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Agricultural Research in New Hampshire

Annual Report of Director
of New Hampshire Agricultural
Experiment Station for the Year 1935

UNIVERSITY OF NEW HAMPSHIRE
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Agricultural Research in New Hampshire

Annual Report of the New Hampshire Agricultural Experiment Station 1935

J. C. KENDALL, Director

This past year marked the twenty-fifth of the present administration of the New Hampshire Agricultural Experiment Station; and a summary of some of the important results of the period was published in Bulletin 287, entitled "Twenty-Five Years of Agricultural Research." The present report, therefore, will confine itself merely to the current year.

The Station is now operating 78 different projects in the fields of Agricultural Economics, Agricultural Engineering, Agricultural and Biological Chemistry, Animal Husbandry, Agronomy, Botany, Dairy Husbandry, Entomology, Forestry, Horticulture, and Poultry Husbandry.

A notable advance in popular support of agricultural experiment stations is signalled in the passage by Congress of the Bankhead-Jones Act. While New Hampshire's Station allotment under this appropriation is small, amounting to only $2,089.30, the fund sets up a system of regional research, in which the various state experiment stations will coöperate with the United States Department of Agriculture. Development of regional and national projects has been evident during recent years.

Through coöperation with the Agricultural Adjustment Administration it has been possible to make a much more definite map of the type of farming areas of the state than has ever before been possible.

A coöperative study in milk marketing has also been developed on a regional basis with the other New England experiment stations and with the Bureau of Agricultural Economics of the United States Department of Agriculture. Preliminary work has already been completed outlining the program, the general purpose of which is to discover possible improvements in marketing methods, practices and facilities and possible improvements in methods of public control.

Our soils program is now achieving the firm scientific basis which it has so long needed. During the year we were able to begin, in coöperation with the U. S. Bureau of Soils, a detailed survey of the better farming areas of the state, combined with a reconnaissance survey of the wooded and poorer areas. The work has been completed in Grafton and Sullivan counties. Sixty-six different soil types have been found thus far, involving 25 different series and 19 phases. Meanwhile improvements in laboratory technique make it possible to give fairly definite recommendations as to soil management.

The northeastern experiment stations have agreed to develop special regional studies of pasture improvement. The details of this program are now being worked out.

Among the developments of the year in our state service work has been the completion of a thorough survey of rural electrification in the state in cooperation with the Emergency Relief Administration, the State Public Service Commission and the Farm Bureau Federation. New Hampshire is already credited by the Edison Electric Institute with having 66.6% of its total number of farms served with electricity, the highest figure for any state in the country.

In our poultry work, we have completed during the year the contagious bronchitis vaccine building, complying with the Federal requirements for handling this service. Pullorum samples reached a new high of 239,000 tests. The development of the Bang's disease testing program by the State Department of Agriculture is also resulting in a considerable extension of laboratory work. As a result of this and of the action of the last Legislature in appropriating increased funds for Animal Industry work, it is possible for the State Department of Agriculture to take over financial responsibility for both pullorum and Bang's tests. Samples will be collected by the State Department, and the Station will conduct the laboratory phases of the work —a similar arrangement to that carried on for so many years in respect to analyses of feeding-stuffs and fertilizers and seed testing. With the reduced poultry fees it now seems probable that pullorum tests this year will run to 300,000 or more.

There have been few changes in personnel. H. C. Woodworth has been on leave of absence during the year, assisting the federal Resettlement and Land Use Division of the northeastern states. L. E. Washburn resigned as assistant in animal husbandry September 1, and his place has been taken by Roger Doe. A. M. Jorgenson replaced L. J. Bowen as graduate assistant in botany. The soil survey has been in charge of W. J. Latimer, assisted by M. H. Layton for the U. S. Bureau of Soils. They are being assisted by Paul Scripture, W. H. Lyford and W. H. Coates of the Station staff.

The technical equipment of the animal nutrition laboratory was augmented during the year by the installation of an electrical psychromoter with which to measure the amount of water lost by vaporization from the bodies of horses and cattle. This contribution was made by the Carnegie Institution of Washington, which is coöperating in the animal nutrition investigations, and funds have been supplied by the same institution for the building of a respiration chamber larger than any before available for the measuring of animals of unusual size. This chamber has already been tested and used experimentally.

The following is a brief review of significant findings in our various projects during the year.

Digestion Experiments with Dairy Cattle

As in past year the nutrition experiments have been conducted in cooperation with Dr. F. G. Benedict, director of the Nutrition Laboratory of the Carnegie Institution of Washington.

Digestion experiments carried out with oat hay show that when cut at the right time and properly cured it exceeds any other hay so far tested in metabolizable energy and it is surpassed only by alfalfa and red clover hay in digestible crude protein content. The digestible energy is 66.8 per cent of the total energy ingo. The metabolizable energy per 100 pounds of hay is

104,730 calories and the digestible crude protein is 7.87 per cent of the weight of the hay. (*E. G. Ritzman and F. G. Benedict—Purnell Fund.*)

Physiological Investigations of Dairy Cows

The outstanding result of this work over a period of five years has been the unexpected lability of the dairy cow's basal metabolism. As expressed on the comparative basis of 500 kilograms of body weight per 24 hours and in muscular repose (ie., lying), the variation found in the same individual ranges from 10 percent with a dry cow (measured only twice) to 90 percent with two dry cows measured over a period of several years. It would seem in view of this new information that the concept of constancy in the basal metabolism of animals which has prevailed among physiologists in general for so many years, must of necessity be revised. The possibility should be recognized that great changes in the endogenous metabolism may take place even within a relatively short time without concurrent changes in body weight. (*E. G. Ritzman and F. G. Benedict—Purnell Fund.*)

Complete Balance Experiments with Dairy Cows

Five cows (two Holsteins and three Jerseys) were used in this work, feeding them for three months on concentrates only. In a series with all five cows only corn meal was fed, and in another a mixture of four parts linseed oil meal mixed with one part of bran. The amount fed was approximately maintenance. The animals ceased rumination within a week from the time that hay was left out of the ration, but with the exception of one animal which tended to bloat on corn meal no trouble occurred. The digestibility of energy ranged between 80 and 84 percent and the digestibility of crude protein between 60 and 70 percent. It was demonstrated that the stimulus to rumination is apparently of a purely mechanical nature since one of these cows when fed alfalfa ground to a meal ceased to ruminate as quickly as when she was fed nothing but corn meal. (*E. G. Ritzman and F. G. Benedict—Purnell Fund.*)

Nutrition of Horse, Pig and Goat

Five experiments were carried out to determine the methane production of the horse, pig and goat. The pig subsists primarily on concentrates and tubers and produces no methane. When fed on hay alone the goat produces about the same amount relative to total energy as do cows, and the horse produces about half as much.

The comparative study of the basal metabolism of the goat begun two years ago has been completed and the results are being prepared for publication. They show that the adult female goat has a measurably lower basal metabolism than the female sheep, and young goats have a lower metabolism than lambs of similar age. (*E. G. Ritzman and F. G. Benedict — Adams Fund.*)

Sheep Breeding Project

Progress in the development of multinippled sheep and improvement of milk yield of ewes may be observed from the fact that every animal in the flock now has four or more nipples. In the first generation hybrid in which four nipples appeared two of these were usually rudimentary. The increase

in number of nipples, their functional capacity and general increase in milk yield is now marked.

About half of the ewe flock now has four functional nipples and the milk yield in ewes is noticeably improved. With another two years of breeding the whole ewe flock should have four functional nipples, after which it will be possible to report further on the manner of inheritance of this trait.

Progress in the improvement in twinning is more or less at a standstill with about half the ewes breeding twins. Although only twin-bred sires are being used, no further marked progress is expected until the ewes can be selected on this basis. Due to the small flock this must be delayed until the four functional nipple trait has been established in the whole flock. (*E. G. Ritzman—Adams Fund.*)

Preliminary Study of Dairy Herd Replacements in Southern New Hampshire

The purchasing power of dairy cows declined rapidly from 1930 through August, 1934, at which time it stood at 55 per cent of pre-war. Cows were relatively cheap during 1932 and 1933. A survey of 200 southern New Hampshire farms shows that the average price paid by farmers for productive grade cows during the year ending May 1, 1933, was $71. The average feed costs of raising a heifer to age of freshening exclusive of pasture costs was $67. Farmers generally admitted that it was cheaper to buy cows than to raise them, but stated among other reasons that disease was less likely when replacements were raised rather than purchased. The survey supports this reasoning.

