application of commercial fertilizers and the culture of nitrogen-supplying legumes. Commercial fertilizers are necessary where livestock is not kept. The principal commercial fertilizers were described in the bulletin. Thirty-seven brands, prepared by 11 manufacturers, and 7 samples of ground rock phosphate were reported upon, and other information ^{re} matter given.

PREPARATION OF PURE STARTERS

Professor E. G. Hastings, in Bulletin No. 181 of September 1909, gave instructions for the propagation of pure starters for butter and cheese making. A "starter" is a quantity of milk in which acid forming bacteria have grown until large numbers are present. The addition of such a starter to milk or cream seeds it with healthy bacteria which, by their growth, cause the acid-fermentation to progress rapidly, and in a more definite manner than otherwise would be the case. It is of great importance that uniform starters of known quality be used, as the flavor of butter or cheese produced depends upon the nature of the bacteria producing the acid in the cream or milk. Pure cultures usually contain but a single kind of tested and proved bacteria which will multiply rapidly in large quantities of cream or milk in the factory. Methods of propagating starters were described. Most of the appliances needed for the work could readily be constructed by any butter or cheese maker. He can also obtain, from a dealer in dairy supplies, the appliances needed for determining the acidity of the starters and of milk and cream. The essentials of successful starter making, to insure butter and cheese of high quality

were stated to be cleanliness, close attention to details, proper sterilization of vessels, careful transferring of the "mother" starter and correct judging of the quality of the starter.

SCORING OF BUTTER AND CHEESE

Bulletin No. 182 of October, 1909, gave a full account of the Wisconsin butter and cheese scoring exhibitions. It was planned and directed by Professor E. H. Farrington and M. Michels supervised the details and prepared most of the contents. The latter expert formerly had been in charge of the Scoring Exhibitions. They were begun in the spring of 1907 by the Dairy Department of the Station, in cooperation with the Wisconsin Dairy and Food Commission, which had conducted a butter and cheese scoring exhibition in 1906. The first exhibition was held in May 1907 and there was during the year a total of 1,399 entries of butter and 778 of cheese from 254 creameries and 195 cheese factories. At an exhibition held at the State Fair, in September, there were 172 entries of butter and 161 of August cheese. The exhibitions proved of high educational value to butter and cheese makers. The bulletin also outlined the causes and remedies for butter and cheese defects, on the basis of data used in connection with the scoring exhibits. The matter presented formed a manual of direction in butter and cheese making not previously available. The average score of all the exhibitors during the year was 93.11, while the average of the 31 regular exhibitors was 93.81, and of the irregular exhibitors 92.96.

CLOVER GROWING

The growing of clover for seed and forage in northern Wisconsin was considered in Bulletin No. 183 of November 1909 by Professor R. A. Moore and E. J. Delwicks. The crop had no equal for that district, as a soil improver feed for livestock and as a catch crop. Most soils of the district had produced excellent yields of hay and seed. Mammoth red clover was superior to alsike and medium red clover for sandy soils. There had been an increasing demand for good clover seed. Methods of seeding, harvesting and curing clover hay were described. Clay soils gave the best yields of clover seed, since drought severely affects sandy soils. To insure a good seed crop the clover for hay should be mowed between June 1 and 20. Only one crop of alsike or mammoth clover can be cut each season. For seed, the clover should be mowed early in the morning, before the heads become brittle, with a mower having a bunching attachment. The bunches should be allowed to stand from 5 to 10 days, and be turned for drying if a rain occurs. Usually the crop can best be threshed in the field where little handling is necessary.

SWINE MANAGEMENT

Practical swine management was the subject matter of Bulletin No. 184 of November, 1909. The major section on management was written by Professor J. G. Fuller, and that regarding common diseases and parasites by Dr. A. S. Alexander. The importance of raising high quality purebred boars was stressed, and they should be mated with carefully selected sows of the finest quality and individuality, to insure large and healthy litters.

The typical sow should have a quiet a quiet disposition and her udder should show 12 teats. Suitable rations for boars and sows were prescribed, and instructions given for the proper care and feeding of young pigs. Common diseases and parasites were to be avoided by strict attention to sanitation and all other preventive measures. Illustrations of desirable types of hogs, methods of ear marking, feeding fixtures, portable houses, a dipping plant etc. accompanied the text. The section of diseases and parasites gave information about lice, worms, scows, constipation, thumps, canker sore mouth and rickets, together with remedies for the parasites and ailments mentioned.

SANITARY STALLS FOR STABLES

In Bulletin No. 185 of November, 1909, Professor C. A. Ocock offered practical advice regarding sanitary stalls for cows, with plans and specifications for their construction. Four types of stalls were described and illustrated. Particulars regarding concrete stable floors and stall mangers were also ^{given} ~~given~~. Blue prints of the detailed drawings of the stalls, gutters and mangers shown in the bulletin had been prepared and were offered to farmers and others at the cost of printing.

FARM HORSE IMPROVEMENT

Suggestions for the improvement of Wisconsin horses were made by Dr. A. S. Alexander in illustrated Bulletin No. 186 of December, 1909. The value of horses in Wisconsin on January 1, 1909, was shown to be \$70,834,000 or \$2,029,000 more than the cows, sheep and swine combined; hence the importance of doing everything possible to conserve and enhance the value of the horses population. The proper methods of grading up horses by the

sound, individually excellent, pure-bred stallions, and selected mares was explained, and particulars about the Wisconsin stallion license law given. A campaign for better horse breeding was advised and should be based upon the following requisites: grading up with sound muscular sires; continuous use of pure-bred stallions of a chosen breed; use of sound stallions and mares; proper feeding and care of the mare and foal; working of stallions regularly; home production of pure-bred stallions to replace grades, mongrels and scrubs used at that time; organization of community associations for promoting horse breeding; and the encouragement of the industry by prizes at county fairs for pure-bred stallions and mares and their ^{progeny} ~~pregnancy~~.

Mr. Alexander in Bulletin No. 188 of December, 1909, also presented statistics relative to Wisconsin horse, breeding and a list of the stallions licensed for public service in 1909. The stallion law was already having a good effect in the elimination of grade stallions. While 65 percent of the stallions licensed in 1906-1907 were grades, only 58 percent of the sires licensed in 1908-1909 were grades. The number of pure-bred stallions had increased in 37 counties of the state, while grade stallions had decreased in 40 counties. A new license certificate for stallions to be described as "Mongrel or Scrub" had been provided by the legislature in ^{an} amendment to the law approved June 9, 1909. Sixteen other states had enacted stallion laws similar to that first enacted in 1905.

COMMUNITY BREEDERS ASSOCIATIONS

In Bulletin No. 189 of February, 1909, Professor G. C. Humphrey explained the value of community breeder's associations in the improvement

of dairy cattle. Among the advantages mentioned as important was the fact that such associations could secure official tests for advanced registry at a reduced cost and could cooperate to secure protection against fraud and contagious disease. Some 31 breeders' associations had been organized since 1906 as a result largely, of Professor Humphrey's efforts. Advantages in buying and selling might also be obtained by cooperative advertising, purchase exchange and sales. Methods to be employed in organizing an association were fully explained and a sample Constitution and set of By-Laws submitted for the information of breeders. A list of the Wisconsin associations functioning in 1910 followed.

INSECTS INJURIOUS TO FRUITS

The common insect pests of fruits in Wisconsin were listed and described, with informative illustrations, by Professor J. G. Moore, in Bulletin No. 190 of February, 1910. Some of the illustrations were made from insects donated by M. W. Richards and L. R. Detjen, Deputy State Nursery and Orchard Inspectors. Enough of the life history of each insect was given in the text to enable the fruit grower to identify a pest threatening serious damage to his fruit crop. Eternal vigilance was advised as necessary to detect the noxious insects and provide means for their control before they have caused serious injury. Insects that feed by means of mouth chewing parts, and those that feed through mouth sucking parts, were described in the bulletin. Orchards were advised to know the insect, know what to use against it, how to use the remedy and be careful to apply it thoroughly. Full instructions were given relative to each of these requisites.

TESTS OF DAIRY COWS

In Bulletin No. 191 of February, 1910, Professor F. W. Wall and Roy T. Harris presented the record, in detail, of a decade of official tests of dairy cows. (1899-1909) The tests had been conducted in 27 counties for 109 breeders, on a total of 2,764 cows with a most beneficial effect upon the entire dairy industry. During the year ending October 1, 1909, 1,479 dairy cows had been tested, an increase of over 11 percent over the previous year.

FEEDING DAIRY CALVES

In Bulletin No. 192 of February, 1910, entitled "The Dairy Calf at Meal Times" the author, Professor D. H. Otis emphasized the importance of proper care, feeding and management of Wisconsin's annual calf crop which totals 2,189,600 head. About 70 percent of these calves have to be raised on skim milk, and detailed advice were given as to the best methods of such feeding. Grain and roughage feeding was also explained, and the best methods advised, together with instructions for proper management of the young animal to insure maximum development and avoidance of losses. The author stated, in conclusion, that "calf feeding requires skill and good common sense. The art of calfrearing cannot be taught out of books, bulletins and papers. There must be brains and intelligent interest properly to articulate the calf with its feed and environment. There are no hard and fast rules that can be laid down. The earmarks of an intelligent feeder are seen in his herd. The calves are thrifty, active, with bright eyes, smooth glossy coats, always hungry, and playful and lusty."

IMPROVED TESTS OF DAIRY PRODUCTS

In Bulletin No. 195, of February, 1910, Dr. S. M. Babcock and Professor E. H. Farington described the Wisconsin Hydrostatic Cream Balance they had devised as a simple apparatus for the correct weighing of cream into test bottles. The new balance was fully described and illustrated. Its essential parts are a hollow brass float which supports a platform upon which the cream bottle is placed. The cream is weighed by pouring it slowly into the bottles until the float sinks to a certain point. Fat-saturated alcohol, placed on top of the fat in the cream test bottles after it is ^{whipped} weighed in the tester, aids in making an accurate reading, by giving a level surface from which the fat may be accurately measured. This method, recommended by the authors, may increase the accuracy of the test from one-half to two percent. They also described and illustrated a new milk sediment test which furnished a rapid and accurate method of determining the amount of dirt in milk as it comes into the receiving station of the creamery or cheese factory. The device furnished at small cost a means of grading milk according to the sediment in it. A pint of milk used in the test, is poured through an absorbent cotton disc which collects the sediment.

CURD FROM BUTTERMILK

In the same bulletin (No. 195) Professor J. L. Samme's described a new method of collecting buttermilk curd from heated buttermilk so as to secure all of the curd in a firm condition. The curd thus obtained may be made into a product called "buttermilk cream", or into another product called "buttermilk cheese". A yield of 12 to 15 lbs. from 100 lbs.

of buttermilk can be obtained by the process. Thomas Otto a dairy student, made the initial discovery of the process which was perfected by Professor Samme's.

STATION CIRCULARS OF 1910

As a new feature in the publications of the Experiment Station, 16 Circulars of Information were issued during the fiscal year ending June 30, 1910. Of these circulars Nos. 1, 4, 11 and 15 pertained to the Wisconsin feeding stuff law, the seed inspection law, licensed feeding stuffs and fertilizers in 1910, and the analysis of licensed commercial fertilizers in 1910. Circular No. 3 gave popular and condensed directions relative to the propagation, care and examination of pure culture starters for butter and cheese making. Circular No. 3 offered directions for the proper making and use of the various sprays for potatoes. Spraying machines were also described and discussed. Circular No. 5 gave instructions for the making of hollow concrete fence posts and also gave information relative to posts of the solid core variety. Circular No. 6 presented a synopsis of the drainage laws of Wisconsin, together with forms of documents, the essential petitions, reports, specifications and contracts. Circular No. 7 outlined the various activities of the Agricultural Extension Service. Thirty-seven kinds of service in 10 Departments of the College and Experiment Station were described. Circular No. 8 gave all the necessary particulars about corn judging and Circular No. 9 similar information regarding dairy cow competitions. Circular No. 10 explained and described the successful operation of the Hart Casein test, when used in conjunction with the Babcock butter-fat test, in cheese factories. Circular No. 12 gave

directions for the spraying of the home orchard, the preparation of effective insecticides and fungicides and estimates of the field cost of spraying.

Circular No. 13 by Dr. A. S. Alexander described the chief diseases menacing the new-born foal and gave instructions for their prevention. Circular No. 14 told how to test the salt content of butter by the use of silver nitrate and circular No. 16 drew attention to the value of root crops, and prescribed methods for their cultivation, harvesting and storing.

THE EXPERIMENT STATION IN 1910-1911

During the fiscal year ending June 30, 1911, continued expansion in the resources of the Wisconsin College of Agriculture and Experiment Station had been brought about by the addition of buildings, equipment, and new members of the teaching and research staff. The staff had increased to a total of 72 persons, of whom 14 were full professors, 19 associate and assistant professors, 16 instructors, and 23 assistants. The new Horticultural Building had been completed, bordering the Linden Drive. It cost about \$60,000 and consisted of a two story and basement brick, 48x128 feet, with an attic suitable for laboratory use. It was ^{to be} then occupied by both the Horticultural and Plant Pathology Departments by January 1, 1912. The Home Economics department had also been provided with a seven room cottage, ^{near} ~~near~~ Agricultural Hall, to be used as a laboratory in house management work. During the year the sheep barn and offices had been entirely rebuilt. The new barn, 24.5 feet by 154 feet, of two stories with a root cellar below occupied the site of the old sheep fold, and provided ample accommodation for the growing experimental flocks. The Department of Experimental Breeding was provided with a suitable building to house the small animals and poultry used in its inheritance research work. The Board of Regents had also authorized the construction of a new Agricultural Chemistry building, to be located on University Avenue, immediately south of the Agronomy building. Ground had been broken for the building. Plans had also been prepared for an additional building for use by the Departments of Home Economics and University Extension. It was to be located on Linden Drive.

NEW LANDS ACQUIRED

Through the liberality of the Legislature of 1911, 187 acres of lakeshore lands, part woodland, had been purchased for use by the Experiment Station, as an addition to the University Farm. Director Russell was certain that the purchase of this property would prove of inestimable value to the University in the generations to come and his prediction soon began to be verified.

Reclamation of the University Farm marsh lands was progressing. The area had been divided into a small tract of about 22 acres, which had been tile drained during the previous year at a cost of \$47.50 per acre and used for corn growing. The tiled field produced about 17 tons of silage corn per acre. Considerable work had also been done on the larger tract of marsh land. A pumping station, equipped with a 12 horse-power stationary engine and a windmill, had been installed, the main open ditches dug and all protection dykes and ditches constructed. Between 30 and 40 acres of this tract were to be plowed during the autumn of 1911 in readiness for corn growing the following season.

A third sub-experiment station had been established in 1911 at Marshfield on the Colby clay that predominates there, and in several of the counties in the north central part of the state. A machine shed and a lean-to for a small dairy herd, as well as a concrete silo had been constructed at the Spooner sub-station during the year. The initial work of clearing and subjugating the 182 acre Ashland Junction sub-station had been begun in the autumn of 1911 and a small tract of winter⁴ wheat planted. Two orchard tracts on the Bayfield peninsula and Madeline Island, which for 5 years had been under contract of the experi-

ment station, were to be attached for administrative purposes to the Ashland Junction Branch Station.

Changes in the Staff and Organization During the Year, a separate Department of Agricultural Bacteriology was organized and Prof. E. G. Hastings, made chairman, and also Bacteriologist of the Experiment Station. These changes had been made necessary by the continued growth of the agricultural bacteriological work of the Station, which made it advisable to separate it entirely from that of a general hygienic and medical nature.

VETERINARY SCIENCE

A separate Department of Veterinary Science was likewise organized. Previously the work in that science had been done in association with that of the ^{Animal} Husbandry Department, and it had continued to grow in importance until a new plan of management had to be arranged. Dr. A. S. Alexander who had conducted the work from 1901 as lecturer and later as Professor and Station Veterinarian had to give up the latter work on account of the progressive aggravation of a crippling ^{injury,} suffered when he was acting as sole official veterinarian of the first International Live-stock Exposition at Chicago, Illinois in December, 1900. During the second semester of 1909-1910 the active work of the Station Veterinarian and some of the teaching work was admirably done by Dr. John Spencer, a graduate of the Toronto, Ontario, Canada Veterinary College, who had previously served as professor of Veterinary Science and Station Veterinarian at the Virginia Agricultural College and Experiment ^{Station at Blacksburg, Va.} On leaving the University of Wisconsin he engaged in the preparation of biologies at St. Paul Minnesota.

At the beginning of the fiscal year of 1911 Dr. Frederick Brown Hadley, a native of Vermont, and graduate Doctor of Veterinary Medicine of the Ohio State University was appointed chairman of the new Veterinary Department. He had served from 1907 to 1908 as instructor in Veterinary Medicine at the Washington State College and as assistant professor of anatomy and surgeon from 1908 to 1909. Then he was made assistant professor of Veterinary Anatomy at Ohio State University. While at the Ohio ^{state} University he had assisted the late Dr. ^FStyrtinus Sisson in preparing ^{and} publishing ^{his} monumental text book on Veterinary Anatomy which became and has ^{aimed} remained the standard work on the subject in America. Dr. Hadley soon became well and formally known by his excellent books, "The Horse in Health and Disease" (1915) and "Principles of Veterinary Science" (1920) which have been widely used as texts on these subjects particularly by agricultural students. His work has been largely in connection with the study and control of the contagious abortion disease of cattle now known as "Bangs Disease". He was instrumental in the perfection of the agglutination blood test for the diagnosis of Bangs disease and the first to advocate and employ the test in a large way, and to train veterinary practitioners to apply the test themselves and ^{thus} make possible its wider application. Later, in cooperation with Dr. A. Beach, also a graduate in Veterinary Science of the Ohio University, the manufacture use and distribution of hog cholera serum was undertaken at the Station. Studies were also made by Dr. Hadley of inherited epithelial defects in Holstein calves and the nature and method of inheritance of the defect determined. Investigation of bovine mastitis followed, being made possible by the complete laboratory equipment installed for the new department. Working without such equipment in previous years, Dr. Alexander had been unable to do much research

work and devoted the major part of his time to enforcement of the stallion ^{license} ~~braise~~ law of which he was the author in 1905, and educational campaign for the improvement of horse breeding and the teaching of rudimentary veterinary science and hygiene to students of the long and short course classes. He had, however, perfected a plan of preventing navel infection and consequent "joint-ill" (pyemic arthritis) in new-born foals which he originated in 1890 when practicing at Wayne, Illinois and serving as a professor in the Chicago Veterinary College; outlined a plan of preventing "white scours" in calves and originated the Salol (1), Bismuth subnitrate (2) remedy for scours which became widely popular. He also investigated sheep disease in the Ladysmith district which he found to be liver fluke infestation introduced by sheep from the Southwestern states; also coughing disease among young cattle in the LaCrosse district which he found to be ergotism. He also did useful work relative to gravel in sheep, necrotic stomatitis, mastitis and ^{other} ~~to the~~ diseases directed the control of an anthrax outbreak ^K in the Station dairy herd, and made several physical examinations of the Station dairy cows with particular attention to conditions to the mammary glands.

AGRICULTURAL JOURNALISM AND COUNTRY LIFE WORK

J. Clyde Marquis, who had been Station Editor, and in charge of Agricultural Journalism for the past three years, resigned his position at the end of the fiscal year and John Y. Beatty, who had been an editor of the ^{Orange Judd} ~~Orange Judd~~ publications, was appointed in his place. With the beginning of the fiscal year work was being inaugurated for the study of rural problems and research work along social ^{lines} ~~times~~. The work was entrusted to the able hands of Charles Josiah Galpin a native of New York

State who had obtained the A.B. degree from ^{Colgate} Colgate University in ¹⁸⁸⁵ and the A. M. degree from Harvard University in 1895. The Litt. D. degree was later conferred upon him by Colgate University. Prof. Galpin had done considerable teaching work in New York and Michigan, prior to coming to the University of Wisconsin as first University Pastor in 1905-1911. He then served as associated professor of agricultural economics in the College of Agriculture, from 1911 to 1919 and from 1911 to 1917, was also Secretary of the Wisconsin Life Conference. On leaving Wisconsin he became economist in charge of farm population and rural life work of the Bureau of Agricultural Economics of the U. S. Department of Agriculture in Washington, D. C.. He was vice-president of the American Country Life Association and in 1923-24 he traveled in Europe, being delegate to ^{several} Second Congress^s of scientists there and in 1927, was honored by King Albert of Belgium with the Special Agricultural Decoration. He has published several useful text books and is renowned as an "ex-cathedra" ^{writes} writer of many notable bulletins on economic and social problems.

PROGRESS IN RESEARCH WORK

The more important subjects under investigation by the Station Experts during the fiscal year ending June 30, 1911, were as follows: Efficiencies of rations from single plant sources; studies in protein nutrition; mineral requirements for farm animals; grain mixtures for fitting show sheep; Soilage vs. Silage for dairy cows; diagnosis of contagious abortion; Avian tuberculosis; relation of soil bacteria to evaporation; factors influencing availability of rock phosphate; relation of bacteria to solubility of rock phosphate; effect of oxidation and heat on solubility of soil phosphates; relative ^{ion} of sulphur in farm

crops to soil supply; soil management investigations; improvement of farm crops; soil inoculation for legumes; hemp as a ^{weed indicator} eradicated; eradication of mustard; tomato breeding experiments; investigations of fungicides; tobacco diseases; influence of cold on spore ^{germination} ~~termination~~ of certain rusts; surveys of plant diseases and insect pests; cranberry investigations; Cheddar cheese from pasteurized milk; role of bacteria in the manufacture and ripening of Cheddar cheese; buttermilk cheese; mottles in butter; test of a homogenizing device; improvement in quality of the milk supply; distribution of dairy factories in Wisconsin; efficient use of farm labor; farm surveys; agricultural geography and prices and marketing of farm products.

DEMONSTRATION WORK IN 1910-1911

During the summer of 1911 Prof. Norford continued his crop demonstration work on 21 farms connected with the county and state institutions. Nineteen field meetings were held with 2,500 people in attendance. At Ellis Junction over 300 people attended a demonstration of the possibilities of crop raising on Northern soils. At the meetings held by research workers of the Northern branch experiment stations, the results of experiments in the growing legumes, such as alfalfa and soy beans, were reported and the need of inoculation of the soil for these crops stressed. Rotation experiments, fertilizer trials and the influence of drainage and better methods of soil management were also demonstrated and discussed. At other meetings in the state, the subjects considered pertained to conservation of manure, eradication of bovine tuberculosis, hog cholera vaccine demonstrations and potato spraying. The Department of Agricultural Bacteriology had begun the manufacture

of tuberculin in January 1911, and by April over 10,000 doses were turned over to the Livestock Sanitary Board ^{for} gratuitous distribution, and between April and July, approximately 1,200 additional doses were made. The use of tuberculin and the need of its application, were explained and advised at several meetings in the state. Other work accomplished for the benefit of farming included, founding of community breeder's associations; community potato growing centers; cooperative silo building circuits; drainage service; young people's grain growing contests; bankers purebred ^{seed} circuits; dissemination of purebred seed grains; promoting of agricultural work in rural schools; tests of dairy cows; dairy cow competitions; butter and cheese scoring exhibitions; distribution of pure culture starters, and milk and cream testing. Inspection and control work, done by offices ^r of the Experiment Station, included ^{stallion} licensing by Dr. A. S. Alexander; feeding and fertilizer control by Prof. Wall and others; nursery and orchard inspection work by Prof. J. G. Sanders of the Department of Economic Entomology, and seed inspection by members of the Agronomy Department.

PUBLICATIONS OF THE STATION FOR 1911

During the fiscal year ending June 30, 1911, the Experiment Station issued Research Bulletins, Nos. 14 to 18, inclusive; Regular Bulletins, Nos. 196 to 212, inclusive and circulars of information, Nos. 17 to 26, inclusive. Of the regular bulletins, No. 203 consistive ^{ed} of the Director's Report for 1910. The salient points of these bulletins are given, briefly in the following summaries.

RESEARCH BULLETINS OF 1911 (NOS. 14 TO 18 INCLUSIVE)

SULPHUR REQUIREMENTS OF CROPS

Professor E. B. Hart and W. H. Peterson conducted investigations to determine the sulphur requirements of farm crops in relation to the soil and air supply and reported the results in Research Bulletin No. 14. They found that the quantity needed by a number of common farm products is much larger than was found by the previous investigation, W_{olf} in the ash from such products. The amount of sulphur trioxide removed by average crops of cereal grains and straws was found to be about two-thirds of the phosphorus pentoxide removed by such crops: mixed meadow hay removed quite as much sulphur as phosphorus. While alfalfa may even exceed in that respect, the cabbage and turnip may remove 2 or 3 times as much sulphur as phosphorus. An average crop of cabbage would remove about 100 lbs. of sulphur trioxide per acre. Most normal soils contained less than 0.10 percent of sulphur trioxide. An acre ~~would~~ contain from 1,000 to 3,000 lbs. of total sulphur trioxide or about the same quantity as of phosphorus pentoxide. Long cropped and inadequately manured soils were found to have lost, on the average, 40 percent of the sulphur trioxide originally present, compared with virgin soil. Regular and fairly liberal applications of farm manure will maintain, or even increase, the normal sulphur content of soils. The annual amount of sulphur trioxide precipitation with rain, in ^{ed} ~~the~~ Madison, Wisconsin region, might tentatively be placed at from 15 to 20 lbs. per acre. Losses of sulphur trioxide, by land drainage, might in some instances, amount to about 50 lbs. per acre yearly. Even with less annual depletion the atmosphere scarcely could be

depended upon completely to compensate for the losses of sulphur, caused by both cropping and drainage. The data presented showed that a sufficient quantity of sulphur should be supplied, from time to time to make up for that lost by cropping and drainage. The needed sulphur could be supplied in farm manures and in trade fertilizers, such as superphosphate, ammonium sulphate and sulphate of potassium, and the so-called soil stimulant, gypsum or calcium sulphate. No attention, so far as the authors were aware, had previously been directed in America to the importance of the sulphur problem in the management of soils; hence they deemed it desirable to present these views, based upon the research mentioned with extreme caution and conservatism, with the hope that it might lead to further research by chemists and agronomists, finally to establish the relative importance and necessity for sulphur in systems of fertilization.

SPORE GERMINATION

In illustrated Research Bulletin No. 15, I. E. Malhus gave an account of his experiments on spore germination and infection in certain species of oomycetes. He was counselled in the work by Dr. R. A. Harper and Dr. L. R. Jones. The studies were carried on chiefly with Cystopus candidus as it occurs on the common radish. The leading problems considered were: Conditions influencing germination of the conidia; those influencing infection; and the occurrence of so-called physiological species of Cystopus candidus on the various crucifers. The conidia, when placed in water germinated better at a strikingly low temperature than at high temperatures. The minimum temperature was very near zero. While the

masimum was about 25° C.. Germination failed to occur on various nutritive culture media. After emersion of the conidia, the zoospores escaped in 2 to 10 hours; the shortest period for such germination was 45 minutes. It was noticed that the time required for the spores to germinate in spring and summer was shorter than in the late autumn and winter. Light and darkness had no noticeable influence on germination. Spores from frost killed leaves germinated. Germination took place as readily in a nonsaturated as in a saturated atmosphere. Ninety-five percent of the seedlings, purposely chilled, became infected with Gystopus, while the controls, not chilled, usually showed less than 1 percent of infection and never more than 15 percent. The results obtained suggested that a close relation exists between host vigor and susceptibility; in that healthy plants are more susceptible to infection than sickly or abnormal ones. No marked difference was observed in the susceptibility of the cotyledons and leaves of the radish, shepherd's purse, white mustard and garden cress. Twenty-two different varieties of radishes were tested, and no marked difference in susceptibility observed. Infection failed to occur in most of the other crucifers tested. Cabbage was quite resistant against infection, less than 1 percent of the plants inoculated becoming affected.

ECONOMICS IN AGRICULTURAL RESEARCH

Dr. H. C. Taylor, in Research Bulletin No. 16, presented an elaborate discussion regarding the place of economics in agricultural education and research. His paper was illustrated with a number of maps of the United States showing the concentration of milk production in many of the centers previously devoted to wool production, and the various

leading centers of sheep production from 1840 to 1900. Numerous graphs were also presented as an illustration of the complimentary and the competing character of field crops, in these ⁱⁿ demands for the time of the farmer. The various methods in vogue at the Wisconsin Experiment Station, relative to the study of economic problems in agriculture, were fully set forth and explained in the Bulletin. No one of these methods was favored above another. The author stated that all of these ^{are} needed in ^{securing} an intensive and a comprehensive view of the economic forces which affect the farmer. In an appendix there was offered a list of 54 chapter headings for a satisfactory course in agricultural economics.

GROWTH AND REPRODUCTION IN ANIMALS

In illustrated Research Bulletin No. 17, Professors E. B. Hart and E. V. McCollum, ^{Steinbock} H. Steinbock and Professor G. C. Humphrey gave the results and conclusions they had derived from investigations relative to the physiological effect on growth and reproduction of rations balanced from restricted sources. The investigations had been undertaken jointly by the departments of Agricultural Chemistry and Animal Husbandry. Professors Hart and McCollum, aided by H. ^{Steinbock} Steinbock, were in charge of the project and chemical side of the work, while Professor Humphrey was responsible for the feeding and care of the ^{animals} animals used in the experiments. The data presented as a preliminary report on an extended investigation pertained only to growing and reproducing heifers, and extending over a period of 4 years. It had been found that animals receiving their nutrients from the wheat plant alone were unable to perform normally and with ^{their physiological processes in respect to general vigor,} vigor, size and strength of offspring, and capacity for milk secretion.

On the contrary those receiving their nutrients from the corn plant were strong vigorous, in splendid condition all the time, and produced young of great weight and vigor. Animals receiving their nutrients from the oat plant were able to perform all the physiological processes of growth, reproduction and milk secretion, with a certain degree of vigor, but less so than the corn-fed animals. Where a mixture of all the above mentioned plant materials was fed, the animals responded to the ration with less vigor than to the corn or oat rations^{alone}, but with more vigor than to the wheat ration. The authors reserved for the future all final conclusions as to the importance of the factors resulting from the first 4 years of experimentation and were to continue their investigations of the problem. When the wheat-fed animals were changed to the corn ration, they showed marked improvement, within the year, in the size of offspring and in milk secretion. The converse was ^{true} true when corn-fed animals were given the wheat ration.

A SCLEROTIUM DISEASE OF GRASSES

In Research Bulletin, No. 18, A. B. Stout gave an account of his investigations of the effect of a fungus parasite on blue-joint and other grasses. He had found it during the summer of 1907 in the marsh meadows about Madison, Wisconsin. The investigations were carried on, at first, when the guidance of Dr. R. A. Harper, of the Department of Botany of the University of Wisconsin, and under Dr. L. R. Jones, when he assumed the chair of Plant Pathology at the Wisconsin Experiment Station in February 1910. The paper on the subject was profusely illustrated, and showed that the fungus in question (Sclerotium rhizodes) attacks the leaves of various

grasses and causes them to become dry, rigid and bent into characteristic crooks, especially during April and May. Many plants are killed thereby. The author found the fungus on 11 different grasses, in the Madison district. The filaments of the fungus live more or less independently in the soil. The mycelium is ^{perennial} ~~perennial~~ in the soil and underground parts of the plant. It is sterile, so far as had been observed. Production of spore bearing structures was not observed. The infection of the aerial parts of the plant occurs from the underground parts. The fungus was found generally distributed in Wisconsin and was to be considered of economic importance. It destroyed or dwarfed 47 percent of the plants of Calamagrostis canadensis, on one marsh meadow near Madison in the season of 1911.

REGULAR BULLETINS OF 1911.

FARMING IN NORTHERN WISCONSIN

Opportunities for profitable farming in northern Wisconsin were cited by Professor E. J. Delwiche in illustrated Bulletin No. 196 of July, 1910. About 10,000,000 acres of land were stated as available for farming, the climate suitable, and the rainfall abundant and well-distributed throughout the growing season. Unseasonable frosts were said to be rare, owing to the moderat^{ing} influence of the Great Lakes. Grasses, clovers, corn, small grains, potatoes, garden vegetables, small fruits, and, in certain sections, the hardy tree fruits, could be grown. Good grazing lands and favorable markets would make dairying profitable. Sheep raising was recommended in combination with the growing of peas and clover, and as an aid in clearing land. Special crops, such as field peas, canning peas, potatoes, clover for seed, sugar beets and wheat could be produced with profit on the types of soil adapted for their growth. Rotation of crops and growth of clover were advised to increase the humus and nitrogen in the northern cut-over lands. Small, well cultivated farms, operated intensively, were advocated as most profitable.

CHEESE FACTORY PAYMENTS

Methods of paying for milk in cheese factories were described and explained in Bulletin No. 197 of July 1910 by Dr. S. M. Babcock, and Professors E. H. Farrington and E. B. Hart. Tests had been made at nine cheese factories, on the milk of 94 herds to determine variation in the casein content, and to discover the relation of casein to fat, and the effect of fat on the quality of cheese. Herd milk from different sources

was found to vary from 0.3 to 0.8 percent. The daily variation usually did not exceed 0.2 or 0.3 percent. Cheese made from milk containing a relative high amount of fat was slightly better in quality. No indication was shown, by tests, that fat will be the controlling factor in the quality of cheese, under farm and factory conditions because of the non-uniform condition of the milk furnished the factories. The value of milk for cheese making should be based upon the content of both fat and casein, as determined by use of the Babcock fat test and the Hart casein test.

THE RENTING OF LANDS

Methods of renting farm lands in Wisconsin were discussed by Professor H. C. Taylor in Bulletin No. 198 of July 1910. In it, he considered matters pertaining to all forms of tenancy; the tenant; the farm and landlord; what the lease should contain; cash versus share rent; special features of cash leases; methods of leasing lands on shares and share systems in tobacco production.

LAND DRAINAGE

In Bulletin No. 199 of July 1910, Professor E. R. Jones described and explained in detail the principles and practice of land drainages. He stated that over 7,000,000 acres of Wisconsin land requires draining, and mentioned four types of drains that are of fundamental importance for the purpose, viz. (1) Protection ditches to prevent the entrance of excessive water; (2) outlet ditches, where there are no valleys or ravines; (3) surface ditches, where the land is too flat for the water to flow away, and (4) covered under-drains to remove the surplus water from the sub-soils. The benefits of effective drainage were explained, and the

location and construction of drains fully described, together with particular relative to the cost of draining wet lands. He stated, in conclusion, that the Soils Department of the Experiment Station gives ^{aid} and in the organization of drainage districts and in promoting the reclamation of swamp lands. Plans and specifications, for either tile or open ditch drains, are also furnished; but individual assistance is given only where actually necessary, as a demonstration, in localities where better draining has been done.

FEEDS FOR DAIRY COWS

The subject of the selection of feeds for dairy cows being of vital importance to farmers, Professors Wall and Humphrey, in Bulletin No. 200 of January 1911, gave them scientific and practical information regarding all of its phases. Their advice was based upon the experience gained by the feeding of the University Dairy cows. They discussed first, the composition of feeding stuffs and then stated the proper proportions of protein, carbohydrates and fats to combine in a ration. An extensive investigation with the University dairy herd had shown that nutritive ratios of 1:6 or 1:7 can successfully be used. The rule for feeding of the Experiment Station cows was then given. It is to feed as many pounds of grain per day to each cow as she produces pounds of butter fat per week, or one-fourth to one-third as much grain as she gives pounds of milk daily. As cows vary in appetite, each must receive individual attention according to the requirements. It is possible, however, to supply a general grain ration that will be acceptable to most of the cows in a herd. High producing cows need ^{the} that most protein in ^{their} this ration:

and large cows an allowance of feed according to their weight. Dairymen should grow a sufficient supply of roughage and some of the grains needed to feed these herds. Supplementary or purchased feeds should be selected after a careful study of their chemical composition and digestible components, as well as their cost. Tables regarding these matters were ^{printed} pointed in the bulletin and examples given, to show how the tables for preparing rations for dairy cows may be used.

PLANTING COMMERCIAL ORCHARDS

As Wisconsin offers the prime requisites of successful apple growing, as regards soil, climate, market and capable growers, Professor J. G. Moore, in Bulletin No. 201 of February 1911, furnished full and practical information relative to the correct methods of founding orchards and producing choice marketable fruit. While small orchards may be established in almost every part of the state, the locations best suited for commercial orchards are found in the Wisconsin Valley, the Lake Shore Region, and the Northern Lake Shore Region in Bayfield and Ashland counties. The clay, loam soils are best for apple growing. Elevated sites should be chosen to avoid danger of late frosts. A northern or northeastern exposure is preferable. Two-year-old trees are, as a rule, best for commercial planting; although one-year-old trees are quite generally planted. The trees should be bought direct from the nursery man and given proper care when received. Early spring was advised as the best time to plant a new orchard. Methods of planting and pruning were prescribed and the following varieties of apples suggested as hardy and productive for commercial purposes: Wealthy, Duchess, McMahon, Fameuse, North Western Greening,

McIntosh, Longfield, Dudley, Tolman Sweet, and Yellow Transparent. The first five are most popular.

MANAGEMENT OF HEAVY CLAY SOILS

The special problems relating to the management of Stiff Clay soils, such as those occurring along the Southern shores of Lake Superior, in the valley of the Fox River, and to a much less extent along the shore of Lake Michigan, were discussed in Bulletin No. 202 of February 1911, by Professor A. R. Whitson and E. J. Delwicks. This type of soil comprises about 3,000,000 acres in Wisconsin, and, when properly managed, is very productive and adapted to a great variety of crops. The bulletin gave practical advice relative to the clearing of new clay lands and their plowing and draining. Suitable crops and rotations were prescribed, and methods of maintaining fertility advised. Clover, timothy, oats, barley and wheat are well adapted to such land, and corn, potatoes and rutabagas should also be included in the rotation. A four or five year rotation was recommended. Humus and phosphorus being lacking or limited in heavy clay soils, they should be supplied in addition to farm manure.

Bulletin No. 203 of February 1911 comprised the Annual Report of Director Russell for the year 1910.

IMPROVEMENT OF SANDY SOILS

Professor Whitson and F. J. Seivers in Bulletin No. 204 of February 1911 advised farmers how to work and improve the four or five million acres of sandy soils found in Wisconsin. The advice given was based upon special studies made by the Station experts to determine the best

methods of managing this type of soil. The addition of vegetable matter ^{was} imperative to improve the capacity of the soil to ^{hold} add water, as well as to add fertility. Methods of preventing wind blowing sandy land by laying out the fields in long narrow strips, with alternate grass and cultivated crops, and the provision of wind breaks of pine or other trees was recommended. The addition of ⁶nitrogen, phosphorus and potash was advised. The average sandy soil contains only one-third to one-half as much fertility as clay loams. Legumes are beneficial for such light soils, as they supply nitrogen and humus. Applications of lime will aid in securing a stand of alfalfa and clovers, and inoculation of legumes is also necessary. The rotation adopted should provide a legume crop, to cover the soil at least once in every three years.

DEVELOPING MARSH SOILS

The same authors in illustrated Bulletin No. 205, of February 1911, gave full instructions for the development of the marsh soils of Wisconsin which total between two and one-half and three million acres. They outlined the needs of marsh soils, and fully described the necessary methods of drainage. Advice followed regarding the ^{clearing} ~~changing~~ and preparation of a seed bed: information about the chemical composition of such soils and their fertility, and the use of phosphates, potash and other fertilizing elements. Acidity is common and demands the use of lime as a ^{corrective} ~~corrective~~. The crops considered suitable for growth on marsh lands included corn, potatoes, cabbage, buckwheat, and timothy and alsike clover for hay. Wheat and barley could also be grown, after the drained soil had been thoroughly firmed by rolling, while oats and rye might also

succeed fairly well. Excellent pastures could be established on such soil by proper methods of ^acure and management.

TOBACCO CULTURE

Tobacco successfully grown in fifteen counties of Wisconsin and producing annually some 50,000,000 pounds, was in 1911, the sixth among the important crops of the state. Its culture in all phases of the subject was discussed by Professor James Johnson of the Horticultural Department of the Experiment Station in Bulletin No. 206 of April 1911. Sandy, loam soil, followed next in importance by the light clay loams and prairie soils, had been found most suitable for tobacco growing. Under proper rotation the crop does not injure the soil. Fertility may be maintained by liberal applications of stable manures, with potash as the fertilizing element most required. The crops may be well grown three years in succession, followed by corn barley and clover, each one year. A ^{cover} corn crop, such as rye and hairy ^{vetch} is used to advantage. Full instructions were given regarding germination of tobacco seed and growing and curing of the crop. Connecticut, Havana, Comstock, Spanish, and the "Big Seed" or Hybrid varieties of tobacco were recommended as most suitable for Wisconsin production

MANAGEMENT OF ORCHARDS

Professor J. G. Moore, Horticulturist of the Station gave in illustrated Bulletin No. 207 of April 1911, instructions relative to the management of a bearing orchard. A second edition was issued in December, 1912. The subjects discussed were: handling the orchard soil; soil management of bearing orchards and young orchards; pruning bearing orchards and neglected trees; tree wounds and their treatment and spraying the bearing orchard

Bordeaux mixture and lime-sulphur were recommended for spraying purposes. Good spraying machinery should be used since the success of spraying depends largely upon the effectiveness with which the material is applied. Bordeaux mixture controls fungus diseases and Paris green or arsiniate of ^{lead} ~~land~~ is effective for the control of chewing insects.

CROP DEMONSTRATIONS

In Bulletin No. 208 of May 1911, Professor C. P. Hergord gave an account of the crop demonstrations which had been held on state and county farms during the past season. The demonstrations were given at 15 different places and dealt with the following subjects: farmer's corn tests; seed corn selection and breeding; corn planting and cultivation; alfalfa growing; forage crops for summer pasture; production testing and dissemination of pure bred seed grains; treatment of grains for diseases and smut; use of good ^{fanning} mills for cleaning seeds; crop rotation and systems of farming; preparation of seed beds; handling farm manure; the production of hemp fiber and weed eradication.

PRICES OF FARM PRODUCTS

Dr. H. C. Taylor, in charge of Agricultural Economics, discussed the subject of the prices of farm products and presented 15 graphs and maps to illustrate the test. He explained the causes of fluctuation in values and gave information about prices and farm management. He also dealt with the subjects of the supply and prices of eggs, butter, cheese, potatoes, corn and hogs and explained how farmers can study market conditions and obtain information relative to these conditions.

PROGRESS IN DAIRYING

In Bulletin No. 210 of June 1911, Professor C. E. Lee of the Dairy Department, and economist H. C. Taylor, presented particulars and instructive statistics, together with maps of the state, regarding the progress of the dairy industry in Wisconsin, the distribution of dairy cows, creameries, skimming stations, cheese factories and condenseries. Factories influencing the quality of dairy products were also cited and explained.

In Bulletin No. 211 of May 1911, Professor J. L. Sammis discussed butter milk cheesemaking at the creamery, and presented facts similar to and in elaboration of those given in Bulletin No. 195. Instructions were given as to the method of making butter milk cheese, the special apparatus required for the work and the special attention needed in packing the product and introducing it by a thorough advertising campaign. He stated that buttermilk cheese is of high food value, considering its low cost, and that it is very palatable, when eaten alone like cottage cheese, seasoned with salt, pepper or paprika, or when used in salads. It is smooth in texture, easily spread like butter on bread, and by many is considered preferable to cottage cheese on account of its fine buttermilk flavor.

BARLEY CULTURE

Professor R. A. Moore and A. L. Stone in Bulletin No. 212 of May 1911 gave, in popular, and with illuminating illustrations a practical treatise on barley culture in Wisconsin. Approximately 25,000,000 bushels of barley were, at that time, being produced annually in Wisconsin, one-

eighth of all the barley grown in the United States. The best yielding varieties in Wisconsin had been Oderbrucker, Mansbury, Silver King and Golden Queen. Twelve years had been devoted to barley improvement at the Experiment Station with the result that a few reliable varieties had been developed, multiplied in quantity and widely disseminated throughout the state. Methods of barley breeding were described and instructions given as to the approved methods of growing barley for grain preventing Rust and Smuts, harvesting the grain and marketing the crop.

CRANBERRY CULTURE

In Bulletin No. 213 of June 1911, O. G. Malde of the Horticultural Department described the way in which cranberry bogs should be constructed in Wisconsin. Illustrations included a map showing the cranberry districts of the state, a plan of the cranberry bog system, a cross section of a main reservoir dam, and one under construction, the Gaynor scalping plow or under-cutter and Ganor "cross-cutter", ^{various tools} ~~varus tools~~ used in bog operations, a cross section of dams and ditches, bulkhead with stop, the open ditch stop, the wrong kind of bog, sanding a bog in summer and the right way to plant cuttings.

CIRCULARS OF INFORMATION

During the fiscal year ending June 30, 1911, Circular No. 17 to 26 were issued. The subjects considered were as follows: No. 17 Draft Horse Judging, with instructions, score cards and illustrations by Dr. A. S. Alexander: No. 18 the curing and testing of seed corn, by Professor R. A. Moore: No. 19. The control of quack grass and Canada thistles, by Professor A. L. Stone: No. 20. The control of moisture in cheese,

by Professors Simms, Leabs, and Suzuki: No. 21. The distribution of licensed stallions in the counties of Wisconsin by Dr. Alexander. No. 22. Chemical analysis of licensed Commercial feeding stuffs by Professor Woll and also by that expert: No. 24 on commercial feeding stuffs and fertilizers for sale in Wisconsin in 1911, and No. 25. Analysis of licensed commercial fertilizers, in 1911. No. 43. was a Catechism on bovine tuberculosis by Professors Russell and Hastings, which gave full instructions for this use of tuberculin: No. 36. Concerning standard and ^{undesirable} indivisible types of potatoes was written by Professor Milward.

