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Agricultural Research In New Hampshire

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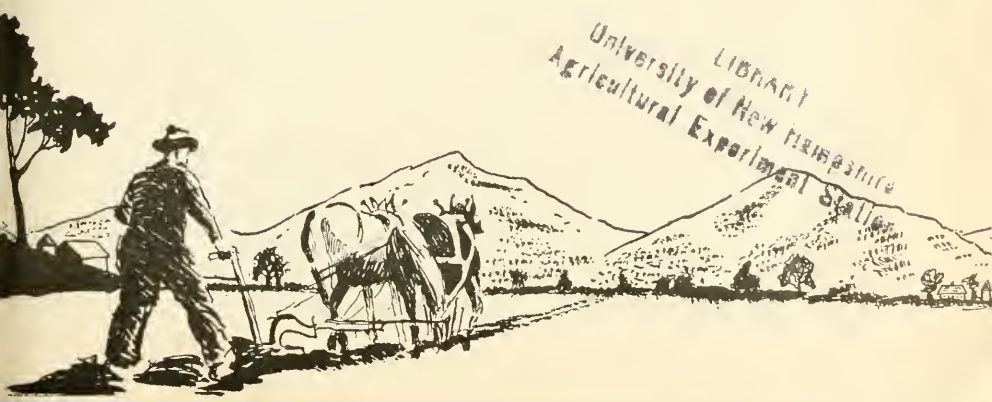

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THIS HAS been a year of readjustment in the history of the station. Development has begun under the new grouping plan which provides for the housing of the plant and animal sciences (except dairy husbandry) at the newly enlarged Nesmith Hall and of the social sciences, including agricultural economics, at Morrill Hall. Throughout the past year, the extension administration has been expanding from its agricultural and home economics basis to a general service drawing upon and including the entire university. A corollary of this has been the physical separation of extension service and experiment station administration which have been so closely interlocked during the past quarter century. Extension specialists, however, will continue to be quartered with subject-matter departments and a close working relationship between the extension and research workers will be maintained. Administration of the subject-matter departments in research and resident teaching will be even more closely centralized.

Although the hurricane of September 21 blew down about half the apples from trees in the experimental orchard and thus curtailed fruit record experiments, damage to other experiments was comparatively slight. A few old trees in the university orchard were uprooted, and about five per cent were tipped. These were righted and seem to be recovering. In the university woods hurricane damage was very extensive but in the research plots was confined to the older stands. Only six of the thirty special study plots were damaged by the wind.

Dean M. Gale Eastman of the College of Agriculture was vice-director of the station during 1938 and is to be director during the coming year. Dr. George F. Potter, who joined the experiment station staff in 1920 as head of the department of horticulture, left in September to accept the position of principal physiologist in charge of the United States Tung Field Laboratory in Bogalusa, Louisiana.

Morris S. Cover, V. M. D., was appointed assistant poultry pathologist and Robert L. Blickle succeeded Miss Barbara Miner as research assistant in entomology. Kenneth G. Nolan, Kenneth Anderson and Elwood Fisher were appointed graduate assistants in botany, bacteriology and horticulture, respectively. Concluding their terms of service were Miss Mary A. Tingley and Miss Elinor T. Robison.

Further development of the research in soil erosion was made possible under an extension of the cooperative agreement with the Soil Conservation Service of the United States Department of Agriculture. Walter H. Lyford devoted half-time to this work during the past year and will be employed full-time on it during the coming year.

With this report the present director closes a term of twenty-eight years of service with the New Hampshire Agricultural Experiment Station. He leaves with regret the many associations in agricultural research which he has enjoyed during the past years -- his colleagues on the staff, in other states, in the Office of Experiment Stations of the United States Department of Agriculture, and in many cooperating agencies. As director also of the Agricultural Extension Service he has served in a joint capacity throughout most of this period, and will now devote full time to the administration of the General Exten-

tion Service, which is being expanded to cover the public relationships of all departments of the university. In this new assignment he will look forward to the same hearty cooperation in all projects designed for the public welfare as he has received in the past.

Publications

Station Bulletin 299	Results of Seed Tests, 1937
Station Bulletin 300	Eggs under the Hammer
Station Bulletin 301	Inspection of Commercial Fertilizers, 1937
Station Bulletin 302	Dairy Herd Replacements in Southern New Hampshire
Station Bulletin 303	Electric Brooding of Chicks. II. Heat Requirements
Station Bulletin 304	Annual Report of Experiment Station, 1937
Station Bulletin 305	Legume and Grass Silage
Station Bulletin 306	Experiments with Grass Hay
Station Bulletin 307	Transportation of New Hampshire Milk, Part I
Station Circular 54	Evaluation of Varieties of Peaches in the Northeast
Technical Bulletin 69	Chemical Studies on Chicken Blood
Technical Bulletin 70	Prevalence and Classification of Haemolytic Streptococci in Pasteurized Milk
Scientific Contribution 60	A Freezing Apparatus in Which Change of Temperature is Automatically Controlled
Scientific Contribution 61	Case History of Two Winter-injured Baldwin Trees
Scientific Contribution 62	The Occurrence of Seedless Apples as a Result of Frost
Scientific Contribution 63	Photoelectric Measurements of Apple Leaf Areas
Scientific Contribution 64	Availability to Apple Trees of Potassium Applied on the Surface of Sod Mulch Orchards in New Hampshire
Scientific Contribution 65	Confinement versus Open Range for Bronze Turkey Breeders

Balanced Metabolism Is Important to Plant Growth

During the past several years T. G. Phillips, T. O. Smith and J. R. Hepler have been carrying on experiments to study the effect of potassium deficiency on the metabolism of plants. A second technical bulletin containing their results up to the end of 1938 was made ready for publication under the title, "Some Effects of Potassium and Nitrogen on the Composition of the Tomato Plant."

Tomato plants were grown in sand at two levels of nitrogen supply, with and without added potassium, until the first symptoms of potassium deficiency appeared. Plants supplied with a low level of nitrogen were stunted; but when the potassium was also deficient, they were not so badly stunted as when the potassium was available in the usual amounts.

These results tend to confirm the idea that the balance between

potassium and nitrogen is an important factor in the growth of plants. (*Adams Fund*)

Carbohydrates in Timothy

Work has been begun by T. G. Phillips and T. O. Smith on a new project, the object of which is to determine the chemical composition of timothy, especially in regard to its carbohydrates. (*Adams Fund*)

Inspection of Feeding Stuffs and Fertilizers

In the enforcement of the law regulating the sale of concentrated commercial feeding stuffs, 400 brands were analyzed by the department of agricultural chemistry for the State Department of Agriculture. These analyses required about 3,000 individual determinations. Brands of commercial fertilizers, 103 in all, were also analyzed for the state, and required about 760 determinations. (*Miscellaneous Income*)

Chemical Services to Residents of the State

The testing of soil samples has been continued. From July first, 1937, to June 30, 1938, the number of samples received and tested was 2,596. Feeding stuffs, fertilizers and other miscellaneous materials to the number of 135 have been analyzed for residents of the state. This work required 440 individual determinations.

Budgeting the Orchard

Items of expense in connection with developing a fruit orchard including labor, materials, and use of equipment have been plotted over a 60-year period by H. C. Woodworth and assistants. The resulting curves are based upon records of New Hampshire orchards modified to accord with the experience of successful orchard men.

The yearly yields of apples which could be expected in the 60-year period were also plotted. Assuming a land charge of five per cent for interest and two per cent for taxes, the use of land would require eight cents per bushel of apples produced during the commercial life of the orchard. This is reduced to 5.9 cents per bushel when semi-permanents are planted and one half of these taken out at the end of 25 years. It is further reduced to 4.6 cents when fillers are planted and taken out at the end of the 18th year. Since the other costs are largely associated with expenses per tree, it was noted that the planting of permanent trees without semi-permanents or fillers is the most economic practice when land is low in value. (*Purnell Fund*)

Land Utilization in Grafton County

As compared to central and southern New Hampshire, holdings in Grafton county are larger and local people own and occupy a smaller proportion of the total acreage. In Dorchester, for example, there are 27,953 acres under private ownership which are divided into 196 tracts. Of these, 41 were classified as farms containing a total of 3,869 acres; 113 were forest tracts containing 20,181 acres; six including 631 acres were classified as places vacant but buildings habitable; nine tracts comprising 1,219 acres were vacant with buildings in ruins; one tract of 46 acres was classified as a mine; 26 were summer homes with a total of 2,007 acres. Only 37 tracts containing 3,568 acres were occupied by local residents.

The purpose of this project, in charge of H. C. Woodworth, is to have available a plan of use for land areas in back towns and to record economic, social and governmental tendencies. (*Purnell Fund*)

Failing Pastures Cause Drop in Late June Production

In studying daily milk production on typical wholesale dairy farms of the Colebrook area, a sharp drop in daily marketing was noted on a number of farms in late June and early July. Further study of the situation indicated that on these farms most of the cows freshened in April and May and that the drop in production came 30 to 60 days later at a time in the lactation period when production should be high. The abrupt decline in the production curve was due to failure of about half the operators to supplement pastures. All dairymen were subject more or less to the same seasonal pasture problem, but some observed the situation and supplemented the failing pastures.

These efficiency studies directed by H. C. Woodworth are for the purpose of determining the most profitable forms of organization and production practices and obtaining basic data on inputs and outputs. (*Purnell Fund*)

Farming Areas Mapped in Detail

Town maps indicating location and size of agricultural enterprises were checked in the field by conferences with qualified local people in each town in Cheshire and Hillsboro counties. Then using all available information, including economic data, soil survey records, markets, the experience of local people and the observations of the field agent, each town was mapped according to the relative opportunities in commercial dairying. These town maps were in turn fitted into a county map indicating similar data.