For 164 of these farms complete data were obtained relative to the tuberculin test. Of the 2,837 cows tested, 59 per cent had been raised on their respective farms and 41 per cent were purchased cows. Forty per cent of all the cows reacted. Only 29% of the cows raised on the farms where tested were reactors compared with 55% of the purchased cows. There were 22 herds in which all cows were purchased, and 51 in which all cows were raised; the reactors amounted to 49 per cent and 15 per cent respectively of the cows tested. Those farmers who subjected their herds to examination between January 1, 1931, and May 1, 1933, lost 48 per cent of their cows, and those who had their herds examined before 1925 lost only 31 per cent. In general, greater losses were incurred as a result of delay.

There were no reactors in four dual purpose herds. Mixed herds in which no breed was predominant lost 68 per cent of the cows tested. The per cent loss on other farms according to majority breed were as follows: Holstein, 42; Jersey, 37; Ayrshire, 33; and Guernsey, 24.

Forty per cent of the grade cows were reactors as compared with 36 per cent for purebreds, but 33 per cent of the purebreds that were raised on the respective farms reacted and only 28 per cent of the grade cows.

For the year ending May 1, 1933, four per cent of the cows on the 200 farms aborted and 2.7 per cent failed to breed. Slinkers amounted to 7.7 per cent of all the cows owned by farmers who purchased one-half or more of their replacements, compared with 3.2 per cent for farmers who raised more than one-half of their replacements. For 20 farms on which all replacements were bought, 10.1 per cent of the cows aborted, and for 52 farms

on which all replacements were raised only 1.7 per cent aborted. Those farmers who purchased a bull which had been used for service previous to the time of purchase had more abortion cases than those who purchased a bull before such service, the percentages being 6.3 and 3.4 respectively. Only 2.2 per cent of the cows were slinkers on farms where the bull was raised, although in many cases he was purchased as a calf. Eighty-five farmers used their bulls for servicing neighbors' cows, and 87 per cent did not. The percentage abortion in these cases was 4.7 and 3.7 respectively. (*H. C. Grinnell—Purnell Fund.*)

Spray Management Studies

This past season, 45 apple growers kept records of labor, materials, and equipment used in spraying. Although the season was very favorable for the development of the apple scab fungus, in most instances a commercially clean crop was obtained. The cost records are now in process of analysis.

A study has been completed of a part of the records having to do with the practice of transporting water or spray mixture to the sprayer by means of a "supply" tank mounted on a truck, thus saving that time usually lost by hauling the sprayer back and forth from orchard to the water supply.

In the Rockwood orchard, spraying was done with a small machine of six to seven gallons per minute capacity with a 100 gallon tank. Operating in 1934 without the supply tank, 8,700 gallons were applied at an average rate of 79.6 gallons per machine hour or 39.8 gallons per man hour. In 1935, using the supply tank, 20,200 gallons were applied at a rate of 129.4 gallons per machine hour, or 41.7 gallons per man hour. Allowance must also be made for the fact that in 1935 the spraying was in charge of a more skilled operator than during the previous year. It appears, therefore, that the use of the supply tank did not increase the efficiency in man labor, but that by increasing the output of the machine about 62.5 per cent it made it possible to cover the orchard in a considerably shorter time. Timeliness is an exceedingly important factor in disease control.

In the David Whiting orchard, a machine of 25-30 gallons per minute capacity and 300 gallon tank is operated. In the early season sprays, filling from waterholes in the orchard, 21,000 gallons were applied at the rate of 280 gallons per machine hour or 93.3 gallons per man hour. In the later applications, using the supply tank, 30,635 gallons were applied at the rate of 402.9 gallons per machine hour, or 100.7 gallons per man hour. This indicates a slight increase in labor efficiency. Furthermore, late in the season, the waterholes had dried up, and the efficiency without the supply tank would have been lower than in the early part of the season. When the costs of operating truck and sprayer are included, it is found that for the early application in which the machine was filled directly from the waterholes, the application cost per 1,000 gallons was $5.80, whereas for the late sprays, when the supply tank was used, it was $7.00.

Records in both orchards seem to show that carrying the water or the mixed spray materials to the tank is advantageous chiefly as a means of speeding up operations when quick coverage is needed to protect against disease. From the point of view of economy of operation, providing wells or waterholes in the orchard or constructing a system of supply tanks about the orchard is more desirable. (*H. C. Woodworth, G. F. Potter, and E. J. Rasmussen—Purnell Fund.*)

Land Utilization

The survey was completed of all the occupied places in the southern Grafton County area, and the data retabulated. The retabulation makes no significant change in the summary, except to re-emphasize the self-sufficing nature of the agriculture. Data for some sixty additional farms were included. A definite area comprising 255 farms and 192,600 acres of land was designated for special consideration.

Average Gross Receipts on Farms By Groups
Receipts from Agricultural Products

Group	No. farms	Per cent of farms	Total receipts	Agr'l products	Forest products	Outside work	Pension, gifts, etc.
0- 50	118	46.3	$399.36	$9.82	$20.18	$285.52	$83.84
51- 100	25	9.8	502.60	77.93	94.44	271.11	59.12
101- 500	59	23.1	729.29	242.64	67.88	321.91	96.86
501-1000	34	13.3	1,131.93	684.18	69.94	281.19	96.62
Over 1000	19	7.5	2,502.21	1,769.35	343.18	279.15	110.53
	255	100.0					

Confining the data to these 255 farms, the analysis shows very nearly the same relationship that was reported last year for 577 farms. The area immediately adjacent to the defined region is heavily influenced by its non-agricultural character. With 46 per cent of the farms selling less than $50 worth of agricultural products, outside work for most farms in the area supplies most of the cash for meeting necessary cash expenses.

The small income from agricultural products and the limited opportunity to increase this income by expanded farm production on farms in the first two groups offer little inducement to attempt to rebuild the farm. The process of deterioration on these farms as well as on some of the larger farms in the area cannot be stayed for long without livestock. Hay fields are so rapidly growing up that even for the few the purchase of standing hay from one farm to bolster up the lack of hay on another rundown farm is becoming more and more difficult.

While these farms may be dropped from consideration in so far as agricultural production is concerned, they still offer town problems as to roads when used as retirement and summer homes. (*H. C. Woodworth and M. F. Abell—Purnell Fund.*)

Study of Egg Marketing and Grading Methods, Prices, Quality, and Weights

Grading percentages on over 11,000 cases of large brown eggs during the first year of the New Hampshire Auction have been summarized for individual and all producers. About 95 per cent of the cases graded specials; about 73 per cent averaged over 26 ounces per dozen net weight, and 12 per cent averaged 27½ ounces per dozen. This is an exceptional record for weight and quality. Total membership on the Auction in November, 1935,

had exceeded 400, and volume had reached a peak of over 1,000 cases a week.

The Auction has stimulated greater interest in weights and quality. The new fresh egg law effective July 1, 1935, will require still greater attention to be given these factors, and a large per cent of New Hampshire eggs will now be sold on a weight-quality basis. (*L. A. Dougherty — Purnell Fund.*)

Type of Farming Areas in New Hampshire

New Hampshire agriculture has been definitely separated into type of farming areas. This has been made possible through coöperation with the Agricultural Adjustment Administration in a nation-wide regional planning project. One of the specific features of this project in attaining its broad objective was to differentiate the agriculture of each state and region into areas and sub-areas with respect to soil conditions, erosion problems, crop and livestock systems and farm practices. A comprehensive survey of New Hampshire agriculture was accordingly undertaken. With the assistance of selectmen and other town officials, all commercial farms were located on town maps. A list of farmers including number of cows and number of hens was deducted from the town inventory. This list was checked against those names appearing on the map and supplemented with facts concerning other farm enterprises such as potatoes, maple sirup, tree fruits, small fruits, cord wood, vegetables, etc. For each farm having three or more cows it was noted whether the business was retail or wholesale, to whom the milk was sold and where it was consumed. From these town maps and the supporting details, large county maps were constructed showing the exact location of each farm in accordance with a definite legend adapted to indicate the kind and size of each enterprise. After diligent study of these county maps a state map was deducted which outlines 10 definite type of farming areas on an enterprise and use basis as follows:

Wholesale milk and pulpwood
Wholesale milk and potatoes
Wholesale milk
Wholesale milk and hens
Wholesale milk, apples, and hens
Wholesale milk, hens, apples and vegetables
Hens, wholesale milk, and apples
Apples, wholesale milk, and hens
Retail milk
General farming—mostly small scattered farms having some good farms among numerous marginal farms

The White Mountain National Forest, State Forest Reservations, and other non-agricultural lands were also outlined.

The commercial dairy farms (three or more cows) located on the county maps represent about 40 per cent of all the census farms in the state but have 90 per cent of all the cows. This is evidence to the numerous one and two-cow farms which predominate, especially in the general farming regions.