TWENTY FIVE YEARS UNDER THE HATCH ACT

The Annual Report of Director Russell for 1911-1912 announced that 25 years had passed since the Hatch Act led to the founding of the Agricultural Experiment Station. At the time of its enactment, farmers were skeptical as to what science could do to aid them in their business; but gradually that impression gave place to more confidence in the work of the experiments and the value of their teachings and discoveries when applied to practical agriculture. During the 25 years, experimental work had undergone material changes. Problems existing then had largely been solved. While those remaining were more fundamental and of a more scientific, ^{or} ~~apparent~~ ^{ly} ~~or~~ less practical type. What benefits might accrue from their experimental investigation remained to be seen and could not be foretold. It was the opinion of the Director that the successful and efficient experiment station could not remain contented with mere investigation in the laboratory. The principles worked out there in detail must be tried out in the crucible of field experience to make sure that wrong conclusions are not published on the basis of inadequate data; and the results of the laboratory must be extended to the farmers of the state. That, indeed, was to be considered the true function of a government endowed Agricultural Experiment Station.

The original Hatch Act, appropriating to each state \$15,000 annually, was supplemented in 1906 by the Adams Act, promulgated by Hon. H. C. Adams, Member of Congress from Wisconsin, which added ultimately an additional \$15,000, making

the Federal Grant to each state a total of \$30,000. The expectation was that as the need for additional funds occurred, this nucleus would be supplied by the State Legislature, and that expectation had, in Wisconsin, been generously confirmed.

RESEARCH PROJECTS IN PROGRESS

The more important ^{lines} times of investigations in progress during the fiscal year ending June 30, 1912 included some that had not yet been completed. The completed results of others had been published in bulletins issued from time to time; but these formed only a fraction of the entire group of problems in course of investigation. Some of these may be mentioned, in brief, as follows:

Trouble and loss from pea blight had led the Pea Cannery Association to seek aid from the Experimental Station in finding a remedy and they subscribed a fund sufficient to permit research work on the subject to be undertaken by Prof. L. R. Jones and R. E. Vaughan. They found that spraying with Bordeaux mixture helps to control the disease; and these ^{iv} results, obtained from the years work, pointed clearly the course which should be followed by growers in order to hold pea blight in check.

The work of Prof. L. R. Jones relative to the fungus diseases which had devastated the cabbage crop of the state and driven many growers out of business, was even more notable. He had proved that the use of various commercial fertilizers and soil disinfectants utterly failed as preventive agents for the control of the cabbage disease on infected soil. For

several seasons, therefore, he had concentrated his attention chiefly toward the breeding of resistant strains of cabbage and now was able to report substantial progress in that direction. Seed from resistant plants he had developed produced 86 percent of live plants, while commercial seed planted on infected fields gave in 1912 only 21 percent of living plants. The work was being continued and extended with most hopeful results, and it may be stated here that eventually they solved the problem and practically ended the troubles and losses from the devastating disease which had come to be known as "Cabbage Yellows".

Continuing his study of tobacco diseases, J. Johnson of the Horticultural Department had found that a solution of 1 part of formalin to 50 parts of water kills the fungi in tobacco seed beds, while steam sterilization not only prevented "damping off" but also killed weeds. It also greatly increased the rate of growth and the general vigor of the tobacco plants. The "black rot" of tobacco had been conclusively proved to be due to the fungus Sterigmatocystis nigra promising measures of control were, regulation of the moisture content of the leaf and of the temperature of fermentation.

Continued investigations on the leaf blight of barley, conducted by A. G. Johnson of the Plant Pathology Department, had shown that three distinct species of fungi are involved and each of them capable of producing a specific disease. Of these "leaf stripe" disease had apparently proved most troublesome. It causes the entire plant to collapse. Leaf blotch was caused by the two other species of fungi. Field experiments

had shown that treatment of the seed with formalin solution, such as is done to prevent the Smitts of barley and oats, effectively controls the leaf stripe disease, but is less effective against the leaf blotch disease.

Professor Ganders, economic entomologist, who had been investigating insect pests of crops advised spraying with Paris green or arsiniate of lead to control the codling moth, the larvae of which are the common "apple worms". A solution of 4 lbs. of arsiniate of lead and 50 gallons of water also, kills the larvae of the strawberry leaf roller and nicotin solution the larvae of the leaf mining insect. To help control the locust and grasshopper pests he advised that fall plowing be done wherever and whenever possible, in preparing land for planting.

Professor Hastings, agricultural bacteriologist, had been investigating avian tuberculosis, as data gathered by Prof. Halpin of the Poultry Department had found the disease widespread in Wisconsin. It proved to be primarily, an affection of the liver and spleen and is contracted mainly through feeding. It is transmissible to swine. Close contact of healthy and diseased birds will transmit the infection.

The Agronomy Department had conducted comparative tests on 90 plots at the Hill farm in 1911-1912, and had planted 183 ^{centogenic?} centgener breeding plots to oats, millet and wheat. There were 11 varieties of pedigree barley in the advanced breeding plots and 8 varieties of oats in the field areas, to determine yields and other characteristics. Pedigreed seeds, developed at the Station, had been widely disseminated. About 100 crosses had been made on wheats and 50 on oats, from which future selections

would be made. Considerable work had also been done in crossing barleys, especially the ^{bearded} bearded pedigree varieties with the ^{beardless} beardless barley. Experiments in flax and corn growing had been conducted with success at the Superior sub-station, and with corn at the Spooner sub-station. At the latter station Pedigree No. 8 corn, which had been especially acclimated for the northern parts of the state, had produced 73 bu. per acre, and at the Ashland station Pedigree No. 8 wheat, a strain of the Kharkoff winter wheat, had yielded 35 bu. of the acre. Experiments in alfalfa growing had continued at the branch stations and produced valuable results. It was stated by some successful growers that as little as 8 lbs. of seed to the acre, instead of the 20 lbs. usually sown had been secured good stands of alfalfa. Tests were also in progress at the Madison station and in cooperation with 250 members of the Alfalfa Order of the Experiment Association, to determine the best rate of seeding for the Wisconsin climate as well as the best time for summer and fall seeding.

The value of experimental work done at the Cranmoor station bog, relative to cranberry culture, in charge of Superintendent Malda, had been well demonstrated by the practice of "sanding" to insure against injury from summer frosts then developed. In June on five consecutive nights, all of the surrounding bogs of the old type had to be flooded for protection. Where bogs were not so handled considerable loss occurred. On the station bog no flooding was done, from spring till fall, but complete immunity from summer frosts was obtained. Fertilization with

phosphates and nitrates had almost doubled the yield of cranberries in the plots treated. Two applications of iron sulfate solution had held in check and retarded the growth of weeds and grass.

Prof. J. G. Moore, Station Horticulturist reported that of the seedling apples which had borne fruit, three had proved worthy of testing out in the field. A seedling of the McMahon had been pronounced valuable; one of the Walbridge was an improvement over the parent and a seedling of Famense of a type entirely different from the parent, seemed of merit for Wisconsin conditions. Hyd^e King and Garfield of the newer varieties of apples tested were being propagated for future dissemination as they had proved suitable to Wisconsin conditions.

Trials on upland soils by Prof. Norgard of the Agronomy Department had shown that hemp cannot be profitably grown on other than the best lands. Experiments conducted on the Horicon marsh indicated that peat land will produce a large crop of hemp with good fiber. A heavy crop of hemp was fairly successful in eradicating quack grass and Canada thistles. Aside from lack of fertility, soil packing was the chief menace in hemp growing. To prevent this trouble it was advised that hemp be grown on corn land that had been in sod the previous year; or grown on sod land; or on land heavily manured with strawy manure and then top dressed with rotted manure thoroughly disked into the soil.

Dr. Leon J. Cole, of the Experimental Breeding Department, experimenting with pigeons, rabbits, rats and mice, had made some interesting discoveries. One was that in pigeons ^{dun} dens, yellow and silver are dilute conditions of the so-called intense colors - black, red and blue, respectively. Such discoveries

furnish a satisfactory explanation of certain formerly inexplicable results secured in breeding, where birds bred supposedly "pure" for color have not bred true.

Studies in soil management were in progress on poor sandy soils at the Spooner and Crivitz branch stations. Prof. Whitson had found that it is best to seed clover alone when conditions made it impossible to secure a catch of it with a nurse crop. Deep seeding and heavy rolling after seeding had proved beneficial. At the Sparta branch station, on extremely sandy soil, improvement in crop production had been attained by use of suitable legumes, and moderate applications of essential mineral fertilizers. By applications of moderate amounts of potash and phosphorus, good crops of serradella, yellow lupine and cowpeas could be grown without liming; but with the same treatment, medium red and mammoth clover failed. By the addition of lime in 1911, a good catch of clover was secured. Small crops of corn and potatoes were grown on soil where legumes had been used as fertilizers. In 1911, sandy soils in a virgin condition at the Crivitz Station in Marinette County, were inoculated and seeded to alfalfa without liming. In 1912, the limed plot gave 43.3 per cent increase in yield over the unlimed plot. On heavy clay soils in the Ashland Station district, the need of phosphorus treatment had been proved. The addition of rock phosphate produced an increase of 10 per cent in potatoes and nearly 12.5 per cent in clover hay.

Professor E. R. Jones had in progress studies on peat drainage in Portage County, where the underlying sand is used as a basis for under-drainage.

The State Soil Survey, carried on cooperatively by the Wisconsin Experiment Station, the State Geological and Natural History Survey, and the Bureau of Soils of the U.S. Department of Agriculture, had made rapid progress in the examination of the soils in Douglas, Bayfield, Burnett, Washburn, Sawyer, Ashland, Forest and Florence Counties; and with the State Forestry Department of soils in a part of the State forest reserves, to determine the agricultural value of certain lands. Soil survey work was completed in Fond du Lac, Juneau, La Crosse, Kewaunee, and Columbia Counties, and in 1912, in Jefferson County. Surveys had begun in Bayfield and Dane Counties. In all, 85 different types of soils had been described in the detailed work.

Prof. Peterson, of the Soils Department, had been studying the condition of phosphorus in typical soils, especially peat, and E. Truog of the same department, had continued the study of the loss by leaching of phosphorus from heavily manured soils, and on the solvent action of organic matter on rock phosphate.

Prof. Tottingham of the Agricultural Chemistry Department and Prof. Hoffmann of the Agricultural Bacteriology Department, had continued their studies on the action of fermenting manures on phosphates, added as reinforcing materials. They had found that fermentation over periods of 3 to 6 months caused a marked decrease in the amount of water-soluble phosphorus in manure alone, or in mixtures of manure either with rock phosphate (floats) or with acid phosphate. The addition of either cholorform of formaldehyde, to inhibit bacterial action, greatly reduced the decrease in water-soluble phosphorus in such mixtures,

indicating that the loss from fermentation had been due to bacterial development.

Professors Hart, Station Chemist, and Professor Peterson of the Agricultural Chemistry Department had found by improved methods of analysis that the sulphur content of cereals is nearly as high as their content of phosphorus, while other plants may contain much more sulphur than phosphorus. Their studies had also shown that three times as much sulphur may be lost in drainage as is brought to the soil by rain. Tests by Prof. Totttingham, of the same department, had shown that under greenhouse conditions, rape and radishes, both high in sulphur, sulphur fertilization had a marked effect on the dry matter.

Prof. Hoffman had begun a study of the effect of green manuring upon the germination of seeds subsequently sown. The results so far secured indicated that the decomposition of green manures caused a reduction of the oxygen supply, and an increase in the carbon dioxide present in the soil atmosphere. This change in the gaseous content of the soil was considered the cause of cotton and flax failing to germinate, as these seeds being rich in oil require more oxygen for germination than do corn, clover and wheat. Prof. Hoffmann also studied the effect of various soil treatments on the bacterial activity of the soil at the Hill farm. He found that the application of sugar markedly increased the fixation of nitrogen in the absence of any legume, while the addition of starch had a similar but less marked effect. The increase in nitrogen fixing power was less marked when *kainit* and floats were applied together

with either sugar or starch.

SOME DAIRY INVESTIGATIONS

Studies relative to the manufacture and ripening of cheddar cheese in cooperation with the Dairy Division had been continued by the Departments of Agricultural Bacteriology and Agricultural Chemistry. It was ^{found} ~~formed~~ that the group of high-acid-forming bacilli always make their appearance following the period of activity of the lactic bacteria, and gradually increase in numbers until they form from 50 to 99 per cent of the total bacterial content. The coccus or round forms of bacteria were also found predominant at some time, making it probable that they are constantly present in large numbers in cheddar cheese. Over 250 bacterial cultures, isolated from normal cheddar cheese, had been studied. While a rank flavor results from the development of great numbers of high-acid bacilli, it requires lactic bacteria or cocci for the development of the best cheddar flavor. The studies showed also that small differences in acidity are much more easily detected by the rennet test than by titration; the rennet test is therefore the more delicate one for use by the cheese maker. It was shown by Professor Hart, for the first time, that certain volatile compounds (esters) were progressively formed during the ripening process of cheddar cheese. Volatile fatty acids and alcohols were also found in varying amounts in normal cheese, but not in chloroformed cheese or milk.

It was hoped that work being conducted by Chemist Flint, detailed by the Dairy Division, would demonstrate that certain

bacterial types are responsible for the production of definite compounds which cause flavor in cheddar cheese. Representatives of the coccus group, abundant in cheese at some time during the ripening process, produce large amounts of volatile acids. Most of them also produced alcohol, but only two were capable of forming esters. The studies showed that representatives of both the coccus and high-acid-producing groups, are able to produce ammonia in normally ripening cheese.

As the quality and also the yield of cheese varies from day to day in the factories, an attempt was made to establish practically a uniform condition in milk delivered daily for cheese making purposes. Professor Sammis had developed a process whereby the milk is pasteurized and then made uniform by the addition of a small amount of hydrochloric acid, before adding the pure culture "starter" to effect the cheddar process. The work had been carried on in cooperation with the Dairy Division of the U.S. Department of Agriculture. The results showed a greater yield of cheese from pasteurized milk than from raw milk, to the extent of 5.37 per cent in 1911. The cheese from pasteurized milk also averaged 3.7 per cent better in quality than that from raw milk. Pasteurized milk can be cured, without injury, at 70 F. At one factory, however, small holes developed in the cheese from pasteurized milk and an endeavor was being made to remedy the defect.

During the past year, Professor Binkendorf had perfected a simple apparatus for measuring the overrun or "swell" in ice cream making and also designed and perfected a new way of using a burette for calibrating milk and cream test bottles.

Professors Sammis and Lee had continued the search for the cause of mottles in butter. They found that mottling in butter may be produced entirely independent of the casein, and that the thorough working of butter is highly important to prevent the production of mottling which seriously depreciates the value of the product.

A study had been begun by Mr. Baer of the Dairy Department of the value of different modes of procedure in the manufacture of ice cream. Both stationary and continuous type freezers were used, under conditions similar to those employed by commercial manufacturers.

During the past two years, Professor Farrington had successfully used a one per cent solution of common bleaching powder for deodorizing both the effluent from the septic tank at the University creamery and the raw sewage in the drain at the Verona creamery station. The solution greatly diminishes the offensive odor, but does not check the decomposition of the sewage. The solution employed was made by mixing 1 pound of bleaching powder with 100 pounds of water, allowing the sediment to settle and using the clear liquid to sprinkle in the creamery filter beds at the rate of about 1 gallon to 150 cubic feet or 1,100 gallons of sewage.

Animal Feeding Experiments

The experiment which for 5 years had been carried on by the Departments of Agricultural Chemistry and Animal Husbandry to determine what would be the physiological action of rations restricted to single plant sources upon cows subjected to the strain of reproduction had been continued. The previous results

had been reported in Research Bulletin No. 17. During the past year, an attempt was made to determine the disastrous effects of feeding an exclusive wheat ration. Upon rations consisting of the wheat grain and corn-sho⁺ver, healthy calves were produced; but when wheat straw^w formed the sole roughage, no matter what grain was used, the urine of the animals became acid and weak calves resulted. When corn grain and equal parts of wheat, straw and alfalfa were fed, normal calves were produced. The wheat ration was not found toxic in any part of the plant or insufficient in protein, but proved injurious by causing an acid condition in the animal, owing to an insufficient supply of lime and other alkaline elements in the roughage. Pullets restricted to an exclusive ration of wheat grain and its products made as rapid growth and reproduced chicks with apparently as great vitality as pullets fed rations from any other grain.

The study of the mineral requirements of animals was also continued, especially as regards lime (or calcium) and phosphorus. The experiments disproved the popular belief that the feeding of a ration high in mineral matter, especially lime, to pregnant sows will cause an undue development of the bony structures of the fetus, and consequent difficulty in parturition. The tests emphasized the desirability of liberal supplies of lime in the rations of pregnant animals.

Experimenting in the feeding of rats, Professor McCollum showed that these animals could make appreciable growth on rations containing only inorganic phosphorus, and that the animal has much greater power of building the organic compounds found in its

body than had generally been believed. Working with hens, he found that they produced eggs rich in the phosphorus, contained in fats (lecitins), when fed on rations which contained no such compounds. He was not able to produce normal growth with young rats fed any natural grain, but secured normal growth by feeding skim milk powder or egg yolk. An acid diet did not injure rats, but that may not be true for herbivora. Although the mineral content of egg is highly acid, and that of milk slightly alkaline, both led to normal growth in rats.

Research on the subject determined ^{the fact} that normal dry rations of grain and hay contain ample sulphur for wool production, and that additional supplies seem to have no influence upon the proportion of pure fiber formed.

Metabolism experiments with pigs, conducted by Professor McCollum, showed that when a very narrow nutritive ratio of 1:2.7 was fed, supplying 20 times the protein required for maintenance, over twice as large a percentage of protein was stored for growth as on a wide ration which supplied only 5 times the maintenance requirements.

To throw more light on the question of whether animals can use for growth the so-called amid nitrogen present in roots, silage and hay in the same manner as they use the nitrogen in the form of the more complex true proteins, young heifers had been specially fed for 2 years. Their rations consisted of alfalfa hay as the sole source of nitrogen for some of the animals, while others were fed rations from the corn plant, in which practically all of the nitrogen was in the form of crude protein. Since the growing heifers tested, uniformly stored as

high a percentage of the total nitrogen of alfalfa hay as they did of the corn plant, it was concluded that the amid nitrogen was not worthless for growth, but that with animals fed, the entire nitrogen of alfalfa hay was of full value.

One result of two years of cow feeding for production and feed consumption, as a part of the Wisconsin Dairy Cow Competition Campaign conducted by Professor Wall, was the discovery that large cows within each breed were as a general rule, more economical producers than small ones. The cow that ranked first in actual butter fat consumed feed costing 168 per cent more than that used by the lowest producer in the competition, but in return produced 882 lbs. of butter fat, or over 4 times as much as the poorest cow. The increase of 23 per cent in the total amount of feed eaten by the 25 best cows in the competition, compared with the 25 poorest cows, was accompanied by an average production 78 per cent greater than that of the poor cows.

Three years of feeding trials conducted by J. L. Torney of the Animal Husbandry Department in the feeding of corn silage to fattening steers had, to date, shown that feed to be a most economical one for the purpose. It was found profitable to feed silage as the exclusive roughage to fattening steers, under the prevailing market conditions and especially so when hay is costly.

Sugar beet tops ensiled with shocked corn was fed to cows by Professor Humphrey and while the resultant silage had a slightly stronger odor than ordinary silage, it was not offensive, and the feed was relished by the animals. The beet tops were

run through the cutter in equal quantities with the corn fodder, enough water being added to give the mixture the proper moisture content. The silage, been well packed by tramping, did not develop molds or undesirable fermentations. Chemical analysis showed it to have practically the same composition as clear corn silage. The cows did as well on it as on regular corn silage.

Various Station Activities

The cost of producing butter fat was again studied by Professor Taylor, economist, in conjunction with the office of Farm Management of the U.S. Department of Agriculture, represented by Mr. Juve. A chart was published showing the results in a graphic way. The records gathered have shown clearly that the factors of cost vary widely on different farms; therefore, the chart could not be used for drawing general conclusions. The data obtained would, however, be valuable in determining what to produce and when to produce it on the individual farms where the facts were gathered.

Professor Taylor also continued his studies on the history and geography of American agriculture. As a result, a set of about 300 maps had been constructed, showing the distribution of every line of production, in 1909, and of all the important kinds of farm property in 1910.

Professor Otis, economist, continued his survey of farm management on Wisconsin dairy farms. It concerned the amount and distribution of capital, the amount and sources of farm income, and the expenses. Data, obtained from 80 farms, indicated that there is a close relationship between the percentage of

operating capital and the net profits or management income of the farm. To insure maximum profits, the operating capital must be sufficient thoroughly and properly to equip the farm.

A study of the marketing of Wisconsin cheese was begun by the Agricultural Economics Department, under the direction of Professor Taylor, to obtain an accurate picture of the business as it actually exists; that being the basis necessary for further suggestions for improving the methods of marketing. All steps of the marketing process were to be studied and special attention given to the history of the Dairy Boards. A preliminary statistical study had already been made to show the primary destination of cheese shipped from Wisconsin.

C. J. Galpin, economist, had been engaged in tracing what might be called the paths from the various social institutions of twelve major villages in Walworth County to the farm homes surrounding each village. The survey was to show the extent of each rural community centering in a village; and the comparative influence of various village institutions out among farm homes, and of those of the similar institutions of other villages.

During the past year the Veterinary Science Department had been cooperating with farmers for the eradication of contagious abortion from these ⁱⁿ herds. The new complement fixation test of the blood had been used as the method of diagnosing the disease. Over 500 cows had thus been tested. Thirty five per cent of the animals tested showed presence of the infection. The Veterinary Department had also undertaken the manufacture and distribution of antiserum to be used in the prevention of

hog cholera. Already 135,000 cubic centimeters of the serum had been made and distributed through the veterinarians of the state. Public vaccination demonstrations had been conducted by Drs. Hadley and Beach to encourage use of the preventive serum.

Over 65,000 doses of tuberculin had been manufactured by the department of Agricultural Bacteriology and distributed to the farmers of the state through the medium of the State Live Stock Sanitary Board. A campaign for the eradication of bovine tuberculosis in Wisconsin was being actively carried on.

Other useful activities included as extension projects: Banker's pure bred ^{seed} and contests, Young people's grain growing contests, dissemination of pure bred seeds, an alfalfa growing campaign, farm crop demonstrations, weed eradication, land drainage surveys, cooperative fertility demonstrations, community breeders associations, horse breeding clubs, community potato growing, cooperative silo building circuits, distribution of building plans, and of published material for rural schools, butter and cheese scoring exhibitions, official tests of dairy cows, cream testing, distribution of pure culture starters, and the sending out and operation of educational trains for the advancement of better seeds, potato culture and livestock breeding. Seed inspection, ^{feed and} fertilizer control, ^{ery} nursing and orchard inspection and stallion licencing were also continued.

Building Activities

The new building for the Horticulture and Plant Pathology departments was completed and occupied in January, 1912. A one story brick building 24 x 38 feet, equipped with a crematory furnace had been constructed at an expense of \$1,500 west of the Station farm buildings. The structure was designed as a

quarantine establishment, as well as a crematory for the incineration of dead animals. It was, for the present, usefully employed in the manufacture of hog cholera antiserum. A new and separate poultry plant was established on the Sandsten tract near the farm house occupied by Professor Halpin. The barn on the place was remodeled to serve as an incubator and brooding room. Fifteen colony houses with covered runs were constructed for use in the breeding and physiological work in progress. A creamery at Verona was purchased as a gathering center for milk to be shipped to the University Creamery and for experimental and teaching work. The Agricultural Chemistry and Home Economics buildings, begun in the Autumn of 1911, were still in process of erection and expected to be finished in the year 1913-1914. The newly organized Forestry Department was being housed, temporarily, in the Chemistry building.

The badly run-down Eagle Heights farm of 156 acres acquired the previous year, was being improved. Several fields were enclosed by the construction of fences having reinforced concrete posts. New buildings had not yet been begun.

A considerable amount of building had been done during the year at Ashland station farm, including an office building and foreman's cottage and a machinery shed. A foreman's cottage was also being erected at the Spooner Station and a building at the Grand Rapids Cranberry Station remodeled to serve as a summer residence for the Superintendent. Much land clearing had also been done at the various branch stations. Demonstration stations, authorized by an act passed in 1911, were established

in Douglas County, near Superior, and in Rusk County, on the Kennan clay soil prevalent there.

Station Publications

During the year there had been published Research Bulletins Nos. 19 to 24 inclusive; Regular Bulletins, Nos. 214 to 224 inclusive, and circulars Nos. 27 to 38 inclusive.

Notes on the various Research Bulletins follow:

Effect of Heat and Oxygen on Soil Phosphorus

Dr. A. F. McLeod, formerly of the Soils Department, had found by experimentation that when varying strengths of hydrogen peroxide were used to oxidize virgin soils with the object of extracting the phosphorus thus set free; fixation occurred so rapidly that the desired end could not be accomplished. Later, the investigation was continued by Dr. P. P. Peterson and the results published in Research Bulletin No. 19. He found that about 90 per cent of the organic matter of the soil can be destroyed by the use of hydrogen peroxide. Such decomposition increased the solubility of phosphorus about 50 per cent of its total in clay and clay loam soils, and about 30 per cent in sandy soils. The increase always was greater than that obtained by heating the soil to 240 F. The early stages of oxidations increased the solubility of the phosphorus more than the later stages. The solubility of calcium and manganese was not increased by oxidation with hydrogen peroxide. The solubility of iron and aluminum, in fifth normal nitric acid, was increased on oxidation with hydrogen peroxide to about the same degree as phosphorus. Oxidation increased the solubility of phosphorus but slightly in subsoils. Heating, after oxidation, more markedly affected the solubility of phosphorus in the subsoil,

than in the surface soil.

The Availability of Rock Phosphate

E. Truog, of the Soils Department, working with the co-operation of Prof. A. R. Whitson attempted by experimentation to throw light on the subject of factors influencing the availability of rock phosphate and reported the results in Research Bulletin No. 20. He concluded that the availability of raw phosphates, as measured by a growing crop, is influenced not only by its solubility in weak solvents, but also to a large extent by the thoroughness with which it is distributed through the feeding area of the soil. Some species of plants appear to be able to secure nearly an adequate supply of phosphates from insoluble "floats" that were thoroughly mixed through the feeding area of the soil. Carbon dioxide given off by the plant roots seemed instrumental in bringing the phosphates into solution, and thus making ~~that~~ the "floats" available. Carbon dioxide production was greatly increased by addition of farm yard manure to the soil. Availability of phosphorus from "floats" probably would be slow in a heavy clay soil low in organic matter. Addition of organic matter, therefore, was advisable.

Nutrition of the Pig

In Research Bulletin No. 21, Dr. E. V. McCollum presented notes on the creatinin in the excreted urine of the pig. It was finally established that the ratio of creatinin to total nitrogen is between 17.5 and 19 to 100 in pigs fed a nitrogen-free ration. The nature of the repair processes of protein metabolism was also studied. The experiments did not indicate

as wide differences in the nutritive values of the protein of the wheat, oat and corn kernels as would be expected from the known chemical differences in these proteins. It was shown that the pig can utilize the nitrogen of zein, which is "incomplete" chemically, very efficiently for repair of the losses due to tissue metabolism. The average utilization of Zein nitrogen, for this purpose, was about 80 per cent and for gelatin (also "incomplete") 50 to 60 per cent. No evidence was obtained of the formation of additional body tissue from Zein, even when the latter was fed in great excess over the maintenance needs of the animal. Experiments in the feeding of casein, as the only protein, resulted in increases of the body protein of 20 to 25 per cent. These experiments, by Dr. McCollum, were the most successful growing tests, yet reported in which but a single protein was fed.

Research Bulletin No. 21 also contained an illustrated description of a metabolism cage for a pig, devised by Dr. McCollum and H. Steinbock and found practical and satisfactory. It had been found best to use only male pigs for cage work as their urine is deposited within a narrow radius near the center of the floor and the cage being adjusted to just permit the animal to turn around and to lie stretched out when placed diagonally. The feces always will tend to fall near the walls. It was considered important to clip the hair from the heads of the animals to prevent feed from adhering to the face. The cage has to be visited several times daily to prevent undue accumulation of feces on the floor.

Metabolic Water

Dr. S. M. Babcock in Research Bulletin No. 22 presented an elaborate discussion of the production of metabolic water and its role in vital phenomena. The necessary water, which is the most abundant constituent of active cells, is derived partly from free water, or as a normal constituent of feed and partly from metabolic changes in feed and the tissues, as a result of respiration. By hydrolytic action in the body, nutrients are converted into soluble forms adopted to the needs of the living cells. These changes are effected by the action of specific enzymes, and are not directly dependent upon vital processes. The reactions associated with growth of tissue are all dehydrating in character and are effected by energy set free through respiration. Animal cells respire in a similar manner to vegetable cells and with the same general effect, but animals are unable to reconvert the waste products of respiration into soluble nutrients. These have to be eliminated, as they usually are toxic. Animals that excrete urea require a liberal supply of water, aside from that normally contained in their feed, to keep the urea content of the blood below a toxic concentration. The water requirements depend largely upon the amount of protein consumed. The author concluded that metabolic water derived from the oxidation of organic nutrients, would probably be sufficient for all animal needs, were it not for the elimination of poisonous substances resulting from protein degeneration.

Soil Bacteria and Evaporation

As there are certain biological factors in the soil which undoubtedly are closely connected with the movements of soil.

water, Conrad Hoffman, of the Department of Agricultural Bacteriology, began an investigation to determine what relations, if any, exist between the movement of soil water and bacterial activities in the soil. J. E. Grant and A. A. Vass, under his direction, performed much of the experimental work involved. They concluded in Research Bulletin No. 23 that changes in the quantity and quality of the various chemical substances in solution in the soil water result from bacterial activities. These changes help to cause the movement and circulation of soil water, and especially upon the surface tension of soil moisture. The production of carbon dioxide, by bacteria in soil, also increases the surface tension of soil moisture. It would appear, from the experiments conducted, that the activities of the soil bacteria are factors that ^{should} ~~showed~~ to be considered in the movement of soil water, not so much because of the cells themselves, but on account of the by-products they form, and their subsequent influence upon such factors as the surface tension, capillarity, viscosity, etc. of the soil moisture. They further concluded that the biological feature of the soil apparently forms an important contributory factor in determining the movement of soil water.

Diagnosing Contagious Abortion Disease

Drs. F. B. Hadley and B. A. Beach of the Department of Veterinary Medicine, had been devoting much thought and work to the subject of contagious abortion disease in cattle and means for its detection and control. In Research Bulletin No. 24 they gave a detailed account of their experimental work with the complement fixation test of the blood, as a practical

method of detection. The nature of the test and the technique for its application were explained and described in detail, and they concluded that the accuracy of the method of diagnosis employed is as great as that of any method based upon a biological reaction. They had found it possible to run tests on 50 or more animals a day without undue exertion, and recommended the test as a reliable means for the detection of affected animals:

Regular Bulletins of 1911-1912

Reinforced concrete having become recognized as being equal, if not superior, to all other materials available for the construction of silos, Professors G. A. Ocock and F. M. White, in Bulletin No. 214 of July, 1911, furnished plans, specifications, and instructions for its successful use. They advised that a good silo should be cylindrical, air-tight, and with a smooth-surfaced interior and walls that will be non-conductors of heat and cold and capable of resisting strong winds. The size of the silo should be adapted to the size of the herd and large enough to put out $1\frac{1}{2}$ to 2 inches of silage daily. A silo of 38 tons capacity will furnish enough silage for 14 cows for 180 days. Directions were given for the building of home made forms for silo construction. The forms used ⁱⁿ for building solid walls ^{silos} vary in width from 2 to 4 feet. An inside and outside form is used at the same time. The walls should be well reinforced. Particulars also were given as to the building of concrete block silos. Hollow two piece blocks were recommended as most economical and satisfactory. Any farmer can construct the blocks with an inexpensive form. The

silo should be located on the south side of the barn or be sheltered by other buildings. A creamy mixture of cement and water should be applied as a preservative to the interior of plastered or concrete silos. Coal tar, asphaltum or creosote should not be used on such silos.

Professors J. G. Halpin and C. A. Cooch, in Bulletin No. 215 of August, 1911, gave similar plans and instructions for the building of poultry houses. The bulletin also contained particulars regarding the poultry house, site, colony and long house systems, size and width of the house, and types of roofs, foundations, floors, walls, partitions, ceilings, and interior fixtures. Drawings, plans and bills of materials accompanied the text.

Explosives for Clearing Land

Bulletin No. 216 of November, 1911, by J. F. Kadonsky, gave the results of cooperative investigations between the U.S. Department of Agriculture, Minnesota Northeast Experiment Farm, and the Wisconsin Agricultural Experiment Station, in the use of explosives for the clearing of cut-over lands. The bulletin told how the charge of dynamite or nitrite should be placed and exploded. Deep charges were considered unnecessary and the use of the explosive in bulk form advised. How to insert caps was explained. How to use explosives on clay and soil was advised and information given about electric blasting machines. The reasons for the occurrence of misfires were offered and instructions given for the boosting and blasting of boulders. The bulletin was ^{profusely} ~~properly~~ and structively illustrated.

Management of the University Dairy Herd

Professors G. C. Humphrey and F. W. ^{Well} Worth in Bulletin No. 217 of December, 1911, presented the records of the University Dairy herds for 1909-1911, and offered the lessons gained from their experience in handling the herd. Net profits of nearly \$50 per cow were shown for the year 1911, despite the great increase in the cost of feed. Twenty-two cows averaged 354.77 lb. of butter fat and 8,536.3 lbs. of milk, per cow, during the year ending May 6, 1911, an increase over the previous year. The authors again asserted that high protein rations are less economical than medium protein rations. The reason for cows gaining in production, but losing in weight, during the first weeks of pasturage was said to be the unusual exercise, together with the succulence of the grass. Production may be increased and loss in weight reduced to a minimum by feeding hay or silage during the first few weeks the cows are on lush grass in spring. The authors acknowledged their obligations to E. W. Fox, dairy herdsman, W. E. Markey and A. C. Oosterhuis, assistants in animal husbandry, and J. C. Jurriens and Miss Emily Bresee, assistant chemists, for faithful and efficient work in connection with the investigation reported in the bulletin.

Bulletin No. 218, of December, 1911, contained the annual report of Director H. L. Russell for the year 1911.

In Bulletin No. 219 of April, 1912, O. C. Malde added to his bulletin No. 213. on cranberry bog construction, similar information relative to the management of the bogs, when prepared and planted for fruit production. The subjects discussed were:

care of new planting and of bearing cranberry vines, weather conditions, resanding and pruning, destruction of weeds, fertilizers, frost protection, insect prevention and control, reclaiming old cranberry bogs, and marketing vines for planting.

Grading of Cream

How better cream might be obtained by grading and a new method of testing butter for moisture were discussed in Bulletin No. 220 of May, 1912, by Professor G. H. Benkendorf, of the Dairy Department. He estimated that one million dollars would be added to Wisconsin income could the quality of butter made in the state be improved enough to increase the value one cent per pound. Quality of creamery butter was injured by improper cleaning of separators and poor care of cream on the farm. Cream should be sweet and clean, so that it may be ripened properly by the buttermaker and pasteurized without loss of fat. Selling rich cream is more economical than selling thin cream. Acidity of cream can be determined quickly and accurately by use of a solution of alkaline tablets. The new moisture test for butter was described and explained.

Profit from Farm Manure

Professor E. B. ^HStart of the Department of Agricultural Chemistry estimated that there is an annual loss of at least \$25,000,000 from careless management of farm-yard manure and in Bulletin No. 221 of June, 1912, explained how the loss occurs and how it might largely be prevented. In it he stated that the average value per year of mixed farm manure is \$30 per 1,000 lbs. live weight of animals. A ton of such mixed manure contains about 10 lb. of nitrogen, 5 lb. of phosphoric acid and

10 lbs. of potash making it worth \$2.25. Eighty per cent of the fertility elements in feed is recovered in the manure. Liquid excrement is more valuable than solid, pound for pound. Leaching by rains is one great source of loss and large losses of nitrogen occur by fermentation. To prevent losses it is best to have manure fresh and spread it on reasonably level fields. Two tons of fresh manure are required to make 1 ton of rotted manure. There are two ways of maintaining the fertility of most farms: First, in systems of stock farming, by purchasing additional feeding stuffs; and second, by adding purchased fertilizers to the manure in the form of rock phosphate and gypsum, at the rate of about 40 lbs. of each per ton. The bulletins presented tables and explanatory notes relative to the average composition of fresh manures; amount and value of different manures; fertilizing constituents in feeds and farm products; fertilizing constituents in one ton of bedding; fertilizing constituents of manure from a given ration and in solid and liquid excrements; gain in yield from use of manure; losses in manure from leaching, when exposed for 5 months and from leaching from solid excrement; gain in yield from use of fresh manure; plant food removed in a 3-year rotation; replacing fertility by feeding wheat bran and effect of style of farming on fertility. Instructions also were given relative to getting the most good from manure and how best to store manure under cover and outdoors.

Crop Rotation for Northern Wisconsin

In Bulletin No. 222 of June 1912, Professor E. J. Delwiche explained in detail the value and necessity of following

systematic rotation of crops in order to secure the best results from a given acreage of worked land. Instructions for the following of 3-year, 4-year and 5-year rotations for the various types of farms were prescribed together with information regarding the factors governing selection of crop rotations and methods of arranging fields in rotation.

Climate of Wisconsin

Professor A. R. Whitson and O. E. Baker, in Bulletin No. 223, of July, 1912, presented an elaborate treatise on the climate of Wisconsin and its relation to agriculture. The text was accompanied by ^{numerous} ~~numbers of~~ maps of the State, showing the mean annual temperature in the various counties, during the winter, spring, summer and autumn seasons of the year, occurrence of frosts, average growing periods, rainfall, etc. Explanations of the maps, with information and comments on the effects of climate in its various phases, were given for the instruction of farmers and the bulletin, being entirely new in character and informative, could not fail to benefit them in their practical work.

Selecting Feeding Steers

As numerous inquiries had come to the Department of Animal Husbandry for information regarding the economical production of beef on the farms of Wisconsin, J. L. Tormey furnished it in a convincing and instructive manner, in Bulletin No. 224 of June, 1912. The bulletin was profusely illustrated with excellent pictures of typical beef-bred cattle of the different standard breeds and with these were shown animals of desirable and undesirable type for breeding and feeding purposes. The

subjects discussed included: the sort of cattle to keep for beef-making, how to build up a good beef herd, selecting feeding cattle, classes and grades of cattle on the market, how to obtain feeders, the time of year to buy them, the feeding margin and feeding period, the running of hogs behind feeding cattle, and the different ways of marketing cattle. The author stated that in 1908, the Wisconsin State Board of Agriculture reported that out of 1,600 pure bred bulls in service on the farms of the State, 748 or over 46 per cent were beef bulls of the shorthorn, Aberdeen-Angus and Hereford breeds, although Wisconsin is chiefly a dairying state.

Circulars of Information

The circulars of Information published during the fiscal year ending June 30, 1912, were numbered 27 to 38 and contained much valuable information for farmers. In No. 27, Prof. Sammis gave simple, illustrated directions for testing whole milk, skim milk and cream by the Babcock method, and showed how to calculate factory dividends on the basis of the test. In No. 28, Dr. Alexander reported the progress of Wisconsin horse breeding brought about by the stallion enrollment law of which he was the author and furnished a complete directory of the owners of all stallions licensed for service in the state. In No. 29, Professor Galpin gave complete directions for the making of a social survey. Nos. 30, 31 and 33 by Professor Woll reported chemical analyses of licensed commercial feeding stuffs for 1911, a list of commercial feeding stuffs and fertilizers for sale in the state during 1912, and analyses of licensed commercial fertilizers in 1912. In No. 32, Dr. Russell presented a chronicle

of the history of the invention of the Babcock butter fat test, on the occasion of its twenty-fifth anniversary. In No. 34 Professors Ocock and Wright gave instructions for laying out and installing septic tank systems of sewage disposal, adapted to homes in rural communities, and explained the process by which the sewage is purified in such a system. In No. 35 Professor R. A. Moore set forth the merits of alfalfa for growth in the state, and gave simple instructions for its culture. In No. 36 Professor L. R. Jones discussed the diseases which injure the potato crop, and prescribed methods of prevention, and remedies for their control. In No. 37, Professor Woll described and explained the feed unit system for the determining the economy of production of dairy cows, and in No. 38, Professors Moore and Hatch the work accomplished by Wisconsin bankers contests as a means of disseminating pure bred seeds.

THE EXPERIMENT STATION IN 1912 - 1913

The Directors' Annual Report, nominally for the fiscal year ending June 30, 1913, included data obtained in the entire growing season of 1913. In it he announced that the new building intended for the use of the Agricultural Chemistry department would be completed and occupied during the winter of 1913-14. The removal of the Chemistry department, with its allied sections for feed and fertilizer inspection, would not only greatly relieve the congestion existing in the Central Agricultural building, but take out of a non-fire proof structure a group of laboratories in which the fire hazard is high. The new building included a main part 108 feet by 66 feet housing an auditorium of 400 seating capacity, and had a wing 132 feet by 51 feet, to be used for laboratories. The newly organized department of forestry, and ^{the} poultry department were to be assigned quarters on the second floor.

The new structure, for use by the steadily expanding department of Home Economics, authorized by the Legislature of 1911, was being erected on the Linden Mall, between the Central Agricultural building and University "Hill": The building, when completed, would also house the offices of the University Extension Division. Meanwhile the Home Economics department had been crowded into the attic of Lathrop Hall, the Woman's social building.

No additional lands had been acquired, but the reclamation of the lake level marsh, contiguous to University Bay, had been

progressing. The reclaimed smaller marsh had, that season, yielded its third corn crop.

The farm building on the East Hill farm had, during the year, been remodeled.

Much development had been accomplished on the Branch Experiment Stations. Additional land on the Spooner Station had been cleared and broken, for use by the Horticultural department, in potato experimental work. A foreman's cottage had been completed, and a herd of pure bred and grade Guernsey cattle established. Well equipped farm buildings, with barns and outbuildings and commodious offices for laboratory work, had been provided at the Ashland Station. Considerable clearing had been done at the Marshfield Station, and a forage barn was being erected. Thirteen additional acres had been leased at the Douglas County Station, near the city of Superior, to be used for the growing of a larger supply of acclimated seed for dissemination. The Rusk County Station, located the previous winter at Conrath, on the Kinnan clay loan, was being organized. A small dairy herd was to be developed there, during the summer. Steps had been taken to establish a branch station in Marinette County where, for several years, temporary work had been in progress at Crevitz. The proposed station was to be of the County Demonstration type.

Station Faculty Notes

^{can}
Dunn and Director Russell was in 1911-1912 being assisted in

the direction of the Station by Frank Barron Morrison, who was born on a farm near Fort Atkinson, Wisconsin. In 1911, he obtained the Bachelor of Science degree in agriculture from the University of Wisconsin, and at once became an assistant in Agricultural Chemistry. In 1912, he was made an instructor in that science, then he made Animal Husbandry his specialty, being made assistant professor 1914-1917, associate professor 1917-1919, and professor 1919-1927. In this work he gave notable service and gained additional experience by aiding Prof. W. A. Henry in revising his popular text book "Feeds and Feeding". Later, he was joint author, with Prof. Henry of the 19th edition (1928), and also of the abridged edition which appeared in 1917, with E. S. Savage he had also published in "Feeds and Feeding Manual" in 1915. From 1927 ^{to} and 1928 he was Director of the State Agricultural Experiment Station at Geneva, New York, and Cornell Agricultural Experiment Station at Ithaca, New York. In 1928, at the urgent request of the livestock breeders of New York State, he assumed the position of Professor of Animal Husbandry in Cornell University. His work in animal nutrition, at the Wisconsin Experiment Station, earned him national recognition and he continued to do as valuable work in his later position.

Another notable member of the faculty, who was destined to become esteemed for his work in Agronomy, was Frederick Lawrence

Graber from Mineral Point, Wisconsin. He earned the B.S. degree in agriculture at the University of Wisconsin in 1910; M.S. in 1912; and Ph.D. at the University of Chicago in 1930. From 1910 to 1912, he was research assistant in the Wisconsin College of Agriculture and Experiment Station; instructor, 1921¹²-14; assistant professor, 1914-17; Associate professor, 1917-1920, and, from 1921, he served as professor in Agronomy. His major subject has been plant physiology and his minor subjects, ecology and genetics. He is a Fellow of the American Association for the Advancement of Science, and from other learned societies relating to his specialties. Alfalfa has been his chief subject of research and practical work, and ^{he} has also done much useful work relative to sweet clover, grub injury and other related subjects.

From 1910 onward, in the Agronomy Department, Donald Benjamin Leith, from Eldorado Wisconsin, gave exceedingly valuable service. He had graduated B.S. in Agriculture from the University of Wisconsin and in September, 1910, was made instructor in July 1916, assistant professor, in 1920 associate professor, and in 1929 professor. In 1916, he took over the management of the University farms. His research work began in 1911, with small grain breeding his specialty, and wheat, at first, receiving particular attention. He developed Pedigree No. 2, wheat, a selection from the turkey red variety, which has been the standard of excellence of Wisconsin winter

wheats since that time. He also developed the State's Bride, Pedigree No. 7 variety of oats which has since been grown more than any other variety in Southern Wisconsin. For use on lighter soils, his White Cross, Pedigree No. 19 ^{oat} ~~out~~ has been found early and suitable. To his work is also attributable the breeding of Oderbrucker smooth bearded barley. After many years of patient work, Wisconsin Pedigree Barley No. 37 resulted, and has given a good account of itself ever since. The great increase in the production of barley in the State may be attributed almost entirely to the stimulus given by this high yielding, smooth bearded variety. Rye and corn have likewise benefited greatly from the patient, painstaking breeding work of Prof. Leith and his management of the 540 acres composing the University farms has been most praiseworthy. In the Horticultural department of Vermont University, Richard English Vaughan was, in 1907-1908, gaining experience as an assistant which later was to be made use of at the Wisconsin Experiment Station. He came from Vermont, where he was raised on a farm and in 1907 had obtained a B.S. degree from the University of that state. In 1912, he received his Master's degree from the University of Wisconsin. There, from 1916 to 1918 he was assistant plant pathologist and associate professor 1918-1926. From 1909-1910 he had been instructor in horticulture and agronomy in Mt. Hermon School, Massachusetts and Director of the Department of Agriculture there from 1910-1911. Work done by him at Wisconsin is mentioned

in our reviews of the bulletins of the Station.