The town maps for other parts of the state have been completed in preparation for field work but have not been checked in the field. The work done is very useful in guiding both the present land use program and the Agricultural Conservation program. Incidentally, these maps were exceedingly useful for emergency work after the hurricane. On 48 hours' notice the director of this station was able to have in the hands of the U. S. Forest Service maps covering the entire state and showing in detail the location of roads, farmsteads and type of agricultural enterprises. H. C. Woodworth directs the work. (*Purnell Fund*)

The Conservation Program in New Hampshire

Harry C. Woodworth and Victor H. Smith of this station and Emil Rauchenstein of the national Bureau of Agricultural Economics have completed a manuscript embodying the results of their survey of farms in selected areas participating in the conservation program. The bulletin, which is to be published during the coming year, is entitled "The Agricultural Conservation Program in New Hampshire." (*Purnell Fund*)

Removing Brush in Pastures

In the spring of 1938, seven additional pasture plots were cleared and fertilized, making a total of 18 in the pasture management studies in charge of M. F. Abell. These plots are located in all but one county in the state and include a great variety of brush condi-

tions. Accurate time and expense budgets are kept to aid in determining the most practical methods of brush removal and also of keeping the brush down once it is removed.

Such a good cover of herbage has grown up on all plots where brush has been removed that cows go straight to the improved part of the pasture when they are let out in the morning and return there so frequently during the day that the herbage is kept closely grazed.

It is more practical to select for improvement the better soils and the more open areas, for on poor soils reproduction of good pasture herbage is slow without reseeding. Where the brush was so thick that the pasture plants made up originally less than 25 per cent of the ground cover, they grew in very slowly. Under such conditions it seemed uneconomic to use large quantities of fertilizer, and yet on good soils even small amounts of fertilizer produced a marked response.

Burning is cheaper and takes less time than pulling or cutting, but is less effective (except in the case of gray birch and hardhack) because the dead brush remaining hinders close grazing. Unless cutting is done close to the ground without leaving stubs, it, too, hinders close grazing. Cutting, except in the case of juniper, has been found least effective in brush control. Removal of juniper on the plots was more or less permanent, and pasturing neither helped nor hindered its reproduction. With hardhack, gray birch and blueberry, better control was obtained by pasturing. With sweet fern thorough killing by burning was effective, but pasturing does not keep it in subjection.

On the cleared plots weeds came in as well as grass and other good pasture plants, but this is not entirely a loss for many weeds produce milk and can be later crowded out by proper fertilization. During the coming year analyses of herbage will be made and a fertilizer program set up in cooperation with the department of agronomy. (*Purnell Fund*)

Market Good for Some Kinds of Small Fruits

Apparently blueberries are the only native berries of which New Hampshire hotels and camps can obtain a really satisfactory supply, finds L. A. Dougherty, who has nearly completed field work on the small fruit study. Records on prices, varieties, amounts sold and places of sale have been obtained from individual producers. Retailers in principal towns have been contacted for information on sources of supplies and prices. Summer hotels, camps and tourist homes have also been interviewed for information on sources and prices of small fruits.

Late berries will usually average higher in price than early berries although the latter usually reach a higher price for a brief period. Records from one strawberry grower covering the past five years show that berries sold during the last five days brought an average price of almost 3 cents a quart over those sold during the first five days of the season in spite of the fact that the later berries were smaller. The strawberry season usually runs from three to four weeks. Growers have long sought for a good late strawberry

because it would enable them to avoid much of the competition from cheaper Massachusetts berries, and it would also carry production into the period when more summer residents and visitors are here.

Although the raspberry season is later and usually lasts longer than the strawberry season, the best of the crop is gone before the height of the summer tourist business. Late raspberries and everbearing strawberries in August are of special interest from the standpoint of demand from summer residents and visitors.

In the 1938 season 30 raspberry growers retailed 51% of their crop at an average price of 15.4 cents a pint and jobbed 49% at an average of 11.7 cents a pint. Thirty strawberry growers retailed 22% of their crop at 17.3 cents a quart and jobbed 78% at an average of 12.4 cents a quart. Since raspberries ripen when more summer visitors are here, it is possible for growers to retail a much larger percentage of the crop at very satisfactory prices. Figures from a few blueberry growers indicated a local retail price of about 15 cents and a gross wholesale price of 13 cents on Boston sales and 10 to 12 cents a quart on local jobbing sales.

The Latham raspberry leads all other varieties grown in New Hampshire by a wide margin; Chief, Newburg and St. Regis being the other principal varieties.

The Howard 17 strawberry is by far the most important commercial variety. Aberdeen remains the leading late berry.

A few small plantings of cultivated blueberries have been made, but no cultivated blueberries from local sources are being sold on our markets. Both low and highbush blueberries are commonly found in our markets but the largest shipments to Boston are of the lowbush varieties. They offer interesting possibilities because of their low picking (raking) cost. Lowbush blueberries can usually be raked at from two to five cents a quart as compared to from four to eight cents for highbush berries.

Cultivated blackberries have received little attention in this state and the demand is limited. The Snyder is an important variety, but it is sour, small and unattractive. Eldorado is a much better market berry but the plants are more subject to winter killing. The condition of most blackberries found in retail stores is poor. Prices are usually high, quality considered, but blackberries come in direct competition with blueberries which grow better in this state and are more popular with the public. (*Purnell Fund*)

Rural Tax Studies

Survey blanks have been put in order and completed for approximately 40 towns, reports H. C. Grinnell. Forms are being used to analyze the receipts and expenditures of towns for the fiscal year ending January 31, 1938. This is based on a reclassification of the items as reported to the extent that the totals will depict the amount of revenue required to maintain all departments without loss or gain to current assets and liabilities. The tax delinquency study is partially completed. The remainder of the field work should be completed during 1939. (*Purnell Fund*)

Dairymen Can Save if Trucking Charges Are Reduced

The $300,000 a year now being paid by New Hampshire farmers for transportation of milk to country stations and city plants could

be reduced in two ways: first, by a reduction of charges on routes where they are above competitive levels; second, by a reorganization of truck routes and milksheds. Details of this study have been published in Station Bulletin 307, "The Transportation of New Hampshire Milk, Part I, Analysis of Trucking Charges," by Alan MacLeod and Mary L. Geraghty.

Work is progressing on the second phase of this trucking study. This involves the reorganization of truck routes and milksheds in such a way as to improve the efficiency of milk collection. This study should be completed early in 1939. (*Bankhead-Jones Fund*)

Marketing Forest Products from Farm Woodlands in Certain Areas of Carroll, Coos and Grafton Counties

About 400 tracts of forest land have been included in this survey, which is in charge of Alan MacLeod. Total acreage in these tracts is about 90 thousand acres. Owners of the land have been interviewed and estimates of available forest products have been secured. Woodlands have been classified according to type and quality. The next step will be the collecting of data regarding market outlets, transportation rates, etc.

These data should make it possible to determine, both for a particular town and for the total area, the acreage and merchantable timber on tracts accessible to roads and operated by persons owning equipment available for working in the woods. Forest owners in the area will have available, as a result of this study, usable information in such a form that it will serve as a basis for forming policies and taking action. (*Bankhead-Jones Fund*)

Soil Fertility Studies

Soil fertility experiments carried on over a period of years include: experiments with legumes on neglected haylands; a dairy farm rotation on neglected haylands; an experiment with potatoes in a three-year rotation; a fertilizer experiment with dairy farm crops in the Connecticut valley; experiments in top-dressing old pastures; and a soil survey of New Hampshire. The agronomic work in the studies is conducted by F. S. Prince and P. T. Blood; the chemical phases by T. G. Phillips and G. P. Percival. (*Purnell Fund*)

(The test entitled, "An Experiment with Hay on Neglected Haylands," was discontinued, temporarily, at least, with the publication in March, 1938, of Station Bulletin 306, "Experiments with Grass Hay.")

Legumes on Neglected Haylands

The old Whenal plots were reseeded during 1938 to alfalfa. Instead of applying all the fertilizers as annual top-dressings, part of the plots have been fertilized with three times the normal amount of superphosphate and potash and these are to be compared with an annual fertilizer schedule. Lime was used on the plots which exhibited a reaction of pH 6.0 or below.

A sub-project to study the results of various rates of liming has been carried on by G. P. Percival and P. N. Scripture on the alfalfa plots on the Ireland farm. It has been established that limestone applications have resulted in significant increases in yields per acre of alfalfa hay up to three tons per acre. The effect on the chemical

composition of the alfalfa produced is now being studied. The 24 plots included in the lime test were planted to soybeans, fertilized alike and harvested to note differences in response to the lime variables (zero to eight tons per acre) perviously applied. Where no lime was applied, the yield was only 5,813 pounds per acre; lime at the rate of one ton per acre increased the yield to 9,991 pounds per acre.

On the remaining 72 Ireland plots two cuttings of alfalfa were made after top-dressing in the spring according to the plan of the experiment. The gain, subsequent to the use of nitrogen, seemed to be more than sufficient to warrant its cost. It also appears that a gain of 1,621 pounds of hay each year for three years as a result of 300 extra pounds of 10-20-20 is worth the expense when one takes into consideration the current fertilizer costs and hay prices.

The use of magnesium in magnesium sulphate has given consistent increases on this soil, the response for the 100-pound application being 716 pounds of cured hay per acre each year.