To supplement the maps and charts, numerous statistical tables based on the 1930 census have been effected. A correlation of the type of farming area map with the soils map, supported by statistical tables, gives evidence

to large areas of marginal lands now in agricultural use and sustains the significance of sound land-use policies. (*H. C. Grinnell, H. C. Woodworth, E. H. Rinear, L. A. Dougherty and A. J. Hangas—Purnell and U.S.D.A. Funds.*)

Soil Fertility Studies

Soil fertility experiments carried on over a period of years include: An experiment with hay on neglected haylands, an experiment with legumes on neglected hay lands, an experiment with potatoes in a three-year rotation, a fertilizer experiment with legumes in the Connecticut Valley, experiments with top-dressing old pastures, and a soil survey of New Hampshire.

An Experiment with Hay on Neglected Hay Lands. A field on the Whenal farm in Greenland was used for this work, and a catch of timothy was secured in 1934 after two unsuccessful attempts. The plots were top-dressed in 1935 and harvested in July. The treatments applied were nitrogen alone; phosphorus and potash; and nitrogen, phosphorus and potash. The differences for all three treatments were positive and significant, showing increases respectively over the check of 1,291, 704 and 2,213 lbs. respectively per acre. The effect of the phosphorus-potash treatment in stimulating grass on these plots is rather striking. In the original trials superphosphate alone failed to give a significant response after the first season. In 1934 when the grass was seeded, a uniform fertilizer treatment was applied to all plots to iron out any possible difference in stand due to this factor. The combination of superphosphate and potash appears to cause more stimulation to timothy growth than superphosphate alone, either because of the effect of the potash itself or on account of the combination of the two elements.

Experiments with Legumes on Neglected Hay Lands. Forty-eight alfalfa plots on the Whenal farm were again harvested twice in 1935 under different fertilizer and lime treatments. The plots in the experiment included those which had received one ton of lime in 1933, those receiving no lime that year, those receiving 100 pounds nitrate of soda annually, 500 pounds of superphosphate annually, 150 pounds of muriate potash annually, and 20 tons of manure in 1926.

While good alfalfa was produced during the first course of the experiment with two tons of lime, it is apparent that the extra lime applied in 1933 is of benefit to the alfalfa when the check plot with lime is compared to the check minus lime. Nitrogen, phosphorus, and potash all increased the yield of alfalfa in ascending order.

Among the plots that had no additional lime in 1933, those that had four tons of lime in 1926 outyielded plots that had but two tons of lime in the same year by almost 1,100 pounds per acre. The plots receiving complete fertilizer yielded more than 4½ tons of hay per acre in 1935, even though no manure nor lime have been added since 1926.

A sub-project of the legume experiment located on the Ireland farm, which is adjacent to the Whenal farm, is an effort to grow alfalfa largely without manure but with moderate to heavy applications of fertilizer variables. The stand secured in 1934 was harvested twice in 1935. Prior to seeding, one ton of lime was applied to all save three plots and also those which are embraced in the lime test. The alfalfa was seeded in 1934 with a

uniform application of fertilizer. In the spring of 1935 the fertilizer variables were applied.

Seeded without manure, it is quite evident that the nitrogen in the fertilizer is utilized by the alfalfa crop. Yields for the first cutting on those plots where nitrogen was omitted in the formulæ are below the check plot yields in four cases out of five, regardless of the other fertilizer treatment. In these experiments where no manure was applied as a general treatment, it appears that phosphoric acid and potash both stimulate the yield of alfalfa, and to about the same degree where equal quantities of the elements are applied.

Potatoes in the Legume Experiment. Potatoes were grown on one section of the Whenal farm field in 1935 on land that had been previously limed, but on certain plots aluminum sulphate and sulphur were applied prior to planting the potatoes to note the effect of these substances on scab control. While the degree of acidity does not absolutely follow the amount of acidulating material applied, the trend is for these materials to depress the pH and to control scab.

A Dairy Farm Rotation on Worn Out Hay Lands. A three-year rotation in potatoes, oats and clover is in progress on the Lane farm in Pittsfield, 1935 being the third year of the experiment. Potatoes were grown on one section of the field with varying fertilizer treatments.

Decreases for the omission of phosphorus, potash and for the no-fertilizer plots proved significant.

The first three years of this experiment indicate that varying the potash in the formula has more influence on yields than any other element, that magnesium is not a factor in potato production on this field, that broadcasting is equal to drilling as a means of distributing the fertilizer and that double strength fertilizers are slightly better than single strength materials for stimulating yields.

Oats were seeded on the plots that were in potatoes in 1934 without additional fertilizer. It is interesting to note that leaving out an element depressed the yield, and that doubling an element increased the yield to a slight degree. The no-fertilizer series yielded about three-quarters of a ton less oat hay than the average of the check plots,—a significant difference.

Clover was harvested from these plots which were in oats in 1934 and potatoes in 1933. As no fertilizer was added to either the oats or the clover, yield differences were slight from the various series. The 4-8-14 series which yielded over one-quarter ton more dry hay than did the 4-8-7-check plot was the only significant difference.

Potatoes in a Three Year Rotation. Growing conditions for the three-year rotation of potatoes on the Jackson farm, Colebrook, were not as satisfactory in 1935 as in previous years. Yields were low for the area, and there seemed to be more variation than usual within the plot series, a fact which results in fewer significant differences for the various treatments.

Ammo-phos-A and nitrate of potash did not do as well as formerly. It is possible that these acid-forming fertilizers increase the acidity of the soil enough to be detrimental to the potato crop. Leaving potash out of the fertilizer mixture has seriously depressed the yield of potatoes.

In the oats crop harvested from the plots which were in potatoes in 1934, all series to which lime had been applied yielded more than the check plots. Increasing the phosphoric acid in the fertilizer had more of a residual stimulus on oats than increasing the potash.

In the hay crop harvested in 1935 the series that had lime showed increased yields over the check plot series. This soil is too acid to grow clover without lime, and hence where the clover is stimulated the yield is increased. The hay was practically a failure where no lime was used.

A Fertilizer Experiment with Legumes in the Connecticut Valley. The plots on the field of the Livingston farm near Claremont were in winter wheat in 1934, which served as a nurse crop for alsike clover on forty plots and for red clover on forty plots. The plots were top-dressed in 1935 and harvested in July and again late in August. Lime did not increase the yield of alsike clover materially, when used alone. In combination with phosphorus and potash and nitrogen, phosphorus, and potash it increased the yield about one-quarter ton per acre as compared with these treatments with no lime.

The outstanding fact gleaned from the experiments during the past five or six years is that neither phosphorus nor potash stimulate the yield to any great extent when used alone, but in combination they give results that are more than additive.

Results for red clover are not vastly different from those with alsike (*F. S. Prince, P. T. Blood, T. G. Phillips, and G. P. Percival — Purnell Fund.*)

A Soil Survey of New Hampshire

A complete survey of New Hampshire soils was started in May, 1935 with the coöperation of the U. S. Bureau of Soils. W. J. Latimer of that organization was detailed to head up the work.

Field operations started in Grafton County on May 1 and were concluded on October 15. A report on the soils of this county will be written during the winter.

Operations were taken up in Sullivan County upon the completion of the work in Grafton and continued until November 15, when the party broke up for the winter.

The three assistants employed by the University spent the winter months making a mechanical and chemical study of the soils collected in Grafton during the summer of 1935. (*Purnell Fund.*)

Time of Cutting Hay

The original plots used when this work started in 1930 have been continued. Data on relative yields and protein percentages do not vary much from year to year. The effect of continued early and late cutting upon the stand of grass is being determined. Observations in 1935 indicate that there is little difference in stand so far with a slight disadvantage for the plots harvested June 20. (*F. S. Prince and P. T. Blood—Hatch Fund.*)

Grass Hay Top-Dressing

In tests of various carriers and levels of nitrogen for top-dressing, the different nitrogen carriers ranked as follows: Cal nitro, sulphate of ammo-

nia, nitrate of soda, cyanamid, and calcium nitrate. Complete fertilizers with nitrogen equal to the various nitrogen carriers proved superior for hay production. (*F. S. Prince, L. J. Higgins, Paul T. Blood, T. G. Phillips and G. P. Percival—Hatch Fund.*)

Lime-Sulphur Injury

Lime-sulphur is credited with causing either scorching or yellowing of foliage of the apple. Scorching has been produced experimentally, depending upon the temperature of the environment at the time the spray is applied. Yellowing of the foliage sprayed with lime-sulphur has not been produced experimentally; it has not been found to be associated with scorching.

Data obtained regarding lime-sulphur effect upon the bean is not sufficiently extensive as yet to permit analysis. In one experiment undertaken for the purpose of studying the effect of successive sprayings on loss of weight we obtained the following results:

	Per cent loss in weight
Plants sprayed 4 times at weekly intervals	17.65
" " 5 " " " "	14.56
" " 6 " " " "	13.40
" " 7 " " " "	13.90
" " 8 " " " "	16.26

These results indicate that the injury produced by lime-sulphur is not cumulative.