From 1910 to 1911 Edward M. Gilbert, a native of Wisconsin served as instructor in botany in the Wisconsin College of Agriculture. In 1911-17 he was assistant professor, and associate professor, 1917-1923. In 1923, he was made professor of botany and plant pathology and became favorably known by his useful text books. "High School Botany" and "College Botany".

The South gave the Department of Plant Pathology an eminent worker in George Wanamaker Keith. He was reared in a cotton plantation in South Carolina. In 1909, he had graduated B.S. in Clemson Agricultural College, and at the University of Wisconsin earned his Master's degree in 1911 and Ph.D. degree in 1914. He came to Wisconsin University as lecturer on plant pathology, 1912-1914; was assistant professor, in 1914-1917, and was made associate professor in 1919. Before coming to Wisconsin, he had obtained considerable experience in his specialty, having been assistant in plant pathology at the South Carolina Experiment Station, from 1909 to 1910, and special agent and scientific assistant in fruit disease investigations for the U.S. Department of Agriculture, during the summer seasons from 1910-1913.

William Harold Peterson came from New York state to the University of Wisconsin as assistant in Agricultural Chemistry in 1909, and then served as instructor, assistant and associate professor consecutively

until 1925 since when he has held the position of professor. He obtained his B.S. degree from Wesleyan University and M.A. degree from Columbia University. In 1913 he received the Ph.D. degree from the University of Wisconsin, and in 1914 studied in the University of Berlin. His specialties are nutrition and fermentation in which lines he has done excellent work at the Wisconsin Experiment Station.

In 1909, Emil Truog, a native of Wisconsin, obtained his B.S. degree in agriculture from the University of Wisconsin and his Master's degree in 1912; from 1909 to 1912, he served as assistant in soils and later as assistant and associate professor. He spent his early life on the home farm, where he obtained good practical experience which has been useful to him in soil testing work, which has been his specialty.

Much useful soil testing work has also been done by Edward John Grauk, from Independence, Wisconsin, who graduated B.S. in Agriculture from the University of Wisconsin in 1911 and M.S. in 1918. He has done much of the state soil survey work under Professor Whitson, having been soil surveyor for the Experiment Station, from 1911 to 1912; taught soil subjects, from 1912 to 1916. He was chemist in charge of the State Soils Laboratory 1916-1929 and in the latter year, was made associate professor of soils.

Another assistant in the Soils Department, from 1909 to 1912 was Frederick Ludwig Musbach, from Saukville, Wisconsin, who received the

B.S. degree in agriculture from the University of Wisconsin, in 1909.' He did notable work in connection with the Wisconsin Geological and Natural History survey, and has been superintendent of the Marshfield, Wisconsin. branch experiment station as professor in the department of soils. In 1925, he traveled in Europe studying matters pertaining to his specialty.

Wilbert W. Weier, from Vernon, Wisconsin who obtained the B.S. Agr. degree from the University of Wisconsin in 1908 and M.S. degree in 1917; also served as assistant professor in the Soils Department in 1911-1913 and for a time was an associate soil technician in the Bureau of Chemistry and Soils, U.S. Department of Agriculture, Washington, D.C. He was the author of "Productive Soils" in 1920, and in 1923, received the degree of Ph.D. from the American University.

The Soils Department also had in Herman Wenzl Ullsperger, a valuable assistant professor of soils from 1911 when he graduated B.S. from the University of Wisconsin until 1913-1914. He also was an expert in horticulture, and later became general manager of the ^{Fruit growers' Union and} Fruit Growers' Canning Company of Sturgeon Bay, Wisconsin.

The tobacco industry of Wisconsin owes a debt of gratitude to James Johnson, who was born at Deerfield, Wisconsin, Graduated B.S.A. in 1909, M.S. in 1911 and Ph.D. 1918, from the University of Wisconsin. and then was made a member of the Horticultural Department staff. He served as assistant from 1909 to 1911; instructor, 1911-1915; assistant professor 1915-1919; and associate professor, 1919-22. In 1922,

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he was made professor. In addition to his connection with the University, he has been resident agent of the U.S. Department of Agriculture in tobacco investigations and from 1915 to 1917, was collaborated for the U.S. Department of Agriculture in the same line of work.

From 1911 to 1922, Aaron Guy Johnson, a native of South Dakota, from the State College of which he received the B.S. degree in 1907, served as assistant, instructor, assistant professor and associate professor of plant pathology in the Wisconsin College of Agriculture and Experiment Station, and in 1914 obtained the Ph.D. degree from the University of Wisconsin. In the latter year, he was appointed pathologist in the office of Cereal Crops and Diseases of the Bureau of Plant Industry of the U.S. Department of Agriculture at Washington, D.C.

In the Animal Husbandry, John Lawless Tormey, who was reared on a farm near Fennimore, Wisconsin, and obtained the B.S.A. degree from the University of Wisconsin in 1907, had been doing excellent work with especial reference to beef cattle, from 1908 to 1913 for the College of Agriculture. He served as assistant professor from 1913-1917, and then was associate professor from 1917 until 1918, when he became fieldman for the American Shorthorn Breeders Association, with headquarters at Chicago, Illinois.

A. C. Oosterhaus, another graduate in agriculture of the University of Wisconsin, who gained experience as a dairyman on his father's

farm near Sheboygan, Wisconsin was also active in the Animal Husbandry Department the same time as Professor Tormey, and became well-known in the State as an expert demonstrator of the points of dairy cattle, and then, care and feeding. Later, he became actively associated with the Carnation Milk Company, at Oconomowoc, Wisconsin and there has done much useful work.

William Harman Wright, who was born and reared on an Indiana farm, and had received the B.S. degree from Purdue University in 1908 and M.S. from the University of Wisconsin ^{in 1909} and Ph.D. in 1924, ~~In 1909~~ began work at the Wisconsin College of Agriculture in 1909 as assistant in agricultural bacteriology, and, from 1911 to 1915, was assistant professor in that subject, and from 1916 associated professor until the time of his tragic death, in his office at the Experiment Station, on May 3, 1929. He was a graduate student at Cornell University from 1915 to 1916, and did special field survey work on potato diseases for the U.S. Bureau of Plant Industry during the summers of 1918 and 1919. With Prof. E. J. Hastings, he was the author of "The Laboratory Manual of General Agricultural Bacteriology" 1920 - 1922. In 1924 "Bill" as he was affectionately known by associates and students was one of the brightest, most efficient and most active "live wires" of the Experiment Station Staff during his day, and his death was a shock and sad blow to everyone who knew him.

Agricultural bacteriology was given impetus in its usefulness to farmers and scientists by the coming of Dr. Edwin Brown Fred to the Experiment Station in July 1913. A native of Virginia, where he was reared on a farm, he received the B.S. degree from Virginia Polytechnic Institute in 1907 and Ph.D. from the University of Goettingen, Germany in 1911. Specializing in micro-biology, he soon stimulated the successful growing of alfalfa and soybeans by preparing and disseminating root-nodule cultures for the inoculation of the seeds of those legumes. He has also rendered valuable service in many other branches of bacteriology.

In 1912, the Department of Agricultural Economics was greatly strengthened by the addition of Benjamin Horace Hibbard to its faculty. He came from Iowa, where he had earned his B.S. degree from the State College in 1898. In 1902 he received the Ph.D. degree from the University of Wisconsin from 1902 to 1912 he was Professor of Economics in Iowa State College and he assumed the like position ^{and} coming to Wisconsin. In 1911 he served as expert special agent on agriculture for the U.S. Census. He is the author of a "History of Agriculture in Dane County, Wis." and "Effect of the Great War Upon Agriculture and quickly assumed a position of commanding power and usefulness in his department in the University of Wisconsin.

From 1912 to 1914, Robert Francis Howard served as assistant Professor of Horticulture in Wisconsin University and 1914 became

Chairman of the Department of Horticulture in the University of Nebraska. A native of Missouri, he received the B.S.A. degree from the University of that state in 1908, and M.A. from the University of Nebraska in 1912.

RESEARCH WORK IN PROGRESS

Professor Taylor of the Agricultural Economics department was studying the problem of the marketing of lending agricultural products. Results of a study of Cheddar Cheese marketing had been published in regular bulletin No. 231. Studies relative to cooperation, for local problems and state regulation, for state-wide questions were being continued by Professor Hibbard. The study was to be ^{of} attended to include Swiss, Limburger and Brick cheese, also produced in Wisconsin.

In 1912, Professor Taylor also undertook a study of the various phases of the marketing of the potato crop. That advice might, from the facts learned, be given relative to any opportunities for greater economy in the middlemen processes. Professor Hibbard, of the Agricultural Economics department, had begun a study of rural credits in the two widely separated counties of Dane and Rusk. Interest rates on farm loans, in the older southern county, ranged, at the time of the study from 5 to 6 percent, while in the newer northern county, rates were 6 to 10 per cent. To facilitate the obtaining of more money at that time could be had in the northern part of the state as suggested, as possible, that farmers there might organize local credit unions.

VALUE OF MANURE IN DAIRY FARMS

Cost accounting studies were being conducted, in representative Wisconsin farms by the department of agriculture economics, in cooperation with the Office of Farm Management of the U.S. Department of Agriculture, represented by Mr. Juve, to determine whether the value of manure pays for labor in a dairy herd. It had been found that on most farms studied, the value of the manure much more than paid for the labor merely of feeding and caring for the herd, not including milking. The manure also offset the labor cost of feeding and caring for steers and young stock. Many "boarder cows" were revealed in herds studied, and very irregular feeding in one of them. Profiting from the data obtained by the study and advice given by the experts a farmer who lost \$63.16 on his herd in 1911, made a clear profit of \$453.72 in ¹⁹¹² 1912. Another farmer by disposing of his poor cows, increased his profit from \$26.11 in 1911, to \$350.18, in ¹⁹¹² 1922.

FARM INVESTMENTS

Data obtained by Professor Otis from his studies in farm management, on 175 representative Wisconsin dairy farms of various type, showed that farmers, who had increased their investment in operating capital were realizing greater profit than those operating their less intensively. It was evident that the managerial income be regarded as the test of efficient management, and that each which influences the health and growth of crops and livestock, want management of labor, or the marketing of the farm product direct and decided influence on the income. Unless

the farm income is greater than the amount the farmer would receive as interest on his investment, plus the wages he could get, his farm operations, as a business, cannot be regarded as successful.

RURAL SOCIAL SURVEYS

During the year, C. J. Galpin, of the Agricultural Economics department had completed a social survey of Walworth County and had supervised surveys of communities in other sections. The information obtained presented a picture showing every home in all its social connections with all other homes in the community. Such a social inventory would serve as the basis for intelligent social planning for the neighborhood. ^{a report} ~~Our part~~ of the work accomplished included a chart of the County, showing more clearly than statistics, the attendance of children at the schools of the district. Another chart showed a survey of a school district in Sauk County, and indicated the location of every farm, along with many other interesting and important facts for study by children. The surveys made, to date, had demonstrated that a village or small city of the agricultural type, in Wisconsin, is the center of a real rural community. Mr. Galpin, in collaboration with G. W. Davis, county superintendent of schools of Sauk County, Wisconsin, had been perfecting, for use by the teachers and advanced scholars in the county² schools of Wisconsin, a method of making rural school-district surveys.

PLANT NUTRITION STUDIES

Continuing their work on the subject, Professor Hart and Mr. Drescher had found that such high protein and sulphur plants as r pe, radishes, turnip and clover, responded in a marked degree to the application of a fertilizer supplying additional sulphur. Dr. Peterson found that, where no sulphate fertilizer had been ^appplied, the plants combined absolutely no circulating sulphates. The opposite was the case when there was a larger amount of sulphates in the soil. The soils used in the experiments contained normally about .0.4 percent of sulphur trioxide. In studying the form and distribution of sulphur in some of our common crops, Dr. Peterson, found that June grass and red clover contain volatile sulphur compounds. That was a new discovery.

Professor Hoffmann, bacteriologist, had found, by experimentation relative to the source of injurious compounds in the soil, that extracts prepared from cropped loam and sandy soils invariably retarded bacterial development, while those from marsh soil previously cropped to corn, oats, or clover in all cases increased bacterial development. These facts might have a valuable bearing on the choice of proper rotations for the various crops, on certain types of soil.

Mr. Primm, of the Agricultural Bacteriology, department, who had been making an intensive study of free-living bacteria on the digestion of the cellulose or fiber of plants, had succeeded in perfecting a method whereby these bacteria can be more readily isolated and studied.

Mr. Truog, of the soils department, had continued his studies on the availability of different phosphates for the more important agricultural crops. Contrary to the general belief that aluminum and iron phosphates are relatively unavailable to plants, 9 of the 10 plants tested made better growth on aluminum phosphate than on calcium phosphate, and 6, better growth on iron phosphate.

Soil management studies were in active progress at the various Branch Experiment Stations, and the State Soil Survey had been vigorously pushed during the past year. In accordance with a resolution of the 1913 Legislature, a general survey was being made of all lands included in the territory in which the Forest Reserve was being developed. It had been completed in 12 counties.

During the year, the Agronomy department had continued its work in the breeding of varieties of corn, oats, barley, winter and spring wheat, ~~rye~~, peas, soy beans, millet and sugar beets. Satisfactory progress had been made.

For 3 years, the Animal Husbandry and Agricultural Chemistry Departments had been carrying on trials to determine whether soiling crops or corn silage is the most satisfactory and economical for the feeding of dairy cows in summer. It had been found that, on farms where a sufficient number of cows is kept, silage is the most economical green feed for use in summer, up to the time when corn reaches the milk stage; then if desired, the green corn may be substituted for silage. Where a site is not available, or only a few cows are kept, a well-planned system of soiling crops must be relied upon.

ANIMAL NUTRITION

During the winters of 1911-192¹⁹¹² and 1912-13, Professor James G. Fuller, of the Animal Husbandry department, had conducted finding trials with a total of 11 purebred draft foals, to study their rate of growth, character of development and the cost of feed. On a ration consisting of 60 percent ground oats, 15 percent corn meal, 10 percent wheat bran and 15 percent cut alfalfa hay, of which each foal ate an average of 16.5 lbs. daily, the animals attained weights of 1,000 to 1,200 lbs. in one year. During the feeding periods of 140 to 233 days, the foals gained an average, per head, of 2.1 lbs. per day in weight, at an average daily feed cost of 18 cents. The estimated average cost of feed for the foals for the entire year was \$51.66 per head. While such feeding could not be recommended as worthwhile for poor foals of inferior breeding, it was believed profitable as forced feeding, for pure-bred, or good grades, so that maximum growth might be attained at an early age.

Further data had been obtained, by the departments of Agricultural Chemistry and Animal Husbandry, in the studies of the mineral requirements of farm animals. It had been found that a 1,000 lb. pregnant cow requires 1.8 to 2.1 ounces of lime per day, for fetus building and milk production, which is usually supplied by the ordinary farm roughages, such as hay and corn-storers, but not by a roughage ration largely composed of straw. Continued experiments, by Professor McCollum, relative to the value of fat from various sources in the

rations of animals indicated, for the first time, that the fat from substances such as egg or milk fat for young animals may differ in food value from fats of other origin. Specific experiments with fats used in the manufacturer of butter substitutes were in progress.

GENETICS AND VETERINARY RESEARCH

Professor Leon ^{J.} Cole, of the Experimental Breeding department, had been conducting tests to determine the effects of certain poisons on the germ cells of the male, but had not yet obtained decisive results. It had, however, been found that alcoholic poisoning of male rabbits had a marked effect in lessening efficiency^{cy} as sires, while rabbits, ~~guinea pigs~~^{given lead}, experimentally were not injured as sires, but their young averaged smaller in size and lower in vitality so that they died at an early age, compared with those from the untreated sires.

To determine the effect of inheritance in the ability of cattle to produce milk, or meat, Professor Cole had begun experiments in the crossing of Jersey and Aberdeen Angus cattle. The crossing was being done, not to form a new breed, or combine the good qualities of the two breeds crossed, but to help formulate rules by which the breeder may obtain desired results more quickly and directly in his mating work. A large number of hereditary characters were being studied including total milk production, percentage of fat, size and shape of oil globules, viscosity, and other properties of the fat, rate of growth, form of body, and such superficial characters as color, horns, etc. Necessarily, the experiments would have to be conducted

through several generations so that progress in accumulative results necessarily would be slow.

Professors Hadley and Beach, of the Veterinary Science department had been studying, in cooperation with Professor Halpin of the Poultry department, an outbreaking^{of} chicken-pox in the Station, flock, and testing, comparatively, the new Mantenfil method of vaccination against the disease. They had found the method sufficiently promising to warrant more extended studies. The Veterinary department had also continued its experimental work relative to contagious abortion of Cattle etc. Both the complement fixation and the agglutination tests had been studied, as laboratory methods of diagnosing presence of the infection, and experiments were in progress on vaccination with both killed and living cultures of the causal organism, Bacillus Abortus. In some cases, animals treated with vaccines and subsequently infected with large doses of living cultures to produce abortion, in control heifers, had delivered full time healthy calves. Recognizing the importance of the subject the Legislature had appropriated \$5,000 for further study of the problem.

PASTEURIZED MILK CHEESE

Continuing the trials of Prof. Sammis method of making cheese from pasteurized milk, investigations, during the summer of 1912, showed that the extra cost of making such cheese was rather less than \$2.25 per 1,000 lbs. which would be fully offset by a gain of only 1½ per cent in yield, thus leaving a substantial profit from increased

yield alone, when the process was used. The flavor of the pasteurized cheese was uniformly excellent, and an increase in yield of 5 percent was obtained. Professor Sammis also had devised a similar process of making brick cheese. Experiments with it showed an increased yield of about 5 percent. The cheese produced was free from taints and had a better flavor than that made from raw milk.

For two years past, Mr. Baer of the Dairy Department, had been conducting experiments with both the stationary and continuous type of freezers of ice cream to determine the factors which govern its over-run or "swell", body and flavor. It was found that, up to a certain limit, the longer a cream is held cold, the more viscous or thicker it becomes, and the greater is the tendency to produce a high over-run during the freezing process. For this reason, the temperature of the freezing mixture should not be too low. To produce a good "swell", a speed of at least 100 to 150 revolutions per minute is necessary in the ordinary batch type freezer, and from 200 to 250 revolutions, in a continuous machine. Too rapid freezing produces a soggy and coarse grained ice-cream. The opposite is the result when freezing is too slow. Homogenizing the cream tends to produce a firm and smooth cream. A badly tainted or slightly sour cream cannot be made into a well flavored ice-cream.

Tests conducted by Mr. White of the Agricultural Engineering Department, to determine the relative economy of engines of various sizes under different loads, showed that the larger (6 H.p) engines, are just as economical in the use of fuel on a small load, as are the smaller engines (3 H.p), ^{when} when carrying the same load, ^This he considered an exceedingly important fact to bear in mind when selecting an engine.

PLANT DISEASE SURVEY

Professor L. R. Jones reported that little climatic injury to orchard and small fruits occurred during the winter and spring of 1912-13; but there were some evidences of the root killing and body canker which occurred the previous year. Fire blight and apple scab were prevalent, and apple rust continued a menace, where the red cedar abounds. Wealthy was most seriously affected. Spraying gives considerable protection, but eradication of red cedar seemed imperative. Potatoes, truck crops and field crops, had also been given attention. Potatoes were freer from disease than for some time previous, "Club root" had broken out as a cabbage disease in several sections, in addition to black rot, soft rot, yellows and black leg, heretofore found serious. In field crops rusts and leaf blight had been more destructive than in the previous season. "Stripe disease" a comparatively new trouble, had proved destructive, and, in some instances, had caused a loss of 20 per cent of the stand of grain. "Leaf spot" had so far, proved the only important disease of alfalfa; especially in young stands of the plant.

An insect pest survey also had been conducted. Cotton scale of maple trees, cut worms, maggots affecting onions, radish, cabbage and cauliflower, and apple worm, pluricirrculis, San Jose scale were reported on and remedies prescribed. Methods for control of the house fly were likewise suggested. Onion pests had been studied by Prof. Sanders, of the Economic Entomology Department. Methods for destruction of the adult onion maggot fly or thrips were tested by Dr. H. H. Swerin, in a field near Racine. A sweet and poison bait spray gave good results. Profeseor Jones and Mr. Vaughn found the application of formalin solution to the seed in the drill row, the simplest and most effective way of

controlling onion smut disease. On the treated plots smut was reduced to 2.6 per cent, and the yield increased to 520 bushels per acre, compared with 25 per cent of smut and a yield of but 280 bushels per acre on the untreated control plots. The investigations of pea blight, begun the previous year, were continued by Mr. Vaughn, of the Plant Pathology Department. Positive benefits were obtained by plowing and harrowing immediately after removing the crop, and repeating these operations three times before freezing. Ensiling of the green vines ^{was} ~~were~~ advised. Further trials of cabbage seed, from "yellows" resistant plants, were made, and satisfactory results obtained in "cabbage sick" soil, ^{an} ~~less~~ abundant supply of "resistant" seed was harvested and was to be available for distribution and demonstration trials, by the Plant pathology Department, on a commercial scale. The results obtained by the department, during the year, by the formalin treatment of barley seed, were satisfactory. Treated seed showed a greatly reduced amount of loose smut and practically escaped invasions of the barley stripe diseases.

The Horticultural Department also gave information about root rot and black rot in tobacco. ^{both} ~~each~~ of which diseases had been prevalent and destructive in Wisconsin. Steaming of seed beds was prescribed, to prevent root rot and fumigation with formaldehyde solution advised, after cleaning tobacco warehouses, as a preventive of black rot.

The Department also reported experiments in the forcing of rhubarb. The best results had been obtained with two-year-old roots. Commonly, the roots are frozen before being forced. As the crop could be grown under the forcing benches in the greenhouse, it may prove a valuable adjunct to other ^{crop} ~~crops~~ grown in the house.

CRANBERRY INVESTIGATIONS

Mr. Malde had been continuing his studies of cranberry production problems at the Cranberry Station, near Grand Rapids. Losses had been caused by severe frosts on unflooded bogs. The application of rock phosphate on bare peat bog, at the Station, had greatly improved vine growth and crop yield; but it also stimulated the growth of grass. Nitrate of potash increased the size of the fruit, and improved its color. Prof. L. R. Jones and Prof. C. L. Shear, of the U.S. Department of Agriculture who had been studying "false blossom" of cranberries, concluded that parasites were not responsible directly or indirectly, for the existence of the malady, and that it was a physiological trouble, due to unfavorable cultural conditions. Proper drainage was considered the most important factor in the elimination of false blossom.

The work of the Agricultural Extension Service had been continued during the year, along the same lines as have previously been reported, and with imminent success.

STATION PUBLICATIONS OF 1912-1913

During the fiscal year ending June 30, 1913, the Experiment Station published 5 Research Bulletins, 7 Regular Bulletins and 6 Circulars of Information. Brief summaries of these publications follow:

TECHNICAL BULLETINS

The first Research Bulletin No. 25, reported studies on the factors concerned in the ripening of Cheddar cheese. The authors were Professors E. J. Hastings and E. B. Hart, with Alice C. Evans, bacteriologist cooperating. The experimental work was done, jointly, by the Station staff members and experts of the U.S. Department of Agriculture. The report dealt with the bacteriology of Cheddar cheese, flora of milk, differences in the composition of cheese, biological problems, bacteriological methods, the bacterium lactis acidi group and their role in Cheddar cheese, acidity of curd and whey, effect of acid on expulsion of whey and on the texture of the curd and ripening of cheese and its protective action. The rate of bacterial growth in cheese, and the method of examining cheese, also were considered, and the results stated. Many tables accompanied the text. It had been determined by previous investigators that the only group of bacteria found constantly in great numbers in Cheddar cheese is the Bact. lactis acidi group and that the roles of this group, in that type of cheese are as follows: They favor rennet curdling, shrinking of the curd, and expulsion of the whey. The acid also causes "matting" of the curd, activates the pepsin of rennet extract, prevents the growth of putrefactive bacteria, and can form acid in the absence of the living cell. The development of Bact. lactis acidi develops growth of the B. Bulgaricus group of acid-forming bacteria and they reach numbers comparable with those of the lactis acidi

group especially in the first month of ripening. The authors also considered it probable that ococcus forms are constantly found in large numbers in cheddar cheese.

DAIRY PRODUCTION

In regular bulletin No. 226 Prof. F. W. Woll published brief popular discussions of results obtained from two years of dairy cow competitions, conducted by the Station staff for the benefit of dairy farmers. In Research Bulletin No. 26, he presented additional information regarding some of the more scientific results along the lines of dairy husbandry and animal nutrition, that would be of direct interest mainly to students and investigators of dairy problems. A total of 347 pure bred cows and 48 grade cows completed the yearly records. Elaborate tables, as an appendix gave the chief facts connected with the production of the cows ^{during the record years} ~~showed~~ ^{the total production of the cows} the three breeds represented to rank in the following order: Holsteins, Guernseys, Jerseys. The large producers ate more feed and more concentrates than the low producers, made up of larger proportions of concentrates and of smaller proportions of pasture grass and hay, or other dry roughage than that used by the low producers. The percentage of concentrates used by the high producers was 38 to 61 higher than that of the low producers. The total number of feed units, in the ration for the high cows, was 18 to 26 per cent in excess of the total feed units, in the rations of the low producers. The largest production of milk solids, for the year, by a competition cow, was 2800.7 lbs. and the cow also held the highest record of 888.2 lbs. of butter fat, for the year's production. On the average, for all cows giving milk 10

to 12 consecutive months, the percentage decrease in the production of milk, per month, was as follows: 2nd to 7th month, 5%; 8th month, 10%; 9th month 13%; 10th month, 20%. Beyond the 10th month, the monthly decrease was practically the same as that of the 10th month, for cows bred to produce a calf within a year from the date of last calving. The decrease in production of total solids and butterfat were slightly larger during the early part of the lactation period, and slightly lower (1% or 2%) toward the close of the period. It was found on the average for all the data secured for Guernsey, Jersey and Holstein cows, that the standard deviation for daily milk yield during the official monthly periods was 3.1 lbs, and the coefficient of variability, 5.5%. The corresponding figures, for percent of fat, were .29% and 7.6%. For cows kept under normal herd conditions, and not greatly crowded with feed, these figures probably would prove somewhat too high.

CHEESE FROM PASTEURIZED MILK

In Research Bulletin No. 27 Prof. J. L. Sammis of the Wisconsin Station and A. T. Bruhn of the Dairy Division of the U.S. Department of Agriculture, gave an account of the results they had obtained in the manufacture of cheddar cheese from pasteurized milk. The Government Dairy Division was represented at Madison by expert cheesemakers, J. W. Moore, F. W. Laabs, and A. T. Bruhn, in succession by Bacteriologists, L. D. Bushnell, Alfred Larson and Miss A. C. Evans, in succession; and by chemists, S. K. Suzuki, and E. F. Flint. Prof. Sammis, of the Wisconsin Station, had charge of the work on this project, from the beginning. Numerous tables, illustrations and the graphs accompanied the text of over 100 pages. A resume^{was} of the work on the project ^{obtained in previous years,} ~~was given.~~ In 1911, better facilities were provided for weighing large quantities of milk and cheese, quickly and accurately, whereby

the yields of cheese obtained from raw and pasteurized milk were carefully determined. During the year 1911, the average gain in the yield of green cheese was 5.37% more from pasteurized milk than from raw milk. Green pasteurized milk cheese shrank a little more than that from raw milk. After curing at 60% to 70% F. for about 100 days, the gain, in yield of pasteurized milk cheese over raw milk cheese was 4.22%. The average loss of fat, in whey from pasteurized milk was about .17%, or less than half the loss in ~~all~~ average factories using raw milk. The gain in yield of pasteurized milk cheese is due partly to fat and partly to moisture. That cheese varied less in quality than raw milk cheese averaging better than 3.7 points ~~of~~ a total score, than the raw milk made from portions of the same milk supply. It scored higher than the raw milk cheese in 96% of all cases. Since pasteurized milk cheese can be stored without injury at 70[°], it was thought that, in many cases, the cost of cold storage might be avoided. Raw milk cheese loses considerable amounts of fat when stored at 75% to 85%, while pasteurized milk cheese lost none. Pasteurized milk cheese can, at the age of one week, and possibly earlier, be put into cold storage at 34° without injury. A new method of manufacture was described.

AVIAN TUBERCULOSIS

Tubercle bacilli had not been found in any avian (bird) tissue submitted to the Experiment Station for examination prior to 1906; but during the 3 years prior to 1912, great numbers were received. Professors E. G. Hastings Bacteriologist, and J. G. Halpin, poultry specialist, therefore, had been studying the matter and fully discussed the subject in Research Bulletin No. 28. They described the disease, stated its economic importance, told

how the bacilli are voided by the birds, how infection is controlled and spread and transmitted from flock to flock, the nature of the causal bacillus, the infection by it of other animals, and vice versa. The hygienic significance of avian tuberculosis was explained and methods of eradicating the disease prescribed. Seven plate illustrations of various phases of the disease accompanied the text.

SOLUBILITY AND AVAILABILITY OF PHOSPHORUS

In Research Bulletin No. 29 Professor W. C. Tottingham, Chemist, and C. Hoffmann, bacteriologist, described experiments they had conducted to determine the nature of the changes in the solubility and availability of phosphorus in fermenting mixtures. They found that fermentation over periods of 4 to 6 months, caused a decrease of the water-soluble phosphorus in manures, and mixtures of manure with rock phosphate. The losses were greatest in mixtures where they amounted to more than one-half the soluble phosphorus originally present. The addition of chloroform or formalin, to inhibit bacterial action, greatly reduced the losses of water-soluble phosphorus in mixtures of manure and rock phosphate. Acid phosphate, when mixed with fermenting manure, underwent essentially the same changes in solubility as did rock phosphate. When chloroform was added, however, the acid phosphate decreased markedly in solubility, while, with rock phosphate, no decrease occurred. The results of the investigation indicated that bacteria cause a decrease of the water-soluble phosphorus of manure. However, so far as the results of past experiments indicate conditions in field practice, the final results from mixing rock phosphate with fermenting manure appeared advantageous. In the case of acid phosphate, it appeared inadvisable to mix the material with fermenting manure. It was advised, as

probably better practice, to add it to the manure at the time of application to the field.

POPULAR BULLETINS OF 1912-1913

In July 1912, appeared Bulletin No. 223, on the climate of Wisconsin which has already been summarized in the record for 1911-1912, and in that month followed Bulletin No. 225, by Professor J. G. Milward, of the Horticultural Department on the commercial varieties of potatoes for production in Wisconsin. The bulletin was attractively illustrated, a new and instructive feature being three full page colored plates showing the standard varieties of early and late potatoes, and standard and early varieties under trial. Three other plates (uncolored) showed good and bad types of the long and round white groups of potatoes, ^{and of} the rose types of tubers. The text discussed the standard varieties and their characteristics, as illustrated, quality in market stock, influence of soil on potatoes; systems of potato farming, "running out" of varieties; how improvements might be made; potato exhibits; the potato judging score card and rules for the holding of exhibitions. The author stated that 275,000 acres of Wisconsin soil produced 30,000,000 bushels of potatoes in 1911, and that double that acreage is available for potato growing. The raising of pure seed of standard potatoes was said to have wonderful possibilities, in Wisconsin, and that community potato growing should aim to select a few standard types, eliminate all mixtures and provide standards and means of sorting and grading and introduce improved methods of handling at loading stations.

DAIRY COW COMPETITIONS

During the past 12 years official testing of dairy cows under the supervision of experts of the Wisconsin Experiment Station, had become increasingly popular

and useful. In Bulletin No. 226 of July 1912, Professor F. W. Woll and R. J. Harfis gave a full account of the work accomplished by the cow competitions to date, and illustrated their report with many illustrations of winning cows. The need of such testing and exhibits was emphasized by the fact that, as stated by the authors "It is variously estimated that one-fourths to one third of the number of cows in Wisconsin—one of the best dairy states in the Union—belong to the class often referred to as "robber cows" or "star borders" for the reason that they do not pay for their keep, to say nothing about yielding a profit to their owners^d. The retention of these profitless cows is due to the fact that their owners do not know how the accounts stand with the various cows in their herds as regards productiv^{es} of milk or butterfat, the amount of feed consumed, ^{and} its cost. The average production of butterfat, by the dairy cows of the state, was estimated at about 170 lbs. a year, equivalent to less than 200 lbs. of commercial butter. On the other hand, many herds, where official testing was done and accurate accounts kept, were producing over twice 170 lbs of butter fat a year and equivalent to less than 200 lbs of commercial butter. On the other hand, ~~many~~ herds; where official testing was done and accurate accounts kept, were producing over twice 170 lbs of butter fat a year and the number of these herds was increasing each year. All dairyman were gradually being educated in better methods of dairy management and were advised to note the records made by the competing cows, and benefit by their profitable accomplishments.

NURSERY AND ORCHARD INSPECTION

In Bulletin No. 227, of December 1912, Professor J. G. Sanders reported on the inspection work done from 1910 to 1912. One hundred forty seven

nurseries, embracing 619 acres of nursery stock, were licensed in Wisconsin, and 19 Wisconsin ~~and 19 Wisconsin~~ dealers in nursery stock and 57 nurseries outside the state, had also been licensed. The bulletin gave information about the inspection of imported plants; the history of the Wisconsin inspection law; the purpose of inspection; nursery conditions in Wisconsin; opportunities of Wisconsin nurserymen; need of a State nurserymen's association; losses of nursery stock; points to be observed when buying stock; changes in the Wisconsin law; state inspection laws; and important nursery pests and diseases. In the latter part of the bulletin, which was well illustrated, information was given regarding San Jose Scale, oyster-shell scale, scurfy scale, European fruit scale, cottony maple scale, apple aphid, woolly aphid, strawberry root louse, flat-headed borer, bronze birch borer, poplar borer, and fungus and bacterial diseases. The bulletin closed with a list of the names and addresses of licensed Wisconsin Nurserymen and dealers in 1911-1912.

Bulletin No. 228, of January 1913, contained the Annual Report of Director H. L. Russell, for 1911-1912.

Land Drainage

In Bulletin No. 228, of April 1913, Prof. E. R. Jones gave an elaborate treatise, in simple language, on the right drain for the right place. He presented reasons for the drainage of land and told why drains should be dug; then he described the various kinds of drains, with illustrations, and mentioned the kinds of land needing drainage. Various farm projects were cited and explained and a system

of farm drainage prescribed with instructions for carrying out its plans. The questions of tiling machinery and farm labor were also discussed, and the role of the farmer, as a drainage engineer, stated in detail.

SOIL ACIDITY AND LIMING

In Bulletin No. 230, of May 13, Prof. A. R. Whitson and W. W. Weier discussed the important subjects of soil acidity and liming. They explained why acidity is detrimental to fertility and the relation of acidity to the growth of legumes to the availability of phosphorus to the supply of calcium and to weeds. Some results of liming were next stated and the cause of soil acidity and methods of detecting soil acidity explained. The varieties uses and application of lime were fully discussed and the best methods of application advised. Other subjects considered were: the value of ashes, land plaster and acidity; should marsh soils be limed?; how to grow alfalfa on acid soils, and liming and soil improvement. It was advised in conclusion that lime rarely acts as a true fertilizer, cannot inoculate, is not a cure all for every soil ailment and only corrects acidity in soils. To grow alfalfa on acid soil, liming should be done first, and inoculating next.

MARKETING WISCONSIN CHEESE

Bulletin No. 231 of April 1913, was prepared by Prof. H. C. Taylor, W. A. Schoenfeld and G. S. Wehrwein. It was written and published at the request of the Wisconsin State Board of Public Affairs, and presented a thorough statistical study of the processes of marketing the various types of cheese produced in the State. Informative figures accompanied the text, together with a map of the

state indicating the location of the cheese producing regions and tables showing the primary shipments of cheddar cheese from Wisconsin, for the year 1911, and showing the amounts received by the cities in the various states. The authors concluded that the provision of an open market with uniform inspection and grading of cheese, with a view to the maintenance of fair dealing and high quality of products was a problem of statewide importance. Whether it could best be accomplished by the federation of the patrons' organizations, or by state activity, was a question for future efforts to determine; meanwhile, the cheesemakers of Wisconsin were advised to concentrate their attention upon the manufacture of high grade goods, and the sale of those goods under conditions which would insure free and open competition.

CIRCULARS OF INFORMATION 1912-1913.

These publications included nos. 39 to 44. No. 39 by Dr. F. B. Hadley gave directions for vaccinating ~~some~~ swine against cholera, and described the preparation of antiserum and the various methods of vaccination. In No. 40, Dr. A. S. Alexander presented his annual report on stallion enrollment with a directory of owners of licensed stallions in the state. During the year he had delivered 86 lectures on horse breeding and Veterinary subjects in various centers of the state. No. 41, by A. C. Baer of the Department of Dairying, explained and discussed the importance of the milk sediment test and its applications. Circulars Nos. 42, 43 and 44, by Prof. Woll, contained his annual reports on the chemical analysis of licensed commercial feeding stuffs for 1912, a list of licensed feeding stuffs and fertilizers for sale in Wisconsin in 1913, and analysis of licensed commercial fertilizers in 1913.

EXPERIMENT STATION PROGRESS DURING 1913-1914

Director Russell's Annual Report for the fiscal year from July 1, 1913 to June 30, 1914 was published in April 1915, as regular Bulletin No. 250. In it he announced that the Home Economics Building, authorized by the Legislature of 1911, had been completed and was now occupied. Arrangements had been made by the staff of the Home Economics department to take up research problems that are pertinent to their line of work. Two hundred sixty students had enrolled in the four year course of the department. A new fire proof stack room had been added to the equipment of the Agricultural College Library. Ample space had been provided by an addition of the reading room of a two story wing, 25 feet by 50 feet. A new hog house had been added to the farm group, just north of the beef cattle barnyard and in connection a well-lighted and ventilated series of concrete-floored pens. The quarantine building, previously provided, was fitted for anti-hog cholera serum production, by the construction of quarters for the needed swine, and equipment of laboratories. Further development of the branch experiment stations had steadily proceeded. A concrete cellar having a capacity for the storage of 2,000 bushels of potatoes had been provided at the Spooner station, and an addition to the dairy barn erected. A commodious forage and stock barn had been completed and equipped at the Ashland Junction station, together with a drying shed for the storage of sheaf grains and forage. At Marshfield, the farmstead buildings had been concentrated at one point, a forage and stock barn built, and some small out buildings constructed. Steps were taken during the year to replace the temporary station at Crivitz by permanent structure. Additional lowland had been leased, making 55 acres in all available for demonstration station purposes. At the Rusk County branch station at Conrath, a new tract of 80-acres of cut ^{over} ~~or~~ island had been exchanged for a portion of that originally rented. This tract was being prepared

for use; a cottage for the foreman had been built and a barn sufficient for the accomodation of the dairy herd was being constructed.

STATION STAFF WORKERS

In 1914, Arthur Henry Kuhlman, of Lowell, Wisconsin, who had received the B.S. degree from the University of Wisconsin in 1910, and had served an assistantship in the Animal Husbandry department from that year until 1913, was appointed an instructor in that department. Continuing his work in animal husbandry with signal success until 1917, he was appointed an emergency demonstration agent for Dodge County, Wisconsin and a year later went to the South Dakota State College at Brookings, as Associate Professor of Animal Husbandry. He had received the M.S. degree in agriculture from the University of Wisconsin in 1916, and earned the Ph.D. degree in 1928. In 1929 he was appointed Professor of Dairying in Oklahoma A & M College.

Victor Emanuel Nelson of Eau Claire, Wisconsin, who had received the B.S. degree in Agriculture from Wisconsin University in 1912, and the M.S. degree in 1914 was, in the latter year made an Instructor in agricultural chemistry in his Alma Mater, and worked faithfully there until 1917 when he was appointed associate chemist in Johns Hopkins University. He worked there until 1919, when he became assistant Professor of Chemistry in Iowa State College, specializing in animal nutrition and physiological chemistry. From 1920-1923, he was Associate Professor, and in 1923 was promoted to full professorship. His work in his specialties proved highly useful and appreciated.

From 1913 to 1916, Asher Hobson, a native of Kansas served as resident assistant in Marketing in the department of Agricultural Economics in the Wisconsin *Agricultural* Experiment Station. In 1915 he had received the M.S. degree in agriculture from Wisconsin University and in 1913 had graduated B.S. in the University of Kansas.

His rise in his line of work was rapid and well earned. After serving as field agent in Marketing in the U.S. Bureau of Markets until 1917, he was appointed Director of Farm Markets for the State of Washington. There he worked until 1919 when he became Assistant Chief in the Office of Farm Management of the U.S. Department of Agriculture. In 1920 he was appointed Associate Professor of Economic Agriculture in Columbia University and worked there until 1922. From the latter year until 1929 he was American Delegate to the International Institute of Agriculture at Rome Italy and then became Economist in charge of the foreign agricultural information service of the U.S. Department of Agriculture, Washington, D.C. In September 1931 he was appointed Chairman of the department of Agricultural Economics in the University of Wisconsin.

In 1914, George Byron Mortimer, earned the degree of Bachelor of Science in Agriculture from the University of Wisconsin and became a member of the staff of the Agronomy department of the Experiment Station. He was reared on a farm near Chilton, Wisconsin and there obtained a practical knowledge of farming which gave him a good foundation for the notable work he was to do in the University. He rose to the position of Associate Professor of Agronomy, and gained a fine reputation as a most capable teacher, who brought inspiration to his students, and as an expert in the various phases of his specialty.

From 1913 to 1918 George Frederick Potter, a native of Madison, Wisconsin and half-brother of the efficient librarian of the Wisconsin College of Agriculture, Clarence S. Hesan B.S. was made an Instructor in Horticulture there. He had received the B.S. degree from the University of Wisconsin in 1913 and in 1916 the M.S. degree; from 1918 to 1920 he served as Assistant Professor of Horticulture, specializing in pomology, and in 1920 was appointed Professor of Horticulture and Horticulturist of the Experiment Station of the University of New Hampshire,

Durham, N. H.

In 1914 James Ambrose James came to the College of Agriculture as Assistant Professor of Agricultural Education. He was born at Livingston, Wisconsin and received the B.S. degree in Agriculture from the University of Wisconsin in 1912. Afterward, he did graduate work at Columbia University and at his Alma Mater. From 1904 to 1910 he had taught in rural and graded schools and was principal of a high school; then, from 1912 to 1914 he was superintendent of Racine County, Wisconsin, Agricultural School. On coming to the University of Wisconsin he assisted in Extension work until 1919. In 1919 he was appointed Assistant Dean of the College of Agriculture and Professor of the department of Agricultural Education and served in that position until 1932 when he was given full time as teacher trainer for agricultural education.

Joseph Frank Wojta who was born at Two Creeks, Wisconsin and reared on a farm, was in 1914 appointed State Leader of County Agricultural Agents in the University of Wisconsin. In 1898 he had obtained the B.S. degree from that University, in 1902, B.S.A. and in 1904, M.S.A. From 1890 to 1896 he taught in rural schools, and was principal of a high-school from 1898 to 1900; then he was made an Instructor in the University of Minnesota in 1902 and served there until 1904, then he was appointed Director of Agriculture and Instructor in Adolphus College where he remained until 1907. From 1907 to 1914 he was the enterprising superintendent of the Menomonee County Agricultural School, Michigan, where his excellent work attracted the attention of Dean and Director Russell and led to his appointment to the Wisconsin University position where he has served with distinction and success.

In the 1914-1915 period we find Edward Richard McIntyre of New London, Wisconsin, who later became an associate editor of the Wisconsin Agriculturist and Farmer, working as assistant to Professor A. W. Hopkins in Agricultural Journalism. Workers

in other departments at that time were: Agricultural Bacteriology: Vermilion
Ernst, Freda Bachman, H. Fulmer and R. L. Primm.