A Dairy Farm Rotation on Neglected Haylands

This experiment on the Lane farm in Pittsfield has now proceeded through two courses of the three-year rotation of potatoes, oats and clover. Next year sweet corn will be included in the rotation instead of potatoes since sweet corn is an important canning crop in this section of New Hampshire. The field will also be laid out in a system of strip cropping for erosion control.

The field is divided into three sections so that each of the crops has been in production every year. The fertilizer is applied only to the potato crop, the oats and clover that follow being produced on any residue the potato crop leaves. Yields have been secured on the potatoes each year and the following table gives an average of the six years for this crop under different fertilizer treatments:

Lane Farm Potatoes, Six-Year Average

Treatment	Bushels Per Acre	
	Yield	Diff. From Check
1T 4-8-7 Check	244	
500 lbs. lime; 1T 4-8-7	243	-1
1000 lbs. lime; 1T 4-8-7	245	1
1T 0-8-7	236	-8
1T 8-8-7	256	12
1T 4-0-7	202	-42
1T 4-16-7	258	14
1T 4-8-0	185	-59
1T 4-8-14	259	15
½T 8-16-14	269	25
1T 4-8-7, hill	256	12
1T 4-8-7, without magnesium	253	9
No fertilizer	164	-80

Omitting phosphorus from the formula has caused a significant decrease in yield, 42 bushels per acre, while doubling the phosphorus has brought a gain of 14 bushels per acre. Potash variations give similar results. Included in this experiment is one series of plots which received no fertilizer whatsoever. While the yield has averaged 80 bushels less than the plots receiving one ton of 4-8-7 fertilizer, the relatively high yield of 164 bushels per acre causes us to

wonder whether our farmers may not be applying too much plant food to the potato crop for highest economy.

An Experiment with Potatoes in a Three-Year Rotation

On the Jackson farm in Colebrook a rotation of potatoes, oats and hay is in progress with much the same procedure as on the Lane farm. Eighty pounds of elemental nitrogen (the standard application) appears to be sufficient for optimum potato crops. As on the Lane farm yield data indicate that the 1-3-3 ratio is preferable to the 1-2-2 now commonly used by potato growers. On the Jackson farm neither basic slag nor magnesium appear to exert any stimulation to potato yields.

Lime and phosphorus residues both appear to exert a beneficial influence upon oat yields. Lime especially has resulted in excellent responses in yields of hay. The differences among the plots in the field are noted mainly in the absence or abundance of clover, the unlimed portions of the land being too acid to produce it.

Cooking Qualities of Potatoes

Because of the interest manifested by farmers and others in the cooking quality of potatoes, experiments have been begun by J. L. Haddock and P. T. Blood to try to discover what the causes are of differences in this respect.

Last fall 23 different samples of potatoes were collected from the fields of farmers in various sections of the state. These samples included several popular varieties grown on the same field and on widely separated fields. In order to make these tests somewhat more significant a sample of Russet Burbanks from Idaho was obtained. The potato samples were boiled, and several more or less experienced persons recorded their best judgment as to the quality, giving most emphasis to texture and flavor, but noting color of flesh and other factors.

Potatoes with a high specific gravity are more mealy than lighter potatoes, for the more starch a potato contains, the heavier it is. There was a fair rate of agreement in the scores on mealiness that the judges gave the potatoes and the corresponding specific gravities.

One of the interesting things shown in the tabulated results is the tremendous variation within the same variety, samples of Green Mountain, for instance, ranking both highest and lowest. Obviously, then, it is not possible to select one or two tubers as an adequate sample for a cooking test. Mealiness is widely distributed within a given lot of potatoes, as shown by careful cooking experiments. This work will be continued, especially in regard to the relationship between the specific gravity of a potato and its mealiness.

Investigating New Potato Varieties

New plant varieties developed in the past by plant-breeding scientists have contributed so much to present-day agriculture that whenever new varieties of plants are announced, farmers are keenly interested. This is particularly true of potato-growers who are vitally interested in varieties possessing any combination of superior characters such as high yield, good cooking quality, good tuber type, resistance to diseases, etc.

Trials of ten different varieties were made in 1938 by J. L. Haddock and P. T. Blood who observed the growth habits and general suitability to New Hampshire conditions. The varieties Chippewa, Mesaba, Smooth Rural and Houma are very promising and should be given further trials. Houma, for example, is an excellent yielder, free of disease, slightly later than Green Mountain in maturing, but not too late. Chippewa matures ten days ahead of Green Mountain and has yielded 30 to 100 bushels per acre better in this year's tests. It is, however, somewhat inferior to Green Mountain in its cooking quality.

A Fertilizer Experiment with Dairy Farm Crops in the Connecticut Valley

A crop of mixed clover and timothy hay was secured from plots on the Livingston farm in Claremont in 1938. Yield data show that for optimum legume crops a balanced fertilizer program is necessary with potash being the most important single factor for success.

Experiments in Top-dressing Old Pastures

The test of fertilizers on old pastures has been continued without change on the Seavey farm in Stratham during 1938. The type of response that is being secured appears to point more definitely in favor of the use of complete fertilizers than was the case during the first few years of the test and for this reason we have felt it desirable to continue the work. All the treated plots show increases over the untreated plots. Nitrogen stimulates forage growth much more than the other two elements. Basic slag does slightly better than superphosphate; muriate of potash and superphosphate stimulate the sward to about the same degree. The triennial application of superphosphate is somewhat better than an annual one, although the annual dose of potash is superior to the triennial application.

On plots similarly treated in the Livingston pasture, data indicates that the three elements are nearly equal in promoting the yields of pasture forage.

Soil Survey of New Hampshire

The survey of Hillsboro county, begun in the autumn of 1937, was continued in 1938. At the close of the field season the county was slightly more than half mapped so that the prospects are favorable for completing this area in 1939.

In accordance with a new agreement signed in June, 1938, the Soil Conservation Service is cooperating in the survey of Strafford county; and in addition to the soils, the degree of slope, land cover and erosion factors are being mapped. To do this it has been necessary to plane table the open land, a factor that has slowed up the work materially. Help with the survey from the Conservation Service did not arrive until October 11 and the net result has been that less than 140 of the 379 square miles of Strafford county have been surveyed, whereas the Hillsboro party mapped almost 400 square miles. If the cooperative agreement involving the Soil Conservation Service stands, it will take several years longer to complete the soil survey of New Hampshire than we had originally anticipated.

The personnel for the soil survey has been as follows: Hillsboro county -- C. S. Simmons, Division of Soil Survey, United States

Department of Agriculture; W. H. Lyford, New Hampshire Agricultural Experiment Station. Strafford county -- B. H. Williams, Division of Soil Survey, United States Department of Agriculture; F. J. Galdwin, Soil Conservation Service, United States Department of Agriculture: W. H. Coates, New Hampshire Agricultural Experiment Station.

Greenhouse Fertility Tests on Native Soils

The study of the natural fertility of various soil types found in the state was continued in the greenhouse by P. N. Scripture and P. T. Blood during the winter of 1938. Hermon fine sandy loam and Worthington loam were the soils selected for comparison this year as they differ greatly in the source of parent material.

The Hermon soil is a member of the podzol group, developed under a coniferous vegetation from parent material accumulated by glacial action from granites and other coarse-grained rocks. The texture is sandy and the soil is well drained. The normal Hermon soils are so stony that they must be cleared before cultivation.

The parent material of the Worthington soils is glacial till accumulated from calcareous schists which were rather fine grained and produced a soil of heavier texture. Though the parent material originally contained lime, it has been largely removed by leaching so that the soil is now quite acid.

The Hermon fine sandy loam was collected from an uncultivated field near Bow Lake in Strafford. The Worthington soil was brought from a field in Colebrook which had been hayed annually but otherwise unused for many years.

Yield data showed that the addition of lime to the Hermon loam practically doubled the amount of barley obtained; but a complete fertilizer was necessary to obtain the maximum yield. Potassium was less necessary than nitrogen or phosphorous, but the yield was increased one-third when it was used. A nitrogen application is absolutely essential for growth on this soil and phosphorus is a requirement of any increase in yield. Although increases were observed in practically all cases where the minor elements -- boron, magnesium, manganese and copper -- in various combinations were added with the complete fertilizer, the question of their significance is still being studied.

With the Worthington loam, the same results in regard to nitrogen, phosphorus and potassium were observed as with the Hermon; but the increases for lime were not quite so great. Little can be said for the minor elements on Worthington soil as they decreased the yield very slightly in every case where they were used with lime with the sole exception of copper.

Flood Damage in Alluvial Deposits

In cooperation with the division of research of the Soil Conservation Service, W. H. Lyford, Jr., has been studying the nature and sources of alluvial deposits in the Merrimack and Connecticut valleys to discover potential flood menaces and means of control. Most flood damage to New Hampshire farms is due to the streams cutting into the banks of sand and gravel deposits, mostly of glacio-fluvial origin. Accurate transit surveys were made of "raw" banks at four differ-

ent points on the Merrimack river and subsequent surveys of the same banks are to be made in order to have accurate data of the amount of stream bank cutting. Maps of the Merrimack river banks showing vegetation, present condition and physical features were made in the vicinity of Nashua with the hope that a study of them will lead to some economical, practical method of stream bank stabilization, thus providing a means of control of harmful deposits and of stream bank cutting. (*Purnell Fund*)

Types of Pasture Herbage Compared

Eight harvests were secured in 1938 of the 12 strains of wild white and Dutch white clover which were seeded in 1936. The interesting thing about these yields is their magnitude, ranging from 2¼ to 3½ tons per acre for this low-growing type of pasture clover.