Further work was carried out with the potato.

The data showing reduction in yield to date are as follows:

	Per Cent
In 1934 loss in yield due to spraying plants grown at 20°C.	5.33
" " " " " " " " " " " 15°C.	7.71
" 1935 " " " " " " " " " " 20°C.	9.00
" " " " " " " " " " " 15°C.	3.10

(*O. Butler—Adams Fund.*)

Bitter-Pit in Apples

Work begun the previous year on the value of heavy mulching for the control of bitter-pit was continued. During the season, rainfall and temperature of the air and soil one inch below the surface were taken from April 15 to November 1. Soil moisture and nitrate determinations were also made every six inches to a depth of 18 inches. During the spring the moisture determinations were made when the trees were at definite stages of development, but during the summer and autumn definite time intervals were used. At the beginning and at the close of the season the amount of water in the soil under the mulched and non-mulched trees was practically the same, but during the summer it was higher under the mulch.

The temperature of the soil under mulch was lower than under sod in the early part of the season and higher at the close of the season.

The effect of mulching in increasing the nitrate nitrogen in the soil was brought out most strikingly by 1935. The difference was carried over during the winter and continued through the season. As the effect of the May 29 application of nitrate had about disappeared on the July 2 sampling, the

greater amount of nitrate nitrogen in the soil under the mulched trees in mid-summer must be caused by leaching of nitrate down from the decaying mulch. On August 1, for example, the parts of nitrate nitrogen per million on the dry basis showed 41.36, 77.94 and 67.57 for the mulched trees and 4.41, 2.32 and 3.50 for the non-mulched.

Tests to determine the nitrate nitrogen in the soil below the mulch level, taken on October 23, showed that the upper two inches contained the most, with a decrease with each deeper sample.

When the apples were harvested the fruit from the mulched trees was not quite so green on the average as the fruit from the unmulched trees, and the per cent of bitter-pit was also lower. Sample boxes of the fruit harvested from each tree were placed in common storage and were subjected to the pressure test when placed in storage and at intervals until March 14th. The fruit from the mulched trees when placed in storage showed less resistance to pressure than the fruit from the non-mulched trees, and the percentage difference shown at that time remained practically unchanged throughout the period of storage. Some bitter-pit developed in storage in the fruit from the mulched and non-mulched trees, but the percentage found in the latter was much higher than in the former. (*O. Butler—Purnell Fund.*)

Apple Scab

Studies of apple scab were continued on: 1. effect of pressure on control; 2. effect of night versus day spraying; 3. effect of use of one and two cover sprays; 4. effect of use of calcium arsenate in lieu of lead arsenate in lime-sulphur solution, especially from the point of view of spray injury; 5. test of the value of Cal-mo-sul, Kolofog, and flotation sulphur. Cal-mo-sul was used throughout the spray schedule, Kolofog beginning at the pink application, and flotation sulphur beginning at the calyx. Satisfactory control was obtained with all these materials, but scab infestation was not sufficiently severe to adequately test them.

Two cover sprays gave better control than one cover. Spray injury on foliage was slight and not increased by calcium arsenate, and the finish of the fruit on all the plots was excellent.

The trees sprayed at night were freer from scab than the trees sprayed during the day, but the average results to date indicate that over a period of years, time of spraying, all other things equal, does not materially affect the degree of protection afforded.

Four hundred pounds pressure gave better control than either 200 lbs. or 300 lbs. pressure. However, these results seem to be purely accidental as fluctuations occur from year to year.

The data so far secured indicate that irrespective of the length of the snow cover, or the mean temperature of winter, as ascospores mature during the last 10 days of April, and discharge occurs during the first wetting rain following maturity. The ascopores were mature April 24th, but no discharge occurred in nature until May 10. The delayed discharge was no doubt due to the scantiness of the rainfall. The first rain after April 24th occurred on May 4th (0.02 in.) and the next on May 9th (0.37 in.). The pre-pink spray, it may be observed in passing, was applied May 5th. (*O. Butler, E. J. Rasmussen, S. Dunn—Hatch Fund.*)

Hemolytic Streptococci in Pasteurized Milk

It has been found that hemolytic streptococci are much more prevalent in pasteurized milk than is commonly supposed. Samples of such milk with standard plate counts of only 5000 bacteria per millilitre have been found to contain in addition, when an appropriate culture medium was used, from 1,000 to 50,000 hemolytic streptococci per millimetre. Morphological and cultural studies of the organisms isolated have been made. (*L. W. Slanetz—Hatch Fund.*)

Effect of Place on Mosaic and Leaf-Roll

Due to toxic soil used in 1933 the series of experiments on mosaic and leaf-roll plants grown at a mean temperature of 20°C. and 15°C. was broken due to the loss of cultures grown at 15°C.

Most of the plants grown at 20°C. were, however, saved and in 1934 work with complete sets was resumed. At the same time a new series comprising healthy and mosaic plants was started to verify the results obtained with the first series.

During the period covered by this report the 6th generation of cultures of the original series was grown, and the second generation of the second series.

One of the main features of the work has been the study of the effect of growing cultures continually at 20°C. and 15°C. and the effect of moving the cultures from one year at one of these temperatures to the other temperature the following year.

So far the healthy or mosaic plants have shown no tendency to run out, though a change in temperature from one year to the next does affect the yield. In the case of leaf roll there is very definite deterioration and at present after six generations there is hardly a plant left. It made no particular difference whether the cultures were moved from year to year or kept at the same temperature. During the year there were only 17 leaf-roll plants growing at 20°C. and 17 growing at 15°C. Had there been no deterioration there would have been a total of 234 plants instead of 34. At the end of the growing season only four plants in the series grown at 20°C. and four plants in the series grown at 15°C. produced tubers of a maximum weight of not less than 40 grams.

The seed pieces or leaf roll plants grown at 20°C. were hard when the cultures were harvested in 23 per cent of the plants, but in the cultures grown at 15°C. 70 per cent of the seed pieces were hard.

Moving leaf-roll plants from 20°C. to 15°C. caused an increase in yield in the majority of cases.

In the case of the cultures of mosaic plants there has been no tendency to run out and yield at 20°C. was in general higher than at 15°C.

In the case of the healthy plants we found in the first series that growing cultures one year at 20°C. and removing them the next to 15°C. the yield obtained was not so high as in the cultures that had remained continuously at 15°C. and that two years were required to bring the yield up. In the case of the second series of healthy plants we secured during the year partial confirmation of the results secured with the first series. (*O. Butler—Purnell Fund.*)

Ruptured Egg Yolk in the Domestic Fowl

Studies were continued on the relation of bacteria to ruptured egg yolk. Pasteurella Avicida, which has been described as causing the disease, was not recovered from any of the birds examined. A number of other organisms have, however, been isolated but no one species has been found constantly present and none of them, when inoculated into the birds, have produced typical ruptured egg yolk symptoms. (*L. W. Slanetz — Purnell Fund.*)

Fruit Bud Formation

Plots of McIntosh trees at Durham and Temple, N. H. sprayed for two seasons with mild sulphur have as yet shown no greater fruit bud formation than control plots sprayed with commercial lime-sulphur solution. Thus in the blocks at Durham, the average per cent of all spurs blossoming in May 1935 was for mild sulphur 94.5, and for lime-sulphur 94.0, while in the Rockwood orchard at Temple, the percentages were mild sulphur 91.0, lime-sulphur 92.0. Percentage bloom in 1935 reflects only spray treatments of 1934. The effect of this year's spraying on fruit bud formation will not be evident until the spring of 1936.

In a second test, likewise designed to influence the carbyhydrate supply, eight groups of four McIntosh trees each were selected, the trees of each group being uniform as to size and vigor, and reasonably close together in the orchard. One tree in each group was left untreated as a control, and the other three were thinned—one on June 20, one of July 15, and the third on August 10. About one apple was left to five fruit spurs which would give approximately 60 leaves per fruit, of which approximately one-half were small primary spur leaves. Subsequent to thinning, the total leaf area per fruit was about 100 square inches.

These treatments gave very definite responses in size and color of the apples as is indicated in the following table.

Effect of Thinning McIntosh

U. N. H. 1935 (Trees 17 years old)

Date of Thinning	No. Trees	Yield Lbs.	Size Fruit Ins.	% Red Color
June 20	8	479	2-¾	68
July 15	6	462	2-11/16	64
Aug. 10	7	390	2- 9/16	64
Not Thinned	8	687	2-⅜	54

Here the thinning treatments have definitely reduced the load of fruit per tree and there is correlated response in size and color of the fruit. Results of other investigators, both in Eastern orchards and in the Pacific Northwest, lead us to expect there will also be increased fruit bud formation on the trees thinned early. When these data are available in the spring of 1936, these tests should relate the response of McIntosh in this climate to that of York, Delicious, and other varieties in the Shenandoah-Cumberland Valley and Ortley, Yellow Newton, and Delicious in the Pacific Northwest.