AGRICULTURAL CHEMISTRY: Marguerite Davis, H. A. Drescher: AGRICULTURAL ECON-
OMICS: R. V. Gunn, ^{C.} V. A. ^{V.} June, H. O. Watrud; AGRICULTURAL ENGINEERING: R. A.
Andree, C. J. Griffith, L. M. Schindler, H. V. ^{J.} Lennank; AGRONOMY: T. L. Bewick,
J. I. Ehrhridge, J. J. Garland, H. Lutz: ECONOMIC ENTOMOLOGY: A. C. Burrill, S.
B. Fracker: FEED AND FERTILIZER CONTROL: C. L. Adams, J. C. Jurgens, W. H.
Strowd, HORTICULTURE: J. R. Hepler, R. H. Roberts: POULTRY HUSBANDRY: M. E.
Dickson, J. B. Hayes, O. N. Johnson, SOILS: ^{Guy} Gary Conrey, O. J. Noer, O. R. Zeas-
man, VETERINARY SCIENCE: H. E. Lobbe,

STATION RESEARCH WORK

Soils Experiments

Research work relative to many agricultural problems made satisfactory pro-
gress during the fiscal year. Mr. Truog of the Soils Department, devised a new
qualitative method and apparatus by which the acidity in soil could be much more
accurately determined than by the litmus paper method previously in vogue. It
could be carried out as accurately on the farm as in the laboratory. A new quant-
itative method of determining accurately the total acidity had also been devised
and was being tested. A preliminary examination of the relation of the amount of
phosphorus in the plant to the form of phosphate in the soil, was being made. Pro-
fessor Fred of the Agricultural Bacteriology department and Prof. Whistson and
Mr. ^{Grant?} Grant of the Soils Department had begun a comparative study of problems regard-
ing the relation of soil acidity to nitrogen availability in soils. The problems
were being studied on ^{miami} Miami silt loam, a neutral soil from the Experiment station
farm at Madison and the types of acid soils such as the Plainfield sand from the
Sparta experimental field, the Colbysilt, and acid peat. The management of sandy

soils at the Sparta experimental field by Mr. Ullsperger was showing that these poor soils may profitably be farmed when proper methods are followed. Excellent crops of corn, clover and rye had been grown by the proper use of fertilizers. On the Spooner branch station, where the soil is Plainfield sandy loam, Professor Whitson and Musbach had laid out plats in three year rotations such as would be followed on a grain farm, a dairy farm and a mixed stock and grain farm. Other plats had also been laid out for the comparison of equal money values in phosphorus applied as untreated ground rock phosphate, and as acid phosphate; to determine the value of potassium fertilizers, and to determine the value of lime, applied in addition to rock phosphate and manure. Annual legumes also were being studied. New fields on the Ashland branch station were being fitted for four year rotation work with wheat, oats, clover and corn. At the Marshfield branch station, Professor Musbach was busily working to find the best methods of managing the Colby silt loam soils which cover large areas of Marathon, Wood, Clark, Taylor, Lincoln and Langlade Counties and smaller areas of some other northern counties of the state. The management of marsh soils was being studied by Mr. ^{Ulls}Ullsperger on a farm at Bancroft, similar to tests made by Mr. Weir on a farm at Evansville in 1913, and on another farm at Palmyra. Field drainage problems also were being studied by Prof. E. R. Jones with special reference to the use of vertical drains. He had concluded that essentially the same results can be secured by the use of ordinary tile without the special and expensive drain head. It was becoming more and more evident that in constructing open ditches care must be taken to give the sides a proper slope and to make the ditch of such proportions that it will be self-cleaning, and that the earth removed from the ditch be ^{spread} opened so that it cannot slide back into the ditch.

The Soil Survey being conducted by the Experiment Station in cooperation with the State Geological and Natural History Survey and the Bureau of Soils of the

U.S. Department of Agriculture, had been actively pushed throughout the year, in order to supply maps showing the soils of the northern and undeveloped portion of the state, for the information of prospective settlers. Detailed surveys of Kewanee, Fond du Lac, LaCrosse, Juneau, ^{Wausseau} Waukesha, Iowa and the Bayfield area, covering 7,000 square miles, had been completed to date, and the reports were printed and ready for distribution. The Legislature of 1913 passed a resolution requiring a special examination of the soils of the area within which the State Forest Reserve was being developed. This examination had now been completed as the report was to be presented to the next Legislature.

BACTERIOLOGICAL AND CHEMICAL STUDIES

Professor Conrad Hoffmann had shown that green manures may have a deleterious effect upon some ^{seeds} seeds, notably those rich in oil. Professor Fred continued those studies during 1914. He found that the germination of flax, cotton, soybeans, hemp, mustard and lupines is affected by green manuring, ^{while} white corn, oats, ^{wheat} wheat, buckwheat, and sunflower seeds are not affected in that way. Professor Fred made experiments to determine whether bisulfid of carbon added to soil, facilitates ^{ates} plant growth, as some observers had alleged. He found that the most consistent beneficial results were obtained with plants, such as mustard that demands a large amount of sulphur. A marked harmful effect was, on the contrary, produced by the addition of carbon bisulfid to acid soils. Professor Tottingham continued his studies of the influence of sulphur on the growth of clover. A 20% increase in the clover crop resulted where sulfates were used in green house tests. Professor Peterson continued the work on the form of sulphur in plant materials. He found that ^{seeds} seeds contain practically no sulfates; all of the sulphur present being in organic combination.

AGRICULTURAL ECONOMICS

Professor H. C. Taylor completed, during the year, his study of the problems of marketing cheddar cheese, and foreign types of cheese. He had made a similar study on the marketing of potatoes. Butter was to be studied the following year in cooperation with the office of Markets of the U.S. Department of Agriculture. The Department of Agricultural Economics had also been developing a system of accounting which would enable the farmer to judge of the relative profitableness of his different crops, kinds of livestock and types of farming. Professor Otis had applied the new farm survey method on about 200 farms.

AGRONOMY RESEARCH WORK

Professor Norgard, of the Agronomy department, had been active in introducing hemp culture in certain portions of the state, particularly where noxious weeds were prevalent. The need of better machinery for more perfect and economical handling of the crops and a profitable market for hemp, were problems to be solved. Professor Graber had continued his work with alfalfa and had found seed from Oklahoma and Nebraska equal to that of the northern-grown crops for use in Wisconsin. Cultural trials with different methods of planting, with and without a nurser crop, and efforts at seed production, were in progress during the year. The acreage under alfalfa was rapidly increasing in the State. Plant-breeding experiments were being conducted. Improvement of canning and field peas was a major project. Fifty-nine strains of field and canning peas were being tested on pea-sick soil of the University farms, to test their susceptibility to disease. Immunity from the blight fungus was the chief problem being studied. Mr. Leith continued his studies as various strains of wheat, barley and oats. Mr. James Johnson of the Horticultural department had been making gradual progress in the improvement of his cross of the Cuban and Little Dutch varieties of tobacco.

BRANCH STATION WORK

Professor Delwiche had continued his plant-breeding experiments at the Ashland, Spooner and Marshfield Sub-Station^s. His efforts were being directed to the perfecting of better strains of winter wheats for growth in the Northern counties of the State. Rust had been fatal to most of the spring wheat varieties. He had made available for distribution several varieties of pure line peas suitable for production in those districts. Further testing of corn had been carried on with No. 25 Corn, and other promising varieties. Oats were also tried out with success in all three stations. Excessive rainfall had been detrimental at the Ashland Station. The professor had established successful soy bean growing centers in Burnett, Washburn, Portage and Marinette Counties. At the Spooner Station 50 variety tests were carried out.

Superintendent Malde had been active in his Cranberry development^{work}. The testing of 176 varietal strains of cranberry plants, in the nursery of the Cranberry Branch Station, had been continued and observations and experiments on the various cranberry insects were progressing.

WORK WITH NOXIOUS INSECTS

Professor Sanders of the Department of Economic Entomology, had devised a method of controlling the extremely destructive larvae of the imported onion fly, and during the year had tried it out with several onion-growers. It proved remarkably effective in securing a perfect strand of onions on the farm of N. E. Rasmussen of Oshkosh. The Spray used consisted of one fifth of an ounce of sodium arsenite to a gallon of boiling water sweetened with a pint of New Orleans molasses. During the past summer the tobacco split worm had been found in the state and was being studied. Favorable weather in 1914 had brought out an unusual abundance of many kinds of insect pests. The May or June beetle had been abundant in

← the southern counties of the state so that control of the White Grub became a problem. Grasshoppers, the "cotton maple scale", the "Army Worm" and plant lice or "Aphids" had also kept Professor Sanders busy by their prevalence.

The plant pathologists of the Station had been equally busy in their experimental and control work relative to plant diseases. Fire blight had been severely destructive in orchards and among small fruits. Pea blight, potato diseases and root rot of tobacco were also studied. Cabbage diseases had continued to ^{take} battle an exceedingly heavy toll. Cabbage "Yellows" had become so prevalent that profitable cabbage growing in the Southwestern portion of the state had been rendered very difficult. This disease and club root were therefore causing just concern there and were spreading to other districts. Consequently the research men were seeking methods of control. Cucumber diseases and those of the ^Ginsing plant were also receiving attention. A resistant strain of one of the leading commercial varieties of cabbage for growing on "cabbage sick" soil had now been developed and fairly tested with success by the Plant Pathology departments. Selected seed of this "resistant" strain was soon to be placed in the hands of cabbage growers. Control measures by use of formaldehyde, against onion smut, had been continued with success by the plant pathologists. They had also been studying the influence of drainage on pea blight, and endeavoring to find resistant plants for propagation. Mr. Vaughn of the Department had inspected 10,000 ^{acres} of growing crop under the control of 27 factories. Lack of rotation had been found the chief contributory factor in the production of pea blight.

VETERINARY PROBLEMS

During 1914, the Veterinary department tested about 1,000 head of cattle by the complement fixation method to determine whether they were infected with the contagious abortion disease. Dr. Hadley also made tests of the efficacy of methylene

blue which had been advocated as a remedy for the disease. The results secured were unsatisfactory. Mr. Sherman of the Bacteriology Department examined the milk of 88 cows for the presence of Streptococci supposed to have a relation to septic sore throat of man which is known to be spread among human beings through the agency of milk. He found the germs in about 40 per cent of the samples tested. This made it evident that in discriminate condemnation of milk on the basis of the Streptococci it contained would be manifestly uniform and that differential methods should be devised to enable harmful types of such organisms to be separated from the harmless types. The latter are common in clean milk from perfectly healthy cows.

Professor Beach and Dr. Lothe of the Veterinary department and Professor Halpin of the Poultry department, isolated a bacillus resembling the bacillus causing fowl cholera, when investigating an outbreak in which nearly 2,000 chickens died in less than 10 months. The new bacillus caused death in about 5 or 6 days when introduced beneath the skin of healthy fowls. They believed that this bacillus is present in addition to those causing group or chickenpox, in those cases where the mortality is excessive. A vaccine had been prepared to immunize fowls against the disease mentioned.

DAIRY RESEARCH WORK

Professor Sammis and other experts of the Dairy Department, continued their experimental work relative to the manufacture of cheddar cheese from pasteurized milk, buttermilk cheese, bottle-washing trials, pasteurizing milk in bottles. Leakage of milk bottles, and ice cream experiments, work which had been or was to be reported in the various bulletins of the Station.

POULTRY PROPAGATION

The Poultry Department had extended its work to include wildfowl, and for several years had been wintering a small flock of quail and these birds were being

protected and encouraged on the University farms. Professor Halpin had also made material progress in raising wild mallard ducks. The Poultry department had now a flock of several scores that had been propagated with ease. Their raising was recommended as a good commercial proposition for farmers who have small ponds or streams. Five different varieties of geese were being raised by the department viz.: Tonlonse, Embden, African, White China ^{and} as wild or Canadian. Studies also were in progress on the various methods of fattening geese for market.

The effect of such poisons as lead and alcohol on the vitality of the male germ cells of poultry was being studied by Professor Cole of the Department of Experimental Breeding. He found that the influence of lead poisoning, in the case of the male, distinctly affects the vitality of the offspring. Rabbits were similarly affected. Alcohol was also injurious.

FEEDING EXPERIMENTS

Professors Humphrey and Oosterhous had been continuing their feeding trials with the Station dairy herd to determine whether, under Wisconsin conditions, it would be profitable for dairymen to sell some of their homegrown grains and purchase protein-rich concentrates, when alfalfa and clover hay and corn silage are fed as roughages. The results to date were somewhat favorable to that conclusion. Professor McCollum of the Agricultural Chemistry department had been continuing his studies on the differences in the nutritive value of different fats. The data obtained confirmed the previous results and indicated that lard and tallow, as well as such vegetable fats as olive oil, and cottonseed oil, differs from egg and milk fat. The professor was, in 1914, engaged in an effort to find out the nature of the constituents of butterfat, which is indispensable to growth.

The study of the physiological effect of rations from single plants sources, upon cows subjected to the strain of reproduction, which, for the past seven years

had been conducted by the Departments of Agricultural Chemistry and Animal Husbandry had now been narrowed down to a detailed study of the corn and wheat plants on reproduction. To date no normal calves had been produced by the exclusive feeding of a chemically balanced ration from the wheat plant and its products, while a ration from the corn plant had always produced vigorous offspring. Professor McCollum and Mr. Steenbock had been conducting pig-feeding experiments which made it evident that undue emphasis had been placed by some on the necessity of a balance of acids and bases in the diet of these animals. A similar study of wheat and corn feeding with poultry, had been conducted during the past three years by the departments of Poultry Husbandry and Agricultural Chemistry. Corn, as with cattle, gave the better results. An oat and barley ration ranked midway between corn and wheat in ability to maintain the fowls in a satisfactory condition. Professor McCollum had continued his feeding tests to determine the value of proteins from different sources and had not yet arrived at quite definite conclusions. The value of nitrogen of alfalfa hay for milk production also was being studied by the departments mentioned. Alfalfa had been found to stimulate urine secretion and cause a consequent depression in milk secretion. Further work was in progress to determine the influence of diuretics on milk secretion. The total nitrogen in the cow's daily ration of 16 to 18 lbs. of alfalfa hay was found as effective for building milk protein as an equal amount of nitrogen from the corn plant.

EXTENSION SERVICE

Getting the results of agricultural research work to the farmers of the state cannot fully be done by means of bulletins, circulars and newspaper stories, therefore demonstrations and talks to farmers in person were becoming increasingly necessary. In 1914, the staff members of the Experiment Station were active in that line

of work. Through the passage of the Smith-Lever Agricultural Extension Bill organization of the Extension Service had been made possible. This service had been extended to include not only demonstration work carried out mainly under field conditions, but the County Agricultural Representative System, and educational services rendered mainly through the medium of extension courses, schools, educational trains, exhibits, etc. The extension work done in 1914 included examinations of soils, soil fertility demonstrations, drainage work, crop demonstrations on County and State farms, Seed grain demonstrations, bankers' seed grain contests, young peoples' grain contests, weed eradication, alfalfa work, clover hulling, potato improvement, landscape gardening, sterilization of tobacco seed beds. White grub control distribution of tuberculin, and hog cholera serum, silo construction, sewage disposal, official tests of dairy cows, organization of community live stock breeding associations, butter and cheese^{sec-}~~serv-~~ing exhibitions, farm contests, and instruction by systematic educational work, including extension courses and schools, farmers' institutes, and education trains. Throughout the year Extension staff members also performed the duties of inspection, under state laws, relative to nurseries, feed, fertilizers and seed, and the licensing of public service stations.

STATION PUBLICATIONS

Regular Bulletins Nos. 232 to 240, inclusive, Circulars of Information. Nos. 45~~5~~ to 48, inclusive and Research Bulletins Nos. 30 to 33 inclusive were published during the fiscal year and are briefly reviewed in the following paragraphs:

TECHNICAL BULLETINS OF 1914

The calcium and phosphorus supply of farm feeds and their relation to the animal's requirements was discussed in the first Research Bulletin of 1914, No. 30, by Prof. E. B. Hart, H. Steenbock, and J. G. Fuller. They showed that when growing or breeding swine receive rations wholly composed of grains the amount

of calcium is liable to be nearly or entirely inadequate, so that dangerous conditions threaten. When calcium carbonate or phosphate was added to the ration in the metabolism experiment with growing pigs, the ill-effects of a lime-deficient ration were prevented or offset.

In Research Bulletin No. 31. Prof. James Johnson reported the results of a number of chemical agents he had employed as fungicides in preventing the "damping off" disease of tobacco plants in beds. Sterilization of the soil in the bed by heat proved the most satisfactory method of preventing the disease; but under certain conditions it might be more expensive than the use of formaldehyde solution (formalin) as a fungicide; the heat was applied to the tobacco bed in the form of live steam, as a sterilizer, by the "inverted pan" method.

The same expert, in Research Bulletin No. 32, described the organisms that cause blackrot, shed burn, and stem rot in tobacco, and prescribed measures for their prevention or control.

The comparative efficiency for growth of the nitrogen of alfalfa hay and corn grain was considered by Professors E. B. Hart, G. C. Humphrey and F. B. Morrison in Research Bulletin No. 33. The results of metabolism experiments with growing heifers and dairy cows were discussed. On the plane of intake used the nitrogen of alfalfa hay was as effective as that of the corn kernel.

REGULAR STATION BULLETINS

Fitting Show Wethers

Sheep husbandry always had received much attention from the experts of the Experiment Station and gradually had assumed great importance in the State. Much of the success in popularizing sheep in Wisconsin was to be credited to the excellent practical and demonstrational work done by the able station shepherd Frank Kleinheinz, who, in later years, was made assistant professor in Animal Husbandry. In August 1913, Professor George C. Humphrey and Frank Kleinheinz issued Regular Bulletin No. 232 on the fitting of yearling wethers and lambs for exhibition. The bulletin was profusely illustrated and in addition to

the instructive test presented a table showing the rations fed to University wethers that had won many prizes when exhibited at the International Live Stock Exposition in Chicago. The bulletin told in simple language, how practical breeders should regard show animals, the selection and fitting of wethers for show purposes, their feeding and the results of feeding various grain rations. Instructions also were given for the proper trimming of show wethers, the fitting of show lambs, transportation of show sheep and care and feed at the show. Shepherds were advised to choose sheep, from a well bred flock, that were of proper type and conformation provide all necessary feed and equipment in ample time and begin fitting early. The sheep should be kept gradually gaining and never ^{to} crowded. Their condition and progress should be studied daily and when at the show given the utmost possible care.

Wheat Growing

In Bulletin No. 233 of September 1913, E. J. Delwiche and B. D. Leith outlined briefly the present status of wheat growing in Wisconsin and included reports on the results of experiments which, for six growing seasons, had been carried on at the Experiment Station at Madison and at the branch stations in the different sections of the state. Reasons for the decline of ^{wheat} ~~that~~ growing in the state and growers were advised that the crop should again be produced where the soils are nationally well adapted for wheat culture. The counties where wheat could successfully be produced were listed. The essentials of wheat culture were explained and rotations prescribed; also the way in which the soil should be prepared for the crop; the seed ^{to use} ~~house~~, the time to sow, and manner of seeding, harvesting and threshing. Pedigreed Kaark was recommended for Northern Wisconsin, strains of the Turkey Red type for southern Wisconsin and Blue Stem as an excellent spring wheat, ^{for Wisconsin conditions.}

RURAL SOCIAL CENTERS

In illustrated Bulletin No. 234 of January 1914, C. J. Galpin presented in convincing style a plea for better personal contacts among the farmers of Wisconsin. Isolation and social deficiency of the farmer is a handicap in the development of social institutions in the land. Rural children should be brought together frequently and in larger numbers. To that end, establishment of rural social centers is imperative. On a community scale, the Township High School or Union Free High School is most suitable. Teachers are paid Community social leaders. Combination school houses are sometimes economical. The value of rural club centers, the rural church center and the rural municipal centers was explained and discussed. The author gave it as his conclusion that "If large scale acquaintance--men with men, women with women, children with children--in a rural community once becomes a fact, the initial step will have been taken for assuring the risk of appropriate social institutions on the land of that community".

SOILING CROPS VS SILAGE

For the feeding of dairy cows in summer farmers wished to know whether soiling crops or silage would be preferable. Professors Wall, and Humphrey and A. C. Oosterhuis gave them the desired information authoritatively in Bulletin No. 235 of March 1914. They had fed one lot of cows in the University dairy herd soiling crops and another corn silage for three successive summers and had found that corn silage can be used to better advantage in supplementing poor pasture and in keeping up a uniform and economical flow of milk. Unless an abundance of pasture is a certainty, the dairy farmer should provide silage or soiling crops for summer feed in such quantities as cows will eat without waste. Soiling crops of good quality yield approximately a similar production of milk as does corn silage, but the relative expense of producing and feeding soiling crops is considerably greater than that of producing and ^{feeding} silage. All things considered, therefore, silage was recommended as preferable to soiling crops as summer feed

for cows.

GROWING SOY BEANS

Professors R. A. Moore and E. J. Delwiche, in Bulletin No. 236, of April 1914 advised the growing of Soy beans in Wisconsin for the reasons that the crop is more resistant to heat and drought than are clovers and alfalfa and may be grown on soil too acid for clover. The crop is also important as a soil improver as it gathers nitrogen from the air and stores it in its roots, and, may be substituted as a catch crop for Clover when the latter kills out. It ranks with linseed and cottonseed meal as a concentrated feed for cattle, sheep and hogs. Inoculation of the seed with nitrogen-fixing bacteria is advisable and materially benefits the crop on sandy soils, on where the soil is low in fertility. The authors stated that "Wisconsin Early Black" is best for the northern part of the state, and "Ito San" or "Medium Early Green" for forage. Experiments in breeding were in progress toward further improving and acclimating soy bean for dissemination in the State. The best methods of cultivating the crop were given in detail. Helpful illustrations accompanied the text.

How to control diseases and insects of tobacco was told by Professor James Johnson of the Horticultural Department in Bulletin No. 237 of May 1914. The diseases discussed were: Bed Rot or Damping Off, Root Rot or Black Rot, the Brown or White Rusts, the Mosaic Disease or Calico, Shed Burn or Pale Rot, Stem Rot, Wet Butts or Fat Stem, White Vein disease, Black Rot in sweating, Molds or Masts and a few miscellaneous diseases. The insects discussed were: the Hookworm or Tobacco worm, the ordinary cutworm, Grasshopper pests and some insects of minor importance. Measures of control for each disease and noxious insect were prescribed.

Regular Bulletin No. 238 of June 1914 by Professor B. H. Hibbard dealt with Agricultural Cooperation and Farmers' Companies in Wisconsin, of which, it was

stated, there are over 1,500. These comprised 347 creameries, 290 cheese factories, 35 livestock shipping clubs, 5 fruit exchanges, 40 grain elevators, 609 rural telephone companies and 200 insurance companies. In point of numbers and money handled the dairy enterprises exceeded all other cooperative agencies. Cooperation was defined in the bulletin and prerequisites for its success explained. The author explained how the organization of a company might be effected. The state of Wisconsin would on request furnish all material necessary for incorporation. Legal advice could be obtained free from the State Board of Public Affairs, while specimen copies of constitution and by-laws could be secured from the College of Agriculture. The Bulletin contained a reprint of forms suitable for various types of organization and a copy of the law governing cooperative associations.

Three creamery methods of making buttermilk cheese were explained by Professor J. L. Sammis in illustrated Bulletin No. 239 of June 1914. It was explained by the author that buttermilk cheese is a sanitary food product, that has about the same food value, pound for pound, as lean beefsteak. In addition to ordinary cleanliness with manufacture, the buttermilk used is heated to a pasteurizing temperature of 140° F. or higher, for an hour, during the cheesemaking process. Such pasteurization is sufficient to kill disease germs such as those producing tuberculosis typhoid fever, dysentery, etc. It was advised that buttermilk cheese in the household might be eaten alone or like cottage cheese, mixed with cream, seasoned with salt, mixed with 2 to 5 percent of Spanish pimento, paprika, chopped pickles, olives, nuts or be used in salads. Being smooth, like butter, it could readily be spread on bread and used in sandwiches, with or without butter. The author stated that bakers prefer buttermilk cheese on account of its invariable smoothness of texture, for making of cheese cake and other baking^{ery} foods, in which they formerly used cottage cheese.

Bulletin No. 240 of June 1914 presented the Annual Report of Director H. L. Russell for the year 1913.

INFORMATION FOR FARMERS

Four Circulars of Information Nos. 45 to 48 inclusive, were published in the season of 1914. Of these No. 45 pertained to the distribution of public service stations in Wisconsin. It was the annual report of Dr. A. Alexander on the subject and comprised a directory of owners of licensed stallions, and figures showing the ^{pleasing} decrease in the number of grade and scrub stallions and the desirable increase in the number of sound purebred sires.

In Circulars Nos. 46 and 47 presented lists of feeding stuffs and fertilizers in Wisconsin during 1914. Prof. F. W. Woll and W. H. Stroud together with definitions of the leading feeding materials and general instructions of manufacturers and dealers. No. 47 showed the analyses of feed stuffs offered for sale in Wisconsin, and a copy of the law regulating the industry.

How to rid our farms of weeds was told in Circular of Information No. 48, by A. L. Stone Chief Weed Inspector. He stated that much of the tremendous loss from weeds could be prevented by the simple methods of eradication and control prescribed in the Circular.

ACCOMPLISHMENTS OF THE EXPERIMENT
STATION IN 1914 - 1915

Director Russell's Annual Report for the fiscal year of 1914-1915, was published in May 1916, as Bulletin No. 268. The building program had slowed up since 1913, when the Agricultural Chemistry Building was completed at a cost of \$83,363, a Serum Laboratory at \$2,083, a hog barn at \$3,882, and an addition to the Agricultural Library at \$5,462. In 1914, another hog barn costing \$1,638 had been built and in 1915 an Experimental Breeding Barn was provided at a cost of \$3,000 and a hog cholera serum plant, with equipment, at a cost of \$4,810. The new Soils - Physical Building was in course of erection.

STATION STAFF CHANGES IN 1915

William Allison Sumner, a native of Illinois, who had received the B.S. degree in agriculture from Kansas State Agricultural College, was appointed Instructor in Agricultural Journalism in the University of Wisconsin in 1915. From 1914 to 1915 he had served in a like capacity at the Kansas institution. He was reared on a farm where he had obtained practical information and after graduating gained experience in journalism as editor of the Lincoln, Kansas-Republican. Eminently qualified and successful in his specialty, he served acceptably as Instructor, until 1918, when he was made assistant professor, and in 1923 Associate Professor of Journalism and Associate Agricultural Editor.

JOHN CHARLES WALKER, who was reared on a farm near Racine, Wisconsin, and had obtained the B.S. degree in Agriculture from the University of Wisconsin in 1914, was appointed an Assistant in Plant Pathology and served until 1917. From 1917 until 1919, he was Scientific Assistant in the Office of Cotton, Truck and Forage Crop Disease Investigations, of the U.S. Department of Agriculture. Returning to Wisconsin, he was appointed Assistant Pathologist 1919-20 and then pathologist. In 1922, he traveled in Europe and since that date had been Professor of Plant Pathology in the University of Wisconsin. *and*

resident - ^{agent} ~~agent~~ of the U.S. Department of Agriculture. In 1915, he received the M.S. degree and in 1918 the Ph.D. degree from the University of Wisconsin.

Credit for much of the beauty of the University Campus and grounds about the Agricultural and Farm buildings is due to the skill and vision of Franz A. Aust of Defiance, Ohio who in 1915 was appointed Associate Professor of landscape design in the University of Wisconsin.

AUST obtained the B.S. degree from the University of Minnesota in 1908 and M.S. in 1910. From 1912 to 1913 he was an assistant in landscape design at the University of Michigan and an instructor in the University of Illinois from 1913 to 1915. His specialties, ^{farm} ~~from~~ planning and rural community center planning, found wide scope for useful work in Wisconsin. In 1922 he received the degree of M.L.D. from the University of Michigan.

The Animal Husbandry Department of the University of Wisconsin was strengthened in 1915 by the addition of a notable expert in Gustave Bohstedt, an immigrant from Germany who had become a ^{naturalized} ~~naturalized~~ American citizen in 1912.

BOHSTEDT, received the B.S. degree from the University of Wisconsin 1915 the M.S. in 1916 and the Ph.D. degree in 1925. Serving as assistant in Animal Husbandry in the University of Wisconsin from 1915 to 1916, he occupied a like position in Iowa State College until 1917, when, he returned to Wisconsin as Instructor in Animal Husbandry. In 1918 he was made Assistant Professor and served in that capacity until 1921, when he was made Chief in Animal Husbandry at the Ohio Agricultural Experiment Station and served ^{there} ~~through~~ until 1928, when he returned to Wisconsin University as Professor of Animal Husbandry. He served as Secretary, Treasurer of the American Society of Animal Production from 1921 to 1922 as Vice President 1923-24, and as President 1925. He had farmed in Iowa from 1902 until 1905 and in Texas from 1905 until 1908. Dr. Bohstedt quickly

gained a fine reputation in original research work relative to the nutrition of swine and other farm animals, the results of which will appear in our summaries of the bulletins of the Station. It may also be of interest to mention here that he was an able athlete and rowed in the Hudson River regatta at Poughkeepsie, N.Y. when a Freshman, as No. 2 in the University crew of 1912, and as stroke on the Varsity in 1913, and 1914, and won numerals and "W's" in the corresponding years.

Another able man to join the Station staff in 1915 was Andrew Hamilton Wright, who was reared on a farm near Mankato, Kansas. He received the Bachelor's degree in Agriculture from Kansas State College in 1908 and the Master's degree from the University of Wisconsin in 1915. From 1910 until 1914 he was Assistant Agronomist in the Oklahoma A. & M. College and came to Wisconsin as Associate Professor of Agronomy. His specialties were fibers and special crops. From 1916 he was Secretary of the Wisconsin Hemp Order and did much to advance the interests of that crop in the State. He was one of the great athletes in the Southwest Association during the years 1904-1907. In 1906 he broke the Southwest record in the half mile, running it in 2:00 minutes flat. Others assisting in the work of the Experiment Station in 1915 were C. E. Lee in Dairying, R. S. Goodhue, in Soils and J. O. Rankin in Agricultural Journalism. Later, Mr. Rankin was Associate Professor of Agricultural Economics in Iowa State College and in 1918 was appointed Associate Professor of Rural Economy and Sociology in the University of Nebraska.

PROGRESS IN EXPERIMENTAL WORK

Relative to work being done in Experimental Breeding Director Russell said in his Annual Report for 1915, "Man has ^{remodeled} ~~rendered~~ so completely that in many cases the links between the first forms and the present type can scarcely be traced. Keen observers have here and there done wonders by trying to unite this or that combination. The failures have dropped out and the successes re-

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remain as a monument to their painstaking work. It has taken thousands of years to accomplish the results so far obtained, and the pertinent question is, "whether future advancement is yet to be made?"

The Station workers evidently believed that much research work remained to be done with good promise of the discovery of vital facts in the various lines studied. They had been busily engaged in 1915 and had accomplished much, as was shown by their reports in scientific publications research bulletins and those prepared for the information of farmers.

The Experimental Breeding department had especially concerned itself with the study of the factors governing the inheritance of certain characteristics of both animal and plant life. In working out these principles, the smaller laboratory animals, such as the rat, the rabbit, the guinea pig, and the pigeon, had been found better adapted than the larger domesticated types. The Departments of Agronomy and Horticulture, on the plant side, and Animal Husbandry and Poultry, on the animal side were equally interested in seeking to utilize the principles of inheritance in the perfection and improvement of existing types. Advance in this field necessarily was slow, but the practical worth of such study had already been made apparent by the substitution, in large measure of pedigreed stocks of plants and animals for the mongrel, and scrub varieties prevalent a generation ago in Wisconsin.

AGRONOMY WORK

The Agronomy department continued its tests of rye which, for 14 years had been in progress. The improved variety known as Pedigree No. 1 was proving especially promising and on a Rock County farm, in 1915, produced $46\frac{1}{2}$ bushels to the acre, or $14\frac{1}{2}$ bushels an acre more than the common varieties grown under the same conditions. Professor E. J. Delwiche at the Ashland Branch Station had continued his wheat improvement work. A cross between Minnesota 169 and Red Fife, made by him, had produced excellent results. Some 250 bushels of

pure line spring wheat had been distributed for seed in the Spring of 1915. More than 400 acres of pedigreed winter varieties of wheat had been grown in that year. Pedigree No. 2 winter wheat, of Turkey Red types, in 30 growing tests made by Professor R. A. Moore and B. D. Leish on the Station farm, yielded 49.6 bushels an acre and a ^{Marquis} ~~Marquis~~ spring wheat 43 bushels an acre. Milling and baking tests were conducted with 21 samples of the 1914 crop. Pedigree No. 2 winter wheat in these tests, gave fully as good results as did the standard spring wheats noted for producing the highest grade of flour. The Wisconsin spring wheats also analyzed higher in gluten content, than did the varieties used in standard spring wheat patent flours.

The improvement of canning and field peas had been progressing at Madison and at the Ashland Branch Station. Several hundred varieties had been selected by R. E. Vaughan and tested for resistant powers against pea diseases. Advancer, Horsford's ^{Market Garden} ~~Jardin~~, and Richard Leden varieties proved most resistant. Admiral and Premium Gem were discarded on account of their inability to resist the blight fungus.

Professor C. P. Norgard continued his efforts to have hemp grown as a field crop. In 1914 between 400 and 500 acre had been planted to hemp and in 1915 the resultant crop was sold for \$12,000. Professor L. F. ^{Graber} ~~Becker~~ made comparative trials of more than 200 varieties of alfalfa, and found that the common purple-flowered varieties from Kansas and Nebraska seed had withstood winter killing quite as well as the alfalfa from northern grown seed. Professor Delwiche found that the Superior district Pedigree No. 4 and White Jewel varieties of oats were least liable to lodging which is a common defect on heavy soils. Experiments showed that Sudan grass was promising as an annual forage crop for use in Wisconsin.

ANIMAL BREEDING

The Experimental Breeding department continued the work done in 1914 relative to the effect of poisons such as lead and alcohol on the germ cells of the male, with the same results obtained that year. Work on the inheritance of epilepsy in guinea pigs showed that the disease is inheritable and follows Mendel's Law.

H. L. IBSEN studied the growth of guinea pigs in embryo and after birth. He found that the first and last embryos invariably were larger than those in the middle of the same born of the uterus and that the "titman" or runt of a litter of pigs always is found in the middle of the row of young in the uterus and is not the last one born, as commonly has been believed. Practical breeding problems with poultry, relating to comparative fertility and hatching power of eggs from pullets and hens, the effect of heating eggs held for hatching, and the relative efficiency of dried and liquid buttermilk in poultry fattening were studied jointly by the Poultry and Experimental Breeding Departments. Results were to be reported the following year. Professor Halpin reported that Rhode Island Reds were beginning to show detrimental results, in the experiments being conducted by the Poultry department to determine the influence of class in breeding.

HORTICULTURE AND PLANT PATHOLOGY

The Horticultural department made observations on root killing of apple trees, and accumulated data on soil temperatures throughout the winter. They experts found that cover crops, which held the snow, aid in preventing winter killing and that the roots arising from scions of hardy varieties can withstand greater cold than roots of equal size developing from the stock. There was considerable difference in the ability of scion roots of different varieties to resist low temperatures. Scion roots of Wealthy were much hardier than those

of the Northern Greening. Ordinarily, however, no scion roots are produced the first year. Little^{le} reliance could be placed upon the development of scion roots by young trees as a factor to enable the tree to resist winter conditions.

The root rot of tobacco had been ^{found} ~~formed~~ by far the most serious disease of that plant. Professor James Johnson estimated that the annual loss during the last 3 years in Wisconsin alone had been one million dollars. The disease is caused by the fungus Thielatia basicola. There were two possible methods of controlling the disease; viz. planting only healthy plants in healthy soil, and growing disease-resistant strains. The endeavor was being made to develop a resistant strain suitable for Wisconsin conditions. An old grass sod well fertilized usually gave the best results in respect to controlling root rot.

The Plant Pathology department had established a temporary field laboratory at Sturgeon Bay, in Door County, for the study of orchard and small fruit diseases and their control; one at Waupaca in cooperation with the U.S. Department of Agriculture for the investigation of potato diseases, one at Princeton, Green Lake County; for the study of cucumber diseases, and one, at Racine for the investigation of truck crop diseases prevalent in Southeastern Wisconsin. Alfalfa troubles were also being investigated. ^{Distinct} ~~Distinct~~ fungi were suspected as the cause of a number of different types of leaf and smut buf-spotting and a study of the problem was in progress. Control of barley diseases, and especially of so-called "stripe" disease and net blotch disease was being sought by Professor A. J. Johnson in cooperation with the U.S. Department of Agriculture. Seasonal conditions appeared to have a considerable influence on the production of these diseases. Formalin had given the best results as a disease controller for both the stripe diseases and loose and covered smuts. The Plant Pathology department had continued its work in the development of "yellow" resistant seed from the strains of Hollander and Danish Bala Head cabbage. One hundred pounds of seed from stock found resistant in

1914 had been produced and was to be distributed among cabbage growers the following spring. In some cases, as much as 8 ounces of seed had been secured from a single head. Leading cabbage growers had been invited to cooperate in the production of rot-proof seed. J. C. Gilman (Plant Pathology) ^{discovered} discussed that the growth of the "yellows" parasite organism is greatly increased at temperatures above 64° F. which explained why the disease was so much more severe in a warm summer like that of 1914, in comparison with a cool season such as that of the summer of 1915. The Pathology Department continued its investigation of diseases affecting the canning pea crop and cucumber crop. The wilt, angular leaf spot, anthracnose, and scab diseases of the cucumber were prevalent and belonged to the parasitic group. The so-called "white pickle" or cucumber mosaic, was the worst malady, as it resulted in the formation of a deformed fruit that is wholly worthless for pickling purposes. No parasite had, as yet, been discovered in connection with this disease.

STATE SOIL SURVEY

The year 1915 saw the completion of the preliminary survey of the soils in the northern part of the north-central area of Wisconsin including the counties of Iron, Price, Vilas and Oneida Counties, and the eastern part of Ashland County. Work, to be finished in the winter of 1915, had been in progress in the southern part of the North-Central area, including Clark, Taylor, Lincoln, Marathon and Wood Counties. During the past season the surveys of Buffalo, Wood and Portage Counties had been completed and that of Rock County begun. The reports on Jefferson and Columbus ^{ia} counties and of the preliminary survey of the Northeast section were to be issued the coming summer.

SOIL MANAGEMENT

Trials were made during the season by the soil department at the Marshfield Branch Station, on the fine-grained and poorly drained Colby silt loam to determine the effect of deep plowing and sub-soiling. Beneficial results were noted. Work had been discontinued in the study of exhausted, coarse, sandy soil near Sparta. The 10 year lease of land used there having expired. Work on sandy loam soils was in progress at the Spooner Branch Station. It had been found possible to make such soils productive by building them up by the turning under of green crops etc. Tests made by W. W. Weir (Soils) in the Greenhouse and in cooperation field tests, ^{showed} ~~observed~~ that mine "tailings" which are rich in lime are of some value as a corrector of soil acidity and being an entirely waste product might perhaps be used to some advantage on the land in the ^{mining} ~~running~~ region of southwestern Wisconsin.

E. B. Fred (Bacteriology) and E. J. Grant (Soils) carried out experiments which showed that while the nodular organisms may be found in acid soil, a decided increase in the ^{of} field of hay, as well as in protein, followed inoculation. The preliminary results obtained indicated that partial neutralization ^{leads} ~~tends~~ to the fixation of nearly as much nitrogen as is fixed when sufficient lime is applied completely to neutralize the soil.

The experts just mentioned also studied the rate of formation of nitrates in the neutral Miami silt loam of the Station farm, the acid Plainfield sand from Sparta, and the Colby silt loam and acid peat from Wyville. In all these soils, acid or neutral, organic nitrogenous material was converted ^{erted} into nitrates. The addition of sufficient limestone to neutralize soil acidity stimulated the nitrification of gelatin and casein; but later these limed soils showed a reduction in the amount of nitrates. A study made by the Bacteriology

Department on the effect of green manuring on the germination of certain seeds showed that seeds rich in oil were greatly injured when sown in the presence of green manures like clover. It disappeared in the course of two weeks. Further work showed that sterilization of the soil prevented the injury. In 1915, it was found that a soil fungus (*Rhizoctonia*) ^{caused} ~~carried~~ the injury and that it dies after the green manure undergoes fermentation.

The Agricultural Economics department, Chief, B. H. Hibbard, made a particular study of farm credits in 1915. The studies were made in Dane County, long developed and in Rusk County where relatively pioneer conditions attain. "The average interest ratio paid by Dane farmers on mortgage indebtedness, was 5.13 percent and in Rusk County 7.25 per cent. He advised that longer periods of time for available loans, then the customary 3 or 5 years, would be an improvement; also the extension of personal credit longer than the customary 4 months for commercial papers at the banks. ^{Butter} ~~But~~ the marketing investigating ^{low} were also carried out. by Professors Hibbard and Hobson in cooperation with the Office of Markets of the U.S. Department of Agriculture. The study included the organization of creameries, methods of fixing the prices for butter after purchased, and the shrinkage of butter in transit to the wholesale markets. The quality of butter as it was handled at that time, did not appear to result in a material difference in price. Uniformity of the product adherent to the package and the advertising given to the product ^{care} ~~approved~~ to be vitally important in determination of the price.

DAIRY EXPERIMENTAL WORK

Experiments were made by Professor J. L. Sammis (Dairy) in 1915, to extend the method of pasteurizing milk for cheese-making purposes by use of the "holding" instead of the "flash" method of heating. The tentative results secured indicated that a product of good quality can be made, and also pointed to the possible elimination of the method of acidulating the milk for the restoration of its coagulating power with rennet, as had been found necessary by use of the

flash method of heating. Further trials of the originally recommended system, by commercial concerns, had been altered with success. Experiments were also made with reference to the application of the method to the manufacture of brick cheese. By a modification of the details of the process, an improvement in the flavor of the product was secured, gas producing bacteria were eliminated, and an increase in yield obtained. Trials were under way with experimental lots of cheese branded in such a way that the consumer could trace the origin of the product. The trials aimed to determine the quality of the cheese ^{after} the storage, and the attitude of the market with reference to the use of the brand.

PLANT NUTRITION

W. E. Tottingham (Agricultural Chemistry) extended his previous work relative to the influence of sulphur on the growth of clovers. He found that oats and barley were materially helped, especially in seed production, by an increased supply of sulphates. The effect was less marked than with ^arape and clover. The influence of elemental sulphur, while sometimes beneficial, was found often to exert a poisonous effect. W. H. Peterson, of the same department, found that application of sulphates to the soil increases the volatile compounds in such sulphur ^abearing plants as the radish and cabbage. E. V. McCollum (Agricultural Chemistry) fed young pigs on many rations in which either a single feed, or two or more feeds, mixed in various proportions, supplied protein. The proteins of milk were found most efficient for growth. The proteins from the cereal grains had an efficiency of only 23 to 28 percent, and linseed meal, fed alone, only 18 percent. When three-fourths of the protein came from corn and one fourth from linseed meal, The efficiency was increased to 37 percent. No better results were secured when wheat and wheat embryo were combined, than when each was fed separately. Each feed evidently was deficient in the same amino acids, and one could not supplement the *others*.

E. B. HART (Ag. Chemistry) and G. C. HUMPHREY (Animal Husbandry) found in metabolism experiments with dairy cows that proteins from various sources are likewise of different worth in milk production. Such complete proteins as are furnished by milk proved of high efficiency for milk production.

During the past year Professor McCollum found that not only are fat soluble substances found in egg yolk, corn grain, wheat embryo and the softer portion of beef fats necessary in the diet of animals for continued growth, but another class of substances which are soluble in water, the nature of which had not yet been discovered, were likewise required. These substances had been found, thus far, in egg yolk and wheat embryo and probably were present in corn. Growing rats fed a ration of highly purified casein, egg albumin, dextrin, mineral matter, and butter fat, failed to grow. Normal growth took place when the water extract of wheat embryo was added.

PROFESSORS E. B. HART and E. V. MCCOLLUM carried on experiments with growing pigs, kept in pens away from the soil, to determine the influence of strictly vegetable diets on growth and reproduction. Fed on a mixture of oats, corn, wheat, and oil meal pigs failed to grow; after about 3 months, even when sugar beets and alfalfa hay were supplied 2 or 3 times a week. When but 1 percent of meat scrap was added to the ration, the pigs grew normally. In another experiment, finely ground alfalfa meal, added to the vegetable ration, caused good growth. Alfalfa otherwise did not supply the deficiency.

J. L. TORMEY (Animal Husbandry) carried on feeding trials to study the value of corn silage for fattening Beef cattle. In all cases, the addition of silage to the rations for fattening steers lessened the feed cost, although a heavy concentrate allowance, with less silage, produced more rapid gains. The experiments showed that where a limited amount of cottonseed meal was added to the common wintering ration of corn silage and mixed hay, the steers made good gains without becoming too fleshy to make economic gains on grass. The results would have

been somewhat better had clover or alfalfa hay been fed.

EXTENSION SERVICE

The activities of the Agricultural Extension workers in 1915, were along the same lines as those mentioned in the history for 1914. Farmers throughout the state expressed their appreciation of the demonstrations in various fields. One man said: "You lifted us away from ourselves, gave us new incentives, new ambitions, and new thoughts". Encouraging farmers to keep accounts of their business was one of the useful efforts of the Agricultural Economics Department. The Experiment station cooperated with the U.S. Department of Agriculture in holding a series of 50 meetings in 19 counties of the State, in which the subject of hog cholera and its control was discussed with ^{over} ~~our~~ 5,000 farmers. Seven new breed associations were organized during the year. Many conferences were held at creameries and factories. At Hollandale a creamery was organized for the purpose of churning whey cream secured from a number of cheese factories, thus utilizing ~~wheat~~ previously had been wasted as a by-product. Two cooperative laundries, for creamery and other laundering, were studied by the Dairy department. These laundries had proved convenient, successful and a boon to farm women. The Economic Entomology department began the work of developing and distributing queen bees. Although the work started late, 126 queens were sent out to bee keepers in 12 counties in Wisconsin. Efforts were to be made the following season to increase materially this number. As manufacturing companies and numerous local contractors were now supplying forms for silo construction the Agricultural Engineering department decided to discontinue this service for the state at large. The forms on hand were to be used, until worn-out, in some of the more thinly settled counties in upper Wisconsin, under direction of the county agricultural representatives.

PUBLICATIONS OF 1915

During the fiscal year of 1915, 14 general bulletins, 2 research bulletins and 6 circulars of information were issued by the station, and are briefly reviewed 204

in the following paragraphs:

RESEARCH BULLETINS

Two technical or research bulletins were published by the Station in 1914-1915. The first of them was No. 34, by Prof. C. J. Galpin, and dealt with the Social Anatomy of an Agricultural Community. Walworthth County, Wisconsin, was the community surveyed and the results were presented in Part I. In Part II the general problems of typical agricultural communities were discussed. Eleven illustrations accompanied the text.