Reed canary grass appears among the poor yielders in both the pure seedings and the mixtures. Orchard and smooth brome grass are two promising new varieties which seem well adapted to growing conditions in this state, even better than Kentucky bluegrass. (*Bankhead-Jones Fund*)

Testing Phosphatic Materials of Different Strength and Composition

Plots on the Whenal farm in Greenland were seeded to clover in 1937 at which time five TVA phosphates were applied as follows: superphosphate, 39.8% P_2O_5; monocalcium phosphate, 51.5% P_2O_5; dicalcium phosphate, 44.9% P_2O_5; fused rock, 30.4% P_2O_5 and calcium metaphosphate, 65.5% P_2O_5.

Yield data showed no significant differences, indicating that there is little to choose from among these carriers. (*Bankhead-Jones Offset Fund*)

Soybean Varieties for Seed Tested

In this test under the direction of L. J. Higgins, 33 varieties of soybeans were planted on the Whenal farm in Greenland. Judging from these trials there seems to be some possibility of growing soybeans for seed in the southern part of New Hampshire as a cash crop. The early varieties, such as Spooner Mandarin, Cayuga, and Mandarin Sel, will mature without danger of frost injury if planted by May 20. Of the medium varieties it would be safe to select those requiring 120 and perhaps 125 days for maturity, such as 88803, 03654-A and Spooner Manchu. The yields of 20 to 30 bushels per acre are comparable to yields of soybeans in the Midwest. (*Hatch Fund*)

Silage Corn Varieties Tested

This year 28 varieties were planted in triplicate plots, 20 hills of three plants each; and 21 varieties were planted in single plots of 20 hills each. During the growing season the plants showed uniform growth per plot. Eureka Ensilage ranked first in 1937 and 1938 in dry matter per acre. L. J. Higgins believes that the varieties of silage corn best adapted to New Hampshire are the medium maturing varieties which reach a dough stage in at least 100 days. Certain strains of Sure Crop and Sweepstakes have met this requirement in past years. Cornell 29-5, Cornell 29-3 and Canada Krug also showed much promise. (*Hatch Fund*)

Seed Inspection

The regular seed inspection work for the State Department of

Agriculture was conducted as usual. During the year 443 samples of seed were handled in the laboratory. Of this number 392 were collected by the state inspector and are reported in Bulletin 309; the remaining 51 samples were sent in by private individuals. The referee work was done as usual. The work was in charge of Mrs. Bessie G. Sanborn, seed analyst, assisted by students. (*Miscellaneous Income*)

Studies in Animal Metabolism and Nutrition

During the past nineteen years of cooperation with the nutrition laboratory of the Carnegie Institution of Washington, E. G. Ritzman has carried out metabolism experiments with many animals of different species of farm livestock. With the retirement of Dr. F. G. Benedict of the Carnegie Institution last year, the results of the cooperative researches on cattle have been published in Washington under the title "Nutritional Physiology of the Adult Ruminant."

The summary of nineteen years of experiments is as follows: 13 with horses, including a thoroughbred stallion with a notable turf record, a blue-ribbon Percheron stallion weighing over a ton, a Percheron mare, a standardbred or trotting gelding, a range pony and a very small Shetland pony weighing about 300 pounds; about 300 experiments with 18 beef steers; 4 experiments with bulls; over 50 experiments with 12 dairy cows; over 200 experiments with about 100 sheep; about 30 experiments with 13 goats and 20 experiments with pigs, ranging from a boar weighing 600 pounds down to suckling pigs weighing less than 10 pounds.

These studies have been devoted to a determination of the needs of the animal organism for its own maintenance (i. e. basal metabolism) in support of life under various conditions of season and climate, and particularly to the comparative efficiency of the different species of farm livestock. It has been found that the horse has the highest basal metabolism per unit of size of any animal so far measured. The adult dairy cow has an extremely variable basal metabolism, and lactation has an extraordinary effect on increase in metabolism. This renders the concept untenable that basal heat production is conditioned solely by the rate of heat loss to the environment.

A study of metabolism during growth was begun during this year, experiments being carried out with eight Holstein heifer calves from purebred ancestry. Previously only adult cows have been used. This first year's results have already demonstrated that basal metabolism during growth is nearly double that of the adult dry and farrow cow and compares more nearly with that of the adult when lactating.

In a series of experiments carried out monthly throughout the year on an adult Chester White pig, a considerable variation in basal heat production was obtained although the food and the experimental temperature were maintained constant. The highest basal metabolism occurred during March, April and May; the lowest, during June, July and August with an extreme difference of about 35 per cent. As with cows, pregnancy raised the basal metabolism markedly, and lactation in the pig increased metabolism 62 per cent above the original basal level. This indicates the tremendous internal stimulus to which the tissue cells of the body are subjected in the process of milk formation.

A suitable mask has been constructed so that similar experiments are now underway to study the energy expenditure of the horse. A series of experiments have also been begun to study the effect of ingestion of pure sugars on the respiratory quotient of the ruminant.

These problems relate not only to the best economic interests in feeding of livestock, but also to nutrition as it affects health and efficiency, so that a sound physiological background of the animal organism as a transformer of energy has a potential significance in its application beyond the particular species on which it has been determined. (*Purnell and Adams Funds and Carnegie Institution of Washington*)

Sheep Breeding

The researches of E. G. Ritzman on heredity in sheep have of necessity been divided into three successive phases: (1) inheritance of conformation and of wool, (2) inheritance of milk as indicated by accessory nipples, and (3) inheritance of fecundity as represented by twinning. The second phase (that is, breeding ewes having four or more functional nipples) has now been completed and accessory functional nipples may be regarded as a stable attribute imposed on the original Southdown x Rambouillet hybrid type developed during the first phase. It is now only in very exceptional cases that a ewe does not supply sufficient milk for good lamb growth.

Twinning has up to the present been rather variable, because of the necessity of breeding for other factors as well. This year the twinning rate was 144 per cent. Experience shows that fecundity can be materially increased by the consistent use of twin-bred sires, but an equally rigid selection must be applied to females reserved for breeding stock. Even so, the establishment of a uniform high twinning potency will depend on the development of an inbred strain possessing relatively pure blood lines for this trait.

The nutritional state of the ewes, particularly at the time of mating and probably also during pregnancy, affects twin production. All our breeding stock this fall were supplied with wheat germ oil to build up and maintain a sufficient Vitamin E reserve. (*Adams Fund*)

Plant Injuries Caused by Lime-Sulphur Sprays

Lime-sulphur sprays are effective in combating certain fungous diseases, but even in a 1-50 solution they affect plant health adversely. This is shown by the fact that sprayed plants always show a less than normal weight, whether their foliage is kept unweathered or whether it is exposed to rain and dew at night (i. e., weathered).

In previous experiments on yellow-eye beans conducted by O. Butler it was found that the addition of cane sugar reduced the injuries of lime-sulphur spray. This year sugar was added to lime-sulphur with calcium arsenate and also to lime-sulphur with acid lead arsenate, but corresponding results were not obtained. It was found that on unweathered plants the action of sugar was too slight to be considered. In the case of weathered plants sugar proved beneficial when calcium arsenate was added to the lime-sulphur solution, but was without effect when lead arsenate was used. While weathering does not increase the injury produced by lime-sulphur when arseni-

cals are not present, it causes pronounced increase when either calcium arsenate or acid lead arsenate are used.

It has been generally believed that lime-sulphur spray containing calcium arsenate is more injurious than that containing lead arsenate; but in these experiments lead arsenate was found to be more toxic than calcium arsenate. The difference, however, was not great.

In experiments made comparing the effects of lime-sulphur and flotation sulphur (finely divided sulphur, nearly pure) on beans and potatoes, it was found that on beans .5% flotation sulphur is nontoxic and even 2% is less injurious than the regular 1-50 lime-sulphur. In the case of potatoes, lime-sulphur reduced the yield somewhat more than flotation sulphur. Beans show spray injury by curling or rolling up of leaves as well as by loss of weight. On potatoes, although the yield is decreased, the injury is not visible on foliage and can only be checked by loss of weight in the individual plants. (*Adams Fund*)

Effect of Fertilizer Placement on the Vitality of the Potato Seed Piece

In this experiment carried on by S. Dunn, potato plants were grown in clay loam and in sandy loam, at temperatures of 21°C. and 16° C. and with and without fertilizer. As in previous work, the seed used was cut from the apical, or bud, end of the potato for one series of plants and from the basal end for the other. Fertilizers, when used, were applied in the following different ways: 28 grams per pot distributed in a circle two inches in diameter and almost touching the seed piece; 28 grams per pot distributed in a circle two inches in diameter approximately one-half inch from the seed piece; as above with 21 grams of fertilizer instead of 28. Results were that placing the fertilizer in a band one-half inch distant from the seed piece did not retard the growth as all the sprouts emerged from the soil at the same time.

The rate of growth of the fertilized plants was more rapid than that of the unfertilized plants, especially in the cultures growing at the cooler temperature.

The plants grown from basal seed pieces grew more vigorously than those from the apical seed pieces and in the fertilized cultures grown at the higher temperature they were the more productive, but in the cultures grown at the lower temperature yielded less. In the cultures that received no fertilizer, the plants from distal seed pieces were more productive than those from basal seed pieces. (*Adams Fund*)

Potatoes in Storage

In the 1937-38 experiments, carried on as in previous years by P. T. Blood and O. R. Butler, potatoes were stored in a commercial storage house and in small experimental bins at the university especially constructed for the purpose of studying types of ventilation.