Leaf area measurements, made on June 27, July 5, 17, and August 9, indicate no significant increase in the leaf area per fruit spur resulting from the thinning treatment. (*G. F. Potter—Adams Fund.*)

Apple Pollination Study

In view of the fact that field observation has seemed to indicate a better set on McIntosh trees adjacent to Astrachan trees, even though the blossoming season of the Astrachan precedes that of the McIntosh, a test was carried out to determine whether bees might retain pollen over a period of days. Bees placed in an orchard where Red Astrachan and other varieties were in bloom were transferred to similar caged McIntosh trees—in one case immediately, and in others after storage.

The results seem to indicate that the pollen is injured in the hive or else the bees remove it all from their bodies very quickly. Bees removed from pollenizers only over night doubled the set of fruit, and reduced the number of lop-sided apples by 25% as compared to self-pollination. Yet even this cannot be considered good cross-pollination. The seed content was only slightly better than with self-pollination and less than half that of open pollinated apples. (*G. F. Potter, L. P. Latimer—Purnell Fund.*)

Fertilizer on Strawberries

Since the application of sodium nitrate has definitely caused injury to strawberries on the experimental farm and other nitrogen carriers have not, it was felt that the sodium might be the causal agent. Various chemicals, which included different combinations of sodium, calcium and ammonia with nitrogen, were applied each to a series of 36 replicate plots. Taking the yield of the check plot to which no chemicals were applied as 100% the yield of those to which different salts of ammonia were applied was 99, those receiving calcium salts 94, and those receiving compounds of sodium 73%. There seems to be a very distinct reduction in yield whenever sodium is used. (*L. P. Latimer—Hatch Fund.*)

Variety Tests of Fruits

In new varieties of apples, dark red sports of standard sorts and seedlings of the McIntosh are attracting the greatest interest. Again this season it was possible because of better color development to harvest Starking, a red sport of Delicious, earlier than the parent, but the difference was not so striking as in 1934. Many persons consider the Starking of better flavor than Delicious, possibly because Delicious may be left too long on the tree in the hope of acquiring more attractive color. The 1935 average yield per tree for Starking set in 1926 was 1.1 bushels.

Red Spy and Red Gravenstein differ considerably in appearance from their respective parents. This will be a disadvantage commercially. There will be better color and fewer culls.

For an early season variety, Early McIntosh appears to be generally accepted as being superior to Astrachan, which is of the same ripening season. On the Station farm, the Canadian McIntosh seedling "Melba" has been found to ripen about two weeks earlier than Early McIntosh. It is of good quality and attractive appearance, and appears worthy of trial for use early in the season for roadside stand or other retail trade.

Among late seedlings of the McIntosh, Cortland stills holds the foremost place. During the past two winters it has demonstrated its superior hardiness. The trees which are mostly under observation, although rather young, are exceedingly productive. The apple is well colored and of fairly good appearance. It appears to require picking at exactly the proper stage in order to keep well in storage, but if this is accomplished, its appearance and quality are excellent, from January to May. On a "blindfold test," most persons will prefer Cortland to McIntosh after January 15 or February 1.

On the market it does not sell for as high prices as the McIntosh, but brings returns more nearly in line with those of Baldwin. It is excellent for baking and the flesh does not discolor when exposed to the air, which makes it suitable for salad purposes. (*L. P. Latimer and G. F. Potter—Hatch Fund.*)

Tests of Strawberries

Four replicated plots of each of seventeen varieties of strawberries fruited in 1935, and comparisons were made as to yield, vigor of plants, size and attractiveness of fruit and resistance to disease.

Stevens Late, Dorsett, and Commonwealth set the largest number of runner plants, and Howard Supreme, Redheart, and Clermont the least. Fairfax and Aberdeen each yielded about 7,000 quarts per acre, Dorsett 6,000 quarts, Cato, Clermont, and Dunlap 5,000 to 6,000. Joe and Bliss yielded at the rate of 3,000 to 4,000 quarts, Redheart at 2,000 quarts, and the other varieties between 4,000 and 5,000. Fairfax, Catskill, Clermont and Commonwealth produced the largest fruit, Blakemore and Dunlap the smallest.

Camden, Clermont, and Bliss suffered severely from leaf spot, while Redheart, Howard 17, Stevens Late, and Aberdeen showed the most yellows and leaf crinkle. Fairfax and Belmar suffered least from disease, followed by Joe, Dunlap, Howard 17, and Commonwealth.

The Fairfax was considered the most promising new berry, because of high quality, yield, size of fruit, firmness of berry, attractiveness, vigor of plant, and freedom from disease. Cato was ranked second, and Dorsett third. The Aberdeen is also good, but the fruit is rather soft and quite tart. Commonwealth would rank high except that the fruit rapidly falls off in size as the season progresses. (*L. P. Latimer—Hatch Fund.*)

Variety Test of Tomatoes

In the variety test of tomatoes the Shirley strain of Bonny Best has outyielded other varieties consistently, and there is very little difference between seed grown in New Hampshire and in South Carolina. The New Penn State is very little better than the North Dakota strains, such as Progress or Bison. These strains may prove valuable for northern New Hampshire, where early ripening is an absolute necessity. The new Rutgers is a beautiful tomato, but so late in ripening that it is worthless except for September sales. A new variety showing great promise is Clark's Early. It is more resistant to early blight than Bonny Best, which it resembles.

In greenhouse tests the Field Station strain of Comet outyielded Bonny Best and Marglobe. (*J. R. Hepler—Misc. Income.*)

Contact Insecticides

During the year the study of contact insecticides has involved particular attention to the phenomenon "wetting." A new method has been developed for the study of wetting on leaf surfaces. The new method takes into account the volume of spray, the pressure at which it is applied, and the time elapsed after the spray application. The new criterion of wetting is called "the exposure period." This is defined as the minimum number of seconds' exposure necessary for a spray applied at a definite pressure and distance to effect complete wetting of a leaf surface. Wetting is indicated by the dark glossy appearance of the leaf when covered by a continuous film of liquid actually in contact with it. The results of this study will appear shortly in the series, "Studies of Contact Insecticides."

Another phase in the investigation of contact insecticides which has received attention during the year has been a study of the penetration of white arsenic and sodium arsenite through the integument of insects. The arsenicals are generally considered to act chiefly as stomach poisons when used in insect control, but definite evidence of contact action by sodium arsenite has been demonstrated.

In undertaking this study it was necessary first to develop a standard technique for applying the toxicant. Such a technique was successfully developed.

Quantitative determinations of the arsenic content of treated insects were made by means of a modified Gutzeit method. Preliminary work included determinations of the arsenic content of organs and parts of organs of insects treated with either white arsenic or sodium arsenite. Penetration through the insect integument was demonstrated. Arsenic was recovered from all organs or tissues examined. The results of these studies were published in Technical Bulletin 63, entitled "Penetration of Arsenic into Insects. Studies of Contact Insecticides X."

These studies are being continued, and an attempt is being made to determine the arsenic content of additional organs and tissues. Separate studies of the effects of arsenic on the blood of insects are in progress. These include effects on total cell count, on cell types, on plasma, etc. Additional studies are being made "in vitro" of the digestive tract to determine which parts are penetrated by arsenic. This phase has an important bearing on the elimination of arsenic from the insect's body. (*W. C. O'Kane, J. G. Conklin, L. C. Glover, W. A. Westgate—Purnell Fund.*)

Ovicides

Petroleum oils have been found to penetrate the eggs of insects representing six different orders. The presence of oil was demonstrated in the chorion, underlying the chorion, and surrounding the globular contents of the embryo. A predominance of oil was observed in the micropylar region. The results of this phase of the work are summarized in Technical Bulletin 62, entitled "Further Determinations of Oil Penetration into Insect Eggs. Studies of Contact Insecticides IX." It has been found that apparently the extent of oil penetration depends in part on the state of embryological development. In freshly deposited eggs of the squash bug (*Anasa tristis DeG.*) oil penetration is rather extensive, while in eggs containing well developed embryos, oil was found to have penetrated only in the chorion. In the case of

the gipsy moth egg it has been observed that oils of high viscosity effect a greater degree of penetration than do oils of lower viscosities. (*W. C. O'Kane, L. C. Glover—Adams Fund.*)

Abnormal Relationship of Fat to Solids-Not-Fat in Milk

Serious variations from normal of the relation between fat and solids-not-fat in milk content have made advisable a study of their cause. An examination of the milk from 68 farms selling to one firm, for example, showed that while 30 were producing milk below 3.3% fat standard, 37 were producing milk that did not meet the 8.5% solids-not-fat standard. Two farms producing about the same amount of milk and both testing 3.8% fat, showed solids-not-fat of 8.01 and 9.01% respectively, a variation far beyond any formula to explain.