Research Bulletin, No. 35, by Professors E. B. Fred and E. B. Hart reported the results of experiments they had conducted relative to the comparative effect of phosphates and sulphates on soil bacteria. They found that phosphates cause a much greater increase in bacterial activity than do sulphates; and suggested that possibly the increased crop production of a soil results^{ing} from the application of soluble phosphates is, in part, due to the stimulation of bacterial activity

REGULAR STATION BULLETINS

Improved Dairy Tests

A description of a few new appliances which had been devised and methods tried, in the daily manufacture of dairy products at the University creamery, was presented in Bulletin No. 241, of July 1914. The authors were G. H. Benkendorf, A. T. Bruhn, A. C. Baer and Prof. J. L. Sammis. The text gave the facts regarding an ice cream over run test, a burette for calibrating Babcock test bottles, a wire cutting knife for cutting cheese curd, an attachment for the milk sediment test and cheese making tests with homogenized milk. Explanatory illustrations accompanied the text.

Pork Production

In Bulletin No. 242 of September, Prof. J. G. Fuller advised how hogs might properly be handled, on most Wisconsin farms, so as to pay a profit. He explained the importance of the lard type of hog and also discussed the bacon type hog and mentioned the large Yorkshire and Tamworth breeds as best illustrating the type, while the Poland-China, Duroc-Jersey, Berkshire, and Chester White are known as

lard hogs. How to select a breed was advised and a score card for swine of the lard type presented. The bulletin was essentially practical to make it of great importance and usefulness to farmers. It gave plain advice how to care for the boar, select brood sows, and attend to their mating. Their advice followed, relative to caring for hogs in the breeding season, the sows at farrowing and the pigs, from birth onward. A ^{gestation} fistation table for swine also was given, and how to mark litters explained. Rations, feeding and housing methods then were fully considered and plans for the erection of hog houses of various types illustrated. Treatment for lice and worms was prescribed.

TUBERCULIN TESTING

Prof. E. J. Hastings, bacteriologist, in Bulletin (No. 243 of October 1914) gave in detail an interesting and instructive account of what had been done to date, with the tuberculin test for bovine tuberculosis in Wisconsin. The bulletin especially summarized the work carried on in the state during the years 1909 to 1912, inclusive, previous work having been summarized in Bulletin No. 24 of 1901 and Bulletin No. 175 of 1908-9. It also reviewed the methods that had been used in applying the tuberculin test. The subjects dealt with included: factors influencing the use of the test, history of the test in Wisconsin, increase in testing, law pertaining to the test, disposal of reacting animals, compensations, professional and non-professional testing and the cause and occurrence of no-lesion and of non-reacting animals.

INFORMATION ON DAIRYING

Regular Bulletins Nos. 244, 245 and 246 pertained to the dairy industry. No. 244 of March 1915 by Professors E. H. Farrington and G. H. Brukendorf gave full information about the organization and construction of creameries and cheese factories and presented many illustrations relative to the subject. The various

forms of factory organizations were explained and instructions and sample articles of incorporation furnished. Creamery plans and details regarding equipment followed, and also a sample inspection card for creameries and cheese factories. In Bulletin 245 of February 1915. Prof. Farrington and G. J. Davis Jr. gave instructions for the proper and sanitary disposal of creamery sewage. Plans for a disposal plant were offered and particulars given about methods for purifying sewage. An estimate ^{of} the cost of disposal also was made. In Bulletin No. 246 of January 1915, Prof. J. L. Sammis told how whey butter could be made at Cheddar Cheese factories and fully explained the approved methods of manufacture. Suitable illustrations accompanied the text.

FARM CREDIT IN WISCONSIN

Prof. B. H. HIBBARD and FRANK ROBOTKA in Bulletin No. 247 of January 1915, gave the results of a careful survey of Dane and Rusk, and in part of Douglas Counties, Wisconsin relative to the need of farmers for additional capital from banks, loan agents, insurance companies and private individuals. The number of mortgage farms was increasing, but tenancy was relatively low. Land contracts, included with mortgages were an important kind of land credit. Personal credit was more imperatively needed than land credit, which was comparatively easy to secure at 50 percent of the value of the land. The need was most acute in the northern counties of the state. A law providing for farmers' credit was proposed. An amortization plan and table was furnished by Prof. E. B. Skinner of the Department of Mathematics of the University.

STRAWBERRY CULTURE

PROF. J. H. MOORE of the Horticultural department in Bulletin No. 248 of March, 1915, offered expert advice and information regarding the essentials of successful strawberry culture. Useful illustrations showed the best methods of planting and plates showed the standard varieties of strawberries and also of some of the newer varieties. The grower, in order to succeed, was advised to

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TESTING SOIL FOR ACIDITY

PROF. E. TRUOG, in Bulletin No. 249. of February 1915, described a new test he had devised for the testing of soil acidity. Illustrations of the apparatus were given, together with rules for its correct use. A colored plate or chart showed the varying degrees of acidity, such as very slight, slight, medium acidity, strong acidity and very strong acidity. The color produced ~~on~~ the test paper employed was to be compared with the tints on the chart in order to determine the degree of soil acidity. The author stressed the need of lime to neutralize acidity and cited readers to Bulletin No. 230, on Soil Acidity and Liming by Prof. A. R. Whitson and W. W. Weier for full information on that subject.

Bulletin No. 250, of April 1915 comprised the Annual Report of Director Russell for the year 1914.

PRICES OF CHEESE

In Bulletin No. 251 of April 1915. Prof. B. H. Hibbard and Asher Hobson discussed markets and prices of Wisconsin cheese. A number of illustrations tables and graphs added to the educational value of the treatise. It showed that Swiss, brick, and limburger cheese was being made in a very restricted territory, mainly in Dane, Dodge, Green, Iowa and Lafayette counties. More than half of the factories making these cheese are cooperative. The Sheboygan County Cheese Pro-

ducers' Federation was organized in 1913 and began business in April 1914. It is composed of 48 local cheese factories. In 1913 the average payment per 100 lbs. of milk received by the farmer at the factory was from \$1.29 to \$1.33. The cost of manufacturing a pound of cheese was from 1.2 to 1.75 cents. The storage charge was one-eighth of ⁴ cent per pound, per month, and freight charges for transporting cheese to destination points outside of Wisconsin was from \$.20 to \$2.50 per 100 lbs. The dealer handling the cheese gets a margin of about 1 cent a pound, the wholesaler about 2 cents, the broker from one-eighth to a quarter of a cent, and the retailer from 5.5 to 9 cents. The authors stated that the farmer gets about half of the money paid by the consumer, the remaining half going to pay distributing costs. Producers, and consumers are too far apart. Community effort is needed in standardizing, branding and marketing.

CERTIFIED POTATO SEED

In Bulletin No. 252 of April 1915, Prof. J. G. Milward discussed potato seed certification in Wisconsin. He stated that during the summer of 1914, a plan of official inspection and certification of potato seed stock had been inaugurated in Wisconsin under the direction of the Horticultural Department of the Experiment Station and gave promise of greatly protecting and developing the potato growing industry of the state. The original proposal of certification was made by W. A. Orton, plant Pathologist of the U.S. Department of Agriculture and Professor William Stuart, Horticulturist of that Department. A copy of the certificate accompanied the text.

Bulletin 253 of June 1915 by W. H. Strowd presented some facts about concentrated feeds and a list of commercial feeding stuffs licensed for sale in Wisconsin in 1915. A table also gave the analyses of licensed commercial feeding stuffs, in percentage, for 1914.

State Seed inspection and Weed Control accomplished in 1914, was reported on by A. L. Stone in Bulletin No. 254, of April 1915.

The text including an instructive illustrated section on various common seeds and a description of each. A copy of the law prohibiting the sale of noxious seeds, and relative to the misbranding of agricultural seed, also was printed. Samples of seed might be sent to the State Seed Inspector, Agronomy Building, University of Wisconsin for analysis and report. A fee of twenty-five cents for each sample tested was fixedly the law.

POPULAR BULLETINS OF ¹⁹¹⁴⁻1915

Circulars of Information Nos. 49 to 54 were published during the fiscal year ending June 30, 1915. Of these No. 49 contained the annual report of Professor F. W. Woll and W. H. Strowd relative to the content of licensed commercial fertilizers sold in Wisconsin. Information regarding the essential ingredients of a standard fertilizer were ~~given~~ ^{given}, together with a copy of the law governing the sale of commercial fertilizers in Wisconsin.

Circular No. 50 contained Dr. A. S. Alexander's annual report on the distribution of public Service Stallions in Wisconsin during 1914. It was reported that steady progress was being made in the elimination of grade and scrub sires and substitution of sound pure bred sires in the state.

Circular 51 by Prof. C. J. Galpin and C. W. Davies discussed the subject of social surveys of rural school districts. They stated that a social survey made by the children of a district school is of value to the community, besides helping teach the children civics, agriculture, geography and history.

The control of potato diseases in Wisconsin was discussed by Prof. L. R. Jones in Circular No. 52. It presented valuable information about the more important parasitic and non-parasitic diseases and the various insects affecting the potato, and prescribed effective control measures. The author also stressed the danger accompanying the introduction of unclean seed from other sections of the country.

In Circular No. 53 the judging of draft horses was explained in detail by Dr. A. S. Alexander, and information about the common unsoundnesses of horses given. The text was made readily understood by some 44 accompanying illustrations.

Questions about hog cholera were asked and answered instructively in Circular 54 by Dr. F. B. Hadley. Six Poster Bulletins also were issued during the year and had the following titles: Help Keep these diseases out: Plant Standard Potato Seed. Prevention and Control of Hog Cholera: Help fight these weeds: How do you market your crops?; Improve sandy soils.

WORK OF THE EXPERIMENT STATION IN 1915-1916

During the fiscal year, as told by Director Russell in his annual report which was published as Regular Bulletin No. 275, in January 1917, much time had been spent and money spent by the Experiment Station in studying problems relative to the feeding of farm animals. This had been warranted by the predominating position attained by the livestock industry and in consideration of the fact that the profits from live stock farming depend fully as much upon a thorough knowledge of the value of the different feeds and methods of feeding for the various classes of farming. This was more especially the case since feeds, lands, and labor had become high in price.

The early investigations of the experiment station in animal feeding were largely confined to comparison of the results secured with various combinations of the farm-grown grains and roughages and the common milling by-products, when fed to the different classes of animals. The results of experiments in that direction had been adopted in practice by progressive farmers and, for them, the simpler problems of stock feeding had been solved. The efforts of the research workers were, therefore, now being devoted to the acquiring of a more complete knowledge of the fundamental principles underlying the science of nutrition. In this work the department of agricultural chemistry had, for some years, been especially active and the discoveries made by Dr. E. V. McCollum, Prof. E. B. Hart, and their co-workers in that branch of research work, had already commanded wide attention.

Dr. McCollum's work had chiefly related to the study of the growth-promoting substances essential in food and he had been continuing his laboratory work in that time. He had found that "vitamines" are needed in addition to the well known protein, carbohydrate and mineral nutrient elements in feed. One of these new elements which proved soluble in fats and oils, but that could not be extracted from all foods by ether be proposed to call the fat-soluble A until its exact

chemical properties could be discovered. His results had furnished the first definite proof that butterfat has a food value not possessed by the fats of plants used for human food as substituted for butterfat. He had found, too, that when animals have reached their growth they apparently no longer need any large amount of fat soluble A. for their own bodies; and that the producing female fed a ration in which there is relatively little of fat-soluble A. is able to concentrate the amount in the food into her milk, thus producing a food for her young which is much richer in this substance than was her own ration. Dr. McCollom had also discovered another element which he had called water-soluble B. which is needed for growth and also for the maintenance of adult animals. The substances he had found necessary are widely distributed in the vegetable food stuffs, as well as in meat, eggs, and milk, but they are not present in starch, refined sugar, the plant fats, and polished rice. The disease of the Orient known as "beri-beri" is due to a lack of the two necessary elements worked with by Dr. McCollom. Rats had largely been used in these feeding experiments which had numbered nearly 1,000. The findings obtained were tested on farm animals to determine the practical application to animal feeding.

Prof. H. Steenbock had determined by experiments, that the properties of water-soluble B. are not destroyed by heating in neutral or acid solution, nor by treating with dilute alkalis at room temperatures; but they are readily destroyed by very alkalies, but not in acid solutions at such high temperatures as 240^{to}250F.)

Prof. E. B. HART (Chemist) and Prof. G. C. HUMPHREY (Animal Husbandman) had continued their metabolism trials with dairy cows. In the previous year they had tested the efficiency for milk production of corn protein, wheat protein, and

milk protein, when added to a basal ration of corn stover. During 1916 he had conducted similar trials to determine the efficiency of gluten feed, dried distillers' grains, and old process linseed meal, when added to a basal ration of corn meal, corn stover and corn silage. For comparison casein and skim-milk powder were also tested. The results were that gluten feed showed considerably lower efficiency than linseed meal, distillers' grains and either casein or skim-milk powder. Similar trials were to be made to determine whether the same results would be obtained with other roughages, such as alfalfa and clover hay.

Earlier work, already reported, had shown that excessive feeding of wheat causes decidedly injurious effects upon cattle and swine. Further trials made in 1916 by Professors Hart, McCollum and Humphrey showed that the ill effect of wheat feeding is cumulative. Ill effects do not appear during the first gestation period, but when fed for two consecutive periods or longer the offspring shows the poisonous effect of the wheat grain, being born blind or weak. It was decided that the wheat embryo contains something of a poisonous nature, although being otherwise excellent for growth and containing a large amount of the diet necessity water-soluble B. and a moderate amount of fat-soluble A. The chemical nature of the poisonous element was yet to be discovered.

When swine were fed a ration of wheat meal, wheat gluten, butter fat and suitable salts they failed to grow and lost weight after 9 months, on account of the poisonous effect of the wheat embryo in the ration. Finally, they showed difficulty in moving about, labored breathing and muscular twitching.

The results secured from ^{feeding} ~~feeding~~ chickens on rations restricted to corn, wheat, oats, or barley had been strikingly different from those secured with cattle or swine, which do not grow or reproduce on a wheat ration. The experiments with such rations for poultry had been made by Prof. J. G. Halpin (Poultry Husbandry) and

and Profs. Hart and McCollom. With pullets, the death rate was higher on the wheat ration, but most individuals apparently did as well on the wheat ration as on the corn ration, growing normally and producing fertile eggs. Apparently, chickens were able to withstand or overcome the toxic effects of the wheat embryo. Milk had been found of high value for young chicks.

The effect of a scanty lime supply on egg production was studied by Prof. Halpin and by H. A. Drescher (Agricultural Chemistry). A lack of lime did not produce soft-shelled eggs, although the contrary was expected. A scanty supply of calcium, however, seemed to decrease the egg production. It was concluded, therefore, that a lack of egg production in many farm flocks during the late winter months may be due to an insufficient supply of calcium.

The effect of straw as a winter roughage ration for growing dairy heifers was studied by Professors F. B. Morrison, A. C. Oosterhaus and G. Bohstedt (Animal Husbandry). Two lots each of 9 dairy heifers were fed for 98 days. One lot received a balanced ration including alfalfa hay and corn silage; the other lot was fed 7 lbs. of oat straw per head only, along with corn silage and a concentrate ration. The heifers at only 4.5 lbs. of the straw daily. The heifers fed alfalfa hay and silage gained 0.97 lbs. per head daily, those fed straw and silage gained 0.93^{lbs.} per head daily and were just as thrifty as the others at the end of the trial. The ration containing straw was considerably cheaper than the other. The indications were that straw may often be used satisfactorily and economically, along with silage and protein-rich concentrates, for growing dairy heifers.

Horses fed crushed versus whole oats by Prof. J. G. Fuller (Animal Husbandry) had shown little advantage from crushing. Further experiments on the subject were made in 1916 by Profs. Morrison, Fuller and Bohstedt during spring and summer. During the trial the horses fed crushed oats lost 38.5 lbs. in weight on the average, while those fed whole oats lost only 8.3 lbs. It was concluded that unless oats can be

crushed for considerably less than 10 per cent of the cost of whole oats, such preparation would not pay, even for hard worked horses.

The same investigators found that rape pasture furnishes excellent grazing for pigs during the summer months. Concentrates were also fed and the pigs on rape gave much better financial returns than those fed concentrates in a dry lot.

Ewe lambs were fed roots and corn silage in comparison, by Prof. G. C. Humphrey and F. Kleinheinz (Animal Husbandry). The lambs fed silage made the better gains and were fully as thrifty as those fed roots, and they showed slightly heavier fleeces.

Lambs fed gluten feed and oats by Messrs. Morrison and Kleinheinz during the past winter gained a trifle more than those fed a ration of wheat bran and oats. Prof. Morrison also found that the addition of linseed meal or cottonseed meal to a ration of corn and legume hay for lambs caused on an average only 0.01 lbs. increase in the daily gain per head. Messrs. Morrison and Kleinheinz also determined by feeding trials that less cottonseed meal than linseed meal was needed to balance the ration when fed along with shelled corn, corn silage and a limited amount of alfalfa hay.

Close in breeding of poultry, done experimentally by the experts of the poultry and experimental breeding departments, was continued in 1916 for the fourth year. Distinctly detrimental effects had resulted. The hatching power of eggs was reduced, the period of incubation lengthened, and vitality lowered, and full development retarded.

Soil Management

Professors E. B. Fred (Bacteriology) and E. J. Graul (Soils) continuing their studies during 1916, found that under both greenhouse and field conditions it is not necessary to correct all soil acids in order to grow profitable crops of alfalfa, clover and soy beans. It is necessary to neutralize a larger proportion of the acidity in sand than in the Colby silt loam. ^{They} May also found that nitrification of inorganic compounds proceeds much slower in acid than in neutral soils. Organic

matter, however, nitrifies equally well in either neutral or slightly acid soil.

A series of experiments had been instituted at the Marshville branch experiment station to determine the types of farming best adapted on the close textured soil type of silt loams (Colby) in that section. The tenacity with which this soil type holds water makes the drainage and tillage problems dominant in the work of the Marshfield station. Surface drainage was already in vogue but the problem of tiling still required study.

Prof. E. Truog (Soils) found by his tests, that the more active acids are those which injuriously effect the growth of alfalfa and clover. Tests made of 14 different types of soil showed that the activity or strength of the active soil acidity indicated more clearly the urgency of lime applications than did the total active acidity. Nearly all of these soils responded to phosphate fertilizer. The addition of Kaolin counteracted the toxic effect of definite basic plant poisons, such as guanidine carbonate. It was advanced that soil fertility is more dependent upon the ^{ence}pressure or absence of toxic products in the soil, than upon the chemical inter-relations which take place between the plant and the soil elements.

At the Ashland branch station results during the past season showed a marked benefit from deep tillage of the Superior red clays and it appeared that on the heavy clays of that type the expense of deep tillage may be warranted. It was again found that the application of phosphate fertilizer benefit such clays. An increase of 11 per cent resulted from the application of phosphate fertilizers supplementing the usual stable manure treatment.

The Soil Survey had now mapped over 2,400 square miles of the Colby silt loam lands in the ^{central} cultural part of Wisconsin. Such lands were found unquestionably well adapted for dairying and grain raising, when adequately drained.

Records were being secured by Prof. E. R. Jones (Soils), in a number of projects, on the level of the ground water, and on the effect of drainage ^{on} the "run-off" of marsh lands. Observations were being made of the run-off problem in an area near Jefferson. The run-off is facilitated by the installation of drainage ditches instead of depending upon removal of surplus water by the circuitous routes of the usual meandering streams in marsh lands.

CROP STUDIES

At the Ashland Station, Prof. E. J. Delwiche (Agronomy) had obtained yields of over 100 bushels of oats per acre on land seeded to a pedigreed variety he had developed there. The same variety grown on the fine silt loams of the Colby type at the Marshfield station was, however, found to be much inferior to other strains of oats acclimated for that locality. The same condition had been found to develop in the case of Wisconsin No. 25 corn. These findings showed the absolute necessity of experimenting with different field grains under varying climatic and soil conditions. Prof. Delwiche also had found the White Jewel variety of oats showed a loss of but 40 percent from lodging in comparison with as high as 90 percent suffered by other standard varieties.

Prof. L. F. Graber (Agronomy), by experimentation found that the variegated strains of alfalfas including Balic⁺ and Grimm, possess greater powers of resistance toward winter killing than do the common Alfalfas, whether of northern or southern origin. He also observed that the seedings of common alfalfa are much more susceptible to winter killing during the second winter, than they are during the first. The common strains of alfalfa usually make a succulent fall growth, whereas the variegated strains become dormant earlier in the fall after the third cutting. Prof. Graber concluded that the fall dormancy is a definite indication of the suitability of the strain of alfalfa to withstand severe winter conditions. Peruvian alfalfas proved worthless in Wisconsin.

Sudan grass was experimentally grown by the Agronomy Department for the first time in 1915 and 1916. It succeeded especially well upon warm, sandy loams, and even gave good results on sandy soils. It was concluded that the yield and palatability of sudan grass hay compared with such animal forage grasses as millet made it advantageous for use in Wisconsin where its greatest value would be as a catch crop for hay, like soy beans, in places where alfalfa and clover had winter killed.

Prof. Delwiche having further tested Wisconsin No. 25 corn decided that it possesses great usefulness for the upper parts of the State and especially for the sandy and loamy sections where the altitude is not more than 1,200 to 1,300 feet. Northern bred Wisconsin No. 8 corn, while somewhat later in maturing, is well adapted for silage production as it is leafy in character. For the cooler climate and heavier soils of the Superior region Wisconsin No. 25 and Wisconsin No. 23 were found to mature sufficiently to make good silage, while smut nose flint, although not so prolific for ensilage purposes, still remains one of the best varieties for this section.

Prof. B. D. Leith, (Agronomy) had continued his work in wheat breeding at Madison, and also at both the Branch and Central Stations. Pedigree No. 2 withstood the severe winter and yielded 36.2 bushel per acre in field tests. In milling tests No. 2 also surpassed all others grown as to volume of loaf and was equalled in gluten content by only one other strain.

At the Ashland Station Prof. Delwiche developed a number of ~~pure~~ ^{line} rise selections and cross selections of hard wheat that showed exceptional merit. Several of the new strains yielded 51 to 55 bushels per acre in 1916.

Pedigree No. 2 of the Ito San variety of soy bean gave the best results at the Madison Station, while Early Black succeeded best in Upper Wisconsin. The crop was proving particularly well suited to the lighter soils of the state.

Experimental work by Prof. Graber indicated that sweet clover requires practically the same care and attention to details in cultivation as ^{Does} alfalfa. Station tests showed that seeding prior to August 1 is necessary to insure a good stand. Work on hemp, begun by Prof. C. P. Norgord, was continued in 1916 by Prof. A. H. Wright (Agronomy). During that year over 1,200 acres were grown and an estimated production of 1,500 lbs. of fiber was made. The total value of the crop was estimated to be \$125,000.

Work of the Horticulturists and Plant Pathologists. Studies of the root hardiness of plants were made during the year. In the tests little injury was observed at 21.°F; but then it fell to 24⁻⁴°F, the cambium tissue was injured. The greatest value of cover crops, as a protection from root injury, was found to be their capacity for holding snow. Under a snow blanket the soil temperatures vary slowly and are not likely to reach the killing point. Observations on the production of scion roots were made on about 6,000 nursery trees. Generally speaking, 2-year-old trees, or under, did not produce sufficient scion roots to support the tree in case the stock roots were killed. Apple trees probably do not produce sufficient scion roots to overcome this difficulty.

Prof. James Johnson, continued his efforts to produce strains of tobacco that would prove resistant to root rot. He also made a study of the host plants of the causal organism of this disease (Thielavia basicola) and found 66 new ones not previously mentioned so harboring this fungus. A plant disease survey of the tobacco growing regions of the United States had been begun in cooperation with the Bureau of Plant Industry, of the U.S. Department of Agriculture.

Experts of the Plant Pathology Department of the Station having succeeded in discovering and improving a strain of commercial cabbage resistant to the "yellows" disease, led this department, in cooperation with the Department of Experimental Breeding, to investigate the underlying causes concerned in the

inheritance of disease resistance. Strains of flax developed by the North Dakota Experiment Station were used in the study by W. H. Tisdale, Horlick scholar in these departments. He also studied the first generation of cross-bred cabbage plants produced from resistant and susceptible types when grown on both "Yellows" infected and non-infected soil. A much greater degree of variability in the resistance of these first generations seeds was observed in the case of cabbage than with flax. The resistance of flax was against the wilt Fusarium.

Professors L. R. Jones and A. J. Johnson (Plant Pathology) discovered a new bacterial disease which causes a peculiar leaf blight in barley. Their experiments showed that the germs of the disease live over winter on the grain kernels and infect the seedling plants when such seed is sown. The disease seemed to be less prevalent in Wisconsin than it is farther west. The experiments indicated disinfection of the seed with corrosive sublimate or formaldehyde solutions probably would prove effective against the new disease. The advisability of such disinfection for barley seed, to control smuts, was also recommended.

Prof. G. W. Keitt (Plant Pathology) succeeded in successfully controlling the cherry leaf spot disease by three or four applications of the Bordeaux mixture or lime-sulphur solution. Early plowing under of leaves infested with the fungus also helped materially in controlling the disease.

BACTERIOLOGICAL AND VETERINARY RESEARCH WORK

Dr. B. A. Beach (Veterinary Science), E. G. Hastings (Bacteriology) and Prof. J. G. Halpin (Poultry) continued the experiments they had conducted the previous year relative to tuberculosis of fowls. They found that in every case, inoculation of swine with pure cultures of the avian (bird) bacillus of tuberculosis causes the diseases in those animals, with fatal results. Infection of swine, acquired under natural conditions, might not cause fatal

results. The utilization of the "wattle" test, where avian tuberculin is injected into the fowl proved successful. A flock on a farm near Oregon, Wisconsin, when thus tested, showed that 131 out of 135 hens were tuberculous. Total destruction of affected flocks was advised. Dr. Beach also studied during the year the possibility of concentrating the immune bodies in hog cholera serum; but no definite conclusion had, as yet, been made.

DAIRY PRACTICE

During the year, 15,000 records from 237 cheese factories in 22 counties had been studied by Prof. J. L. Sammis (Dairy) to select a proper basis of payment for milk used in cheese making. His studies indicated that the pooling system is the least accurate of all systems of payment. A new method had been proposed by Prof. Sammis, called the fat-plus-six-tenths method which gave a basis that could be readily computed and relied upon as giving payments agreeing exactly with the average yield of cheese. He also studied the influence of feeding silage on the quality of Swiss cheese. His work, thus far, indicated that by proper cleanliness in feeding silage and handling the milk, it was possible to ^{avoid} prove injurious effects on cheese from the feeding of silage.

Prof. W. D. Frost (Bacteriology) continued his observations on the comparative value of the microscopic plate method he had devised for the determination of the number of bacteria in milk, in comparison with the standard plate method commonly in use. His studies indicated a general agreement between the ^{two} ~~new~~ methods and the adaptability of the new method for rapid control work in board of health and milk control laboratories. He also continued work upon a method of detecting pasteurized milk by microscopic examination.

Miss Freda Bachmann (Bacteriology) found by experimentation that spices check germ growth in canned products. Molds were found to be much more sensitive than bacteria of the action of cinnamon extract.

ENTOMOLOGICAL WORK

Cooperative work carried out by the Departments of Horticulture, Plant Pathology and Entomology relative to the control of the apple coddling ^{moth} work showed excellent results from use of a spraying mixture of $1\frac{1}{2}$ lbs. of powdered arsenate of lead per 50 gallons of spray. Considerable data on the development and control of the plum curculio^{or} and fruit worms were also secured.

C. W. Aeppler (Economic Entomology) developed improved methods of rearing queen bees. The results obtained during two seasons showed that successful queen production may be practically assured.

A. C. Burrill (Economic Entomology) studied the banded apple aphid, which is also known as the grain or oat aphid or louse. Experiment carried out in several orchards showed that it was impossible to control this pest by the use of nicotin sulphate in the form of Black Leaf 40; (1 to 3,000 strength).

Farm marketing problems were studied by the department of Agricultural Economics. The subjects considered were the marketing of Wisconsin butter (Hibbard and Asher Hobson),
Marketing milk (Hibbard and Erdmann) and cooperation (Hibbard). Cooperative creameries were found to be paying somewhat more for butter fat than the privately owned plants.

Prof. C. J. Galpin (Agricultural Economics) studied the farmers' club movement in Wisconsin, and the Agricultural Education Department cooperated with the U.S. Department of Agriculture in field investigations on the need of agriculture as an subject of study in the public school system.

AGRICULTURAL EXTENSION

The Agricultural Extension Department was active during the year carrying the results of agricultural experiment work to the farm. A stump pulling demonstration train operated for 6 weeks in May and June in 16 localities of 11 northern counties, in charge of Carl D. Livingston (Agricultural Engineering). During the

year H. C. Searles and Noel Negley organized 23 new cow testing associations, with a membership of 650 farmers and having over 10,000 cows. One hundred and fifteen community breeders' associations were now active in Wisconsin having been organized by the efforts of the Animal Husbandry department and the Wisconsin Live Stock Breeders' Association. Seventy one of these associations held both winter and summer meetings and 12 held public sales. Some 208 lectures and demonstrations in 96 towns located in 48 counties were given by members of the Animal Husbandry department.

The Economic Entomology department supplied queen bees to the bee keepers of the state, at 50 cents per queen, to help improve the bee strains then in use.

Butter and cheese scoring exhibitions were held during the year, by the Dairy Department, at bi-monthly instead of monthly intervals. - Six hundred and eighty-three tubs of butter were received from 254 creameries and 121 packages of cheese from 84 factories, for judging.

One hundred and eighty nine applications for soil testing and analysis were received during the year by State Soils Laboratory (Prof. A. R. Whitson). The larger number were in groups. Seventy district communities throughout the state were served by the laboratory. One hundred and eighty two farms were visited during the year and 157 reports rendered. Three hundred and sixty-five soil samples were examined, involving 1,527 chemical and physical determinations.

Demonstration trials were carried on by the soils department during the past year on 69 different farms. Twenty-eight of them were on sandy soil, 19 on marsh and 22 on clay silt loams, under direction of W. H. Ullspirger in the northeastern and central portion of the state; F. L. Musbach on the clays in the northwestern portion; and W. W. Weir in the southern part of the state. Mr. Weir, by numerous demonstrations also stimulated interest in the sweetening of sour soils by the use

of lime. Five limestone grinding organizations were organized, and some farmers had also begun such grinding. Work in marsh drainage was continued by E. R. Jones (Soils) and O. R. Zeasman. Over 30 farm projects were under observation as to the effect of drainage systems installed. Five large drainage projects were aided by the department in equalizing drainage assessments, and in 15 drainage projects assistance was given in formulating plans.

Through the medium of the alfalfa order (L. F. Graber, Secretary) cooperative growing trials had been carried on with 800 Wisconsin farmers. Some 1,350 members of the order were assisting in an organized effort to cultivate alfalfa. A. H. Wright held 11 meetings on the county and state institutional farms, with an aggregate attendance of 5,780. relative the applicability of improved and new types of seed. Livestock management and home problems were also considered at these meetings by representatives of the Animal Husbandry and Home Economic departments.

A. L. Stone and H. Lunz (Agronomy) carried on 21 demonstration plots, averaging 3 acres for educational purposes in the warfare against noxious weeds. Inspection of 4,675 samples of seed was also done by these members of the department. J. G. Milward (Horticulture) continued his work for the betterment of potato production in the State. Field inspections and tuber examinations were undertaken. Standardization was the object. During the season 172 applications for such services were received and out of this number 81 certificates of approval were granted.

Ninety demonstrations in pruning and 6 in spraying were carried on by R. H. Roberts (Horticulture) in 1916. The Plant Pathology department supplied cabbage seed of the new "yellows" resistant type, known as Wisconsin Hollander to over 100 farmers in the Racine-Kenosha district. There, the new type of resistant stock had been grown on an area aggregating 320 acres. The use of the Wisconsin resistant strain of cabbage seed had also given entirely consistent results in Pennsylvania, Ohio, and New Jersey. J. C. Walker (Plant Pathology) continued demonstrations in

the control of onion smut by applying a solution of 1 ounce of formalin per gallon of water. An increased yield of over 60 percent was secured in consequence.

Sixteen thousand five hundred detailed blue print drawings covering barn construction, hog houses, poultry houses, machinery, sheds, and ice houses were in 1916, distributed upon request by the Agricultural Engineering department.

Home problems received attention from the staff of the Home Economics department. Thirteen women's schools and 4 women's courses were held. The department of Agricultural Bacteriology carried on instructional work relative to safeguarding human and animal health with 6 normal schools of the state under the direction of Dr. W. D. Frost. The department supplied the State Department of Agriculture with 77,500 doses of tuberculin produced in its laboratories and to be used in the campaign against bovine tuberculosis in the State. The Veterinary Department prepared and distributed 634,000 cubic centimeters of protective serum against hog cholera and 451,025 cc. were sold to veterinarians and farmers in 33 counties of the state. In the veterinary laboratory 1,472 blood samples were examined by the complement fixation test for contagious abortion, of which 28 percent gave positive reactions. On these samples 123 agglutination tests were also run as a check in perfecting the diagnosis.

ADDITIONS TO THE FACULTY STAFF

From 1916 to 1920 Dillman Samuel Bullock, a native of Michigan, did efficient work in livestock extension for the Wisconsin College of Agriculture and Experiment Station. He received the bachelor of science degree from Michigan Agricultural College in 1902 and master's degree in 1911. In 1920, he obtained the master's degree in agricultural from the University of Wisconsin. From 1912 to 1916 he was Principal of the Marinette, Wisconsin County Agricultural School after having taught agriculture in the Mission Agricultural and Industrial School at Temuco, Chili from 1910 to 1912. Having become proficient in the Spanish language, the U.S. Department of Agriculture made him agricultural commissioner for South America,

with headquarters at Buenos Aires, where he served from 1920 to 1923. Later he was appointed Director of the Agricultural School of the Instituto Agrícola Bunster at Angal, Chile and also served as pastor of the Mission School. When resident in Wisconsin, Professor Bullock organized Cooperative cattle and seed grain buying for Marinette County farmers, and started the Wisconsin Purebred Bull Campaign. Being an accomplished naturalist, he made a fine collection of Wisconsin Mollusks which he presented to the University of Wisconsin. He also collected birds and mammals for the British Museum and American Museum of natural history, and continued such work in Chile.

Harley Frost Wilson, a farm and city raised native of Colorado, was appointed Professor of Economic Entomology in the University of Wisconsin in 1915 and still filled that position with eminent success at the time of this writing. He received the bachelor of science degree from Colorado Agricultural College in 1907, and the Master's degree from Oregon Agricultural College in 1913. From 1908 to 1910 he was with the U.S. Bureau of Entomology and from 1910 to 1915, served as entomologist in the Oregon Agricultural College. He has specialized in the study of the Aphidae and done much valuable work relative to beekeeping and the apiary industry in general.

Since 1916, Professor Wilson has been ably assistant by Charles Lewis Fluke Jr. a native of Colorado who, for a time, was a member of the Colorado Agricultural Experiment Station force. He graduated B.S. from the Colorado State Agricultural College in 1916, and, from the University of Wisconsin, received the M.S. degree in 1918 and Ph.D. degree in 1928.

James Geere Dickson from the State of Washington became a member of the department of Plant Pathology as graduate assistant in botany in 1916 and in 1918 was made a ^{agent} part of the Official Cereal Investigations of the U.S. Department of Agriculture.

which work he has continued since that date. He was associate professor of Plant Pathology in the University of Wisconsin from 1919 to 1925, and was made professor in the latter year. He received the bachelor of science degree from Washington State College in 1915; M.S. from the University of Wisconsin and Ph.D. in 1920. He has specialized in cereal pathology, agronomy and botany.

Arthur Robert Albert, from Burnett, Wisconsin who had obtained the B.S. degree from the University of Wisconsin in 1915, was in that year appointed assistant in the Soils Department of the Experiment Station, served until 1917 and then was made instructor in 1921. He traveled for the Armour Fertilizer Works for 2 years and acted as 1st Lieutenant Field Artillery O.R.C. for 10 years, and later in France. He was a graduate student at the University of Minnesota 1929-30. In 1926 he was made superintendent of the Hancock and Coddington Branch Experimental Farms of the Wisconsin College of Agriculture.

Joseph Aloysius Becker of Hurley, Wisconsin where he was reared on a farm, served as assistant in the Agricultural Economics department of the University of Wisconsin, 1915 to 1917, and as farm help specialist of the U.S. Office of Farm Management of the Department of Agriculture from 1917 to 1918; as field agent of the Bureau of ^{Crop} ~~Crop~~ Estimates in Ohio, in 1918, and in Wisconsin as field agent and statistician for the Wisconsin State Department of Agriculture 1919 to 1922. In 1923, he was appointed agricultural statistician in the Division of Crop and Livestock Estimates of the U.S. Department of Agriculture. He received the B.S.A. degree from the University of Wisconsin in 1914 and M.S. in 1916.

Jesse Raymond Hepler, reared on a farm in Pennsylvania, was an instructor in horticulture in the University of Wisconsin from 1911 to 1917 and became assistant professor of horticulture in the University of New Hampshire in 1917. His specialties were ^{olivi} ~~olivi~~ ~~olivi~~ olivi, lands, and gardening. He served as second lieutenant, Q.M.C. in the U.S. Army during the World War. He obtained the B.S. degree from Pennsylvania State College, in 1911, and M.S. from the University of Wisconsin in 1922.

Fred Reid Murray who was reared on a farm near Ogdensburg, Wisconsin and had received the B.S. degree in Agriculture from the University of Wisconsin in 1916 served as Agricultural Extension ^{agent} ~~agent~~ of the Northern Pacific Railroad Co. from 1913 to 193⁶, and then became assistant state lead^{er} of county agricultural agents for the University of Wisconsin from 1916 to 1919 when he was made manager of the farm business of the Old Commercial Bank at Oshkosh, Wisconsin. He served in that capacity until 1922 and then was appointed secretary of the Wisconsin Live Stock Breeders' Association with headquarters in Madison.

Victor Emanuel Nelson of Eau Claire, Wisconsin who had received the B.S. degree in agriculture from the University of Wisconsin in 1912 and M.S. in 1914, was assistant agricultural chemist of the University of Wisconsin 1912-1914, instructor 1914 to 1917 and then associate chemist Johns Hopkins University 1917-1919, assistant professor of chemistry in Iowa State College 1919-1920, associate professor there 1920-1923 and then professor of chemistry in that institution from 1922 on. He specialized in Animal Nutrition.

Edmund Chester Sauve, who was born at East Tawas, Michigan and had obtained the B.S. degree from Michigan Agricultural College in 1911, and served as instructor in that institution from 1914 to 1915, was a member of the Agricultural Engineering department of the University of Wisconsin from 1915 to 1919. In the latter year he was appointed assistant professor of agricultural engineering in his alma mater, specializing in internal combustion engine work.

Clyde Melvin Woodworth, a native of Illinois was assistant and instructor in genetics in the University of Wisconsin from 1914 to 1919, and then was assistant professor of plant breeding in the University of Illinois from 1920 to 1923. In 1923 he was made associate professor there and in 1929 professor of plant breeding and chief of the Experiment Station at Urbana, Illinois. He obtained the B.S. degree

at Oklahoma A. & M. College in 1910, and the M.S. and Ph.D. degrees from the University of Wisconsin in 1914, and 1920 and gave a good account of himself in his plant breeding work.

Other assistants and instructors working for the Wisconsin Agriculture ^{College and} Experiment Station during the period from 1914 to 1916 were: C. D. Livingston (Agricultural Engineering); H. W. Stewart and L. P. Hanson (Soils); J. W. Brann (Horticulture); A. C. Dalberg (Dairying); H. Fulmer, H. H. Roehm and J. E. Simmons (Ag. Bacteriology); and L. C. Gentner (Econ. Entomology); E. D. Holden (Agronomy); F. D. Lewis (Assistant to the Dean); O. H. Malde (Canberry expert); D. Matson (Dairy); F. E. Mussehl (Poultry); W. Pitz and Nina Simmonds; A. A. Schall (Ag. Chemistry); and C. D. Williams (Feeds and Fertilizers).

PUBLICATIONS OF 1915-1916

During the past year over 100,000 letters were written by the Station Staff, largely in reply to requests for information. In addition to this, the staff prepared over 36,000 pages of manuscript material and 3,400 pages of stencils. The publications issued during the fiscal year consisted of 3 Research Bulletins, 16 regular bulletins, circulars of information and 2 poster bulletins. Brief summaries of these bulletins follow.

RESEARCH BULLETINS OF 1915 - 1916

Of the 3 research bulletins published during the fiscal year ending June 30, 1916, the first was No. 36, by H. Steenbock, V. E. Nelson and E. B. Hart on the subject of acidosis in omnivora and herbivora and its relations to protein storage. The experiments conducted by the authors showed that when swine and calves were fed acid rations they are able to protect themselves against acidosis, or excess of acids over bases in their tissues, by a production of ammonia in their body tissues. In Research Bulletin No. 37, I. E. Melhus discussed the germination and infection

with the fungus of the late blight of the potato (Phytophthora infestions). He presented the results of experiments which were conducted to show the effect of various external influences on the germination of the fungus mentioned and the conditions under which infection of the potato plant takes place. In Research Bulletin No. 38, Prof. L. R. Jones and J. C. Gilman, writing on the subject of the control of cabbage yellows through disease resistance, reported their experiments showing progress which had been made in the production of commercial types of cabbage which are resistant to cabbage yellows, a disease which has proved itself to be a limiting factor to continued success in cabbage growing in many sections of Wisconsin and other states.

REGULAR BULLETINS OF 1915 - 1916

The regular Bulletins published by the Station during the fiscal year from July 1, 1915 to June 30, 1916 were numbered 255 to 270 inclusive. Of these No. 255 of July 1915 gave the reports of licensed fertilizer analysed during 1914; No. 258. A list of the public service stations licensed in 1914-1915; No. 265, Commercial fertilizers, with special reference to their composition; No. 267, facts for the feed buyer, with a list of licensed feeding stuffs with their analyses for 1915 and No. 268, of May 1916, The Annual report of Director Russell for 1915.

The Marketing of Wisconsin potatoes was discussed by Prof. H. C. Taylor in Bulletin No. 256 of July 1915. The author stated that the farmer can reduce the costs of railway transportation and the cost of handling at the central markets, by sending sound potatoes, sorted as to size and free from dirt. A better price could be obtained by producing an excellent standard variety. Proper grading of potatoes was advised. Graders had been quite generally adopted; within the past few years, to remove dirt and the small potatoes which will pass through a one and five-eighth inch screen. The subject of cooperative marketing

of potatoes was considered and its advantages and disadvantages mentioned. Farmers' Companies should be organized under the Wisconsin State law providing for Cooperative companies, as explained in Bulletin No. 238. The State and Federal Authorities could help by watching the processes of the middleman to see that their functions are properly performed and at a fair price. A most important function of the Government is that of studying the problems of marketing, and educating the producer and the consumer as well as the middleman.

CONTROL OF APPLE RUST

The control of apple rust in Wisconsin was the subject of Bulletin No. 257, of July 1915, issued by Prof. L. R. Jones and E. T. Bartholomew. Suitable illustrations accompanied the text. Rust was said to be on the increase wherever the red cedar and apple are found growing in the same neighborhood. How the rust spreads was explained and illustrated. Elimination of the red cedar was imperative, as spraying does not fully control the disease. When the cedar cannot be eradicated two or three applications of Bordeaux mixture should be made to keep the leaves covered during the susceptible period of May and June. Spraying the cedar does little good. ^{Famousey} Farmers Northwestern Greening and McIntosh resist the disease, while wealthy, Johathan and Dudley are highly susceptible.

ALFALFA GROWING

Alfalfa, in 1915, was being grown on 35,000 acres of Wisconsin land, chiefly in the eastern and southern parts. Professors R. A. Moore and L. F. Graber, advised in Bulletin No. 259, of October 1915, that the crop could be successfully grown in every part of the state and they gave full and lucid instructions as to the proper procedure. They stated that a good field of alfalfa may annually produce

four cuttings of hay valued at \$100 an acre. The crop thrives best on old good soil, needs inoculating for success, and gradual inoculation may be accomplished by sowing a pound or two of alfalfa seed to the acre along with a preceding clover or grass crop. Manuring and liming are necessary where the soil is poor or sour. Twenty pounds of seed per acre was recommended and should be sowed in June or July, or early in August if planted without a nurse crop. The last cutting of hay never should be later than September 5.

ADVICE FOR THE SETTLER

Professor E. J. Delwiche having had an extended experience with all matters pertaining to the breaking in and cropping of undeveloped land in Wisconsin, gave settlers the benefit of it in Bulletin No. 260 of October 1915, entitled "First Aid to the Settler". Ten million acres of undeveloped land awaited the settler and the bulletin told him in plain language how to select suitable land and take the first steps in clearing it of brush and stumps. He advised that clover and possibly timothy should be broadcast in the clearings; temporary fence off cropped land; buy one or two cows or beef animals, and a few pigs for the pasture; Sow ^{oats} and peas for winter feed; plant a garden, consult the experts of the branch experiment stations regarding settlers' problems; buy only such tools, as are actually needed; follow a good crop rotation. The bulletin offered instructive illustrations, outlined the best varieties of crops; prescribed the first buildings to erect and the tools to purchase; detailed the proper methods of clearing land, and, in short, gave the settler first-hand information on the subject that would be sure to meet his needs.