Ideally, the temperature of potatoes in storage should be warmer at the top than at the bottom with the ceiling slightly warmer than the potatoes. Results in the commercial bin were not so satisfactory as they might have been because these temperature conditions were

reversed by a downward drift of cold air which caused moisture condensation. Dry rot also developed in the potatoes.

The experimental storage bins at the university were all of the same height and capacity and provided with air intakes and gravity ventilation. In Bin A, which is a new type devised at this station, a false bottom of planks spaced three-fourths of an inch apart was laid over the dirt floor and the air intake opened beneath it. In Bin B a Maine type air conduit was run down the middle and was connected directly to the air intake. Bin C was the ordinary type in which the air intake opens onto the dirt floor upon which the potatoes were stored. At the end of 182 days the potatoes in Bin A had lost 3.35 per cent of their weight, while those in Bin B had lost 4.79 per cent. The potatoes in Bin C at the end of only 115 days had lost 3.23 per cent of their weight. Loss of weight in all cases was greater at the bottom of the bin than at the top. (*Purnell Fund*)

Masking Potato Mosaic

Symptoms of potato mosaic which are "masked" (not readily discernible) when plants are grown at temperatures averaging 68° F. become quite noticeable when plants are placed in a cooler environment of around 59° F. It has been found that fertilizer, also, has a significant effect on the masking of symptoms. In this year's experiments, in charge of O. R. Butler, plants were grown in a soil taken from a worn-out pasture. Some were fertilized with an 8-16-16 fertilizer, some with a mixture of 8-16-16 and cow dung, the rest with cow dung and bonemeal. One series was grown at a mean temperature of 68° F., another at 59° F. The color of the foliage was deepest green in the series fertilized with 8-16-16 and palest in the series fertilized with cow dung and bonemeal. Masking of symptoms occurred in the plants grown at 68° F. and was most pronounced in the series fertilized with 8-16-16 and least in the cow dung and bonemeal series.

In the growing of seed potatoes it is no advantage to have symptoms of mosaic masked; but where a grower is producing for human consumption his yield will be increased when the leaves are a healthy green rather than mottled and grayed by mosaic. (*Purnell Fund*)

Spraying for Apple Scab

Damp weather and other factors caused unusually prevalent scab on the foliage of McIntosh trees in the 1937 season. For the first time in 15 years research workers were able to obtain data on control methods for scab on foliage as well as on fruit. O. R. Butler, who directs this research, found that lime-sulphur spray on the foliage was much more effective than flotation sulphur. Three cover sprays of lime-sulphur proved to be the most effective control measure for scab on both fruit and foliage. (*Hatch Fund*)

Mulching as it Affects Bitter-pit in Apples

Mulched trees averaged 25 pounds higher yield than unmulched trees, but the apple drop was heavier on the mulched than on the non-mulched trees. Fruit from mulched trees developed about five per cent less bitter-pit in storage than the fruit from the non-mulched trees. O. R. Butler directs this work; G. P. Percival was in charge of the chemical phases of the experiment. (*Purnell Fund*)

Potato Seed Certified

Eighty-one acres of potatoes were entered for certification and the entire acreage passed final inspection. Mr. Butler also reports that the potato growers of the state are showing increased interest in new varieties. Warba has yielded well where tried and Chippewa has continued to prove productive. Houma was introduced and the growers who tried it were well pleased with its performance. (*Miscellaneous Income*)

Cod Liver Oil Helps Calves

As in previous trials calves receiving concentrated cod liver oil and skimmilk had very good appetites and appeared to be in better physical condition, as indicated by the glossy appearance of the hair and hide, than did animals on the regular herd ration. Ten calves of four different breeds were given the special ration this year. At the end of six months all were well above the normal weight for that age, their average being 121 per cent, although the group as a whole was slightly underweight at birth. The height of the animals averaged 4.3 per cent above normal.

The results of these comparisons, which have been made for three years by K. S. Morrow, indicate that whole milk feeding of dairy calves can be limited to a period of a few days following birth if skimmilk is supplemented with a cod liver oil concentrate.

During the spring of 1938, a calf-feeding questionnaire was sent to dairymen enrolled in the New Hampshire Dairy Herd Improvement Association to ascertain what methods were most commonly used in raising dairy calves and what phases of the work needed further study.

Only 13 dairymen out of 96 reported feeding concentrated cod liver oil. Eleven of the men who had used it reported satisfactory results. Forty-four had never tried skimmilk powder. Of the 52 men who used it, 28 stated either that it was unsatisfactory as a feed or too expensive.

That there is considerable variance in costs of raising calves is indicated by the figures submitted. Estimates of feed costs to time of first calving ranged from $35 to $125, the average figure being $77.43. The ratio of milking cows to calves was approximately three to one.

During 1939 definite trials of powdered skimmilk in the rations will be made to determine its usefulness and practicability. In addition an attempt will be made to secure the cooperation of a selected group of dairymen in keeping accurate feeding and cost records on the raising of dairy replacements. (*Bankhead-Jones Offset Fund*)

The Cow's Anatomy in Relation to her Producing Capacity

Complete ante-mortem and post-mortem data on four animals from the dairy herd, slaughtered during the past year, were compiled as New Hampshire's contribution to a nation-wide survey being conducted by the Bureau of Dairy Industry of the U. S. Department of Agriculture. The data were sent to the Bureau to be tabulated with similar information from other cooperating stations. There are indications that definite differences exist in the anatomical measurements of dairy animals. What effect, if any, these differ-

ences have on production is still to be determined. K. S. Morrow supervised this work. (*Bankhead-Jones Offset Fund*)

Variability in Milk Solids-Not-Fat

Although the university is said to have had exceptionally good pasture seasons in the years 1937 and 1938, the average solids-not-fat percentage in the milk did not increase to its high level of the previous two years. H. C. Moore, who is in charge of this project, reports that for the year April, 1937, through March, 1938, the fat content increased 0.17 per cent over the previous year and the solids-not-fat decreased 0.11 per cent. This is puzzling because it has been believed that the solids-not-fat-content of milk increases as the fat content increases. When we compare the university data with that compiled from approximately 50 herds supplying a commercial milk plant in central New Hampshire, we find about the same abnormally low solids-not-fat content for the year 1937-38.

Comparisons will have to be continued for some years before definite conclusions can be drawn: but it is obvious that there is a decided variation in both fat and solids-not-fat content in the milk produced on the same farm from year to year and one year cannot be taken as an indication of the composition of the milk from any one farm or group of farms.

According to comparison studies on the daughters of various dams and sires, inheritance is an important factor in determining the composition of the milk given by a herd. (*Purnell Fund*)

Controlling Contagious Abortion in Cattle

Experiments under the direction of C. L. Martin continued as previously to see how long calves vaccinated with a Bang's disease vaccine would react to the standard tube agglutination blood test. The previous years' findings were substantiated to the effect that if calves are vaccinated between the ages of four to six months, the majority of them will give a negative blood test before a year has passed following the inoculation. A few, however, will not give this desired negative reaction. The inoculation did not give 100 per cent protection against abortion, since two abortions occurred in heifers previously inoculated. (*Purnell Fund*)

Control Bovine Mastitis through Prevention

L. W. Slanetz, C. L. Martin and K. S. Morrow have been working on this problem cooperatively, approaching it from the viewpoint of bacteriologist, veterinarian and dairyman, respectively. Surveys conducted during the past three years show that the disease is prevalent in many New Hampshire herds. Out of a total of 243 cows tested in 12 herds from different parts of the state, 92 animals, or 38 per cent, showed mastitis infection. Applying this rate of infection to the approximately 80,000 milking cows in the state, it is estimated that more than 30,000 cows are infected with mastitis.

The diagnosis of this disease is not always simple. The strip cup and brom thymol blue tests are of practical value in instituting a partial control program; but in order to detect all cases of mastitis in a herd, bacteriological analysis of milk samples has been found necessary. It has been found that composite samples can be employed for diagnosis, which greatly reduces the labor, time and materials neces-

sary for the collection and examination of individual quarter samples. The value and limitations of the various tests are discussed in detail in a bulletin[1] prepared during the year and now being distributed.

In the laboratory studies 535 strains of streptococci have been isolated from infected cows. Of these cultures, 87.7 per cent have been identified as *Streptococcus agalactiae*.

From the work done to date it appears that periodical laboratory examination of samples and segregation with gradual replacement of infected animals is necessary for the control of mastitis. C. L. Martin has been using vaccines, prontyln and prontosil; but the data so far secured indicate that none of these methods are effective. An inducto-therm, a short wave-producing machine which causes heat to penetrate deeply into tissues, was also used at the university dairy barn on three different animals which had the chronic form of mastitis, but the treatment did not prove beneficial.