Active work on an investigation of this subject started in December, 1934, with running monthly three-day composite samples of the milk from the cows in the University herd. These data will provide a basis for the selection of certain animals or group of animals for further studies of the effect of such factors as feed and herd management in relation to the problem.

Fifteen-day composite samples from 44 herds delivering milk to one dealer produced among other data the following salient points: That the solids-not-fat content of the milk from these producers showed greater variation in general than the fat; that the solids-not-fat content is higher in the milk during the time of year when the pastures are good; that the solids-not-fat content drops when the pastures become short and when the cows are put on barn feeding; and that at certain seasons of the year the solids-not-fat content decreases when the fat is increasing.

A survey of 64 herds around Colebrook in the Spring of 1935 showed that: In herds where the cows were in poor physical shape the solid content of the milk was low; the farmers' herds that had been fed no grain or little grain during the pasture season were mostly in the low solids group; and the average fat and total solids in the milk from herds receiving only old meadow hay were lower than from a group of herds where some clover or alfalfa hay was fed. (*H. C. Moore—Purnell Fund.*)

Rural Electrification Survey

In the latter part of 1934 there was received from Washington authorization for a state-wide Rural Electrification Survey to be conducted as an E.R.A. Project. The object was: "To determine and locate the potential electric consumption of the area involved, (all unserved area in the state) and facilitate the routing of the necessary distribution lines where they are economically justifiable." Complying with instructions, "that all work should be under the direction of an experienced supervisor who should be an engineer," W. T. Ackerman, Agricultural Engineer of the Experiment Station, was appointed supervisor. The project was sponsored by the Experiment Station, the Public Service Commission, the New Hampshire Farm Bureau Federation, and the New Hampshire Rural Electrification Committee. Of particular interest in the instructions issued from Washington to all states was the recommendation of two publications, one of which was New Hampshire Agricultural Experiment Station Bulletin, #266, as references in conducting the national survey.

During the previous winter a preliminary survey covering Merrimack County was conducted by the Station under Federal funds as a trial method, and also to develop procedure and methods in conducting such a survey.

The Public Service Commission supplied large-scale maps in their possession, experienced field engineers, an office and field supervisor, and general information in the files of the Commission for this year's complete survey.

The Experiment Station made available the information accumulated during ten years of specialized work in this field, drew up the forms and developed the procedure and methods to be employed, provided the project-supervising engineer, and maintained general supervision and advisory capacities throughout the course of the survey.

Actual field activity was started in February, 1935, and completed in August. A copy of the Survey Report comprises ten volumes, one for each district into which the state was divided, and weighs 37 pounds. The report deals entirely with the engineering problems and economic possibilities of extending electric current to all the unserved areas in the state. It contains over 220 detailed maps of towns and possible extensions and work orders for the same. Complete reports are available for inspection at the Agricultural Engineering Section of the University, Public Service Commission, Concord, N. H., and at the Emergency Relief Administration Offices in Manchester, N. H.

The completed record shows the total possible number of extensions to be 1,526. Of this total number, however, only 132 showed that they would produce sufficient revenue to warrant serious study at this time.

Over 10,000 miles of unserved rural roads were traveled by the field engineers to obtain the first figure mentioned and to locate 14,301 possible consumers of electricity on the maps. Nearly half this mileage was repeated to arrive at the second figure mentioned. Of these 132 extensions it was found that only 52 measuring a total of 93 miles in length would produce a revenue of $18 or more per mile per month, and that 80 extensions totalling 156 miles would produce $12 to $18 per mile per month. These two groups of possible lines were called Class "A" and Class "B" lines respectively.

Up to the present the costs of line construction and permitted rate of return, per mile of line, have required about $24 per mile per year to be satisfactory.

The latest reports indicate that New Hampshire has 66.6% of its farms electrified, the highest figure for any state in the country. Arrival at this leading position is largely credited to the research activities started 11 years ago, and to the coöperative efforts developed with the Farm Bureau Federation, utility companies of the state, Public Service Commission, and State Rural Electrification Committee.

Out of this coöperative effort grew the New Hampshire Five Year Plan, which has been accepted by most of the companies in the state. This plan provides that, instead of paying for the construction of the line, as was the old method, customers on a new extension guarantee for five years a monthly return to the utility equal to one-sixtieth of the cost of constructing and equipping the line, and for which they are entitled to consume as much current each month as this amount of money represents at normal rates of the company, at no extra charge. The plan has operated successfully for about seven years.

The complete survey record includes, among other things, a description of the electrical situation in each district, summaries of the Group "A" and Group "B" extensions, with estimated costs and revenues and town maps showing the existing electrical facilities of all types within the town, all possible customers in the unserved areas down to a density of one per mile, etc.

The availability of such detailed information makes it possible for all state agencies interested in developing this field to work with the minimum loss of motion and expense toward as completely an electrified agriculture in the state as can reasonably be accomplished. (*W. T. Ackerman—State Fund.*)

Precooling of Milk

Experiments on the precooling of milk using the wet tank storage type were continued with refrigeration equipment involving circulating gas and a minimum of mechanically operated valves.

Being of a unit type, it was possible for the first time in the experience of this Station to measure the output capacity of the equipment directly in pounds of ice formation. This is a standard unit of capacity used throughout the refrigeration industry, but up to this time has been arrived at in the field of agricultural refrigerating equipment by computation. A method was evolved whereby the ice formed was measured in pounds directly.

The year's study also included investigation of the efficiency of bottom-type evaporator or cooling units, and also a new cast-iron radiator type with fins, located in a vertical position in the center of the bath. For the space occupied by the latter kind it was found that satisfactory cooling could be obtained with a reduction in the over-all size of the tank. While the cooling effect produced by bottom-type evaporator units is satisfactory, it is found necessary to increase the height of tanks to accommodate them, thereby making it more difficult to lift the cans in and out.

One of the difficulties experienced by users of wet tank milk cooling units up to this time had been the length of time required to complete the cooling of the milk. This has been largely due to inadequate circulation in the water bath—many tanks having no provision for this other than the very slow circulation produced by convection currents. The most significant finding of the year was that a $\frac{3}{8}$" iron rod mounted vertically in a tank and having a straight line sweep motion at its bottom point, of about 18", when operated by the compressor unit motor, at a rate of about 100 complete strokes per minute, will produce a uniform temperature throughout the entire mass of the water bath. From this it would seem that the use of circulating pumps (usually driven by a separate motor) requiring a considerable investment and amount of power to operate and which put the water in motion with considerable velocity may be supplanted by this less expensive equipment which will produce practically perfect temperature distribution. (*W. T. Ackerman, H. C. Moore—Purnell Fund.*)

Heat Requirements for Brooding Chicks

Various types of insulation for brooder-house floors were studied in a continuation of the work with electric brooders. (See Station Circular 46.) A double wood floor; a layer of $\frac{1}{2}$" insulating board, sealed in tar paper and

roof cement and covered by matched flooring; two layers of the same type of insulating board and water-proof jacket; and three layers of the insulating board sealed in tar paper were used.

The floor temperature curves showed the same general characteristics as during the 1933-34 runs—that is, a marked drop shortly after midnight with a slow, irregular rise often late the following afternoon. Thermocouple readings taken intermittently showed very little indication of any major heat loss through the floors, as a matter of fact, when continuous all night readings were taken, the temperature under the floors never changed as rapidly as the temperature within the houses, (because they were well banked and boarded up below).

From the temperature readings the loss through the floor appears so small that the "built-in" insulation was not warranted. There was absolutely no correlation between floor insulation and mortality.

From the cost and labor records which were kept on all operations, it was found that the cost for brooding with electricity is practically the same as with coal. Taking averages of all runs with electricity, the current plus labor was about 6.4 cents per bird for 6 weeks, while coal plus labor ran about 6.3 cents for the same period. (Electricity figured at 3¢ per kw. hr., coal, $14 per ton.)

The lowest electricity plus labor cost on any run was 5.5 cents, while the highest in a 10′ x 12′ house was 7.1 cents per bird. (*W. T. Ackerman, G. M. Foulkrod, T. B. Charles, A. E. Tepper and F. D. Reed—Purnell Fund.*)

Pneumatic Tractor Equipment

In general, pneumatic tire equipment for tractors has proved to be very practical and successful in the Station tests. After two seasons of use the feather-edge mould mark is still in evidence. Some gouging and chipping of the treads has occurred, and two tears of the rubber casing down to the first layer of cords has occurred. This latter difficulty was experienced with both sets of tires and is in the nature of accidental injury.