POULTRY RAISING

As Wisconsin has an ideal climate, an abundance of feed and is near a good market, the possibilities for successful poultry raising there are first class. To aid farmers in dealing properly with the industry, Prof. J. G. Halpin and J. B. Hayes, in Bulletin No. 261 of February 1916, furnished the necessary information

and instructions about every phase of the business. Illustrations clarified the text. It was advised that ^{late} moulting hens are the best layers, and early hatched chicks are best. Incubators should be run strictly in accordance with the directions given by the manufacturer. How to handle and ^{feed} find little chicks was explained in detail and advice given for the prevention of losses. The bulletin was admirably adapted for the instruction of poultry raisers.

ICE CREAM MAKING

Prof. A. C. Baer, in Bulletin 262 of February 1916, on the subject of ice cream making, stated that the manufacture of that commodity could be made a profitable side line of a creamery or milk plant without the addition of much equipment. The profits from the manufacture of ice cream are twice as great as from making butter. In Wisconsin, where a 14 percent fat standard is required, a gallon of ice cream will contain approximately a pound of butter, cost not over 40 cents a gallon and sell for at least 75 cents a gallon. The bulletin gave full instructions for the making of ice cream, a few simple formulas for 10 gallon lots of ice cream, and score cards that had been suggested for the judging of ice cream. The author stated that a uniform quality of ice cream can be made throughout the season by careful standardization of the cream. A uniform butterfat content to comply with legal requirements makes it necessary to eliminate all guess work in making up the cream "mix".

SHEEP RAISING IN WISCONSIN

In his excellent Bulletin No. 263 of March 1916, the Station shepherd, Frank Kleinheinz, stated that in few places are better opportunities offered for the economical and profitable production of mutton and wool than in central and upper Wisconsin. The capital required is small. Many settlers use sheep

to help clear their land and put it in condition for dairying. The sheep may be cheaply housed in a shed open to the south and having a hay or straw roof. It must, however, be dry and free from drafts. A pure bred ram always should be used and the flock, at first, should be small until experience is gained. Clover and roots are excellent for sheep and are easily grown in the districts mentioned. Raising of early lambs was advised, as the best prices are obtained for lambs weighing 60 to 70 lbs. in May or June. Feeding additional to the ewes' milk, was recommended. Plain instructions for the successful raising of sheep were given, and numerous illustrations made the subject more easily understood.

BEE KEEPING IN WISCONSIN

All of the regular bulletins of the 1915-1916 period were essentially instructive in a practical way and the idea, apparently, was to offer information on as many ^{branches} of farming as possible. The subject of bee keeping was therefore discussed in detail by N. E. and L. V. France in Bulletin No. 264 of March 1916. Mr. L. V. France, through the courtesy of the Minnesota Experiment Station, where he was an instructor in Bee Keeping, was permitted to cooperate with his father in the preparation of the bulletin. He served as assistant in entomology in the Wisconsin Experiment Station in 1914-1915. Mr. N. E. France had for 18 years been State Apiary Inspector in Wisconsin. Some of the subjects considered in the illustrated bulletin were: Bees needed to distribute pollen; figures on bee keeping; Italian queens imported in 1867; flowering plants which produce nectar; influence of climate and soil on bee keeping; soil types effect the honey flow; essentials for success; the different types of bees; some essentials in bee management; bee diseases ^{found} ~~formed~~ in Wisconsin and what of the future?

CONSTRUCTION OF DAIRY BARNS

In Bulletins No. 266 of April 1916, Prof. Frank M. White and Clyde O. Griffith presented modern plans and specifications for the building of various types of

barns suitable for the dairy industry of Wisconsin. The bulletin was exactly what practically every dairy man in the state needed as a guide and reference in the improvement of these buildings and erections of new ones suitable for their growing needs. The subjects of sunlight, ventilation, convenient arrangement, supplying of fresh water correct types of stalls and details of construction were discussed and use of concrete explained. It was stated that detailed drawings and bills of material for various types of barns could be secured from the Department of Agricultural Engineering of the University of Wisconsin. The plans so furnished were being widely and profitably used throughout the state.

MANAGING THE ORCHARD

Prof. J. G. Moore in Bulletin No. 269 of June 1916 treated briefly those practices of management which seemed best suited to give ^{good} ~~feed~~ returns from the orchards of Wisconsin. He stated that successful orchard culture demands a soil adapted to the fruit grown, planting of hardy varieties, care in planting, and adapted and thorough system of soil management, ^{pruning} ~~proving~~ which conserves the energies of the tree and lightens orchard work, and spraying of a character which will control the pests and make the fruit edible and salable. Full instructions were given for the carrying of the essentials of correct management into effect. Varieties of fruit for Wisconsin were mentioned and proper methods of planting, pruning and spraying prescribed. Useful illustrations accompanied the text and the matter offered in the bulletin was well adapted for the practical instruction of the beginning orchardist and the guidance of those already established in the business.

MARKETING BUTTER

The last bulletin of the fiscal year, No. 270 of June 1916, was that on the marketing of Wisconsin Butter, by Prof. B. H. Hibbard and Asher Hobson, agricultural economists of the Station. Their investigations had brought out important ^{facts}

relative to the butter industry of the State. These facts were as follows:

- (1) The making of butter on the farm as an industry was decidedly on the decline;
- (2) the increase in the amount of creamery butter during the past few decades had been phenomenal and unprecedented
- (3) The state was remarkably free from centralizers
- (4) The cooperative creameries, although but 45 per cent of all of the creameries of the state, pay to farmers 3 cents more a pound for butter fat than is paid by private creameries, and at the same time pay the buttermaker an additional \$10 a month above private creamery wages.
- (5) The quality of butter had, at that time, no very close relation to the selling price.

CIRCULARS OF INFORMATION

The intensely practical circulars of information published by the Experiment in the last half of 1915 and first half of 1916 were numbered 55 to 61 inclusive. Circular No. 55, of November 1915, by Prof. L. R. Jones and R. E. Vaughan gave full instructions for the control of apple rust. The authors advised that orchards can be kept free from apple rust by choosing a site where no red cedars exist; by cutting down and burning red cedars where they occur, or by planting varieties that are resistant to rust. The red cedar was not to be confused with the common cedar or arbor vitae which is common in the central and northern swamps of the state. How to fight poultry lice and mites was told by Prof. J. G. Halpin and J. B. Hayes in Circular No. 56 of January 1916. Illustrations accompanied the text. Instructions were given for the use of insect powders, dust baths, house paints and grease and also regarding spraying with whitewash, kerosene, ^{crude oil} ~~candevil~~, coal-tar disinfectant and crude carbolic acid. Circular No. 57, of February 1916, gave instructions for the control of grain smuts and blights, with special reference

to the smuts of oats and barley. The authors, R. E. Vaughan and A. G. Johnson also briefly discussed other widespread diseases, such as the leaf stripe disease of barley. They stated that if seed is sown without killing the spores, loss from smut will certainly occur. The formalin seed treatment had been found most effective and full particulars relative to its application to barley, oats wheat and rye were given. A revised edition of this circular was published in March 1918. In Circular No. 58 of February 1916, Prof. R. A. Moore and J. J. Garland presented a practical and elaborately illustrated treatise on the selecting curing and testing of seed corn. No more useful circular had been issued to date and being authentic in every particular, it was at once accepted as a standard text by farmers and found of inestimable value.

Prof. G. C. Humphrey and W. E. Markey followed with another important and excellently prepared treatise in their Circular No. 59 of February 1916 in the raising of better dairy calves. The facts stated were based upon the experience gained in the raising of calves in the University Dairy herd during the past 12 years by a method which had produced many excellent cows. The authors gave it as their opinion that the surest and cheapest way to secure a most profitable dairy herd is to raise it, and by doing so lessen the danger from contagious abortion, tuberculosis and other infectious diseases. The Circular was reprinted in December 1917.

In Circular No. 60 of April 1916 Professors F. M. White and E. G. Hastings explained how the sewage of country homes could effectively be disposed of by the septic tank method. Plans for the construction of approved septic tanks were given and answers made to questions commonly asked about the subject.

Dr. A. S. Alexander, Station Veterinarian in Circular No. 61 of May 1916 gave practical advice on the care of the new born foal, in which he outlined his method of treating the naval or umbilicus to prevent infection and consequent "joint ill" (pyemic arthritis). He stated that the seriously high death rate

among foals each spring in Wisconsin might be greatly reduced by the methods of management of the mare. ^{and} He suggested by giving better attention to her offspring at birth, ~~and~~ how to raise an orphan foal by hand was also explained.

FACULTY STAFF NOTES 1916 and 1918

In 1917, John Donald Black's name appeared on the roster of the Experiment Station as an instructor in the department of Agricultural Economics. He came from Fort Atkinson, Wisconsin and had received the A.B. degree from the University of Wisconsin in 1909, A.M. in 1910 and Ph.D. in 1918. He served as an instructor in agricultural economics in Western Reserve University 1910-1911 and as instructor and assistant professor in Michigan College of Mines 1911-1915 and after Wisconsin was Assistant Professor of Agricultural Economics in the University of Minnesota, associate professor 1919 and Professor and Chief of the Division of Agricultural Economics there from 1920.

James Isaac Hambleton who was born in Chile, South America January 5, 1895 and ^{reared} ~~moved~~ there on a farm and in the city served as instructor in Agricultural Entomology in the University of Wisconsin from 1917 to 1921 and then was appointed Agriculturist in the Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C. In 1917 he had received the B.S. degree from Ohio State University. He served as 1st Lieutenant of Infantry, U.S. Army from 1918 to 1919 inclusive.

In 1917 A. J. Rousch was serving in the Agricultural Engineering Department of the Wisconsin Experiment Station; G. E. Babbage and J. J. Garland in Agronomy; P. W. Boutwell in Agricultural Chemistry; N. A. Negley in Animal Husbandry and V. R. Pfingstag in Agricultural Bacteriology.

In 1917 the Home Economics Department was benefitted by the able services of Celestine Schmit, Amy L. Daniels, Ellen Hillstrom, and Jean Krueger.

In 1918 Floyd Waldo Duffee, from Wayne County, Indiana where he was reared on a farm, joined the faculty of the Agricultural Engineering Department as Associate Professor. He had obtained the B.S.A. degree from Ohio State

University and had served as an instructor in Agricultural Engineering in Connecticut Agricultural College from 1915 to 1918.

In 1918 Edward Richard Jones, who had from 1905, done admirable work in the Soils Department of the University of Wisconsin, was appointed Professor of Agricultural Engineering and Chief of the Department. He had travelled in Europe, in 1911, to obtain a wider knowledge of soil research work and agricultural engineering.

Other workers whose names appeared in the list of the staff members in 1918 were: G. Baker Agricultural Journalism; C. B. Clevenger in Soils (1917-1920) who afterward was Professor of Agricultural Chemistry in Manitoba Agricultural College 1920-1925, Assistant Research Chemist Wyoming Agricultural Experiment Station 1925-1927, and soil chemist for the Tela Railroad Co. (United Fruit) at Tela Honduras from 1927; W. J. Dormyer, Assistant to Director Russell, E. J. Gross, Agricultural Chemistry; Myrtle Jones, Agricultural Economics; F. J. Kelley and Sarah N. Jones, Experimental Breeding; David Smith and Hazel Kent, Agricultural Chemistry; H. Lunz, Agronomy; Florence M. Couper and Maud Miller, plant pathology; Nellie B. Nichols, Agricultural Journalism and Dwight Getchell, in feeds and fertilizers, analytical work.

STATION PUBLICATIONS 1916 - 1918

During the past two years 23 regular bulletins, 4 research bulletins, 55 circulars of information and 4 poster bulletins were published. In addition, 2 bulletins, the supplies of which had been exhausted, were revised and reprinted.

Brief reviews of these publications follow:

Regular Bulletins of 1916-1917

Rural Clubs

The first ~~rural-club~~ regular bulletin issued by the Station during the fiscal year from July 1, 1916 to June 30, 1917 was No. 271. of August 1916 by Prof. C. J. Galpin and D. W. ^{Sawtelle} Santelle on Rural Clubs in Wisconsin. The bulletin was profusely illustrated, complete in detail and wonderfully well written. The authors stated that good farming depends upon good neighboring. Living on good terms with folks is a part of modern farming as truly as knowing how to farm. A higher level of efficiency is reached in the science and art of local agriculture when families know one another well and meet frequently. Stagnation kills community spirit. A strong circulation of ideas and impulses is needed to counteract discontent and the temptation to sell out and move away. The rural club is a remedy for stagnation. Full particulars were given relative to the farmer's family club. The ~~farm~~ Men's Club, the farm woman's club, the young folks' club and county federation of rural clubs with a summer picnic and a winter meeting for conference on country life matters. A sample "Constitution" for a rural club was furnished and also one for a successful Wisconsin Federation of Rural Clubs in a county with appropriate by-laws. Several programs for meetings were suggested.

Preventing Hillside Washing

In Bulletin No. 272 of August 1916, Prof. A. R. Whitson and T. J. Dunnewald told how erosion or washing can be controlled or prevented. They stated that probably 50 percent of the farms of Wisconsin are subject to erosion of some importance.

It depends on the distribution of the rainfall, the character of the soil, the slope of the land and the vegetation. It may be prevented in many instances, by careful tillage, by alternating crops in side hills, by the use of horizontal channels and terraces and by protecting the ravines and water courses. How to do these wise and necessary things was explained and other necessary advice given.

STATE HORSE BREEDING

In Bulletin No. 273, Dr. A. S. Alexander gave his annual report relative to the distribution of public service stallions in Wisconsin in 1916. He stated that 19 other states had followed the example set by Wisconsin in 1906, by instigating similar stallion license laws. The law in Wisconsin had caused to retire from service no less than 356 ^{rel} mongrel or scrub stallions, while the grades and scrubs had fallen in number from a total of 1995 head in 1907 to 1239 head in 1916. Pure bred sires had increased from 1771 in 1915 to 1814 in 1916 and the percentage of pure bred sires to grade and scrub sires in the state was now 59.2 compared with 58.2 in 1915 and 35 percent in 1907. Heavy losses of foals at birth had been reported.

Judging Dairy Cows

Prof. George C. Humphrey, in Bulletin No. 274 on October 1916 presented a splendidly prepared and illustrated treatise on the art of judging dairy cows. He stated that an efficient judge of dairy cattle makes fewer mistakes in buying them; gets better prices for his surplus stock; selects and builds up a herd of cows of uniform size, type, breed and quality; received a higher and more uniform production of milk and butterfat; makes returns over and above the cost of feed and care; uses better sires and secures better calves; has better success in finding and showing cattle at fairs and expositions and has greater satisfaction and pleasure in ^{owning} running and managing a dairy herd. Types of desirable and objectionable cows were shown and "scales of points" for the judging of Ayrshire, Swiss, Guernsey, Holstein and Jersey Cows printed in full.

Bulletin No. 275 of January 1917 gave an account of the work of the Experimental Station and Agricultural Extension service for 1916 and was written by Director H. L. Russell and his Assistant Prof. F. B. Morrison.

PAYING FOR CHEESE FACTORY MILK

Prof. J. L. Sammis, in regular bulletin No. 276 of January 1917, advised how the Babcock test should be used as a correct basis for the payment for cheese factory milk. It should be used in preference to the pooling system. Figures from 15,000 factories reported in the bulletin indicated that the straight fat test method gives satisfactory payments in 95 per cent of all cases, while at 5 per cent or less of all factories, where patrons kept herds of widely differing breeds and there is constantly a greater difference than 1 per cent of fat between the highest and the lowest patrons' tests in the same month, the fat plus six-tenths system is the easiest method of figuring correct payments. Other proposed methods of figuring payments from fat tests were illustrated and discussed, but not recommended for use. In 2204 cases the change from the Pooling System to the Straight Fat Method of payment made an average difference to the patron of 4.08 cents on the dollar.

MANAGEMENT OF TOBACCO SOILS

In Bulletin No. 277 of February 1917 Prof. James Johnson told how a ^{good}~~poor~~ type of tobacco which will make a good appearance on the market may be grown. To that ^{end} used, the general physical character of the soil, or texture, its state of fertility, and its freedom from the root rot disease must be considered. Decreased yield and quality of tobacco grown on land long used for that crop and moderately fertilized is due largely, not to lack of fertility, but of presence of the root rot disease. That disease therefore has to be combated, by avoiding infected fields and planting the crop on new land, or on soil where tobacco has

not been grown for several years. Plants grown on soil new to tobacco, or on steamed beds should be used. Resistant strains of tobacco should be chosen. Use of acid phosphate fertilized^r was especially recommended and also a judicious amount of rotation and cover cropping. Autumn and spring treatment of the soil was recommended as a means of maintaining fertility and conserving moisture, in addition to merely fitting the soil for planting and ~~letting~~^{holding} down of weeds. Instructions relative to the best methods of managements and practice for all phases of tobacco growing were illustrated and described.

THE COUNTRY CHURCH

Prof. C. J. Galpin in Bulletin No. 278 of January 1917, gave another of his intriguing discussions of social economic life in the country under title of "The Country Church: Its Economic and Social Force". He stated that it is the small, weak, powerless church, poorly located, which tends to surrender agriculture to destructive individualism. It is the strong church, with ~~whole~~^{noble} permanent architecture, properly located, with a capable resident pastor, which unifies agriculture and a unified agriculture, in turn, nurtures the church. How to produce these greatly desired aims in the future development of the rural church was advised in the bulletin. Many instructive illustrations accompanied the text. The story of a country pastor-John Frederick Oberlin- who spent 60 years in a single parish, grappling with the many problems of community life, was attractively and usefully told.

Bulletin 279. of April 1917, by W. H. Strowd, gave an account of the fertilizers sold in Wisconsin. Labs were greatest in the southeastern section of the state where truck and cash crops predominate. The author stated that in general, the manufacturers who are licensed to do business in Wisconsin, comply with the law. Most of the fertilizers analyzed in the Station laboratories meet

the claims made for them by the makers. The Wisconsin fertilizer law was passed in 1895 and amended in 1893.

POTATO GROWING IN THE STATE OF WISCONSIN

In Bulletin No. 280 of April 1917, Prof. J. G. Milward gave an account of ^{what} that was being done that year relative to the development and improvement of the potato growing industry in Wisconsin. It included seed potato inspection, and certification directed by the Experiment Station, and Extension work carried on by its experts together with promotion work of the Wisconsin Potato Growers' Association at that time organized in 26 counties of the State. Special attention was being paid to the promotion of a limited number of recognized standard varieties under a plan of community potato development. The bulletin offered practical advice relative rotations, available manures, handling potato soils, fertilization, seed potatoes, planting operations, cultivation, spraying, harvesting, etc. Useful illustrations impressed the lessons of the bulletin on its readers .

In Bulletin 281 of June 1917 W. H. Strowd told how feed inspection helps farmers. Visits were made by an inspector once a year to practically every retail store in Wisconsin, and endeavors made to obtain and analyze annually at least one sample of every brand of commercial feeding stuff offered for sale in the State. Tables gave the analyses of commercial feeding stuffs tested in 1916.

COOPERATION IN WISCONSIN

The agricultural economists of the Station, professors B. H. Hibbard and Asher Hobson, in their bulletin No. 282 of May 1917 outlined and discussed the various agencies working in a cooperative way for the extension of agricultural industries in Wisconsin. These included the Grange, the American society of Equity, the National Agricultural Organization Society, some 45 per cent of the 83 creameries and 37 per cent of the 1920 cheese factories of the state, cooperative feed, elevator, and produce companies, livestock shipping associations, packing plants, fruit exchanges, tobacco firms, cow testing associations, 50 to 60 coopera-

tive stores, Cooperative laundries, farmers' mutual insurance companies, and mutual telephone companies.

REGULAR BULLETINS OF 1917-1918

The first regular bulletin of the fiscal year from July 1917 to June 30, 1918 was No. 283 on the distribution of public service stallions in Wisconsin. In it D. A. S. Alexander reported further reduction in the number of grade and scrub stallions. Although horse breeding had been somewhat depressed during the season of 1916-17. The average value fell during that time from \$124 to \$120 per head giving the horses of the state a total value of \$85,800,000. The percentage of pure bred public service stallions during the year was 61.5 compared with 59.2 in 1916, and 35 in 1907. In accordance with legislative action, at the suggestion of the College of Agriculture, the enforcement of the stallion licensing law and inspection work was transferred on July 1, 1917, to the State Department of Agriculture, but D. A. S. Alexander was continued in charge on a part-time basis. *Bulletin 283*

BULLETIN 283

This presented a directory of the owners of public service stallions and jacks for 1917 and in addition to the usual statistics gave illustrated instructions for the printing of legal advertising posters for sires in service.

FARM DRAINAGE

In Bulletin No. 284 of November 1917, Prof. E. R. Jones and O. R. Zeasman offered an instructive treatise on tile drainage on the farm. They stated that drainage has reclaimed 1,000,000 acres in Wisconsin, and that the profitable farming of 7,000,000 additional acres depends on tile drainage. Illustrations accompanied the text. The bulletin explained the benefits accruing from drainage,

superiority of tiles over open ditches, tight subsoils, effect of floods, importance of the outlet, the right drain for the right place, potholes, seepage marshes, backwater marshes, sloping swamps, hard-pan, outlet and feeders, where surface drainage does not help, how to plan a system of drainage, how to select tile and how to lay them.

MARKETING MILK

Prof. B. H. Hibbard and H. E. Erdmann in Bulletin No. 285 of December 1917 gave an account of a special study they had made in a number of leading cities in the State relative to the methods and economics of the distribution of market milk. They found that milk prices had not risen as rapidly or so much as have prices of other foods. Grades of milk were not such as are most helpful to the consumer in aiding him to select the class of milk he wishes to buy. Milk for the city trade is bought mostly in the 8 gallon can or by the hundredweight. In many instances, the fat content is not considered so long as the milk contains enough to satisfy legal requirements. Payment on the basis of the fat content gives the producer more nearly its true value. The cost of distributing the milk varied from $1\frac{1}{4}$ to nearly 3 cents. Cooperative or municipal action, by unifying the delivery system would be likely to reduce the expense of delivery. The farmer was getting something over half of the money paid by the consumer for milk. Organization among producers would secure them higher prices, provided capable men were selected officers of the organizations.

Control of Cherry leaf spot in Wisconsin was the subject of illustrated Bulletin No. 286 of February 1918, written by Prof. G. W. Keitt. He pronounced leaf spot the most destructive fungus disease of the cherry in Wisconsin. Two or three applications of Bordeaux mixture or lime-sulphur, with arsenate of lead,

combined with early clean cultivation, would satisfactorily control leaf spot. The first applications should be made soon after the flower petals fall, the second, about 2 weeks later and the third just after the fruit is harvested. Directions for the preparation of the spray mixtures were given.

FEEDING CATTLE FOR GROWTH AND REPRODUCTION

New facts on this important subject were given by Professors E. B. Hart, H. Steenbock and G. C. Humphrey in illustrated Bulletin No. 287 of February 1918. They found that a wheat grain with wheat straw ration was in most cases fatal to both growth and reproduction and would also produce weak or dead calves. So far as reproduction was concerned that was likewise true with a corn grain and wheat straw ration. A legume hay should be fed with wheat grain or its by-products to prevent their ill effects on reproduction and ^{even then} wheat or its by-products should not be fed continuously or too liberally or the offspring would be weak. Poor roughage, such as the straws, tend to induce retention of the afterbirth following premature delivery. A complete ration cannot be made from the oat plants. Exclusive use of oat straw as a roughage for breeding cows will also produce premature, weak or dead offspring. Corn ^{stover} straw, corn silage, or legume hay should replace part of the oat straw. A complete ration can be made from the corn plant and will give normal growth and reproduction.

RURAL RELATIONS OF HIGH SCHOOLS

Professors C. J. Galpin and J. A. James, in illustrated Bulletin No. 288 of March 1918 declared that a high school education is becoming a farm necessity. An education in agriculture for children of the farm would mean more rapid farm progress in all lines. But one-eighth of the area of Wisconsin was, at that time, included in high school districts. The trade area of a town, city or village is related to the attendance in the local high school. Good schools go with good business. High schools must reflect the life of their community.

Good fellowship between the high school and the nearby rural schools cements a friendship between the rural dweller and his city brethren. The high schools needs some farm land as a part of its equipment; home projects of various kinds, such as judging livestock and grains, add interest and stimulate the work of the high school students.

SOYBEAN GROWING

In Bulletin No. 289 of April 1918, Prof. R. A. Moore and E. J. Delwiche advised farmers to grow soybeans because they are more resistant to wheat and drought than are clovers and alfalfa; rank with linseed and cottonseed meals as a concentrated feed for cattle, sheep and swine; produce hay that is about equal to alfalfa in feeding value; gather nitrogen from the air and store it in their roots, thus improving the soil on which they grow and because they may be substituted as a catch crop for clover when that kills out. Soybeans were reported as rapidly becoming one of the most valuable of the minor crops grown in Wisconsin. The bulletin advised as to the varieties best suited for growth in the state and gave instructions for the profitable growing of the crop. They bring the best returns when planted on rich soils, but they can be grown for hay and seed on sandy soils which do not grow clover well.

HINTS FOR THE SETTLER

B. J. Packer, Director of Immigration, Wisconsin Department of Agriculture, and Prof. E. J. Delwiche of the Wisconsin Experiment Station gave, in their Bulletin No. 290 of March 1918 all necessary advice relative to the making of a farm in the out-over lands of Northern Wisconsin. The bulletin contained 71 pages and was profusely illustrated. We found this bulletin one of the most complete, comprehensive and instructive publications yet published for the prospective settler, and one that perfectly supplied all the practical information required by the beginner on a northern farm. One recommendation given it, it was that dairy farming is a profitable line to follow in a new country, so

that a few good cows should be used from the start. Sheep would help in clearing the land of brush and also return a profit in wool and mutton. A pig or two would supply the family larder and a small flock of hens keep the table supplied with meat and eggs. Clovers grow luxuriently in the north: field peas thrive and make a profitable crop for forage and seed: wheat, oats, buckwheat, rye and soybeans can also be grown to advantage and every settler needs a good garden. The agricultural agencies of the state are at the settlers' service.

THE NECESSITY FOR MILK

Professors E.B.Hart and H.Steenbock explained in illustrated Bulletin No. 291 of June 1918, why milk is necessary for the nation's welfare and especially when there is a food crisis in time of war. The authors stated that milk is a perfect food, containing as it does all the factors of nutrition in adequate proportions, and making it an indispensable supplement to other food material during growth. It supplies adequate mineral material for rapid growth, the very best of proteins, an abundance of necessary vitamins, especially the fat soluble vitamin and the water soluble vitamin. It is an absolute necessity in the diet of growing children and they should also be abundantly supplied with eggs. The authors remarked that the public must learn to appreciate, even with advancing prices, the importance of the dairy industry in the nation's welfare.

In Bulletin No. 292 of May 1918, Professor H.C. Taylor discussed the subject of price-fixing and the cost of farm products, the demand for price regulation having increased rapidly during the past year. He recommended total farm profit as the starting point in price-fixing, and that a price commission might well act as a medium for collective bargaining in the sale of farm products and in the purchase of supplies. Price commissions should make a careful study of the demands for consumption at various possible prices and then carefully study the conditions of production to find what supplies can be

produced profitably at the various prices and adjust them with a view
to keeping supply and demand balanced.

WISCONSIN'S HEMP INDUSTRY

That subject was finely presented in Bulletin No. 293 of May 1918, by Prof. A. H. Wright. He stated that hemp raising in Wisconsin had increased seven-fold since 1912, and in certain localities had become a profitable new crop. Several hundred acres must be grown in a vicinity to make hemp production profitable. Wisconsin is the second largest hemp producing state in the Union. Hemp fiber is a national necessity. The crop should be grown in fertile soil and is useful for smothering quack grass and Canada thistle. Fiber hemp does not mature seed in Wisconsin. Seed for planting comes from Kentucky. It is drilled in a well prepared seed bed, in the Spring, and requires no further attention until it is ready to harvest in September. It is harvested with a special machine which spreads the stalks in a thin window^{row}. A few weeks later the stalks are bound, shocked and stacked. The dry, cured hemp stalks are hauled to a breaking mill which removes the woody portion. There are nine of these mills in Wisconsin. The crop averages 1,200 ^{lbs.} ~~us~~ per acre worth gross, an average of \$75 per acre. The illustrated bulletin gave ^{full} ~~free~~ directions for the growing and handling of hemp.

RESEARCH BULLETINS OF 1916 (Nitrogen from Legume Growth)

In Research Bulletin No. 39 of October 1916, Professors E. B. Fred and E. J. Graul dealt with the subject of the gain in nitrogen from growth of legumes on acid soils. In their experiments of 1915, Colby silt loam series, the increase in growth and percentage of nitrogen in inoculated alfalfa, far exceeded that of the previous year. An application of both lime and inoculation gave the greatest yield of dry matter. Applications of lime alone gave a gain in plant growth. In the Plainfield Sand an enormous increase was noted wherever the proper bacteria were added. From the data obtained it was apparent that applications of legume bacteria are even more beneficial to the growth of alfalfa on Plainfield sand

than in Colby silt loam. The effect of lime was the same on each class of soil. Clover on Colby silt loam was not benefited to any decided degree by inoculation or application of lime. A slight increase followed liming on Plainfield sand inoculation alone caused an increase in the yield of clover and in total nitrogen. Lime greatly favored the growth of clover. Lime and inoculation gave a maximum yield of dry matter and the maximum amount of nitrogen. Small applications of calcium carbonate on acid soils proved far more economical than large applications.

FACTORS INFLUENCING RURAL EDUCATION

In Research Bulletin No. 40 of October 1916, Eugene Merritt and Prof. K. L. Hatch, discussing the subject of some economic factors which influence rural education in Wisconsin showed that while the average size of farms in the developed portion of the state was gradually increasing, the average size of the farm family was gradually decreasing. The average enrollment in the one room rural school was consequently decreasing. The rural school of less than 20 pupils was economically inefficient on account of high cost of pupil. Aside from the one room schools, state graded and high schools could most economically and most completely meet the needs of rural education.

USE OF PHOSPHATES BY PLANTS

In Research Bulletin No. 41 of November 1916, Prof. E. Truog presented interesting and instructive facts regarding the utilization of phosphates by agricultural crops, and offered a new theory regarding the feeding powers of plants. He had found that solubility of the phosphates was not the only factor that determines the growth of a plant on that fertilizing element. The new theory expounded was that plants containing a relatively high calcium oxide content have a relatively high feeding power for the phosphorus in raw rock phosphates. For plants containing a relatively low calcium oxide content, the converse was about true. The explanation of this relation was made possible by means of the laws of mass action and chemical equilibrium. The rate at which phosphorus and potassium go into

solution in the local areas in contact with the roots of plants was deemed by the author a more important consideration than the amount of these elements that may be drawn off from the whole soil mass in one extraction. The application of rock phosphate to acid soils, especially several months or a year in advance of the application of lime, seemed to be a desirable practice.

RESEARCH BULLETINS OF 1917
Early Blight of Potatoes ...

With the assistance of Prof. L. R. Jones, the early blight of potato and related plants was studied by R. D. Rand and the results published in Research Bulletin No. 42 of August, 1917. He stated that early blight in Wisconsin occurs commonly on potato, tomato and egg plant. Spread of the spores of the causal fungus (Alternaria ^{*solani*} schani) is chiefly effected by wind and rain. Colorado potato ^{beetles} ~~bugs~~ may also spread the disease. The period of incubation is 48 to ⁷² ~~92~~ hours. Periods of continued drought completely check its spread. The McCormick potato proved highly resistant, but this variety is a poor commercial type. Crop rotation and destruction of the dead potato tops help to prevent the disease. Thorough spraying with Bordeaux mixture proved effectual as a control. This was the only Research Bulletin published in 1917.

SERVICE WISCONSIN FARMERS IN 1916-1918

The annual report of the Agricultural Experiment Station for 1916-1917 and 1917-1918 was published as Regular Bulletin No. 302, in August 1914 by Director H. L. Russell and Professor F. B. Morrison.

Building activities on the Campus had ceased with the completion of the Soils Physics Building in 1916 at a cost of \$49,249, but there had been no let up in the other activities of the Station.

PLANT AND ANIMAL DISEASES

Special attention was being directed toward the control of diseases of plants and animals which otherwise might largely nullify the good effects of utilizing better blood, pedigreed seed and improved cultural practices in plant and animal development. The discovery of the necessary methods for controlling diseases in cabbage by the use of developed resistant strains and localized soil disinfection with onions, was cited as a triumph of the Station research workers during the war period. Climatic influences had also been shown to have a marked effect in the occurrence or severity of plant diseases, and especially as regards the potato and cabbage. Moisture and temperature exerted the most marked effect. Additional facilities of a controlled temperature regulation had been installed. Working in cooperation with the U.S. Department of Agriculture, Professor James Johnson to determine the relation between temperature and the development of the rootrot disease of tobacco had enlarged the scope of his efforts to cover practically the entire tobacco-growing area of the United States. Promising individual plants had also been obtained in the selection of disease-resistant-strains and there was good promise of the commercial success of this work.

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Success had also attended the efforts of the Plant Pathology Department in developing a commercial strain of winter cabbage that could withstand the inroads of "cabbage yellows" and success had likewise been achieved in developing a resistant strain of Kraut cabbage. J. C. Walker of the Plant Pathology Department had also made a series of observations which indicated very clearly that cabbage seed when not disinfected, can transmit the black-leg disease. Experiments were in progress to determine the comparative value of seed treatment with formaldehyde, corrosive sublimate, and dry heat. The application of formaldehyde with his onion seeding of 11.8 acres had brought a Racine grower an increase in yield of 3,380 bushels at a cash outlay of \$59. The process of application was that described in the Director's Report for 1914. A. G. Johnson (plant pathology) had found by experimentation that when ergot-infested rye is immersed in salt brine the ergot spurs with light kernels and some weak seeds rise to the surface and may readily be skimmed off. That investigator had been working with emergency food agents, county representatives and field agents of the U.S. Department of Agriculture to determine the prevalence of stripe disease of barley and some method of control. As a result of the investigation he advised farmers to soak barley and for 2 hours in a mixture of one pint of formaldehyde and 30 gallons of water, then dry it and sow at once as a means of preventing stripe disease and loose smut.

Sterilization of soil in tobacco seed beds had now become widely practiced in the state and J. Johnson (horticulture) had been conducting extensive experiments to determine more definitely the reason for the increased growth of plants and their temporary retardation on heated soils. He found that when soil was sterilized by heat, plant food was not only rendered more available but gradually becomes more available due to increased activity of soil micro-organisms. Com-

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pounds injurious to plant growth are, however, produced at the same time and are believed to be largely ammonium compounds. These compounds gradually are lost as a result of the activity of micro-organisms. The temperature of the soil and other environmental factors are largely influenced in determining the rate at which the injurious property disappears.

An intensive study of the grain stem rust problem in Wisconsin had been made by A. G. Johnson and J. G. Dickson (plant pathology) during 1918, in cooperation with the U.S. Department of Agriculture with the result that in no case was early rust infection on grains or grasses noted apart from infections on the common barberry (Berberis vulgaris). A campaign for eradication of this barberry was in progress.

In 1918 nearly 3,600 observations relating to plant diseases were made by members of the Plant Pathology Department in cooperation with the various county agents, emergency food agents, and field scouts from the U.S. Department of Agriculture, Office of Cereal Disease Investigations and Plant Disease Survey. The survey furnished definite information as to the diseases and localities where control work would prove most useful in succeeding years. An immediate useful result of the work was the detection in 1918 of an early outbreak of potato ^{late} blight in Barron County by W. H. Wright and J. W. Brann and institution of a successful spraying campaign against it conducted by county agent R. L. Cuff.

INSECT PEST CONTROL

Experimental work carried on in the station insectary and in orchards by C. L. Fluke and L. J. Gentner (economic entomology) at five different points in the State showed that for control of the codling moth and plum curculis injurious to the apple crop spraying should be done not only in July and August

and additional treatment should be made before the middle of September.

Suitable spray compounds were prescribed by the experts.

During the past three years the imported cabbage worm had seriously damaged the garden and field cabbage crops in the State. The pest was successfully combated by L. G. Gentner with arsenates of lead and lime, and also with arsenate of zinc, used both in the wet and dry form. Hydrogen arsenate of lead was found to give nearly as good results as paris green for the destruction of the grubs of the potato beetle.

HORTICULTURAL STUDIES

Experiments to determine the effect of fertilizers on cherry production in Door County had been in progress since 1914 by R. H. Roberts and G. F. Potter of the Horticultural Department. Applications of a nitrogenous fertilizer had increased a yield in the cherry crop and seemed to produce a change in the fruiting habit of the tree. Trees so fertilized carried a large proportion of their crop on two-and-three-year old spurs, whereas trees not given nitrogen produced their fruit almost entirely from lateral buds on one-year old wood. It was determined that, for highest production, the cherry should be encouraged to produce long seasonal growths such as occur most markedly in the trees that received nitrogen. R. H. Roberts also noted winter injury to Cherry Blossom fruit buds occurs most readily in buds which are most developed. ^{Pruning} ~~Pruning~~ had an important part in controlling the rate of growth of the tree as had proper soil management. Rather heavy pruning was deemed advisable for the sour cherry where the trees were making sufficient growth to provide for maximum production. It had been found that pruning can be done with much less labor if the cut is made at the outer edge of the "Collar", which is from a quarter to half an inch away from the ~~the~~ main branch. The smaller exposed surface so formed will heal sooner than when the cut is made closer to the supporting branch.

CROP PRODUCTION WORK

Hemp growing had been progressing in the State under the auspices of the Station. The fiber had largely been used instead of high priced sisal for the manufacture of binding twine in 1918. Wisconsin had become the first state in the production of hemp and the quality of the product was ^{proving} ~~growing~~ unexcell^{ed}ent. The crop was being tested out in the English mills as a prospective new outlet for Wisconsin hemp.

B. D. Leith (Agronomy) had been experimenting with a corn developed from the Golden Glow Variety that is more resistant to cold than the ordinary varieties. In 1917 and 1918 this corn matured about one week earlier than the original parent type. Trials made with it in the Northern part of the State had been exceedingly promising. Experimental growing of a red corn developed in a field of white Silver Corn had also been in progress and the new corn was found to ripen two or three weeks earlier than the ordinary No. 7 Silver King Strain. Seed had been made available for more extensive trials of the new variety.

H. W. Albertz (Agronomy) had proved that soft seed corn treated with 15 pounds of salt to each 100 pounds kept well until May while double that amount of salt kept it good until (July).

B. D. Leith (Agronomy) had continued his work towards development of an improved strain of Marquis wheat and had ^{secured} ~~secured~~ a six-year average yield of 35.9 bushels per acre. ^{early seeding is essential for good yields of wheat.} At the Branch Station it had been found that ^{early} in September proved to be the best season for ^{sowing} ~~sowing~~ winter wheat. Heavier seeding of wheat per acre was advised. The practice of "close" threshing of oats was found by A. L. Stone (Agronomy) to injure the vitality of the grain per

seed and increase its susceptibility to attacks of disease. Two hundred twenty-five new varieties and strains of garden, field, and canning peas were ^{being} grown at the Ashland Station, by E. J. Delwiche (Agronomy) in an attempt to develop peas of early maturity, greatest ^{er} producing capacity and improved quality. Two purebred strains of the Horsford market garden variety had proved of fine quality and especially to the heavy red clay of the Superior Section. As early frosts in the fall of 1917 had destroyed much of the sorghum seed of the State A. H. Wright (Agronomy) had continued his breeding work to develop standard varieties. Much of the imported seed used in the spring of 1918 had proved contaminated with alien seeds. L. F. Grazer (Agronomy) who had been studying ways of preventing winter killing of alfalfa recommended as most effective cutting of the crop not later than the first week in September and by seeding hardy varieties such as Grimm, Baltic, Cossack, and Turkestan. To winter killing of alfalfa was attributed the prevalence of blue grass in alfalfa fields. G. B. Mortimer (Agronomy) had been testing the availability of sudan grass as a forage crop and had obtained a yield of 2.1 to 3.4 tons per acre, while from 1,000 to 1,400 pounds of seed to the acre had been produced; A. L. Stone had found that the germinating power of wheat was increased fully 60 percent by two months storage ^{after} the harvesting; while the germinability of timothy seed increased 36 percent after storage for four months. Rye also improved for seeding purposes after storage. From 1912 to 1917 the Genetics and Agricultural Chemistry Departments had been studying the chemical constituents of certain vegetable oils. Selections of soybeans had been made for high and low percentage of oil and low of soils.

iodine number, to measure the relative value of the qualities of these oils for use in paint manufacture. In 1918, for the first time, L. J. Cole found the iodine numbers for the "high-selection" line were distinctly higher than those from the low selection line. The average iodine number of 56 plants in the "high" line was 136.6, whereas that of 43 in the "low" line was only 125.1. As there was practically no overlapping in these high and low lines, the difference was regarded as of considerable significance. E. M. Nelson found that the amount oil and the iodine number in the leaves of soybeans plants, as in the seed, were subject to considerable range. The amount of ether extract, indicating a relatively low oil percentage, ranged from 3.7 to 6.0 per cent. Experiments by L. J. Cole also indicated that less than 1 or 2 per cent of natural cross pollination occurs in soybeans. A far greater amount of natural cross-pollinization was found to occur in the Jimson weed (Datura).

SOIL MANAGEMENT AND STUDIES

J. Swenehart (Agricultural Engineering) found by experimentation that *it* cost 50 per cent more to remove stumps by the use of explosives during the dry part of the summer than in late autumn ~~where~~ⁱⁿ the soil was wet. E. Truog (Soils) found that the true reason for the unfavorable effect of an acid condition of the soil on plants is that the acids prevent the plants from securing adequate amounts of lime from the soil to meet their needs. The stronger the acidity the less time is it possible for plants to extract from the sour soil. The new Truog acidity test enabled its user to determine not only the relative degree of soil acidity but to recommend in a satisfactory way the amount of lime necessary to use to produce proper plant development. Mr. Truog had also devised a simple method of determining the phosphorus content of soils.

Work at the Branch Stations showed that Colby silt loam needs drainage and that the use of commercial fertilizers in connection with green manuring crops will produce a material in the yields of nearly all crops on the sandy soils of the State. With wheat following corn better results were obtained upon the muck plots than upon clay at the Ashland Station. While deep fall plowing of the Superior red clay proved highly beneficial it had no such effect on spring plowing on the Colby silt loams at the Marshfield Station. On the latter soil applications of acid phosphate materially improved the production of corn, while applications of formed limestone benefited oats on new seedling. Rock phosphate also increased the yield of corn. Manure and phosphate gave the best yield of oats on the Spooner Station sandy soil. Corn showed good results from the application^{of} manure, phosphate and potash.

E. B. Fred (Agricultural Bacteriology) advised that the farmer could not depend on the feeding of alfalfa to his animals and inoculate the soil for the growing of that crop. The nodule forming bacteria are destroyed by passing through the digestive tract of the animal. That expert and Miss Davenport (Agricultural Bacteriology) showed by special work on the subject that the bacteria associated with alfalfa are very sensitive to acid, as is the alfalfa plant itself, while the soybean and lupin bacteria are far less affected by an acid reaction. They advised that when the soil is favorable for the plant or is made so, it will also be favorable for the bacteria associated with the particular plant.

ECONOMIC STUDIES

Studies of farm labor conditions in the State by experts of the Agricultural Economics Department showed that wages of farm help had increased to \$26 a month in 1910, \$36 in 1917 and \$43.50 in 1918. Survey records kept of

all of the farms in Verona township, Dane County, Wisconsin for 5 years showed that corn, oats and hay were the principal crops grown, while the chief products sold were milk, cattle and hogs. The incomes for the first 3 years, from 1913 to 1915 inclusive, were low, but in the main, rose to a satisfactory level in 1916 and 1917.

Market milk studies by B. H. Hibbard and H. E. Erdman (Agricultural Economics) during 1917 indicated that the farmer receives at different times from 50.5 to 62.7 per cent of the price paid by the consumer for bottled milk. The study also showed that the same amount of milk delivery work could be secured by about 55 per cent as many men and 37 per cent as many horses as were being used in the work at the time of the survey.

C. J. Galpin (Agricultural Economics) who had been studying the high schools of the state found that seven-eighths of the entire area of Wisconsin is outside of any existing high school district were the high school district extended to cover the area from which the rural students come, it would practically coincide with the trade area of the village or city in which the high school is situated. Mr. Galpin concluded that if a closer relation existed between the country schools and their nearby high school, a larger proportion of country boys and girls would attend the village or city high school.

BACTERIOLOGY AND DAIRY STUDIES

Some work done by the Agricultural Bacteriology Department showed that the methylene blue reduction test measures as accurately as any of the more expensive and complicated tests the bacterial content of milk which is the greatest factor in determining its quality. A. C. Dahlberg (Dairy) found that "leakiness" or movement of brine from within the outside of a package of

butter is not affected by churning temperature or by the moisture content of the finished product, but is due to the condition affect^{ing} of the texture of the product - the conditions resulting in the production of an open texture were: the use of cold wash water, working butter in water, under-working butter, and highly salting it. J. L. Sammis (Dairy) found that a mixture of primost, which consists of the residues obtained by boiling whey--makes possible the use of glucose, where lower-priced sugars are used in the manufacture of candies.

Mr. Sammis had been able to produce a fine grade possessed of physical properties which enabled it to be washed and treated satisfactorily in the manufacture of water-proof glue for use in aeroplane construction. W. Pitz (Agricultural Chemistry) continued the study of the actions of metals ^{on the} with constituents of milk in the production of the so-called metallic flavors in butter. By subjecting casein or milk albumin to the action of hydrogen and iron sulphate in salt solutions, he had been able to isolate chemical compounds that are volatile in character and disagreeable in smell and taste and which impart an off flavor in butter.