This work will continue with other treatments being tried and particular attention paid to the prevention and control of the spread of mastitis through segregation of infected animals and sanitary measures. (*Purnell Fund*)

Bang's Disease Testing

With 47,124 Federal samples, 1,190 New Hampshire private samples and 1,697 out-of-state samples taken, the total number tested for Bang's disease during 1937-1938 was 50,011, as compared to 22,026 for the previous year. The tests were in charge of C. L. Martin. (*Miscellaneous Income*)

Electrical Washing and Sterilizing Equipment for Dairy Utensils

New devices offered for sale by manufacturers are tested for efficiency, labor-saving qualities, equipment and operating costs and degree of sterilizing action obtained. Work on this project in charge of W. T. Ackerman was interrupted in the summer of 1937 by fire which destroyed most departmental facilities, but has now been resumed. (*Bankhead-Jones Offset Fund*)

State Rural Electrification

This service, conducted by W. T. Ackerman, is used as the demand arises. Many conferences have been held with farmers on proposed lines. Two line extensions were made which required four meetings. The work is carried on in cooperation with the State Rural Electrification Committee, the Public Service Commission and other organizations. (*Bankhead-Jones Offset Fund*)

Testing Farm Equipment

W. T. Ackerman and G. M. Foulkrod made laboratory and, when necessary, field tests of equipment, principally electrical, in order to inform cooperative farm organizations and rural service departments of utility companies on the desirability or undesirability of merchandising equipment, the value of which to the consumer has not been satisfactorily determined. Although the project has been

[1]Slanetz, L. W. and Naghski, J; Methods for the Diagnosis and Control of Bovine Mastitis; New Hampshire Agricultural Experiment Station, Technical Bulletin 72, February, 1939.

handicapped by loss of equipment by fire, tests were made on a water-heating pail, a brooder assembly, several electric fence controllers and other devices. (*Bankhead-Jones Offset Fund*)

Contact Insecticides

In their study of contact insecticides, W. C. O'Kane, J. G. Conklin, L. C. Glover and Robert L. Blickle are investigating the rate of penetration of oils through insect integument. Now that a satisfactory technique has been developed, good progress has been made. A series of studies have been completed using a low-boiling and a medium-boiling fraction of petroleum oil, as compared with corn oil, a typical glyceride. Results show that penetration by the low-boiling fraction is rapid; by the medium-boiling fraction penetration is slow, and with the glyceride it is negligible.

Studies with various alcohols indicate that methyl gives the most rapid penetration, followed by ethyl and octyl and then by isopropyl and butyl. Materials still under study include pine oil, mesityl oxide, butyl ether, ethylene dichloride, ethyl acetate and dichlor ethyl ether. All these materials were selected because of their use or possible use as constituents of contact insecticides. (*Purnell Fund*)

Ovicides

The initial rate of penetration of various glycerides, terpenes and hydrocarbon oils has been determined for the eggs of several species of insects; namely, American roach, Mexican bean beetle, Colorado potato beetle and the larger milkweed bug. The oils enter the egg of the American roach more easily than those of the other species, while the eggs of the Mexican bean beetle are the most impervious. Increase in temperature increases the rate of entrance. (*Adams Fund*)

Apple Maggot

A late frost in the spring of 1938 which completely destroyed the set of fruit at the Marden Orchards in southern New Hampshire where the project was being carried on has interrupted this experimental program. However, the complete failure of fruit in this locality provides an opportunity for certain studies of survival and of dispersion of the species under investigation. (*Hatch Fund*)

Insect Record during the Year

A severe outbreak of the army worm occurred in June, 1938, when several fields of growing crops were stripped in southern and central New Hampshire. The department was active in studying the situation and recommending defense measures.

The European corn borer became markedly abundant in various areas in southern New Hampshire; but the situation in northern New Hampshire, where the species is not yet widely prevalent, has remained practically unchanged.

The department has been active in a survey conducted to determine the extent of infestation by the European spruce sawfly, which has been found in a number of new localities and in some has increased in intensity. Preparations are underway for the rearing of a cocoon parasite of the sawfly for liberation during the summer of 1939. Approximately 140,000 cocoons are on hand, and it is hoped to rear over a million and a half parasites this year. (*Hatch Fund*)

The Problem of Winter Injury

A type of winter injury to the trunks of apple trees, which was first noted in 1936 at Wolfeboro in an orchard of mature McIntosh trees under sod culture, is under investigation at this station. This year's experiments, in charge of W. W. Smith, were made on the 18-year-old McIntosh trees in the back field pruning orchard at the horticultural farm. These trees, which had borne a heavy crop in 1937, were given a fall application of various nitrogenous fertilizers. Plots which were laid out in the orchard included check plots with no fertilizer; treated plots receiving 4, 8, 12, 16, 20, 24, 30, 40 and 50 pounds of cyanamid per tree and plots receiving comparable amounts of ammonium sulphate. All trees were sampled frequently with an increment borer and the tissue examined histologically for any changes in cell activity or for injury that could be observed under the microscope.

Although histological and microscopic examinations revealed no difference in the treated and untreated trees and freezing of the tissue gave the same result, and although chemical analyses showed no difference in the amounts of nitrogen in the trunks of fertilized and check trees, it was noted in February that on those trees receiving high applications of fertilizer the bark was loosening from the wood. All those trees receiving 30 pounds or more of ammonium sulphate developed the symptoms observed in the orchards in 1935 and 1936 which had been injured by fall applications of fertilizer. That is, the bark became loose, the wood turned a purplish color underneath and the leaves showed chlorosis, or yellowing. None of the trees receiving the cyanamid even up to 50 pounds per tree showed the injury. Neither did the trees receiving less than 30 pounds of ammonium sulphate.

The experiment was also carried out on other McIntosh trees in a different location at the horticultural farm in much the same way with appreciably the same results.

While it is not yet possible to define the conditions under which this type of injury is likely to occur, research workers here believe that it may occur when no fertilizer is applied in autumn, though according to observations in New England this happens very, very rarely. Under other conditions, when it would not occur naturally, small or "normal" amounts of fertilizer may induce it; under still other conditions only excessive amounts of fertilizer will cause it.

The young Baldwin trees in the 1926 orchard treated as described in the 1936 report, and with treatment repeated again in the fall of 1937, have been examined periodically. These trees were not injured in 1937-38 as they were the year before. The trees injured in 1936-37 that survived have made a strong recovery. (*Adams Fund*)

Changes of Apples During Storage

Storage Qualities of the Cortland Apple

In the fall of 1937 Cortland apples from the horticultural farm were picked on different dates--September 25, 30, October 5, 11, 21--graded, packed and put in storage. Periodically during the winter samples were taken from these lots, examined for spoilage and tested for pressure, acidity, changes in ground color and overcolor. The results are in accord with those found the previous season. In gen-

eral the Cortlands seem to keep much better than the McIntosh in storage. The damage to so many apples by the hurricane interrupted this project in the fall of 1938.

Effect of Pre-ripening McIntosh in Storage

Unfortunately, McIntosh apples lose much of their flavor in storage, especially when they are kept later than Christmas. Since pears, ripened somewhat when they are first picked, will maintain their flavor much better when put in storage, it was decided to hold the McIntosh apples at a higher temperature when first stored to see if this pre-ripening would cause them to maintain their flavor in storage.

Samples of McIntosh apples picked at the horticultural farm were held at about 40° for 18, 36 and 54 days before being transferred to the 32° room. McIntosh apples picked at this same time were stored at 32° immediately for check.

These lots were examined periodically during the rest of the winter. The apples stored immediately had an immature taste characteristic of fruits picked too early although these were picked at the commercial harvesting time. Those pre-ripened 18 days developed a much better flavor, but it seemed to leave the apples by January first. Those pre-ripened 36 days at 40° F. had good flavor as late as March and kept very well but not so long as those stored immediately. Pre-ripening 54 days ripened the fruits to prime eating condition so that they did not keep well after being transferred to the 32° room.

Storage of McIntosh in Relation to Picking Date and Dropping

The proper time to pick McIntosh apples in relation to dropping will have to be worked out for each individual situation. However, the longer the fruit can be kept on the tree without dropping the better the fruit will keep in storage, according to experiments conducted by W. W. Smith at the horticultural farm.

Investigations on the relation of picking date to dropping and to the keeping quality of the McIntosh were conducted on a population of apples in which the trees had been fall fertilized and on a similar population in which trees were spring fertilized. The McIntosh apples were picked on the following dates -- September 10, 15, 20, 25 and 30 -- taken to storage, graded, packed and stored at 32°. The number of drops were counted at each picking time, and the cover and ground color was taken of the drops and of the picked fruit.

Samples of the apples were tested periodically during the winter, and it was found that the later the fruit is picked the better it keeps. No difference could be detected between fruit from fall fertilized trees and those fertilized in the spring. (*Purnell Fund*)

Lightly Pruned Trees Produce More Fruit

Heavily pruned trees produce much less fruit each year than lightly pruned ones according to extensive experiments carried on by W. W. Smith. In 1926 an apple orchard was planted at the university, and since that time the trees have been pruned lightly and heavily in alternate rows. Results have been tabulated each year, and the records favor the lightly pruned trees to a large extent.

This last year it was decided to change this experiment into a "conventional" versus "thin-wood" method of pruning, and from

now on the heavily pruned trees will be pruned by the thin-wood method and the others according to the conventional method. Although it is too early to note any changes, Mr. Smith expects that this will be a real test of the thin-wood method for which so much is claimed. (*Hatch Fund*)

Pollination Project

During the past year the pollination work in charge of L. P. Latimer has been concerned principally with the interesting case of cross-incompatibility observed between Early McIntosh and Cortland apples. As the result of pollination tests made at the New Hampshire station it was discovered that Early McIntosh will not pollinate Cortland, nor will Cortland pollinate Early McIntosh satisfactorily because pollen tube growth is inhibited in the style. (*Purnell Fund*)

Premature Dropping of McIntosh Apples

This is a problem of great economic significance since many growers have occasionally suffered considerable loss of profits because of premature dropping of McIntosh fruit. The drop is known to be heavier in some localities than in others and varies from year to year. In a given orchard individual trees may differ in this respect. It has been found over a period of seven years that certain McIntosh trees at the university farm are consistently heavy droppers and others consistently light.