In operation it has been found that even under the severest conditions of moisture that pneumatic tires, unlike steel wheel equipment, will not dig themselves in. A shallow trough is dug in the soil and the wheel will slip continuously in this trough without increasing the penetration. All of the results above indicated a not too effective tread design.

A difference in traction was found between the two rear wheels on account of one being in the furrow and the other on unplowed or grass land. In order to decrease the slippage which resulted, four weights, weighing from 160 to 165 pounds, were used on the rear wheels in various combinations.

It was also found that under moist and very wet conditions, slippage was excessive, and some traction accessory would be necessary to make equipment usable under such conditions. Special lug-type mud chains, developed by a commercial concern, were purchased to overcome this difficulty. In use these were found to be so heavy that the operators were not likely to apply and remove them at times when they should. Also, the spacing of the lugs was so great that in operation upon firm ground a very bumpy motion was developed. This was sufficiently uncomfortable to the driver to

make it a question as to whether pneumatic tires with lug equipment were any more comfortable to the operator than steel equipment. (*W. T. Ackerman and G. M. Foulkrod—Purnell Fund.*)

Forest Plantations

Since 1913 plantings of white pine, Scotch pine, red pine, European larch, white ash, white spruce, Norway spruce, and Douglas fir have been made but depredations have ruined all the plantings except white pine, red pine, and Scotch pine. Partial plantings of white ash remain. Field mice have been one of the chief enemies of the latter, and Christmas tree thieves make it hard to maintain spruce stands. (*K. W. Woodward—Hatch Fund.*)

White Pine Plots

These plots, both plantations and natural regenerations, now include stands which started in 1924, 1918, 1917, 1903, 1890, 1880, 1860, and 1800 respectively. They are being regularly maintained and measured.

An experiment to determine what happens on cut-over areas with ample provision for reseeding has been carried on since 1924. The area lying southeast of 60-year old seed trees was cut over in 1922, but nothing was done until 1924 to be sure that the Pales weevil would not kill any of the pine seedlings that might start. At that time one plot had all the brush burnt, one had only limbs marketable as cordwood taken off, and one allowed to remain with brush scattered all over it. After ten years, reproduction is twice as abundant on the area which had all the brush burnt as on the other two areas, and valuable species like white ash and aspen are better represented. First raspberries and then cherries came up in the brush piles and kept out better tree species. (*K. W. Woodward—Hatch Fund.*)

Fence Post Durability

An examination was made after five years of a trial white pine fence. Untreated posts were 75% decayed; brush treated 11%; open tank completely treated, and ZMA (a zinc arsenate compound), treatments all sound. The decay varied all the way from one-half inch radially to complete breakdown at the surface of the ground. (*K. W. Woodward—Hatch Fund.*)

Skin Vaccination for Chicken Pox

Last year's work showed that it was not satisfactory to vaccinate chicks for the prevention of fowl pox, at six weeks of age, and immediately place them on range, particularly during the early spring months, the period of inclement weather. It caused a decided drop in feed consumption and a consequent retarding of growth. This year chicks on a commercial poultry farm were vaccinated at eight weeks of age and were kept confined to the brooder house for two weeks following vaccination before they were placed on range. This caused no upset in the chicks.

From this it is concluded that unless chicks can be kept for two weeks in the brooder house following vaccination, it is better to vaccinate them on range after they are 12 weeks of age and before they come into production.

This year birds were vaccinated by means of two sewing-machine needles placed in the end of a small wooden stick about 3/8 of an inch apart. These needles were dipped in the vaccine before each bird was vaccinated, and then pushed through the web of the wing and pulled back. This inoculated four small places in the skin in a single operation, which insured a better take than was procured by the previously recommended method of inoculating on the unfeathered portion of the leg with a small scalpel which made a single small incision of the skin. Another advantage of the wing method is that it does not decrease the market value of the birds if they should be sold before the vaccination lesions disappeared.

To check the degree of immunity produced by the wing method of vaccination, inoculated chicks were later tested by scarifying the comb and inoculating with vaccine. The immunity proved to be solid. (*C. L. Martin and C. A. Bottorff—Purnell Fund.*)

Pullorum Testing

During the past fiscal year 239,487 blood samples from 225,299 birds were tested for pullorum. This was an increase of 29,733 samples over the previous season of 1933-1934 and an increase of 19,856 birds tested. More than one fifth of the total number of adult birds in the state of New Hampshire were tested and, of these birds tested, 99.85% were found to be free from pullorum.

In complying with the National Poultry Improvement Plan the terms "Pullorum Accredited" and "Pullorum 100% Free" flocks were changed to "Pullorum Clean" and "Pullorum Passed" flocks respectively. The third grade of "Pullorum tested" is not recognized as official in New Hampshire. There were 75 Pullorum Clean flocks having 94,947 birds, and 111 Pullorum Passed flocks having 112,219 birds tested during the season. There were 11 flocks, in which only part of the flock was tested, and among the 5,377 birds tested in these flocks, no reactors were found. There were 16 flocks of the 206 flocks tested in which infection was found. This was an increase of 6 flocks over the season of 1933-1934.

Breaks occurred in one Pullorum Clean flock that had previously tested 100% for 8 years with no reactors found, and in two Pullorum Passed flocks which had been negative for one year and four years respectively. (*C. A. Bottorff—Miscellaneous Income.*)

Infectious Laryngotracheitis Control and Vaccination

Due to the outbreak of infectious laryngotracheitis the previous season, funds were secured to erect a building and laboratory for research on the control of this disease and the manufacture of vaccine. The building and laboratory were completed in May 1935. The Federal license #194 was issued by the Bureau of Animal Industry on May 29th, 1935. Only a small amount of vaccine was disposed of to New Hampshire poultrymen by the end of the 1934-1935 season.

Experiments on vaccination and duration of immunity are planned, with studies on methods of preserving the virus. (*C. L. Martin and C. A. Bottorff—Miscellaneous Income.*)

Fowl Pox Vaccine

There were 225,200 doses of fowl-pox vaccine distributed to New Hampshire poultry men during the year and 29,300 doses outside the state.

Studies in the Improvement of Technique for the Eradication of Pullorum

A study of the whole-blood test for Pullorum disease was started to determine if it is satisfactory to use as an official test for flocks in New Hampshire. The work was conducted on two farms during the past year. In studying results of the birds necropsied five birds were found that did not react to the whole blood test but did react to the standard tube test. Salmonella pullorum was isolated from these birds. One bird failed to react on standard tube test but did on the whole-blood test and salmonella pullorum was isolated.

One bird gave a positive reaction to the whole-blood test but failed to react on the standard-tube test and salmonella pullorum was not isolated.

The results of the comparative tests, thus far, do not justify using the whole-blood test as the official test in New Hampshire, even though estimates indicate that it may cost 1 to 1.5 cents less than the standard tube test. (*C. A. Bottorff—Purnell Fund.*)

Record of Performance

Record of Performance work, i.e., official supervision of trapnesting and breeding, was conducted on twelve poultry breeding farms—an increase of three farms over the previous year. The supervisor, a representative of the Experiment Station, makes eight annual visits to each farm, giving it official recognition of records and aids the poultryman in his problems. The number of Record of Performance Certificates which are issued for birds producing 200 or more 24-oz. eggs increased to 370, and the number of advanced certificates which are given for birds laying 240 or more standard sized eggs, more than doubled, amounting to 221. The total number of birds entered was 2,578. (*R. C. Durgin—Miscellaneous Income.*)

Poultry Approval

Poultry Approval, formerly called Poultry Certification, entailed the handling of 14 flocks of 14,893 birds by a member of the Experiment Station Staff, and grading the birds into three classes: breeders, layers and culls. The superior individuals as to type, color and producing qualities, are placed in the breeder class. The birds inferior in type and color or having a standard defect but being good producers, are placed in the laying class. The cost of this work to the poultrymen has been reduced for each bird handled, but entails all expenses incurred, such as travel, lodging and cost of bands. This reduction of expenses, together with the Government stimulation along this line, should greatly increase the Poultry Approval work in the near future. (*R. C. Durgin—Miscellaneous Income.*)

Poultry Autopsies

There were 1,798 poultry autopsies performed at the poultry pathology laboratory this past fiscal year. Of these 795 were adults, 962 chickens, 29 turkeys, 6 pheasants, and 4 ducks.

The principal diseases of the adult group were—ruptured egg yolk, 33.5%; coccidiosis, 21.5%; pneumonia and colds, 11.8%; indigestion, 9.8%; impaction of digestive tract, 9.8%; and tumors, 5.5%.