VETERINARY AND POULTRY RESEARCH WORK

The Agricultural Bacteriology and Veterinary Departments had been studying John's disease of cattle and had succeeded in isolating the causal micro-organisms and in preparing "Johnin", a product similar to tuberculin for the detection of the infection. Five herds had been tested and affected animals that reacted showed lesions of the disease when slaughtered. The experts of the Veterinary Science Department had also made some interesting observations relative to tuberculosis in hogs. The disease proved to be increasing in prevalence. Affected hogs reacted to the tuberculin test. It was most prevalent in hogs fed skimmed milk and whey from factories or that followed feeding cattle in the yards.

Pasteurizing of ^{factory} ~~factory~~ by-products was recommended as a measure of prevention.

J. G. Halpin (Poultry) and E. B. Hart (Agricultural Chemistry) continued experiments relative to the effect of different factors on the growth of baby chicks. They had been attempting to raise chicks in compounded rations of purified food materials in an effort to prevent the common trouble known as "^{weak legs} ~~break-up~~". Yeast was being tried out as a feed in the experimental work.

The experts mentioned above were also studying the calcium requirements for chickens and had found oyster shell and clam shell superior to ground bone, calcium phosphate, and precipitated calcium carbonate in the mash feed.

ANIMAL NUTRITION

During the past year the Agricultural Chemistry and Animal Husbandry Departments had continued the study of the influence of the oat plant and, to some extent, of wheat by-products, on growth and reproduction. In every case where the oat plant was fed miserably poor offspring resulted, where the oat ration was fortified with either calcium acetate or wood ashes, normal offspring resulted. Calcium appeared to be the main mineral constituent lacking in the all-oat ration. Oats fed with corn stover and other roughages carrying a high calcium content gave no trouble whatever. In previous research work, it was found that middlings, starch, and corn stover made a perfect ration for reproduction. During the past year when bran was substituted for middlings and the amount of corn stover was reduced to 4 lbs. in a ration of 14 lbs., in order to provide a proper protein intake, the disease known

as Miller's bran disease developed as indicated by stiffness, too rapid respiration and miserably poor calves. A too low roughage supply and low mineral intake was deemed to be the cause.

H. Steenbock and P. W. Boutwell (Agricultural Chemistry) made a detailed study of the dietary qualities of barley the use of which had become widespread during the war as a substitute for wheat. The results obtained indicated that barley does not differ materially from the other grains in the essential nutritive constituents. Sixty per cent of barley in the ration sufficed to furnish an abundance of water soluble vitamin for growth, and even allowed reproduction. The experts mentioned also studied the presence of fat soluble vitamin in roots and tubers. It was found that most of them contained less of the vitamin than grains. Carrots alone were found richer in the vitamin. Digestive disturbances resulted where roots and tubers were fed exclusively with the ^{diets} ~~dirt~~. They found, likewise, that the vitamin is quite stable in plants such as alfalfa and that ordinary feeds generally contain an excess of potassium, magnesium and phosphorus. Both the magnesium and sulphate radicals were found to be indispensable, at least for growth.

W. H. Peterson (Agricultural Chemistry) found that under certain conditions the oils in rape seed and other feeds rich in volatile sulphur ^{oils} ~~oats~~ are so changed that a toxic condition of the material develops. ~~Slow elimination in the material develops.~~ Slow elimination in the urine and through the skin and uniting with other substances reduced the toxicity. Little volatile sulphur was found in the feces.

E. B. Hart, N. E. Nelson and W. Pitz (Agricultural Chemistry) experimented with rats to determine whether a protein free from lysin will allow milk produc-

tion to proceed. From the results it appeared that an animal can build its young in the absence of lysin, probably doing this from its own tissue, but that the secretion of milk or the rearing of the young by the mother cannot take place. Certain of the skimmed milk powders are deficient in the necessary ingredient, but this could be overcome by the feeding of yeast.

E. B. Hart and H. Steenbock demonstrated that the hairless condition in new born pigs was associated with a deficiency in the iodine content of the feed and that addition of iodine to the ration of the pregnant sow prevented the hairless condition. Mr. Hart also found that roughage fed to swine acts as a depressant in the matter of obtaining a high retention of nitrogen storage in the body. Addition of milk proteins helped to lessen the inefficiency of those supplied by roughage and increased the efficiency of cereal grain proteins.

E. B. Hart and G. C. Humphrey (Animal Husbandry) continued their comparisons of the efficiency of various protein-rich concentrates for milk production. Gluten feed and linseed meal were found equally efficient with alfalfa hay while distillers' grains had a greater efficiency than either of them and cottonseed meal the lowest of any of them. Where distillers' grains could not be had and equally efficient protein mixture could be made from gluten feed and germ oilmeal. It was noted in these experiments that although the experimental animals declined in volume of milk secreted, the composition of the milk was maintained unimpaired.

F. B. Morrison and G. Bohstedt (Animal Husbandry) continued their trials comparing the value of various forage crops for pigs under southern Wisconsin conditions. They found rape pasture worth \$46.02 per acre for the purpose while a mixture of oats, peas, and rape yielded a return of \$18.14 more per

acre on an average. Red clover and alfalfa proved of equal value to ~~rape~~^{rape} for pasture. They also tested, along with George C. Humphrey (Animal Husbandry) the value of barley feed and barley bran as the use of barley flour during the war had made large quantities of the barley by-products available. When barley was fed the yield of milk was decreased 3.86 per cent from that produced on wheat bran. Barley feed caused a decrease of only 0.78 per cent. Farmers had been paying too high a price for barley bran. Barley feed, supplemented with tankage, proved satisfactory for fattening pigs, but less so than ground barley and tankage.

Messrs.: Morrison and Bohstedt experimented in the wintering of brood sows and found that corn may form the main part of the ration for brood sows provided it is properly supplemented by feeds such as skimmed milk, tankage, and alfalfa or clover hay, which are rich in protein and mineral matter, especially lime, and provided the sows are not fed so much corn that they become unduly fat.

Messrs.: Morrison, Fuller and Bohstedt fed work horses crushed oats in comparison with whole oats with each lot receiving the same amount of hay per head. When fed whole oats, the horses gained 5.2 lbs. on the average per head and when fed 95 per cent as much crushed oats their average gain was 8.6 lbs. The two trials made indicated a saving of but 5 or 6 per cent by the crushing of oats for work horses, *whose teeth are in good condition.*

FARMER'S CIRCULARS OF 1916-1917

A Farmers' Poultry House was described in Circular of Information No. 62 of July 1916, by Prof. J. G. Halpin and L. M. Schindler. Plans and specifications accompanied the test, together with a bill of lumber for the building. In Circular No. 63 of August 1916, Prof. E. H. Farrington prescribed up-to-date methods for the care of milk and cream on the farm. A dairy farm score card was printed and by means of which the condition of the farm might readily be determined. How to produce first grade cream was prescribed and the advantages of rich cream explained.

In Circular No. 64 of October 1916, Prof. A. R. Whitson and W. J. Geib emphasized the importance of having the soil of the farm analyzed and gave information about having examinations made by the experts of the Experiment Station. Directions for the taking of samples were given, and the needs of various soils for fertilizers outlined. Circular No. 65 issued by the Extension Service of the College of Agriculture considered the subject of sewing for girls, with Elizabeth B. Kelley, Anna Pfund and Helen J. Dodge as the authors. Useful illustrations accompanied the text. The information furnished was intended primarily for the use of the Club girls of Wisconsin, but the instructions for making garments would be found useful by all girls in the women of the farm.

Crate-Feeding of poultry for market was the subject of Circular No. 66 of February 1917 by F. H. Mussehl offered practical instructions such as are needed by every beginner in the business.

Circular No. 67, of February 1917 was issued jointly by the Extension Service of the College of Agriculture, the Wisconsin Dairman's Association and the U.S. Department of Agriculture, with Noel Negley and R. T. Harris

as the authors. It explained how cow testing pays, and by text and illustrations gave a clear and useful exposition of the subject. How to form an association in a community was explained and sample membership contracts printed.

Canning for pleasure and profit was the subject^{of} illustrated by Extension Service Circular No. 68 of January 1917 written by Elizabeth B. Kelley. It gave instructions for the canning of both vegetables and meat by the most modern methods and proved of great interest to farm women. What to feed the children was advised in Extension Service Circular No. 69 by Dorothy Reed Mendenhall, M.D. and Amy L. Daniels. Rules for feeding healthy infants were given and the infants diet prescribed; also suitable meals up to the tenth year of life. This circular was republished in April 1917. R. E. Vaughan furnished information about fire blight of the apple and its control in Extension Service Circular No. 70 of April 1917 and the growing of beans was discussed in Circular No. 71 of April 1917 by Prof. R. A. Moore. This circular and those following were published under the direction of the State Council of Defense by the Extension Service of the University.

The author advised that beans would be needed by the U.S. Army and Navy. They were at that time worth \$9 a bushel. In circular No. 72 of April 1917, Prof. J. G. Moore and J. R. Hepler advised people to put in backyard gardens and gave them instructions for preparing planting and caring for the beds. In Circular No. 73 of May 1917, J. B. Hayes and F. E. Mussehl advised city dwellers to keep flocks of hens as a war emergency measure, and give them instructions for the care of poultry. How to preserve eggs for winter use was explained in Circular No. 74 of May 1917 by J. B. Hayes and F. E. Mussehl, and in Circular No. 74 of May 1917 Prof. J. G. Halpin gave instructions for the preserving of spring eggs for winter use. That was advisable as one-half of the yearly egg crop is produced in March,

April, May and June and exceeds the supply consumed. The sowing of buckwheat was advised and directions for the work given by Prof. R. A. Moore in Circular No. 75 of May 1917. It was recommended for planting where corn had failed or on a wet field just drained, a sandy corner or an area just cleared. Silver Hult and Japanese buckwheat were suggested as best for Wisconsin conditions. This circular was reprinted in March 1918. In Circular No. 76 "A Wisconsin farmer who, year in and year out, had profitably employed 2 men on his 160-acre farm "gave practical advice, in the form of specific rules" for the getting of farm work properly and efficiently done. In Circular No. 77 of May 1917 Prof. E. R. Jones told farmers how to drain the wet spots on their farms, and in Circular No. 78 of May 1917. Prof. H. F. Wilson advised them how to kill the worms and save the apples in their orchards. Other "Council of Defense" circulars published by the agricultural extension service were Circular No. 79 of May 1917 on how to cook soy beans, prepared by the Home Economics Department of the University, Circular no. 80 of June 1917 in which Amy L. Daniels of the Home Economics Department described twelve ways to use barley. This circular was revised and reprinted in March 1918. In Circular No. 81 of June 1917. Prof. J. L. Sammis, described the moisture test for use in cheese factories. It was published by the Agricultural Extension Service as a regular circulation of information and presented instructive illustrations in addition to the text. More "Council of Defense" circulars were published. Of these No. 82 of June 1917, told how the garden might be defended against insect pests with L. G. Gensner as the author; No. 82 of June 1917, by Prof. J. G. Milward, gave instructions for fighting the "Potato Bug" (reprinted in April 1919) and No. 84 of June 1917 contained advice by Prof. R. A. Moore, on the importance of thorough cultivation for all farm grown crops.

WAR TIME CIRCULARS OF 1918

Under the direction of the State Council of Defense, the Agricultural Extension Service of the University, continued, during the fiscal year from July 1, 1917 to June 30, 1918, inclusive, the publication of circulars of information containing brief advice and instructions relative to practical subjects of especial interest to farmers during the war-time period of emergency production. The first of the series No. 71 was issued in April 1917. The first circular published in the 1917-1918 fiscal year was No. 85, of July 1917 in which Prof. R. A. Moore advised farmer to stack their grain before threshing. As the waste in threshing often is great, and the nation needs all of the crop, it was advised that good care be taken of the harvest. Circular 86 of July 1917, followed and told how to dry surplus fruits and vegetables; while in illustrated Circular No. 87 of July 1917, Prof. F. M. White answered the questions that were being received relative the construction of silos, of the various types. Instructions for the canning of fruits and vegetables were given in Circular No. 88 of July 1917. In Circular No. 89 of August 1917, Ada E. Hunt told how barley, rye, rice, potatoes and rolled oats could be used as partial substitutes for wheat in the making of war-time bread, and Circular No. 90 of the same month, Prof. R. A. Moore and E. J. Delwiche advised how farmers could help to fill the nation's flour barrel. The Extension Service of the College of Agriculture published circular No. 91 in September 1917. In it Hazel Manning gave instructions for the making of new clothes at small cost and furnished patterns for each type of garment described. This Circular was revised and reprinted in November 1919. Circular No. 92 of September 1917 in which Prof. J. G. Moore advised how vegetables should be stored for winter use, was also published by the Extension Service. In "Defense" Circular No. 93 of October 1917, Abby L. Marlatt and Amy L. Daniels of the domestic science department prescribed 12

cooking carp. They advised that carp might, to a large extent, be used as a substitute for meat in the war-time diet. How to remove ergot from rye, and information about this fungus pest, was told and furnished in Extension Service Circular No. 94 of January 1918, by A. G. Johnson and R. E. Vaughan. This circular was reprinted in Jan. 1920. Useful illustrations accompanied the text. In "Defense" Circular No. 95, of January 1918, the Home Economics department prescribed many practical ways of using corn. The authors remarked that "To eat more corn, or maize, as the Indians called it, should be a patriotic duty and a pleasure to American home defense forces". Circular No. 95, was reprinted. In May 1918 Extension Circular No. 96 of February 1918, by Prof. E. B. Fred dealt with the subject of the inoculation of legumes, and was published chiefly to correct some of the false impressions in regard to inoculation. It announced that the College of Agriculture would supply cultures of the kind of bacteria that will produce nodules on the legumes sowed by farmers at the cost of materials, or 25 cents a bottle, sufficient to inoculate 20 lbs. of alfalfa seed. In "Defense" Circular No. 97 of February 1918 Prof. A. R. Whitson gave instructions for the use of fertilizers during war, and in Circular 98, of the same month the Home Economics department outlined various ways of cooking potatoes. Recipes were given for the many potato dishes recommended. The Circular was reprinted in April 1918. Extension Service Circular No. 99, of February 1918 gave instructions for the most effective ways of fighting tuberculosis of poultry; then followed, in the same month "Defense" Circular No. 100, by Prof. E. V. McCollom giving hints on what to eat during the war. He advised to save wheat, use more corn; to save meat,

use beans and fish; to save fats, use just enough; to save sugar, use syrups, and by so doing serve the cause of freedom. In Extension Circular of March 1918, Prof. R. A. Moore stated reasons why Wisconsin farmers should sow spring wheat; while in Extension Service Circular No. 102 of March 1918, E. D. Ball of the State Department of Agriculture, and R. E. Vaughan of the College of Agriculture told farmers the importance of destroying barberry bushes from which the black or stem rust, spreads to wheat, oat, rye and barley fields. In "Defense" Circular No. 103, of April 1918, Professors J. F. Wojta and A. H. Wright advised farmers to grow sugar beets and gave instructions relative to the best methods of cultivating the crop. In Extension Service Circular No. 104, of April 1918 a list of available blueprint plans of farm buildings was published and some sample plans were illustrated. The Home Economics department offered in "Defense" Circular No. 105 of April 1918 suggestions on the use of the cereals and potatoes instead of wheat which at the time was so much needed by our armies and allies. Suitable recipes were presented. The same department in "Defense" Circular No. 106, of May 1918 suggested what the people should eat on wheatless and meatless days and again offered appropriate recipes for all sorts of palatable and nutritious menus.

EXPERIMENT STATION WORKERS IN 1918-1919

John Merrill Fargo, who was raised on a Wisconsin farm and had graduated B. S. in 1919, became an assistant in the Animal Husbandry, Department of Wisconsin College of Agriculture in 1919, and was instructor 1920-1922 and assistant professor from 1922. He served in the U.S. Army 1917-1918, and in 1921 received the M.S. degree from the University of Wisconsin.

Ray Stillman Hulce, who was brought up on a farm near Sugar Creek, Wisconsin joined the Agricultural faculty of the University of Wisconsin in 1918. He had received the B.S.A. degree from the University of Wisconsin in 1911 and the M.S. degree from University of Illinois in 1913. From 1911 to 1917 he was instructor in dairy husbandry in the University of Illinois.

Theodore Macklin who was born in Nanking, China, and had received the B.S.A. degree from Iowa State College in 1911 and the Ph. D. degree from the University of Wisconsin in 1917 was, in 1919 made professor of Agricultural Economics in that institution. From 1911 to 1912 he served as extension dairy lecturer for Iowa State College and from 1915 to 1919 was Professor of Agricultural economics in Kansas State Agricultural Colleges. In 1924 he traveled in the Orient with Director H. L. Russell doing research work in his specialty. Samuel *Weis Mendum* (?) from Boston, Massachusetts and who had received the B. S. degree from Massachusetts Agricultural College and Boston University in 1910 and M. S. from the University of Wisconsin in 1913 served as an instructor in Agricultural economics in the Wisconsin College of Agriculture from 1918 to 1921. From 1913 to 1915 he had acted as farm accountant for

a dairy corporation and from 1916 to 1917 as a farm manager in New Jersey. From 1921 to 1924 he was junior economist in the U.S. Department of Agriculture, Washington D. C., then as associate Agricultural economist until 1925 when he was appointed associate economist analyst in the Department. He also served as manuscript reviewer and editor of "Crops and Markets" from 1923. In 1930 he was serving as Senior Agricultural economist in the U. S. Department of Agriculture.

Duncan Henry Reid, a native of Wisconsin and reared on a farm, served as assistant Professor of Poultry Husbandry in the Wisconsin College of Agriculture from 1919 to 1923 and he was then appointed professor and head of the poultry department of Texas Agricultural and Mechanical College at College Station, Texas. He received the M.S. degree from the University of Wisconsin in 1922.

John Henry Swinehart, from Vandevort, South Dakota, where he was raised on a farm, served as assistant professor of Agricultural Engineering in the Wisconsin College of Agriculture from 1914 to 1918, as associate professor from 1919 to 1923 and as professor from 1923 to 1929 when he became manager of the Agricultural service division of the *Atlas* Powder Company, Wilmington, Conn. He received the B. S. degree from South Dakota State College in 1911, was Agricultural Director of public schools at Jordan, Minn. from 1911 to 1914 and county agricultural agent for Crandon county Wisconsin, 1918-1919. His field work in the use of explosives for the clearing of ^{*stump*} ~~stump~~ land gained him a well merited reputation for efficiency. Among the assistants and instructors on the roster for 1918-1919 may be mentioned the following: In Home Economics Cora E. Binzet; in Agricultural Bacteriology, J. A. Anderson, W. E. Frazier,

C. R. B. Elliott, and O. C. Bryan; in Agricultural Chemistry, Mariana
J. Sell, M. R. Ellis, S. Lepkousky, H. H. Sommer, and Barnett Sure; in
Agricultural economics, Emily Hoag; in Agronomy H. W. Alberts, E. D.
Holden; in Agricultural Engineering, C. E. Wals^h; in Genetics, L. H.
Lust; in Animal Husbandry; A. J. Cramer; in Dairy Husbandry, H. H.
Holland, and C. S. McBride; in Agricultural Journalism, R. O. Nefziger;
in Plant Pathology, Ruth Bitterman, L. K. Jones and W. B. Fisdale; in
Poultry Husbandry; O. M. Johnson; in Soils, E. L. Henning and F. W.
Parker; in Veterinary Science, Otto Stadre; Executive Secretary, F. X.
Ritger.

STATION PUBLICATIONS OF 1918-1919

The Experiment Station during the fiscal year July 1, 1919 to June 30, 1919 published 10 Regular Bulletins, 2 Research Bulletins, and 3 poster bulletins, one of them reprinted, together with 9 new Circulars of Information and 4 reprinted circulars which were sent out under the Extension Service frank.

Brief digests of these publications follow:

WAR TIME REGULAR BULLETINS

In July 1918 Dean and Director H. L. Russell and Professor K. L. Hatch, director of the agricultural extension service of the College of Agriculture published Bulletin No. 294 with the title of "Serving Wisconsin Farmers in War Time". It outlined and explained the various phases of extension work in progress. Upon the declaration of war the College of Agriculture released members of the staff to take up work similar to that of the county agents. On August 16, Congress provided additional federal funds which made it possible for the College to maintain in the field throughout the summer 27 additional men as emergency food agents. There were already 11 regular county agents at work in the state. Soon there were 54 men in the field, giving an almost complete state-wide organization with which to carry on vigorous campaigns for increased food production. Valuable service was rendered; more and better potatoes were ^{raised} ~~raised~~: better seed was bought and sown by farmers; every possible effort was put forth to make each stroke of work accomplish the greatest result in increasing the nation's food supply. (Demonstrations of ^{many} ~~many~~ kinds were made and farmer's meetings held. The meetings included those of breeders' associations. Dairy demonstrations were made to control factory losses. ^{Millers} ~~Millers~~ and bankers cooperated with the College in a bread drive. Bankers led in pedigree wheat distribution. There was hearty cooperation all along the line and all concerned gave their best talents and efforts to the emergency work undertaken.

RIDDING THE LAND OF STUMPS

The Agricultural Engineering Department in Bulletin No. 295 of

August 1918 explained how modern methods and improved machinery make the clearing of land much easier. The bulletin presented many illustrations of the new machinery of various types and purposes at work on the cut-over lands of the northern counties, gave full instructions for their operation, and told how to use explosives in a safe and effective manner. Much of the material was that already published in Bulletin No. 290 on "Farm Making in Upper Wisconsin".

RELATIVE TO CONTAGIOUS ABORTION

In Bulletin No. 296 of September 1918 Dr. F. B. Hadley answered in a plain and convincing way the questions commonly asked by stockmen relative to the cause entry and spread of the contagious abortion disease in herds of cattle. He told how to account for sterility in cows; how to detect abortion disease; how blood tests are made; how to draw a sample of blood for testing; how to manage a cow that has aborted and how to ^{remove} ~~insure~~ a retained after birth; how to disinfect a stable, and how to manage an infected herd and prevent and control abortion disease.

HAIRLESS PIGS

As an increasing number of hairless pigs were being born annually in the hog-breeding belt of Wisconsin, Professors E. B. Hart and H. ^{Steen-} ~~Stien-~~ ^{back} in Bulletin No. 297 of September 1918 gave full information regarding the cause and remedy of the condition. Goiter was stated as the cause of hairlessness in the new-born pig and potassium iodide as the means of prevention together with a complete ration for the pregnant sow. The authors stated that 10 grams of potassium iodide in 100 lbs. of feed for

the sow will prevent the trouble. They, therefore, advised the feeding of a small amount of potassium iodide and increasing the roughage, alfalfa and clover, for the brood sows on farms where hairless pigs were born the previous year.

PRUNING CHERRY TREES

Instructions for the proper pruning of cherry trees were given by R. H. Roberts in Regular Bulletin No. 298 of March 1918. Suitable illustrations accompanied the text. It was stated that pruning keeps up the bearing area of the trees, reduces winter-killing of blossom buds, cheapens production by making lower trees, and lengthens the life of the trees because of the stronger tree heads formed. Young trees should be pruned heavily at planting time. Low-headed trees with many branches are best. Heading back is necessary to prevent crotches. Bearing trees should be pruned for fruit. Pruning cannot take the place of soil, fertility and cultivation.

FARMING SANDY SOILS

In Regular Bulletin No. 299 of March 1919 A. R. Whitson and H. W. Ullsperg^{er} prescribed the proper methods of cultivating sandy soils which compose one-fifth of Wisconsin's area. To improve sandy soils, acidity must be corrected, humus added, blowing stopped and the right fertilizer added. L^miming makes possible the growing of legumes which, with manuring make sandy soils capable of producing ^{more} work. Inoculation was recommended to make legumes thrive. Soybeans should be grown on at least a fourth of the sandy soil farm each year. Clover seed is another profitable

product for sandy soils. Potatoes may be grown when a good degree of fertility has been attained. Hay, legumes and corn support livestock. ^{Nurse} These crops are necessary to protect sandy soil in winter and spring.

Rye is a splendid nurse crop on sand. Alfalfa, vetch, bucketwheat, sweet clover, ^{serradella} Suradella, wheat, barley, oats, and cowpeas may be produced by proper methods outlined in the bulletin. Garden crops do well on sandy soil. Bulletin 299 was republished in January 1923.

War prices and farm profits were discussed by agricultural economists H. C. Taylor and S. W. Mardium in Regular Bulletin No. 300 of March, 1919. Some of the subjects considered were; are farmers making too much? Did they make more during the war than usual? What are the rewards from farming? What does the average farmer make? How many farmers are just making a bare living from their farms? The bulletin helped to answer these and many similar questions, and it gave definite facts and figures from 60 farms in one community in a typical southern Wisconsin township.

Regular Bulletin No. 301 of April 1919, under title of "Wisconsin Wins" contained the annual report of the Agricultural Extension Service for 1917-18 and was prepared by Dean H. L. Russell and K. L. Hatch. It told the story of how the Wisconsin Agricultural Experiment Station and the College of Agriculture devoted their energies toward the end of "More Food" during 1918 when the slogan of every patriotic farmer was "Food Will Win the War". Wisconsin made an enviable record during that period, though the physical strength of new farm populations was taxed to the utmost. The entire program was under the direction of the State Council of Defense, working through the agricultural committee of the county council

organizations. The U.S. Department of Agriculture, the Wisconsin Department of Agriculture, the Wisconsin Live Stock Breeders Association, the Wisconsin Dairymen's Association, the various state and county breeder's associations, the Wisconsin Experiment Association and the State Horticultural Society, united with the College of Agriculture in the planning and execution of the food production campaign.

TECHNICAL BULLETINS OF 1918-1919

QUALITIES OF WISCONSIN GROWN WHEAT

In Research Bulletin No. 43 of January 1919 Professor B. D.

Leith discussed the milling and baking qualities of Wisconsin grown wheats. The hard winter wheats were chiefly studied. No striking difference was found in milling and baking qualities between pure lines of Turkey wheat grown on sandy soil, Kewannee clay loam, and Miami silt loam. In a six-year ^{test} list, Wisconsin Pedigree No. 2 proved fully equal to the Marquis variety in milling and baking quality, and considerably superior in yield. It also compared very favorably in milling and baking quality with the average of the northern spring wheats tested by the same laboratory. Wheat does not deteriorate when grown in Wisconsin. Baking tests showed that yellow berries in hard wheat could not be considered very detrimental.

FARM TENANCY

An analysis of the occupancy of 500 Wisconsin farms was presented by Professor C. J. Galpin and Emily F. Hoag, in Research Bulletin No. 44 of February 1919. The purchase of farms, retreat of farm owners and shifting of tenants were included in the study and fully reported on in the bulletin which contained some 18 illuminating tables and explanatory text.

THE CABBAGE WORM

In Research Bulletin No. 45 of August 1919, Professor H. F.

Wilson, entomologist, gave an instructive treatise on the Common Cabbage Worm in Wisconsin. He was assistant in the study and preparation of the bulletin by R. C. Pickett and L. J. Gentner. The bulletin gave a history of the worm and its distribution, listed the plants upon which it feeds, described the nature and extent of the injury it causes, and prescribed remedies for the pest. Tables showing the results from the use of various spraying materials were presented.

FROST NECROSIS

Professor L. R. Jones, M. Miller and F. Bailey in Research Bulletin No. 46 of October 1919, which was profusely illustrated, fully discussed the subject of frost necrosis of potato tubers which is a local or restricted freezing injury resulting from exposure to temperature sufficiently low to cause ice formation in the tissues of the potato. When the tubers are frozen solid they immediately collapse upon thawing, and because of their wet appearance are easily detached and discarded. When freezing has been slight only a part of the tubers may be so frozen, the rest appearing normal externally. When cut open, however, the effects of frost necrosis are seen in the darkening of the affected tissues. Plants produced by the frost necrotic halves of experimental tubers grew more slowly than those from the control halves, but ultimately produced as large and healthy plants and as abundant a crop. Necrotic symptoms did not appear in the ^{progeny} freezing of frost necrotic seed potatoes.

EXTENSION SERVICE CIRCULARS OF 1918-1919

The first circular of information published by the Extension Service of the College of Agriculture during the second half of 1918 was No. 107 of July 1918, entitled "Food for the Soil" by Professors E. G. Hastings and E. B. Fred. It pertained largely to the legumes, their feeding and their benefit to the soil. It told the story of the nitrifying bacteria of root nodules and gave illustrations to make the text more readily understood. Two "Defense Council" circulars followed. These were No. 108 of October 1918 in which the Home Economics Department gave recipes and instructions for the making of "Victory Breads", and No. 109, of November 1918 in which Professor K. L. Hatch told under the title of "Let us Give Thanks" why the citizens of Wisconsin and peoples of the earth owed a debt of gratitude to the farmers of the state for the increases which had been made that year in the nation's total food supply. In Extension Service Circular No. 110 of March 19, which followed, the Agricultural Engineering department urged that it pays to house farm machinery and offered illustrations to help prove, in a convincing way, the truth of their remarks and the importance of their advice. In Circular No. 111 of April 1919, Professors J. G. Moore and F. A. Aust gave instructions regarding the best methods of planting nursing ^{ery} stock and accompanied their text with illustrations of a helpful character on "hulling ^{healing} in", pruning and setting the various trees: In Circular No. 112 of April 1919 F. A. Aust furnished lists of hardy trees, shrubs and flowers for Wisconsin homes and plans for landscaping grounds, lots and gardens; and instructions for setting out plants and planting them in the best possible manner. In

Circular 113 of April 1919, Agnes Boying of the Home Economics department told how clothes might be made to last longer, with instructions for storing, cleaning, renovating, washing, ironing, and dying various garments and materials. Onion smut was the subject of Circular 114, of April 1918 by Professor R. E. Vaughan and J. C. Walker, and "Control of the Cabbageworm" that of Circular No. 115, of May 1919. Both of these circulars were well illustrated and of a most useful and practical character.

NEW FARM FACTS

The Annual Report of the Experiment Station for 1919-1920 was published by Dr. H. L. Russell, Director and F. B. Morrison as Regular Bulletin No. 323, in December 1920. It was entitled "New Farm Facts" as it presented an outline of the new accomplishments in research work by the various departments in agricultural science.

Work by the staff members of the Animal Husbandry department was first mentioned. Messrs. Morrison, Humphrey, and Hulce had continued their studies by testing silage made of corn stover in comparison with normal corn silage. On corn stover silage the cows gave an average yield of 24.5 lbs. of milk and 0.98 lbs of butter fat daily, and in normal corn silage a yield of 27.4 lbs. of milk and 1.05 lbs. of butterfat, or 11.8 percent more milk and 7.1 percent more butterfat than on corn stover silage. The same experimenters tested hydrolized sawdust, supplied by the U.S. Forest Products Laboratory, Madison, to determine whether it could be used as a stock food. The work showed that a limited amount of such sawdust could be fed to cattle; but in the rations containing it the protein was furnished by other feeds. Further trials were made. Messrs. Morrison, Humphrey and the late F. L. Putney compared the results from feeding rations balanced according to the recent Savage and Armsby standards. The results indicated that rations balanced according to the Savage standard for dairy cows will cause greater production than rations balanced according to the Armsby standards. However, when feeds are high in price, it was considered preferable to feed somewhat less *concentrates* than advised in the Savage standards where economy of production is the

chief object sought.

Messrs Morrison, Bohstidt and Fargo carried on four trials in pig feeding. The trials substantiated the previous work showing the high value of skim milk as a supplement to corn and barley. Where skim milk was sufficient to balance the ration properly, no advantage was found in purchasing tankage, linseed meal, or other protein-rich feeds.

H. Stienbock^{Stienbock} (Agricultural Chemistry) having proved by ^{trials} ~~tests~~ with rats that yellow corn is much richer in fat-soluble vitamins than white corn Messrs. Morrison and Bohstidt, in consultations with Mr. Steinbock^e tested the matter in pig feeding. Results showed, in the ^{test} ~~text~~, that with yellow and white corn at the same price per bushel, the feed cost of 100 lbs. of grain was \$12.00 on yellow corn and \$13.97 on white corn at the prices then current. Further trials were being made *to gain* data on the relative value of yellow and white corn and the effect of various supplements.

Messrs. Morrison and Bohstidt had continued their comparisons of various pasture crops for pigs. A mixture of oats, peas and rape had proved the best annual crop, with rape a close second. Red clover was excellent as a long season crop and easily grown on Wisconsin farms. Soybeans proved a good fall pasture crop, and blue grass with some white clover furnished some pasture in early spring, but was inferior to the other crops mentioned for spring pigs after weaning.

Messrs. Fuller, Morrison and Fargo fed barley versus corn to fattening steers. Considering all the factors involved, ^cCrushed barley proved worth fully as much per ton^{as} shelled corn for beef production.

Experiments by Morrison and Kleinheing^z showed that under Wisconsin^d conditions there was a slight advantage in providing warmer shelter than an open shed for ~~attaining~~^{fattening} lambs in winter unless the building is so located that ^{it} is unusually well protected from prevailing winds. They ^{also} compared the value of protein-rich supplements for fattening lambs. They found that cotton seed meal is fully equal to linseed meal for fattening lambs and that lambs fed gluten feed as compared with those fed linseed meal made a triple larger profit.

E. B. Hart (Agricultural Chemistry) had found that premature, weak or dead calves were born ^{when} ~~them~~. The cows were fed with oat grain and oat straw and that when an addition of salts of calcium or a calcium rich roughage was made to the ration reproduction was successful. He concluded that a ration for reproduction in dry breeding cattle must carry at least 0.45 percent of calcium oxide (lime) as the percentage of total air dried material of the ration. Lack of lime showed as ^{inferious} ~~inferious~~ in swine and chickens. Dead pigs did not occur when sows were fed 15 to 25 percent of alfalfa together with either barley, ground oats or yellow corn for the grain ⁱⁿ ~~is~~ a ration. Messrs. Hart and J. G. Halpin (Poultry Husbandry) also fed chickens to determine the need of calcium etc. in the ration when corn grain was fed with gluten feed only and 1 percent of common ~~the chickens died early, but when corn, common salt,~~ salt, calcium carbonate, and casine were fed ^{they} ~~when~~ reached weights of 3 or 4 lbs. They did best, however, when butterfat was added and attained weights of 4½ to 5 lbs. with normal egg production. There was greater mortality when barley was fed. It needs the supplement of common salt, calcium in some forms and butter fat for successful growth and egg production.

W. E. Nottingham and S. Lepkovsky (Agricultural Chemistry) found by tests that the greatest manufacture of protein in sugar ^{beet} ~~but~~ leaves closely follows the largest production of carbohydrates. A moderately low temperature, such as occurs in late summer or early fall, was found to check the use of carbohydrates for protein building and leave them free to migrate and be stored as sugar in the sugar beet root.

Mr. Hart and G. C. Humphrey compared alfalfa with red clover hay. They found it impossible to maintain nitrogen in positive balance in dairy cows of high daily milk production fed a ration of cereal grain, red clover hay, and corn silage. Alfalfa hay, substituted for red clover hay gave much better results which probably were due to the greater protein intake made possible by the higher nitrogen content of the alfalfa ration. Mr. Hart also found that hays grown on marsh lands vary materially in lime content whether the soil is acid or alkaline. Local marsh hay carrying 1 percent of calcium oxide proved efficient roughage for reproducing cows: but hay from the Buena Vista marsh in Portage county lacked enough calcium to carry on successful reproduction.

WORK OF THE CHEMISTS

H. H. Sumner (Agricultural Chemistry) gave cows sulphuric acid in addition to their regular ration with the result that ammonia production in urine rose, but there was absolutely no change in the milk reaction. J. H. Jones (Agricultural Chemistry) made observations which showed that the lactation period does not in any way influence the readiness of coagulation of milk. Mr. ^{Steinbock} Steinbock proved that the fat-soluble vitamins cannot generally be extracted from plants by water, ether, or fats and

ether, but that alcohol and benzene dissolve it. He and his colleagues did further work during the year in studying the distribution of water-soluble vitamins. It was found low in sugar beets and alike in red and white carrots, and in both the green and white leaves of the cabbage. Further studies were to be made to determine the vitamin content of the leaves of yellow compared with white carrots. Messrs. Hart, ^{Steenbock} Steinback and N. R. Ellis found that summer-pasture milk acts differently from dry-feed milk in preventing ^{scurvy} scurvy. ⁱⁿ These observations have shown that 50 parts of summer pasture milk exerted fully as much effect as 75 parts of dry-feed milk in preventing scurvy. Well matured and partly dried silage from corn, when put into the silo, did not increase the amount of the anti-scurvy factor in milk. Mr. Ellis found that milk powder made according to the process involving a spray in heated air lost its anti-scorbutic property, while milk powder dried by the drum method did not completely lose the vitamin.

POULTRY WORK

Messrs. Halpin and Hart after several years of work concluded that the source of leg weakness in chickens lies in the lack of suitable roughage in the ration. Paper in the concentration of 10 percent of the ration, was the most effective roughage used. Mr. Halpin (Poultry Husbandry) decided that oyster shells lead as lime carriers for egg production by hens, with clam shells a close second. B. A. Beach (Veterinary Science) and Mr. Halpin, treated several flocks during the winter of 1919 with chicken pox vaccine. The treatment was highly effective in preventing progress of the ^{lesion} tissue. ^{Mr.} Halpin by over six years work began with 2 hens whose yearly egg laying records were more than 200 hens has shown what may be accomplished in building up a high producing flock. Under

ordinary management and feeding etc. one hen of a flock of 100 hens, 40 of which laid more than 200 eggs in a year, produced 284 eggs in one year. Results obtained by Mr. Halpin during the past year showed ^{no} advantages in sporing milk for baby chicks. The greatest mortality occurred among the chicks fed meat scrap and dried buttermilk. Skimmilk ranked next to whole milk and buttermilk was least desirable for baby chick feeding.

WORK OF THE GENETICISTS

L. J. Cole (Genetics) failed to find any facts developed in his work with pigeons to confirm the assertion by Riddle that by forcing over-production of eggs by those birds, ^{the} the proportion of the offspring may be changed but M. A. Jull (Genetics) incubated all the eggs laid by a number of hens throughout the entire season and found that some definite rise in the proportion of females to males occurs as the season progresses. J. L. Lush (Genetics) attempted to centrifuge the sperm with the object of securing two groups: it having been assumed that the spermat ozoa are of two kinds in sex-determining influences while some modification of the normal sex ratio was obtained, it did not correspond to what would be expected from the theory. Miss S. V. Jones (Genetics) found by compiling records of the American Aberdeen Angus and Hereford herd books that the number of twin calves produced increases rapidly in dams up to 6 to 8 years of age and remains about constant after that period. With sheep the number of multiple births increases up to 6 years; then there is a decline. Mr. Cole collected a large number of records on double calves (monsters). The color markings showed a great similarity on the duplicated parts, even more than in twin calves. Free martins

(imperfect female twinned with a male) and their bull twins showed no more similarity than normal twins being, therefore, not from a single egg. Studies made for 7 years by the Genetics department in cooperation with the agricultural chemistry department to determine the possibility of increasing the quantity of oil from soybeans succeeded in isolating a high-producing strain as well as a low-producing strain. The genetic and agronomy departments continued their efforts to improve the seed strains of sweet corn for canning purposes. More than 200 crosses had been made between commercial varieties. Self-pollination was also done to study the effect of inbreeding.

VETERINARY SCIENCE ACCOMPLISHMENTS

B. A. Beach (Veterinary Science) tested 7 herds with johnin to detect presence of Johne's disease. Seven percent of the animals tested reacted. The Johne's bacillus in infected tissues were not found present deeper than the submucous coat of the intestines. The germs evidently gain entrance to the body from the intestinal canal; hence the need of keeping the feed of cattle from contamination by excreta. The Veterinary Science department also experimented on a large herd of cattle to determine the comparative value of several different methods of tuberculin testing. The best results seemed to come from testing by a combination of the sensitized ophthalmic and intradermal tests. The intravenous test was not found entirely satisfactory. Dr. F. B. Hadley (Veterinary Science) studied the disease known as "bull nose" and "sore mouth" in pigs and decided that filth-borne infection was responsible for the development of the disease. Sanitation was prescribed as the prevention and removal of the

necrotic tissues followed by swabbing with a 3 percent solution of potassium permanganate the curative treatment. Messrs. Hadley and O. Stader (Veterinary Science) found that sterility in cows was due mainly to secondary genital infections. Promising results were had from hyprodermic use of an ^{autogenous} ~~autochthonous~~ bacterin and from vaginal irrigations with a 1 percent solution of common salt. Vaccine sufficient to minimize 850 head of cattle against contagious abortion disease was prepared and distributed under the supervision of Dr. Hadley. Beneficial results had followed use of the vaccine. Dr. Beach applied the wattle tuberculin test with reasonable success in eliminating tuberculosis from a flocking of 500 chickens.

BACTERIOLOGICAL WORK

W. D. Frost and Misses A. M. Charlton and M. F. Litte (Agricultural Bacteriology) devised the "little plate" method of determining the numbers of bacteria in milk. Their method made a reliable diagnosis possible in 5 rather than 48 hours, the time required by the older way. E. B. Fred (Agricultural Bacteriology) proved by experimentation that legume bacteria are able to live through the winter and will withstand winter temperatures; also that bacteria planted with the seed in early spring will be able to induce nodule formation.

DAIRY HUSBANDRY EXPERIMENTS

J. L. Sammis continued his experiments on the production of cheddar cheese from pasteurized milk, using a regenerative type of machine, in comparison with the "drum" type of pasteurizer. The results showed little or no difference in flavor when the cheese was 30 days old, but the product was being held for further comparison.

WORK OF AGRICULTURAL ENGINEERS

G. R. B. Elliott determined that in soils free from acid, well-made concreted tile show little or no disintegration, but when laid in peat soils marked disintegration occurred. It was advised that for use in acid soils, especially peat, the tile walls should be made of extra thickness and of larger sizes. Messrs. Jones and Elliott ^{found} that the settling of peat in marshes is limited in nearly all cases to the peat above the tile. The depth of laying tile in peat marshes must be carefully considered and allowance made for a certain amount of settling in the peat.

Mr. Duffie's tests on a used mower with the cutter bar both in good condition and in poor condition showed that when the knife was dull and the bar in poor adjustment the draft was increased from 30 to 35 percent. A sharp knife and properly adjusted bar are necessary for successful mowing and least strain in the horses. John Sweinehart continued his tests of TNT explosive for landclearing. He found it best to detonate the explosive with a primed dynamite cartridge. Grade III TNT has the disadvantage of being more readily absorbed through the skin than either of the other grades. Tests of grenade powder, black army blasting powder, and nitro starch were also made. They were found less effective than TNT of the salvaged war explosives.

WORK IN BEE-KEEPING

The Economic Entomology department working in cooperation with the state and local organizations found that winter losses of bees may largely be prevented by providing winter stores of honey of the purest quality

The best results, regarding the temperature for wintering bees were had at 50° F. and the humidity in the cells should never be greater than 72° F. Package bees, for restocking *apiaries* were studied. Parcel post shipments arrived in good shape even after 6 days in transit. Southern Texas was the farthest point from Madison where it was possible to secure package ^{bees} ~~bees~~. Express shipments arrived in much poorer condition, due in ^{main} ~~main~~ to insufficient stores for the journey.

INSECT PEST STUDIES

C. L. Fluke (Economic Entomology) continued the study of the life history and habits of the pea moth, and the testing of control measures. A rotation of crops seemed to offer more hope in checking the ravages of the moth than any other method previously suggested. Grasshoppers were best controlled by the use of poisoned bait. *Concerted* ~~Concurred~~ actions on the part of farmers in communities infested with grasshoppers and army worms was advised as necessary for their successful control by means of poisoned bait. No system of pea aphid control suitable for Wisconsin conditions was discovered.

WORK IN AGRICULTURAL ECONOMICS

Messrs. B. H. Hubbard and S. W. Mendenhall studied the cost of producing milk and found feed and labor the main items in the cost. The rate of production of the cows was also a ~~chieftain~~ ~~factor~~ factor in influencing the cost of milk. They found that, other things being equal, the cost of milk increases ^{as} ~~at~~ the rate of production decreases and all facts point toward the advantage of high producing cows. Messrs. Hubbard and J. D. Black made a survey of farm tenancy and found that it had been a stepping stone to farm ownership. T. Macklin gathered facts from a *quarter* of the pea canning factories of the state in 1919 and found that while canning is an expensive process yet good profits are made in spite of

high costs. Mr. Macklin also completed an extensive survey of the Wisconsin cheese producer's Federation and found that its ~~economy~~ ^{it} of operation ranks ~~it~~ is well forward among the large cooperative concerns of the United States.

Mr. Mendenhall decided that farmers find the widest use for farm accounting in their efforts to place and maintain the prices of farm products on levels which pay the expenses of production and fair wages for labor.

H. C. Taylor and Mr. Black stated that farm wages are \$10.00 a month higher in southwestern than in central and eastern Wisconsin. Mr. Macklin made a survey of the meat and grocery retailers in a typical Wisconsin city and found that over half of the stores are so small that their costs of doing business were higher. On that account the bulk of the stores were unable to make profits.

SOIL STUDIES

A. R. Whitson and F. L. Musbach (Soils) proved by experiments at the Marshfield Branch Station that the plowing under of green crops as manure has a very beneficial effect on soils of the sandy types. A four crop rotation of corn, potatoes, oats and clover, one ^{field} ~~filled~~ of each being grown each year, was found an excellent plan for green manuring practice. The corn was planted in rows 4 feet apart with a green manuring crop grown between the rows. The corn was cut for silage and the green crop plowed under. The plow lands were laid out across the rows of corn and legumes. The good effect of the green manure is generally increased where the rotation has been in progress until 2 or 3 green manuring crops have been added to the soil. O. C. Bryan (Soils) and E. B. Fred found that cowpeas and soybeans dropped off markedly in both growth and nodule formation as soon

as an excess of ^{either} wither acid or alkali appeared, while corn made a reasonably satisfied ^{or} growth under acid conditions sufficient to prevent the inoculation of the roots of both cowpeas and soybeans. Experiments made by the soils department showed that sweet clover has especially strong ^{binding} ~~binding~~ powers for the phosphorus and potassium of glauconite. The plant may therefore become of direct advantage in the use of ^{hitherto} ~~to be~~ ^{unavailable} ~~avoidable~~ potassium and phosphate minerals. Messers. Tru^g and F. W. Parker (Soils) further established the fact that a good supply of lime in the soil helps to keep the phosphates in available form.