Work was begun on this project in 1938, under the direction of L. P. Latimer. Trenches were dug down to the impervious till layer of soil in order to study the soil profile and root distribution of the eight heaviest and eight lightest dropping trees in the orchard. So far extreme differences in soil structure found in the orchard do not seem to be correlated with the amount of dropping. Root samples are being examined to determine how different root stocks might affect the trouble. (*Purnell Fund*)

Strawberry Fertilizers

Experiments were continued by L. P. Latimer on the effect of sodium on strawberries. In 1937 one acre of land to which 15 tons of stable manure had been applied and disced in was planted to Howard 17 strawberries. No further fertilizer was used until May, 1938, when sodium, ammonium and calcium ions in combination with nitrate, phosphate and sulphate ions were applied broadcast about two weeks previous to bloom. Results were somewhat different than in other years when the same amount of fertilizer was applied in August of the year preceding bloom. Sodium applied in the spring did not cause the same reduction in yield as when applied the fall following planting, except where nitrogen was used in the fertilizer. Then a considerable reduction in yield occurred. Ammonia nitrogen causes more excessive leaf growth that nitrate nitrogen, but both types decrease the yield to approximately the same degree. Other ions did not seem to cause injury or improvement to the crop. Further investigations are needed to solve this problem. (*Hatch Fund*)

Variety Tests on Several Fruits

L. P. Latimer was in charge of the following fruit variety tests:

Strawberries

Howard 17 outyielded all other varieties tested withstanding injury from late spring frosts better. Cato gave the next best yield. Fairfax, Dorsett, Commonwealth, and Catskill yielded only half as much fruit as Howard 17 in 1938. The varieties Lupton, Orem, Pearl and Xtralate, tested because of their reported lateness in maturity, yielded crops of fruit too small to recommend for general use. As in previous years, although these so-called late varieties commenced to ripen fruit ten days later than Howard 17, the crop was completely harvested at the same time as Howard 17.

Apples

Melba ripens its fruit five to six weeks ahead of McIntosh and is the highest quality very early variety in the university orchards. The blossoms are quite resistant to frost and the fruit is popular both for cooking and eating. Melba is partially self-fruitful and is, therefore, not so particular with relation to pollenizers. Early McIntosh is ready for harvest three weeks earlier than McIntosh but is of an inferior quality and drops badly. Milton, which just precedes McIntosh on the market, is highly colored and will doubtless be desirable as a roadside market variety. Macoun is attractive and of high quality but does not keep well in storage and also drops prematurely from the tree.

Although Red Gravenstein seems to be quite popular on the market, the variety ripens a few days later than the ordinary Gravenstein and does not seem to be of as high quality. On the other hand, Red Spy is equally good in quality as its parent, the ordinary Spy.

Pears

A fair crop was produced for the first time in several years. Bosc, Anjou, Clapp's Favorite, Lawrence and Sheldon yielded well.

Grapes

Some new seedlings were obtained from the Geneva Experiment Station in New York and planted for trial. Of the older varieties, Worden produced the largest crop.

Peaches

Both Carman and Elberta yielded an excellent crop. The latter seems to have regained its equilibrium after its severe injury in the cold winter of 1933-34. Other varieties are still too young to be judged.

Raspberries

Taylor seems to be the most promising variety as the fruit is of high quality and continues to develop and mature for quite a period after the other varieties have been harvested. Marcy produced fruit of large size and excellent quality. Chief is a hardy variety, reliable in its yield.

Sweet Cherries

Yellow Spanish, Windsor, Bing and Lambert produced good crops of fruit in 1938 and continue to be promising varieties. (*Hatch Fund*)

Blueberry Improvement

Highbush Blueberries

Because of unusually wet conditions in the field, blueberry plants,

rooted in the spring of 1937 and carried over in trays during the winter of 1937-38, were placed temporarily on high, sandy ground which was in a rather good state of fertility. These plants did exceptionally well, and it was noted throughout the state that plants on high ground did much better than those on low areas. This may be due to the better aeration of the soil found in high, sandy ground. Experiments along this line are being conducted by W. W. Smith.

Attempts are still being made to locate the very best wild plants in the state in order to produce a better and hardier type of blueberry by crossing them with the varieties which are already known. Because of a late spring frost which killed most of the fruit little could be done on this project this last year.

Other results of the year's work in connection with highbush berries indicate that: (1) Fungus diseases on young blueberry plants can be satisfactorily controlled by spraying the cuttings with Samosan Jr. as soon as they are set out and by spraying the young plants and leaves whenever there is any indication that there might be some mold starting in the frames. (2) Sorbex peat gives better rooting in propagation trays than fine horticultural peat. (3) Concord and Jersey varieties proved more vigorous growers than some of the other varieties, and the variety Rancocas an exceptionally weak grower. (4) Mature highbush wild blueberries, five or six feet high, can be transplanted so successfully that they will bear a crop of blueberries the following summer. (5) In transplanting rooted cuttings and starting young plants in the field there is quite an increase in growth and response in those plants which are set in soil mixed with wet horticultural peat.

Lowbush Blueberries

Studies of the lowbush blueberries were continued in 1937 and 1938 by W. W. Smith. Large quantities of blueberries were taken from the winnowing machine in the blueberry pastures and frozen, and experiments relative to the growing of young plants from seeds obtained from these berries are being conducted at present.

The plants grown from seed in the greenhouse during the winter of 1936-37 and transplanted in rows in the spring of 1937 have not expanded any but seem to remain at present as individual plants. Each row of these plants is from seeds of the berries of one plant; therefore, all plants in each row have one common parent. It is hoped that these plants will furnish some indication of the variation in plants grown from seed. (*Hatch Fund*)

Apple Rootstock Project

Mother plants of Malling Nos. 4, 1, 9 and 3 were mound layered by W. W. Smith to increase this stock. Buds of the varieties McIntosh, Cortland, Baldwin and Northern Spy were worked onto the Malling stocks Nos. 4, 1, and 9. These buds were taken from trees showing outstanding performance. The McIntosh buds were from trees producing high-colored fruit as well as the Rogers red strain and the Farley's No. 3 red strain of McIntosh. Experiments to determine whether variations in the color of apples are due to some inherent quality of the fruit which can be propagated or to some environmental factor, such as the location of the tree or the stock that the

particular tree is on, are also under way at the horticultural farm. (*Bankhead-Jones Offset Fund*)

Experiments in Vegetable Gardening

J. R. Hepler entered the New Hampshire Hybrid egg-plant in the All-American trials and received a silver medal for excellence.

In an effort to find a popcorn which would mature under New Hampshire conditions with a good yield, a high degree of expansion and good quality when popped, about 80 varieties and strains were planted. There was very little difference in expansion between the different types of popcorn grown excepting that the Spanish or Large Pearl types and the Tom Thumb or Small Pearl types were distinctly inferior to the others in expansion. As far as eating quality is concerned, the hulless types were distinctly superior in tenderness and flavor.

To test hybrid and open-pollinated corns, about 150 different varieties and strains were planted. The hybrids proved better, having straighter rows, more even maturity, larger ears, bigger yields and better quality than the open-pollinated types. Nearly all Golden Bantam hybrids and those containing inbred P 39 are of fine eating quality, but the Whip crosses and the C 6 hybrids are not so good.

The variety test plots of the vine crops, cabbage and tomatoes were under water part of July and August, and the yields were too low to be of any value.

Soil acidity tests with spinach showed that applications of manure are necessary in order to grow a really satisfactory crop. Tests were made under controlled conditions in the greenhouse and substantiated outdoor tests as well as the experience of practical growers.

Mr. Hepler also conducted an experiment to determine the fertilizer needs of Blue Hubbard squash. One pound of 5-8-7 and one forkful of manure in the hill gave the largest yield. Manure alone in the hill did not give so many squash, but the size was about the same in both plots. Densities of the various strains of Blue Hubbard were compared. (*Hatch Fund*)

Transplanting Ornamental Trees

Observations on transplanted 5′ to 7′ sugar maple trees from the nursery and from the woodland and also 5′ to 7′ nursery trees of white ash were continued during 1938. This study to determine the best time for transplanting ornamental shade trees was begun by H. S. Clapp in the autumn of 1936. The data indicate that for this area early fall transplanting and early spring transplanting are preferable to late fall transplanting and late spring transplanting. (*Hatch Fund*)

Sustained Yield Study in Northern New Hampshire

The sustained yield study in Coos county (and Essex county, Vermont) which has been in progress for several years, made good headway during 1938. The project is administered by the U. S. Forest Service in cooperation with the state forestry departments, extension services and agricultural experiment stations of New Hampshire and Vermont. Detailed maps are being prepared for each township together with data on area of timber, growth, type,

volume of merchantable timber by species. It is expected that a management plan for the region as a whole will be available within the near future. Approximately 200 CCC men have been employed in the work and at present about 260,000 acres of farm woodland have been inventoried and mapped. This project is one of the largest and most intensive pieces of work of its kind being carried on in the United States.

(Note: It is impossible at this time to report on the other forestry projects because records of experimental plots were destroyed by fire and the plots themselves were damaged by the hurricane.)

Poultry Improvement Programs

Record of Performance

With an increase this coming year (1938-39) in R. O. P. membership, eleven members will enter approximately 7,000 birds under the program as compared to seven members having entered 2,300 birds during 1937-38. Of these 2,300 birds, 677 met R. O. P. requirements. To meet R. O. P. requirements, birds must lay a minimum of 200 standard-sized eggs in a laying year.