The principal diseases of chicks were: pneumonia, 47.9%; indigestion, 37.7%; pullorum, 12.3%; coccidiosis, 10.2%; tremors, 3.5%; and uremia, 2.7%. (*C. L. Martin and C. A. Bottorff—Miscellaneous Income.*)

Inspection Service

Fertilizer and Feeding Stuffs Inspection. In enforcement of the law regulating the sale of concentrated commercial feeding stuffs, 408 brands requiring 3,100 individual determinations were analyzed for the State Department of Agriculture; and in enforcement of the law regulating the sale of commercial fertilizers 109 brands requiring 720 individual determinations were analyzed. (*T. O. Smith and H. A. Davis—Miscellaneous Income.*)

Soil Testing Service. The testing of 650 soil samples for residents of the state was carried on between July 1, 1934 and June 30, 1935. The service continues to be important since samples arrive in large numbers.

Seed Certification. Ninety-four acres of potatoes were entered for certification, 2½ acres failed to meet requirements and 9 acres were withdrawn after having passed first inspection. Growing conditions were especially favorable during the year and the mean yield obtained was 450 bushels per acre, the highest recorded to date and 123 bushels per acre above the mean for the previous 13 years. (*O. Butler—Miscellaneous Income.*)

Seed Inspection Service. The seed inspection work for the State Department of Agriculture was conducted as usual. From July 1, 1934 to June 30, 1935, 459 samples of seed were handled in the laboratory. Sixty-eight of these samples were sent in by individuals and the rest submitted by the state inspector. (*Betty G. Sanborn and L. J. Higgins—Miscellaneous Income.*)

Publications

Station publications issued during the year were as follows:

Station Bulletin 281—Inspection of Commercial Feeding Stuffs 1934
" " 282—Results of Seed Tests 1934
" " 283—Inspection of Commercial Fertilizers 1934
" " 284—Station Report 1934
Technical " 61—A Study of the Factors Affecting the Development of the Embyrosac and Embryo in the McIntosh Apple
Station Circular 43—Power for the Grindstone
" " 47—Fertilizer Experiments with Sweet Clover
" " 48—Top-Dressing Pasture Lands with Fertilizer
Scientific Contribution 45—Effect of Application of Sodium Chlorate and Ammonium Thiocyanate on Subsequent Sowings of Wheat
" " 46—Results of Incorporating a Heavy Application of Superphosphate Deeply into an Orchard Soil
" " 47—Effect of Crop and Treatment on Winter Injury to Baldwins
" " 48—Ability of the Basal Metabolism of the Dairy Cow

FINANCIAL STATEMENT

Expenditures of the New Hampshire Agricultural Experiment Station for the Year Ending June 30, 1935

	Hatch Fund	*Adams Fund*	*Purnell Fund*	*Supplementary**	*Total*
Personal services	$10,406.37	$12,852.70	$47,899.09	$20,863.35	$92,021.51
Supplies and materials	733.41	1,033.08	3,687.83	2,786.14	8,240.46
Communication service	879.82	.....	59.40	497.96	1,437.18
Travel expenses	367.54	89.60	4,447.02	6,570.47	11,474.63
Transportation of things	326.68	20.20	145.80	108.70	601.38
Publications	588.44	.....	261.55	111.17	961.16
Heat, light, water, and power	700.22	.....	41.24	75.69	817.15
Contingent expenses	19.03	16.00	48.41	1,291.54	1,374.98
Equipment	978.49	736.91	2,985.41	990.34	5,691.15
Buildings and land	.....	251.51	424.25	6,498.40	7,174.16
Balance	.....	.....	.....	25,930.04	25,930.04
Totals	$15,000.00	$15,000.00	$60,000.00	$65,723.80	$155,723.80

*This fund includes expenditures from the following sources:

State appropriations	$5,458.00
Sales and miscellaneous income	60,265.80
	$65,723.80

Poultry Science Association Meeting

The 27th Annual Meeting of the Poultry Science Association was held August 6 to 9 with the Poultry Department of the Experiment Station acting as hosts. More than 200 delegates representing institutions in 30 different states, the District of Columbia, England, East Africa, and Canada attended.

There were 86 different topics discussed on the four day program. Papers on original research being presented for the first time claimed the attention of the poultry scientists.

Bankhead-Jones Act

Public—No. 182—74th Congress H.R. 7160

AN ACT

"To provide for research into basic laws and principles relating to agriculture and for the further development of coöperative agricultural extension work and the more complete endowment and support of land-grant colleges.

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled

TITLE I

. . . .

"Section 1. The Secretary of Agriculture is authorized and directed to conduct research into laws and principles underlying basic problems of agriculture in its broadest aspects; research relating to the improvement of the quality of, and the development of new and improved methods of pro-

duction of, distribution of, and new and extended uses and markets for, agricultural commodities and byproducts and manufactures thereof; and research relating to the conservation, development, and use of land and water resources for agricultural purposes. Research authorized under this section shall be in addition to research provided for under existing law (but both activities shall be coördinated so far as practicable) and shall be conducted by such agencies of the Department of Agriculture as the Secretary may designate or establish.

"Section 2. The Secretary is also authorized and directed to encourage research similar to that authorized under Section 1 to be conducted by agricultural experiment stations established or which may hereafter be established in pursuance of the Act of March 2, 1887, providing for experiment stations, as amended and supplemented, by the allotment and payment as provided in Section 5 to Puerto Rico and the States and Territories for the use of such experiment stations of sums appropriated therefor pursuant to this title.

"Section 3. For the purposes of this title there is authorized to be appropriated, out of any money in the Treasury not otherwise appropriated, the sum of $1,000,000 for the fiscal year beginning after the date of the enactment of this title, and for each of the four fiscal years thereafter $1,000,000 more than the amount authorized for the preceding fiscal year, and $5,000,000 for each fiscal year thereafter. Moneys appropriated in pursuance of this title shall also be available for the purchase and rental of land and the construction of buildings necessary for conducting research provided for in this title, for the equipment and maintenance of such buildings, and for printing and disseminating the results of research. Sums appropriated in pursuance of this title shall be in addition to, and not in substitution for, appropriations for research or other activities of the Department of Agriculture and sums appropriated or otherwise made available for agricultural experiment stations.

"Section 4. Forty per centum of the sums appropriated for any fiscal year under Section 3 shall be available for the purposes of Section 1: Provided, That not to exceed 2 per centum of the sums appropriated may be used for the administration of Section 5 of this title. The sums available for the purposes of Section 1 shall be designated as the 'Special research fund, Department of Agriculture,' and no part of such special fund shall be used for the prosecution of research heretofore instituted or for the prosecution of any new research project except upon approval in writing by the Secretary. One-half of such special research fund shall be used by the Secretary for the establishment and maintenance of research laboratories and facilities in the major agricultural regions at places selected by him and for the prosecution, in accordance with section 1, of research at such laboratories.

"Section 5. (a) Sixty per centum of the sums appropriated for any fiscal year under Section 3 shall be available for the purposes of Section 2. The Secretary shall allot for each fiscal year for which an appropriation is made, to Puerto Rico and each State and Territory an amount which bears the same ratio to the total amount to be allotted as the rural population of Puerto Rico or the State or Territory bears to the rural population of Puerto Rico and all the States and Territories as determined by the last preceding decennial census. No allotment and no payment under any allotment shall be made for any fiscal year in excess of the amount which Puerto Rico or any State or Territory makes available for such fiscal year out of its own funds for research and for the establishment and maintenance of necessary facilities for the prosecution of such research. If Puerto Rico or any State or Territory fails to make available for such purposes for any fiscal year a sum equal to the total amount to which it may be entitled for such year, the remainder of such amount shall be withheld by the Secretary. The total amount so withheld may be allotted by the Secretary of Agriculture to Puerto Rico and the States and Territories which make available for such year an amount equal to that part of the total amount withheld which may be allotted to them by the Secretary of Agriculture, but no such additional

allotment to Puerto Rico or any State or Territory shall exceed the original allotment to Puerto Rico or such State or Territory for that year by more than 20 per centum thereof.

(b) The sums authorized to be allotted to Puerto Rico and the States and Territories shall be paid annually in quarterly payments on July 1, October 1, January 1, and April 1. Such sums shall be paid by the Secretary of the Treasury upon warrant of the Secretary of Agriculture in the same manner and subject to the same administrative procedure set forth in the Act of March 2, 1887, as amended June 7, 1888.

"Section 6. As used in this title the term 'Territory' means Alaska and Hawaii.

"Section 7. The Secretary of Agriculture is authorized and directed to prescribe such rules and regulations as may be necessary to carry out this Act.

"Section 8. The right to alter, amend, or repeal this Act is hereby expressly reserved." . . .

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