The soils experts, working at the Coddington Research Station in 1919 found that soybeans on raw peat land are an excellent hay or forage crop. Soybeans returned from 2 to 3 tons of hay an acre. Oats and peas also made an excellent growth of hay.

HORTICULTURAL STUDIES

R. H. Roberts (Horticultural) conducted pollination experiments to determine whether the sour cherry in Wisconsin is self, or interfertile, or sterile. The work was done in Door county orchards with Richmond and Montmorency cherries. These varieties proved strongly self-fertile in 1920. Though few insects visited the orchards they bore a normal crop. J. G. Milward (Horticulture), cooperating with the U.S. Department of Agriculture made trials to determine some of the factors influencing freedom of seed potatoes from disease, vigor, and productiveness. Several varieties of potatoes were tested and the most marked differences were found in Triumph. A strain of that potato obtained from J. W. Smith, of Kent, Wisconsin showed the least infection. About 20 growers of certi-

fied Triumph seed used the Smith strain in 1920 with success as it showed good resistance to mosaicⁿ disease.

The Horticulture Department was finding Salome a promising winter apple, the fruit being of better quality and keeping better than Northwestern.

Working in cooperation with the U.S. Department of Agriculture the horticultural experts found that a new wilt disease would not injure Wisconsin. This wilt was first reported from Maryland in 1916 and later in Ohio and Kentucky. James Johnson (Horticulture) studied the brown rot of tobacco disease which had recently appeared in Wisconsin. He found it often associated with black rot. He suggested as methods of control: Avoiding infected soils: selecting soil that had not recently produced crops susceptible to the disease; and establishing of a crop rotation in which host plants of the known rot are not included.

COMBATING PLANT DISEASES

L. R. Jones (Plant Pathology) and his staff studied the comparative resistance of Wisconsin Hollander Cabbage against cabbage yellows and found that with increasing age the resistant character is intensified. Plants of this variety in the early seedling stages were relatively susceptible to attack by the yellows fungus. G. W. Keitt (Plant Pathology) further verified the previous conclusions that spraying and clean cultivation were the most successful remedies in the ^{case} of cherry leaf spot. Bordeaux mixture 3-3-50, gave a slightly better control than lime-sulphur 1-40.

Mr. Keitt also made progress in his studies of the organism causing apple scale. In general, lime-sulphur gave satisfactory results in controlling the disease, while Bordeaux mixture caused heavy russetting of varieties susceptible to that type of injury.

F. R. Jones and W. B. ^TFisdale (Plant Pathology) studied a disease of string beans used for canning purposes and pronounced it a bacterial blight. Growers of beans for the canners were advised to grow their own seed and thus prevent bringing into the state diseases from outside bean-growing regions. W. B. ^TFisdale (Plant Pathology) studied the spot disease of Lima beans which was proving troublesome and decided that it was caused by a bacterial organism. J. Monteith (Plant Pathology)

STATION PUBLICATIONS

During the fiscal year from July 1, 1919 to June 30, 1920, 13 new Regular Bulletins, 2 reprints as well as 3 Research Bulletins and one new and one reprinted poster bulletin were published by the Experiment Station. The Extension Service also issued 12 new Circulars of information and reprints. Summaries of these publications follow:

STATION SERVICE TO WISCONSIN

The first Regular Bulletin of the fiscal year of 1919 was No. 302 of August and contained the Annual Report of the Experiment Station for 1916-17 and 1917-18, written by Director H. L. Russell and F. B. Morrison.

In Regular Bulletin, No. 303, of June 1919, H. F. Wilson, entomologist presented a list of common insecticides, with drawings, illustrative and explanatory matters which would enable the horticulturist and farmer to deal intelligently with the subject. It stated that the best insecticide is the one which burns the foliage of the plant the least, sticks best, and at the same time kills quickly. It must also kill the insect before the latter can seriously damage the plant; possess no properties that will injure the plant; be low enough in price to permit its use in large quantities; must spread well and must remain in suspension sufficiently well to permit of a uniform coating of poison on the spread parts. This bulletin was reprinted in April 1920.

STEM RUST OF GRAINS

It having been proved that the common barberry spreads stem rust of grains, A. P. Johnson and James G. Dickson, in Regular Bulletin No. 304

of August 1919, gave full particulars on the subject and furnished profuse illustrations to make it more readily understandable by the farmer. Stem rust and leaf rust were discussed; each kind of grain having a different leaf rust, while all grains are attacked by the same species of stem rust fungus. It was shown that the tall, common and dangerous barberry is universally rusted in Wisconsin. The common barberry of either the green-leaved or purple-leaved variety, harbors the stem rust, and it is also found on the Mahonias which are not widely planted in Wisconsin. The dwarf Japanese barberry does not carry the stem rust and is, therefore, harmless. It was recommended that to control stem rust of grains the eradication of barberry bushes was imperative.

WHEAT GROWING

As wheat is a profitable crop to grow in many parts of Wisconsin, E. J. Delwiche and B. D. Leith, agronomists gave in Regular Bulletin of September 1919 an instructive, illustrated treatise on that subject. They gave descriptions of the Turkey Red, Marquis, Fife, Bearded Spring, Prelude, Blue Stem and Duram ^{or} Macaroni varieties which are best suited for crop production in the state. Winter wheat is best for Wisconsin. Pedigreed varieties had been made available and were preferable. Directions for preparation of the ground, sowing the seed, harvesting and stacking were given. Proper crop rotation was also explained and advocated as a means of obtaining the highest yields.

SOILS OF NORTHERN WISCONSIN

In cooperation with the Wisconsin Geological and Natural History Survey and United States Department of Agriculture Regular Bulletin No. 306 was published by the Wisconsin Experiment Station in April 1919. The authors were soils experts A. R. Whitson, T. J. Dunnewald and Carl Thompson. The Bulletin presented 13 chapters of scientific and practical matter on the subject and an immense general map in color showing the distribution of the various types of soil in northern Wisconsin. The text of the bulletin and the valuable map mentioned gave evidence of a tremendous amount of field work done by the authors and their assistants and presented reliable facts and information that would prove of inestimable value to all interested in farming matters in northern Wisconsin. The Bulletin attracted wide attention and was reprinted in April 1922.

RURAL FAIRS

Professor C. J. Galpin and Emily F. Hoag in Regular Bulletin No. 307 of November 1919 discussed in detail "The Rural Community Fair". Many good illustrations accompanied the text. The authors had found by investigation that throughout Wisconsin the rural fairs are usually as excellent and painstaking in workmanship as are the great country exhibits which represent dozens of countries. The community fair awakens the community pride, spirit, and life. It includes every person in the neighborhood and every organization of business there. It is a day on which the whole countryside plays and renews acquaintanceship. The fair should, therefore, result in a better community and well organized, efficiently managed with the community interests at heart prove to

be a community asset of real value.

Professors R. A. Moore and L. F. Garber had, for several years, ~~had~~ been directing enthusiastic attention to the growing of alfalfa in Wisconsin and gave their experience and advice on the subject in Regular Bulletin No. 308 of December, 1919. Many fine illustrations added to the interest and instructive value of the text. The authors stated that where alfalfa can be grown successfully it excels all other hay crops in yields to the acre, feeding value, drought resistance, and enrichment of the soil and eradication of weeds. Three cuttings of alfalfa may be obtained in a favorable season. The bulletin gave plain and practical instructions for the proper seeding, fertilizing, harvesting and storage of the alfalfa plant and hay.

MARSH SOILS

How to manage marsh soils had become a real problem to the farmers of Wisconsin, therefore, Professor A. R. Whitson and H. W. Ullsperger who had thoroughly studied the proposition in all of its aspects presented their conclusions ^{on} ~~in~~ the subject in Regular Bulletin No. 309 of December 1919. Useful pictures accompanied the text. The authors gave practical advice ^{on the} ~~with~~ factors necessary for the successful management of marsh soil: such as drainage, preparation of the seed bed, use of manures and other fertilizers and selection of suitable crops.

THE PEA MOTH

The pea moth had been causing the pea growers of the northeastern counties of Wisconsin so much trouble, that C. L. Fluke Jr., entomologist

devoted special attention to the subject and as the result told in Regular Bulletin No. 310 of April 1920 all about the insect and gave advice as to the best methods of control. Illustrations made the reading matter more easily understood. He had not found spraying successful and the trap light method of capturing the moths also failed. Thorough cultivation, early threshing, burning of rubbish, selection of the best early maturing varieties of peas and as early planting as could be done were advised as the most effective measures of control.

SORGUM SYRUP

A. H. Wright in Regular Bulletin No. 311 of April 1920 on the subject of "Sorghum for Syrup in Wisconsin" stated that sorghum yields from 8 to 15 tons of green material to the acre, from which 70 to 150 gallons of syrup can be manufactured. An active community demand for such syrup had been experienced and climate, soil, and methods of farming in Wisconsin are all suited to the development of commercial sorghum industry. The bulletin told how to grow the sorghum crop, harvest the crop and produce and market syrup of good quality. Illustrations accompanied the text.

ACIDITY OF SOILS

As all soils in Wisconsin should be tested for acidity, Professor Emil Truog in Regular Bulletin No. 321 of June 1920 gave detailed information, with illustrations, regarding the application of a new soil acidity test which indicated positively not only the presence of acidity,

but also, the degree of acidity. He stated that soil acidity is *injurious* because it keeps many plants from getting all the *lime* ~~time~~ they need. It is also detrimental to the favorable chemical, physical, and bacteriological processes of the soil. Instructions for the proper application of needed *lime* ~~times~~ as a corrective of acidity were also included in the bulletin. A second edition of this needed and very instructive bulletin was published in August of 1921 as No. 312.

OCCURRENCE OF OFF COLORED CALVES

Many breeders having been terribly disappointed when red colored *calves* occasionally were dropped by their pure-bred ~~pedigreed~~ black colored cows or black and white Holstein cows, and some vexatious *laws* ~~lawsuits~~ having resulted Dr. Leon J. Cole and Sarah V. H. Jones, in Regular Bulletin No. 313 of June 1920, fully explained the reason for the mystery, on the basis of their scientific knowledge of heredity. Pictures in color illustrated the text which caused quite a sensation among breeders so new was the subject to them and so satisfactory the explanation presented. It was shown that both sire and dam are equally to blame for the throwing of a red calf in a black breed. Black is dominant and red is recessive. Red calves appear only when both parents are red; when one parent is red and the other is black, but carries red from some ancestor, or when both parents are black, but carry red, as is the case when red calves appear in purebred black breeds. The chance is one in four that a red calf will be produced when two blacks carrying red are mated.

RESEARCH BULLETINS OF 1920
LEASING SYSTEMS

Professor B. H. Hibbard and J. D. Black, in Research Bulletin No. 47 of October 1920, presented an elaborate treatise on the farm leasing systems in Wisconsin. Sample forms of the regular cash lease and the half-and-half dairy lease were shown and explained. Many other forms of leases were described and much valuable advice on the subject, in all its phases, was offered for the benefit of both landlord and tenant.

DISEASE RESISTANT CABBAGE

Research Bulletin No. 48 of November 1920, written by Professor L. R. Jones, J. C. Walker and W. B. ^IWisdale, gave particulars about the type of cabbage they had been developing and which had proved remarkably resistant to cabbage yellows, caused by the soil fungus Fusarium conglutinans, of the commercial varieties of cabbage Volga had proved most resistant and the Houser somewhat resistant, but neither of those varieties met important commercial needs. The authors set themselves the task of developing a type of cabbage that would at the same time meet all commercial needs and prove resistant against the yellows disease. From the standard winter storage variety, Hollander or Danish Ball Head ^{they} developed the resistant strain known as Wisconsin Hollander. Late experience showed that an earlier maturing variety was needed and this was supplied in ~~the~~ Early Wisconsin Hollander. For the needs of the Kraut industry, resistant strains called Wisconsin Brunswick and Wisconsin All Seasons were developed and distributed. Many other strains were being tried out in the field. Work on the disease-resistant cabbage strains was to be continued by the Experiment Station in cooperation with the Bureau of Plant Industry of the U.S. Department of Agriculture

and with certain other experiment stations.

ANIMAL NUTRITION

In Research Bulletin No. 49 of November 1920 Professors C. B. Hart, ^{Steenbock} H. ~~Steenbock~~ and G. C. Humphrey reported the results of their continued experiments on the influence of rations restricted to the oat plant on reproduction in cattle. This ration was found inadequate for efficient nutrition of breeding cows. The offspring were born prematurely and were either very weak at birth or born dead. Addition of calcium salts to the ration in the form of a carbonate (wood ashes), as a phosphate (floats), or as calcium chloride influences the production of offspring of fair *vigor*. The improvement was also secured to a greater degree by the feeding of natural roughages such as corn stover, clover, alfalfa or marsh hay.

POPULAR CIRCULARS OF 1919-1920

In Extension Service Circular No. 116 of August 1919 Professor Abby L. Marlatt and Nell B. Nichols of the Home Economics department advised the women of Wisconsin to eat vegetables to keep well and to lower the food bill. The practical text included a "Vegetable Calendar" for Wisconsin and a chart showing various ways to prepare vegetables to make them attractive and palatable. In Circular No. 117 of August 1919, John Swinehart^e and W. N. Clark showed how land clearing contests help to clear the land. Methods of conducting contests were explained. In Circular No. 118 of September 1919, Professor C. J. Galpin and Eleanor Weisman discussed the subject of "Playdays in Rural Schools;" and gave full particulars regarding the holding of meetings, picnics, etc. and furnished *information* about various games for such occasions. "Self-Feeders for Hogs" was the subject of Circular No. 119 of October 1919, by Prof. G. Bohstedt of the Animal Husbandry department. Pictures of several types of self-feeders were shown, plans furnished for their construction and mixtures of feed to put in them for different lots of pigs prescribed. The author stated that a self-feeder saves feed, time, and backache; ~~keeps~~ keeps pigs from squealing and fretting; makes it easier to rotate hog pastures and pushes pigs to an earlier and usually better market. In February, 1920, Circular No. 52 of November 1914, on Control of Potato Diseases, by Profs. L. R. Jones and R. E. Vaughan was published in revised form as Circular No. 120 by the Agricultural Extension Service of the College of Agriculture as the keen demand for it had exhausted the first edition. Circular No. 121 also appeared in February 1920 and was written by D. S. Bullock. It was entitled "Pure Bulls Pay" and advocated

the use of purebred sires in preference to those of *scrub* and grade breeding. He stated that cow-testing association records showed that cows sired by purebred bulls produce annually from ~~129~~⁴⁹ to 85 pounds more butterfat than cows sired by the low grade bulls. In every way the employment of purebred bulls was preferable. In February 1920, Circular No. 122 by Professor C. J. Galpin, G. W. Davis, and Grace Wyman, Stone was published on the subject of "Social Surveys of Rural School Districts". They advised every teacher to make a social survey of the rural district surrounding the school. Doing^{so} would give the teacher a back^ground for the important community service to be rendered. The value of a look about the district would bring out facts about the farms, homes, crops, profits, neighborhood history, local officers, and community progress and prosperity. The Circular instructed them how the survey should be made. Culling of the farm flock of poultry was the subject of Circular No. 123 of February 1920, written by Prof. J. G. Halpin, D. H. Reed and J. B. Hayes. They advised that it pays to cull out poor layers anytime to save feed, and labor cost; but to make a profit on them it is best to cull in late summer and early fall, before the rush of spring chickens lowers the market price of old hens. Breeding should be done for egg production. It was reprinted as No. 123 in October, 1921. In Circular No. 124 of March 1920, Charles L. Fluke Jr. told how to fight oyster shell scale which probably occurs in every apple orchard in Wisconsin. It could easily be checked by using the proper spray at the right time. For the purpose it was advised to use liquid lime sulphur, 1 gallon to 12 gallons of water while the trees are dormant. IN Circular No. 125 of March 1920, W. C. Frazier told the story of the legumes

and the action of their root nodules and bacteria in taking nitrogen from the air. How to inoculate to insure this desirable action was explained in Circular No. 126 of March 1920, consisted of the annual report of Dr. H. L. Russell, Director of the Station and K. L. Hatch, Director of ^{*the extension service of the station on the activities of*} that department of the College and Experiment Station for the year. It cited 25 different lines of useful extension work then in progress under title "*Demonstrations Convince*". *Circular No. 127* of June 1920 prescribed "The Hot Lunch in Rural Schools". In it Gladys Stillman gave a number of suitable recipes for such lunches and gave directions for their proper preparation. In Circular No. 128 of November 1920 Dr. B. A. Beach and F. B. Hadley offered "First Aid to the Stockman" in caring for farm animals, preventing their diseases and giving appropriate first aid to those that became sick. The Circular was revised and reprinted in September 1921, as it had proved of great interest and ^{*value*} future to stockmen and farmers.

LIVESTOCK SHIPPING ASSOCIATIONS

In Regular Bulletin No. 314 of August 1920, Professor B. H. Hibbard, L. G. Foster and D. G. Davis, agricultural economists, outlined the history of Wisconsin Shipping Associations, explained the advantages of such cooperative associations and conditions required for their successful operation. A form of constitution and by-laws was given for the guidance of those who propose starting such an organization.

BUTTERMILK AND COTTAGE CHEESE

In Regular Bulletin No. 315 of June 1920, J. H. Sammis advised that creameries should turn skim^kmilk and buttermilk into marketable products. Cottage cheese and buttermilk cheese could be produced to advantage and at a profit. A market should, however, be formed before beginning to manufacture large quantities of cottage cheese. Practical method of making buttermilk cheese had been devised by the Wisconsin Experiment Station and these and methods for the manufacture of cottage cheese were explained and illustrated in the bulletin. Buttermilk cheese was said to find a good market where it is brought to the attention of the retail consumer.

FARM LABOR IN WISCONSIN

H. C. Taylor and J. D. Black (agricultural economists) in Regular Bulletin No. 316 of June 1920, cooperating with the office of farm management of the United States Department of Agriculture fully discussed the subject of Farm Labor in Wisconsin. They gave advice on

how much labor to hire, where to hire it, how to hire it and how to manage it and keep it after it is hired. They stated that only one-half ^{fifth} of the work ^{on} in Wisconsin farms is done by hired labor working out. Better homes, better living conditions and year-round work are more important than better wages and shorter hours. They expressed the conclusion that the final solution of the farm labor problem will probably come from keeping more sons on the farm and keeping farmers from retiring to the city, and by adjusting the size of the farm to the amount of labor that can thus be provided. The bulletin was written on the basis of data gathered in 1918 and earlier.

OFF-YEAR APPLE BEARING

The first Regular Bulletin published in the 1920-1921 period was No. 317 of July 1920, by R. H. Roberts in the subject of "Off-Year Apple Bearing and Apple ^{Spur} Spine Growth." Numerous instructive drawings, etc. accompanied the text. The author stated that biennial bearing appears to be related to nutritional conditions, and not to overbearing. Thinning the fruit did not insure regular bearing. Biennial bearing is related to ^{spur} spine growth; regular bearing to both tree and ^{spur} spine growth. Blossom bud ^{formation} firmation depends upon nutrition. Pruning has a marked effect upon ^{spur} spine growth. Cultural practices should be based on the ^{spur} spine and tree growth. Cultivation is not always necessary; but a quickly available nitrogenous fertilizer often is needed.

CREDIT NEEDS OF SETTLERS

In Regular Bulletin No. 318 of October 1920 of ~~the Experiment Station~~

agricultural economists Richard T. Ely, B. H. Hibbard and Alonzo B. Cox presented an elaborate discussion on the credit needs of settlers in Upper Wisconsin. They concluded that the settler needs \$1,000 to \$1,500 in capital, or in capital and credit, to make normal progress through the pioneering stage. The development stage required an available capital of at least \$2,500 so that permanent buildings may be erected, a good dairy herd bred and sufficient farm machinery acquired. The farmer and the farm ought to be sufficient basis for the credit needed. Most of the failures among settlers are due to financial difficulties. The authors expressed the opinion that "the great object should be not to subsidize the farmer but make his security as mobile as that of the merchant or manufacturer. A few states which have the problem of credit needs of settlers are adopting heroic measures to meet the needs".

Regular Bulletin No. 319 of September 1920, gave the annual report of the Director of the experiment station and was written by Director H.L. Russell and F.B. Morrison.

~~and was written by Director H. L. Russell, and F. B. Harrison.~~

CLEARING CUT-OVER LAND

John Swinchart, expert ⁱⁿ the subject, told in Bulletin No. 320 of December 1920 entitled "Clear More Land" how ^{land} ~~low~~ could now be cleared with comparatively less ^{expense} ~~expense~~ than were before: As farm products and developed land were bringing high prices he believed that the cut-over lands of Northern Wisconsin offered a good opportunity for the new farmer. He told in a most practical way how brushing should be done, stumps removed by use of stump pullers and explosives and the stumps properly piled and burned. *So useful* and instructive did this bulletin prove that it had to be reprinted in January 1923.

COSTS IN CHEESE MAKING

J. L. Sammis and O. A. Juve, dairy experts, told in Regular Bulletin No. 321 of November 1920 how cheesemakers save money by figuring costs. They advised that accurate cost records are essential at either a large, or a small cheese factory and that carelessness in figuring is expensive. To figure a price for making cheese to yield a ^{fair} ~~fair~~ annual labor income to the maker, require, said the authors, a summary of all costs of making. Once begun, this system can be followed easily from year to year. Five sample blanks were offered in the bulletin to aid the cheesemakers in figuring, his costs.

FEDERATION MARKETING

Theodore Macklin, Agricultural Economist, in Regular Bulletin, No. 322, of December 1920, discussed the subject of "Marketing of ^{by} Federations." He said that farmers are weary of ~~the~~ system in which farm products unavoidably pass ^{into} with other people's hands at low prices only to be held until needed by consumers and then sold at much higher prices. Their ambition is to build up a system which will enable them to retain ownership of their products until consumers need them. This, the author believed they could accomplish by having their own middlemen. Federated local organizations may successfully feed markets and stabilize prices where individual locals cannot. The author fully explained how such federations could be formed and managed. He said that two outstanding features of the Federation are efficient management and financial returns. The organization and its management, because of experience, market connections, and efficiency would, if enough cheese, for example, were handled, ^{lead} best to price stabilization so far as that is possible. "Articles" for the organization and conduct of a Cooperative Association were given in the bulletin for the guidance of those who desire to adopt the federation plan of handling products.

The annual report of Director H. L. Russell and F. B. Morrison for 1919-1920, was published in December, 1920, as Regular Bulletin No. 323, with the title of "New Farm Facts." It was fully illustrated and summarized the research work etc. of the Experiment Station for the period mentioned.

CIRCULARS OF 1920-1921

The subject of "Profitable Cows" was discussed by A. J. Cramer and R. J. Harris in Circular No. 129 of September 1920. The circulars gave much practical advice on cow management and a register of production for some 421 cows tested by the numerous state cow-testing associations and ^{found} ~~formed~~ qualified for the registry of production. The testing work was working wonders in improving the dairy herds of Wisconsin.

What name should be chosen for the farm was considered in Circular No. 130, of September 1920, by Professor Franz A. Aust and Gladys Baker and a long list of suitable names was suggested. The Annual report of the Agricultural Extension Service of the College and Experiment Station was presented in Circular No. 131 of January 1921, by Director H. L. Russell and Professor K. L. Hatch. It gave an account of the educational activities of each department of the service, with appropriate illustrations, and showed the vast amount of practical and scientific information being placed before the farmers of the state by demonstrations, lectures, publications etc. A list of the Wisconsin County Agricultural agents was appended. Professor J. G. Moore, in Circular No. 132 of March 1921, presented such a useful and well illustrated treatise on "The Vegetable Garden" that it had to be reprinted and revised as Circular 132 in October 1922. One scarcely could ask for a more complete and practical guide to profitable gardening than was given ~~to~~ by this admirable circular, and it consequently was greatly appreciated by its readers. No phase of the subject was neglected and the advice and instructions given were based upon long practical and scientific experience. In Circular No. 133 of March 1921. R. E. Vaughan and A. G. Johnson told farmers how to treat

seed grain to prevent destructive smut. The use of formaldehyde in a solution of 1 pint to 30 gallons of water was recommended for the purpose. In Circular No. 134 of March 1921 Professor J. G. Moore told horticulturists and farmers how to ~~preserve~~^{prune} small fruits in such a useful manner that the treatise had to be republished in October 1922. In Circular No. 135 of May 1921. C. L. Fluke Jr. gave instructions for the poisoning of grasshoppers and furnished formulas for suitable "bait" for the purpose.

RESEARCH BULLETINS OF 1921

Marsh Drainage

In illustrated Research Bulletin No. 50 of September 1921 G. R. B. Elliott, E. R. Jones and O. R. Zeasman told the story of the reclaiming of the University of Wisconsin marsh by pump drainage. Open ditches and the use of wind and ~~positive~~^{gasoline} pumping engines failed, but electric power and deep tile draining succeeded. The experience ~~joined~~^{gained} in the draining of 130 acres of lowland adjacent to Lake Mendota, and nearly 80 acres of it lower than the lake, taught the authors that the shrinkage of peat above tile drains is of such extent that the tile may have to be relaid in from 10 to 20 years. Tile 3 feet deep are too shallow; those 4 feet deep and 8 rods apart are more efficient than tile 3 feet deep and 4 rods apart. Where seepage is great in acid peats, tile 5 feet deep are most efficient. Well-made cement tile are satisfactory for the purpose. They last and act best when imbedded in underlying clay. The pump should be started before the tops of the tile outlets are submerged. An electric automatic starter for the pump ~~series~~^{serves} in place of a constant attendant. A simple augur pump that permits sticks and debris to pass through it without clogging or binding is most satisfactory. An emergency pump should be kept ready for action. About 1/2 kilowatt hour of power was used per acre in 24 hours to lift the water 7 feet. The dry weather seepage amounted to about .1 inch in 24 hours. The maximum requirement was about .8 inches in 24 hours from the entire area.

RURAL PRIMARY GROUPS

In Research Bulletin No. 51 of December 1921 Prof. J. H. Kolb presented a study of agricultural neighborhoods. The bulletin had many colored maps and a wealth of original matter on the interesting subject

discussed. The study was carried on cooperatively by the College of Agriculture and the Division of Farm Life Studies of the Office of Farm Management and Farm Economics, U.S. Department of Agriculture . The author advised that organization plans must recognize rural primary groups, many of which are too small for efficient service. Village and rural groups should federate, with active primary groups and the Village center forming a community. Non-grouped areas should organize and inter-community organization, on the county basis, is necessary for administrative purposes. Practical implications were outlined and advised for rural and high schools, farmers' organizations, village commercial associations, rural and village churches, and for social and welfare agencies.

CIRCULARS OF 1921-1922

The road to better marketing was pointed out by Prof. Theodore Maklin, Agricultural Economics Department, in Circular No. 136 of July 1921. The importance of organization among farmers was stressed to improve and conduct assembling, grading and standardizing, packaging, processing, transporting, storing, financing and distributing in connection with marketing enterprises. The marketing of meat animals, butter, milk, potatoes, peas, root and sugar beets by organizations was advised. The author counselled farmers to devote their energies to creating actual organizations that would distribute products, stabilize prices, and offer goods and services to consumers under improved conditions. In this way Wisconsin farmers could actually stabilize prices and secure a higher proportion of what the consumer pays.

Frank Kleinheinz, University shepherd, and Prof. G. C. Humphrey, Animal Husbandman, in Circular No. 137 of November 1921, explained why it would pay sheepmen to employ a good ram. They were also advised to select young ewes as yearlings, two-year-old, or perhaps three-year-olds are more desirable than older ones for starting a flock. They should likewise discard broken-mouthed ewes and ewes with bad udders and choose those having good size desirable forms and dense fleeces. Then the lambs should be fed especially well during the first year as a sheep makes its greatest growth during that period. The flock too, should have good care throughout the year. Illustrations accompanied the text. In Circular No. 138 of November 1921. Prof. J. L. Sammis of the Dairy department prescribed "Milk Drinks for Everybody!". Recipes for such drinks were furnished. Farm butchering of ^{pork} prok was well explained as to approved methods in Circular No. 139 of December 1921 by experts of the Animal Husbandry and Home Economics Departments. Fine illustrations made the various operations

easy to understand and practice. The methods of salting, ^{brine} home curing, dry curing and smoking meats, and rendering lard were explained and recipes furnished for the necessary preservatives and the making of various kinds of sausage. The departments of Agricultural Journalism and Home Economics told in Circular No. 140 of December 1921 "How to Have a Successful Milk Campaign". Such a campaign would benefit a community by leading to a wider use of milk with resultant improvement in the health and mentality of children. Adults also would profit by using more milk which is not only a "perfect food" but a most inexpensive one as well. The circular was properly illustrated and showed samples of the various posters used in the campaign.

In Circular No. 141 of January 1922, Prof. J. G. Halpin and J. B. Hayes of the Poultry department discussed the subject of "Feeding for Eggs". Various feeds were considered and different combinations of them prescribed in rations for laying hens, including both scratch feed and mash methods of feeding were advised. The authors stated that the use of tonics for the laying flock is a useless expenditure of money and should be discouraged. The same amount expended in good feed would bring better results.

In Circular No. 142 of February 1922 Director Russell and Prof. K. L. Hatch presented the annual report of the Agricultural Extension Service of the Wisconsin Agricultural College and Experiment Station entitled "A Decade of County Agricultural Work". The cover page showed full length photographs of E. L. Luther, Wisconsin's first county agent and of A. W. Brown and Arthur Taylor who were members of the first local agricultural committee for Oneida County. The various phases were reported on, explained and illustrated. A list of Extension projects, with assignments of specialists accompanied the

text. In Circular No. 143 of March, 1922, Prof. E. B. Fred and Audrey Davenport told all about "Bacteria for Legumes" and published a complete list of the wild legumes of Wisconsin. Once more they explained the beneficial influence of root nodules and their bacteria in gathering nitrogen from the air and advised inoculation as necessary to success in growing alfalfa and other legumes. Frank Kleinheinz, in Circular, No. 144 of April 1922 furnished another of his practical advice papers under title of "When Lambing Time Comes". Instructions were given regarding each step in the management of the pregnant ewe; Caring for her at lambing time and management of the new born lambs, Circular No. 145 of April 1922 prepared by the Agricultural Extension department experts recounted the story of "Fifty Years of Dairy Progress" and proposed plans for another fifty years. A "Foreword" to the Circular was written by Prof. K. L. Hatch, Director of the Extension Service. He stated that the purpose of the circular was to portray briefly the accomplishments of the past fifty years as summarized in the exhibit, and to outline plans for the future development of dairy marketing organizations as recommended by committees representing the various branches of the dairy industry. The circular showed numerous pictures of the exhibits made at the National Dairy Show in St. Paul, October 1921, and again shown during "Farmers' Week" at the College of Agriculture. The exhibit, commemorative of half a century of unbroken progress of Wisconsin dairy industry had been made possible by a special appropriation from the State Legislature. A statue in honor of the late Governor W. D. Hoard was unveiled on the campus at the time of the second display of the Dairy exhibit.

Circular No. 146 of April 1922 consisted of a "Register of Productive Cows". It was prepared by A. J. Cramer in charge of the registry who stated

in the preface to the circular that the Register of Production was started to secure better breeding, better feeding methods and better care for Wisconsin dairy cows. It was also to help emphasize the necessity of judging a bull according to the work of his daughters, increase the purchase and sale of cows on the basis of yearly production and to establish recognized yearly records for purebred and grade cows when these cows would otherwise be without records. A total of 1,199 cows had been enrolled in the Register to date. The new entries with their records, were listed in this circular.

Norman S. Fish in Circular No. 147 of May 1922 under title of "Turn on the Water" explained the advantage of having running water in the farm house and told how a system might be installed. Suitable illustrations accompanied the text. In Circular No. 148 of April 1922, entitled "Keep the Stump Puller Working", John Swenhardt told how several hundred stump pullers then owned in Wisconsin should be repaired, equipped and greased for at least 100 days work in 1922. These idle pullers, he stated, were one of the reasons why 17 cut-over counties were paying over \$4,000,000 for feed that year. Pictures showed pullers being efficiently worked.

RESEARCH BULLETINS OF 1922

Winter injury of cherry blossom buds are mentioned in Research Bulletin No. 52 of July 1922. R. H. Roberts discussed the subject of the development and winter injury of cherry blossom buds, Illuminating illustrations accompanied the ~~text~~^{text}. The author concluded that the early part of July, in Wisconsin, apparently is the only period of differentiation of cherry blossom buds. The rate of development, after initial differentiation of the floral parts, and not the actual time of such differentiation governs the total amount of development of the buds before the winter season. The extent of winter killing of the blossom buds of the cherry depends largely upon the amount or degree of their development at the beginning of winter. The condition which renders the more advanced buds susceptible to injury is probably the presence of large central vacuoles in the cytoplasm of the cells. Embryonic tissue, having dense cytoplasm proved relatively more resistant to cold in some plants than were tissues composed of cells with large vacuoles.

SCAB OF THE POTATO

In Research Bulletin No. 53 of July 1922, Prof. L. R. Jones, H. H. McKinney and H. Fellows explained the influence of soil temperature on potato scab. Many instructive illustrative plates accompanied the text. They found that the disease developed at all soil temperatures, 11° to 30.5° C. but was comparatively slight at either extreme. A temperature of 22° C. should be accepted as about the optimum soil temperature for scab development, where the "Wisconsin tank" method is used in the greenhouse. In a field trial, approximately 25° C. proved to be most conducive to scab development. The scab lesions tend to be segregated upon the "stem end" portion of each tuber. The immediate relation of temperature to the development of scab seemed, to the authors, to be cumulative from season

to season, whereas the influence upon the host was immediate and temporary. Further and more critical study of the subject was deemed necessary.

LIME AND INOCULATION *For Alfalfa and Clover*

In Research Bulletin No. 54 of October 1922, Professors E. J. Graul and E. B. Fred discussed the value of lime and inoculation for alfalfa and clover on acid soils. The evidence obtained from experimentation showed that the amount of nitrogen fixed per acre yearly due to the activity of the legume and its root nodule bacteria, under the proper conditions, is decidedly largely both for non-acid and acid soils, provided the legume is adapted to the reaction of the acid soil. It was not considered necessary to neutralize all of the soil acidity in order to produce a profitable crop of alfalfa. Small applications of ground limestone usually produced a decidedly beneficial effect on the growth and nitrogen content of legumes. The amounts of nitrogen fixed per acre for one cutting, according to soil conditions was shown in tables. The results of the field and greenhouse studies showed that alfalfa and clover on the acid soils made the most profitable growth where the nodule bacteria were added, and the acidity of the soil was neutralized in part by small applications of limestone.

INFECTIOUS ABORTION IN SWINE

In Research Bulletin No. 55 of September 1922, Doctors F. B. Hadley and B. A. Beach, Veterinarians gave the results of an experimental study of infectious abortion in swine. The authors found that infected swine are much more likely to introduce the disease in a herd than is the feeding of dairy products containing bovine abortion germs. The microorganism causing the disease in cattle and swine seemed closely related. The strains of Bacillus abortus from

swine and cattle were culturally similar, but biologically unlike . The strains of abortive bacilli of bovine origin failed to cause abortion in pregnant cows inoculated. Those of porcine origin caused abortion in sows tested and in the only pregnant cow inoculated. The results showed that the infectious abortion of swine and of cattle are not caused by an identical organism. The average inoculation period of infectious abortion in sows was found to be 23.2 days; in cows, 58 days. The intradermic test was shown to be of no practical value as a means of diagnosis. Serologic or blood tests were found to be the most satisfactory means of detecting the disease in a herd of swine. Vaccination proved a certain means of conferring active immunity, and gave promise of being an effective means of control, but whether it should be used generally had not been determined.

Circulars of 1922-1923

The ~~Secondary~~ ^{of the} Series of Circulars entitled "Fifty Years of Dairy Progress" (begun with No. 145 of April 1922 on Marketing) appeared in August 1922 and contained an address on the future of Wisconsin Dairying delivered by Director H. L. Russell at the University of Wisconsin on January 30, 1922, at the celebration of the semi-centennial of the establishment of Wisconsin Dairy-men's Association. It had particular reference to the Production side of the industry. The third of the series appeared as Circular No. 150 and contained the address of D. A. E. Taylor of the Food Institute, Stanford University, California delivered at the Wisconsin Dairyman's Association Convention at Madison. It dealt with Competition in the dairy industry under title of "The Competitive Menace of the Tropics". Circular No. 151 of September 1922, gave an account, by Prof. George C. Humphrey on "Dairying in Northern Wisconsin". Good advice on the care of worthwhile dairy cows was given and rations for them prescribed. In Circular No. 152 of September 1922 Professors R. A. Moore and G. B. Mortimer presented an instructive paper on "Corn Judging". Sample score cards were shown and numerous pictures were printed to show good and poor types of corn ears and kernels. A table showed standards for leading Wisconsin varieties of corn. Circular No. 153 of October 1922 discussed the subject of "Better Shipping Crates for Livestock". The circular was prepared jointly by experts of the Forest Products Laboratory of the U.S. Department of Agriculture, officers of the Wisconsin Livestock Breeders' Association and ^{members} ~~numbers~~ of the agricultural staff of the University of Wisconsin". Many pictures of serviceable crates and plans for their construction accompanied the text.

TECHNICAL BULLETINS OF 1923

Blossom Bud Formation

In Research Bulletin No. 56 of January 1923, R. H. Roberts reported on tests he had made on the effect of defoliation upon blossom bud formation. He found that buds which formed at defoliated nodes of American plum species were noticeably smaller than the average. When alternate leaves, instead of all or a part of the leaf blade, were removed, the number of buds formed undefoliated nodes were somewhat reduced. Cutting the midribs ~~to~~ transversely near the base of the blade had a marked inhibiting influence upon bud development. Removing one half of the leaf blade by a cut parallel to the midrib reduced bud development to about the same degree as removing half of the leaf by cutting completely across it transversely. The spurs developed from defoliated nodes were much smaller and shorter than from other nodes. The author suggested that the difference in nitrogen reserve is a large factor in giving this condition.

FISH/FLAVOR IN BUTTER

B. J. Smit, under direction of H. H. Sommer of the Dairy Department, studied the cause etc. of the fishy flavor sometimes met within butter. The work was done in preparing a thesis for the degree of Ph.D. from the University of Wisconsin. He found that the conditions favoring the development of fishiness in butter are: A high acidity in the cream; high salt content in the butter; overworking the butter and the presence of iron or copper salts. He concluded that the development of fishiness in storage butter is due to the chemical decomposition of the lecithin normally present in butter and that pasteurization tends to eliminate the fishy flavor.

RELATIONS OF TOWN AND COUNTRY

Prof. J. H. Kolb, in "Research Bulletin No. 58 of December 1923", presented another of his elaborate studies of the agricultural economics type. The title was "Service Relations of Town and Country". As was the case with his previous research bulletin No. 51 on "Rural Primary Groups" numerous graphs and maps accompanied the text. The author showed that the economic service includes merchandising, marketing and financing. This he fully explained and also considered the educational religious social, communication and organization service. He advised that the mutual implications for the townsmen mean that his town must become the specialized service ^{station} ~~at a time~~ for the larger community; and that the implications for the farmer involves the assumption of a keener responsibility for the larger community life rather than attempting to hold to a family or a neighborhood economy. The farmer is in real need of this larger organization relationship where his own interests may be safe-guarded and at the same time united with those of the town or city.

RESEARCH BULLETINS OF 1924

Anthracnose of Cane Fruits.....

Under the direction of Dr. G. W. ^{Keitt} ~~Kritt~~, Leon K. Jones in the period of 1920-1923, made a survey of the cane fruit industry of Wisconsin. In Research Bulletin No. 59 of May 1924 he presented his findings relative to anthracnose on black raspberries in the state and control measures for the disease. The author found that the minimum temperature for the growth of the causal fungus Plectodiscella veneta Burk on dextrose-potato agar is about 11° C, the optional, between 20° and 26°, and the maximal, about 31° C. The period of incubation on the canes was found to be 3 to 9 days. The disease appears on the ^{young} growing canes between May 13 and May 20, and the lesions caused continue to increase in number throughout early summer. Resistance to the disease develops when the plants ^{cease} reach growth in July. Suggestions as to control were given.

RURAL RELIGIOUS ORGANIZATION

In Research Bulletin No. 60 of June 1924, Prof. J. H. Kolb and C. J. Bornman presented a study of the origin and development of religious groups. The bulletin dealt ably with the present outlines of religious organizations; social history of the religious groups; the original source of the groups and their general distribution, in Dane County, Wisconsin; the tendencies and problems of readjustment and the future in rural religious organizations. Numerous graphs and maps accompanied the text which was of a highly interesting and instructive character.

RESEARCH BULLETINS OF 1925
Changes in Silage

In Research Bulletin No. 61 of January 1925, Professors W. H. Peterson, E. ^{g.} Hastings and E. B. Fred presented the results of a study of the principle changes which take place in making silage. They were assisted in the analytical work by J. A. Anderson, L. A. Burkey, Audrey Davenport, B. Domogalla and E. G. Schmidt. They found that the first notable change was in the composition of silo gases, oxygen disappeared in 4 or 5 hours, carbon-dioxide increased rapidly for about 48 hours and comprised 60 to 70 percent of the silo gases, then it gradually decreased for several months. No trace of hydrogen, methane or hydrocarbons were found. Increased temperature was the second notable change. It amounted to 7°C. near the ^bottom, and 20°C four feet from the top of the silo. The temperature continued high for 60 to 70 days. From 24 to 48 hours after ^{smiling} ~~existing~~ bacteria appeared in large numbers and caused fermentation. Ethyl alcohol, ac^eetic acid and lactic acids were formed and originated largely from sugar. A marked destruction of pentosans and starch was noted being, in part, converted into fermentation products. The chromogenic bacteria were prevalent in unbelievable numbers but lived for only a short time. The pentose fermenters of aciduric bacteria were most active. Inoculation of corn silage with certain bacteria produced a more vigorous and sustained fermentation but under field conditions scarcely was considered worthwhile.

CONTROLLING WILDFIRE OF TOBACCO

Professor James Johnson and Herbert F. Marwin, in Research Bulletin No. 62 of August 1925, reported the results of experiments on the control of wildfire of tobacco. They were made in cooperation with the office of Tobacco

Investigation of the Bureau of Plant Industry, U.S. Department of Agriculture.

Numerous illustrations and tables accompanied the text. The investigators mainly studied the factors which may account for seed-bed infection, together with methods of preventing such infection. Seed bed infection was found the source of practically every case of wildfire in bacteria in the field. No satisfactory method of preventing spread of the disease in the field had been found. A solution of silver nitrate (1-1000) gave the best results as a seed disinfecting agent, when two 5-to 10-minutes treatments were given and the seed dried between treatments. The wildfire bacteria were found to produce a toxin in host tissue and cultures, this being responsible for the chlorosis produced in plant tissue.

Professor Johnson, in another cooperative experiment on the transmission of viruses to tobacco from apparently healthy potatoes, gave the results in illustrated Research Bulletin No. 63 of September 1925. He found that at least two different viruses are commonly, if not universally, present in most standard varieties of potatoes. The infections caused by them are known as "mottle", "spot-necrosis" and "ring spot". One or more of the viruses can be transmitted readily to a large number of different species of the solanaceous family. Ordinary tobacco mosaic, combined with the virus from healthy potatoes, resulted in a combination disease with striking necrotic effects. The experiments indicated that potatoes are either "true carriers" of viruses, or that potato protoplasm is actually the causal agency of one or more of the virus diseases of tobacco and other solanaceous plants.

PEA DISEASE

Fred Reuel Jones, Pathologist, Bureau of Plant Industry, U.S. Department of Agriculture, and Maurice B. Linford, Industrial Fellow in Plant Pathology, University of Wisconsin, reported in Research Bulletin No. 64 of July 1925, a survey of pea ^disease in the state. The diseases studied were: Rootrot caused by Aphanomyces which is the most prevalent and destructive in Wisconsin, and the less important pea diseases Fusarium stem and rootrot; footrot; seedling injury caused by Rhizoctonia and by species of Pythium; an undescribed wilt disease; leaf and podspot or "blight", caused by Ascochyta; ~~Septoria~~ *leafblotch caused by Septoria*; leafspot new to Wisconsin; anthracnose; downy mildew; bacterial blight and mosaic. Occurrence of each of these diseases and a description of each was noted and furnished. Advice relative to the control of root rot was also given.

FERTILIZER EXPERIMENTS

In Research Bulletin No. 65 of October 1925 Emil Truog, H. J. Harper, O. C. Magistad, F. W. Parker and James Sykora reported the results of experiments conducted under a fellowship grant from the Soil Improvement Committee of the National Fertilizer Association. A. R. Albert assisted in starting the experiment. They studied the methods of application and effect of various fertilizers on germination, early growth, hardness, root growth, lodging, maturity, quality and yield on the different crops tested. The results attained with each crop were stated in summaries of the various experiments conducted.

SERVICE INSTITUTIONS

In Research Bulletin No. 66 of December 1925, Prof. J. H. Kolb, Economist, furnished one of his elaborate and instructive papers on Service institutions for town and country. The institutions studied included the high school,

library and hospital with relation to rural standards of living and suggested unit requirements for each. Many illuminating graphs and tables accompanied the text.