Poultry Approval

During the year 1397-38 New Hampshire poultrymen had 21,000 birds handled and selected by R. C. Durgin, selecting agent. This process of selection and culling is called "Approval." Both Poultry Approval and N. H. R. O. P. regulations comply with the provisions of the National Poultry Improvement Program. (*Miscellaneous Income*)

Fine Versus Coarse Grit as a Feed Ingredient for Poultry

According to studies made by A. E. Tepper, C. A. Bottorff and R. C. Durgin, fine granite grit is not detrimental to chick growth. Three groups of 75 Barred Plymouth Rock chicks were placed in growing batteries, and the pullet chicks within such groups maintained until 16 weeks of age. All birds were fed the New England College Conference ration for growing chicks including hard grains following the seventh week. The mash portion of the feed contained one per cent chick size granite grit for Group One and one per cent fine granite grit (waste) for Group Two. Group Three received no grit. Histological analyses of whole gizzard, gizzard linings and certain portions of the intestinal tract were made at stated periods. (*Bankhead-Jones Offset Fund*)

Brooder Efficiency Depends on Proper Management

Extensive experiments by T. B. Charles, A. E. Tepper, P. A. Wilcox and R. C. Durgin prove that no definite statements concerning the rearing efficiency of types of brooders can be made. They found that aside from fuel costs the variations are so minor or insignificant as to make necessary but one conclusion: proper management of the brooder chosen governs to the greatest degree the success or efficiency of the brooding operation. (*Purnell Fund*)

Test of Gas-burning Brooders

To further test the practicality of gas-burning brooders, which proved highly successful in the spring of 1937, one lot of chicks was started in the same house and with the same brooders on January

20, 1938. Results of the experiment conducted by T. B. Charles and P. A. Wilcox indicated that the heating unit was not large enough to provide an adequate temperature for starting chicks in sub-zero temperatures in an uninsulated 10′ x 12′ colony brooder house. Manufacturers followed the suggestions that the top of the brooder be insulated and a new heated head provided, and with changes the same gas-burning brooders will be tested out this coming season. (*Purnell Fund*)

Vitamin A Requirements for Growing Chicks

A complete report of this project covering the years 1931 to 1936 has been printed as Bulletin 310. (*Purnell Fund*)

Protein Requirements of Chickens

Further experiments by A. E. Tepper, R. C. Durgin and T. B. Charles in feeding chickens varying levels of proteins substantiated many tentative conclusions drawn last year. The chemical phases of the project were under the direction of S. R. Shimer. Findings for the years 1935-38 have been published in Bulletin 312.

As the percentage protein content of ration increased from 15 to 19 per cent, a definite increase in body weight of chicks fed these rations also occurred.

There is no apparent relationship between per cent protein fed and total feed consumption, but a very definite relationship occurs between total feed consumed and body weight attained.

Those groups receiving fish meal as the sole source of animal protein concentrate averaged heaviest in weight, heaviest in production, lowest in feed cost per dozen eggs produced and earliest in sexual maturity.

There appears to be no significant relationship between per cent protein fed and size of egg laid.

The maximum level in a ration at which meat scraps or dried skimmilk may be used is quite definitely lower than the level at which fish meal may be used.

No outstanding distasteful odor or flavor could be detected in meat or eggs from birds fed the fish meal ration which contained 19 per cent of protein.

No significant relationship was observed between mortality and type of animal protein source fed. (*Purnell Fund*)

Laying Cages versus Floor Pens

According to studies made by T. B. Charles and P. A. Wilcox, chicks brooded on the floor consume slightly more feed per pound of gain than do those brooded in a battery. This is probably due to at least two factors: first, greater exercising area, causing the burning of more energy; and second, more wastage of feed from the floor feed hoppers than from the battery feed hoppers.

Approximately 300 chicks of each breed, single-comb white leghorns and New Hampshires, were hatched at the same time, and records were kept for nineteen weeks.

Time studies of labor requirements of floor and battery brooding under the conditions of this experiment indicate that it required about fifty per cent more labor to care for the chicks brooded in batteries in comparison to those brooded on the floor.

It was found, also, that labor for feeding and cleaning in the cage groups for a year of production was two times as many man hours as for the floor groups with 74.81 hours of labor to care for a pen of 120 hens on the floor, against 147.99 hours for 120-hen laying cage.

Controlling Moisture in Poultry Litter

In cooperation with W. T. Ackerman and G. M. Foulkrod of the agricultural engineering department, Mr. Charles and Mr. Tepper have begun this new project, which, it is hoped, will reveal the factors causing excess litter moisture and the practical steps for its correction. In November, 1938, an experimental "plot house" was built to shelter the sample litters from the weather and still expose them to the action of the outside air. Records of litter moisture, air temperature and air humidity are being plotted into curves. (*Purnell Fund*)

New Hampshire Sets Pullorum Eradication Record

A new record for the largest per cent of adult birds in the state tested and the lowest per cent of pullorum of any state in the United States was established during the season 1937-38 under the supervision of the New Hampshire Department of Agriculture, Division of Animal Industry. Forty-seven per cent of the total adult birds of the state were tested with 99.94 per cent not reacting; i. e., pullorum free. This was the highest per cent of non-reacting birds found since the work was started in 1918. There were 549,064 blood samples tested from 420 flocks as compared to 549,482 samples from 442 flocks the previous season.

Eleven flocks were added to the pullorum clean list making a total of 96 flocks in which were tested 167,834 birds. One flock was removed from the pullorum clean list because of infection, and four on account of failure to test.

There were ten breeds of chickens, four breeds of turkeys and one breed of geese tested during the season. This large volume of testing was probably due to the low cost of testing to the poultrymen since the New Hampshire Department of Agriculture shares in the laboratory costs. (*Miscellaneous Income*)

Studies on the Control of Coccidiosis in Poultry

Birds artificially infected with chronic coccidiosis showed definite improvement under litter treatment with sulphur in one case and the feeding of bicarbonate of soda in another case, according to studies made by C. L. Martin, T. B. Charles and R. C. Durgin. Working with five pens of infected birds and one control group, they found that although sulphur in feed had no beneficial effect on egg production, the groups treated with sulphur in litter and fed bicarbonate of soda led all the rest in egg production. The experiment also showed that the feeding of 10 per cent milk sugar seems unwarranted as a means of combating chronic coccidiosis. There was also some evidence to prove that birds may be so slightly infected with chronic coccidiosis that no clinical symptoms appear, and yet they will produce a less number of eggs. This work is to be continued to check these results. (*Purnell Fund*)

Epidemic Tremors

Since epidemic tremors is on the increase as a poultry disease in

New Hampshire, experiments are being carried on by C. A. Bottorff, A. E. Tepper, R. C. Durgin and T. B. Charles at the poultry pathology laboratories to combat it. Few conclusions have been reached yet, but the work will be continued next year. (*Purnell Fund*)

Rickets Not Caused by Chronic Coccidiosis

Rickets in young chicks are not caused by chronic coccidiosis, as was previously supposed, according to experiments made this last year by C. L. Martin at the Poultry Pathology Laboratories. Working with four groups of chicks, four to six weeks old, he found that rickets occurred first, followed by the chronic coccidiosis infection instead of the other way around. (*Purnell Fund*)

Fowl Pox Vaccine Distribution

The total number of doses of fowl pox vaccine distributed to New Hampshire poultrymen during the fiscal year 1937-1938 was 264,400, a decrease of 29,800 from the previous year. This work was in charge of C. L. Martin. (*Miscellaneous Income*)

Laryngotracheitis Vaccine Disposal

During the season of 1937-1938, there were 65,400 doses of laryngotracheitis vaccine distributed to poultrymen in New Hampshire, as compared with 97,100 doses the previous year. The vaccine was used on 12 farms in two counties as compared to 17 farms in five counties the previous season. C. A. Bottorff is in charge of this work.

The distribution of this vaccine was carefully supervised and no vaccine was allowed to be used except under the following conditions: (1) Properly diagnosed outbreak; (2) where an outbreak had occurred the previous year; (3) where a flock had been vaccinated the previous year; (4) where one flock or two closely adjoining flocks have been vaccinated due to an outbreak. (*Miscellaneous Income*)

Poultry Autopsies

Poultry autopsies made by C. A. Bottorff and C. L. Martin at the poultry pathology laboratories during the fiscal year numbered 1,762 and included 602 adult poultry, 1,097 chicks, 56 turkeys, 6 ducks and one grouse.

Ruptured egg yolk was the leading trouble, being found in 24.2% of all adult birds examined. Other principal diseases in adults included: coccidiosis, 20.7%; roundworms, 11.7%; leukemia, 7.8%; ulcerated gizzard, 5.8%; internal hemorrhage, 5.6%; tumors, 4.6%; indigestion, 4.4%; tapeworms, 3.9%; and coryza, 3.3%.

The principal diseases of chicks were as follows: ulcerated gizzard, 31.5%; pullorum, 12.6%; coccidiosis, 12.5%; epidemic tremors, 10%; indigestion, 9.7%; pneumonia, 9.2%; navel infection, 8.3%; and perosis, 2.6%. (*Miscellaneous Income*)

FINANCIAL STATEMENT

Expenditures of the New Hampshire Agricultural Experiment Station for the Year Ending June 30, 1938

	FEDERAL FUNDS				Bankhead Jones Offset	Supplementary*	Total
	Hatch Fund	Adams Fund	Purnell Fund	Bankhead Jones			
Personal services	$ 9,520.89	$13,977.73	$50,907.90	$ 5,699.03	$ 4,529.60	$27,131.81	$111,766.96
Supplies and materials	608.16	517.39	2,746.27	11.04	170.39	4,354.72	8,407.97
Communication service	811.30	5.16	63.43	.80	6.40	396.54	1,283.63
Travel expenses	626.74	51.50	2,866.49	512.00	86.05	2,313.48	6,456.26
Transportation of things	324.62	18.98	98.83		26.63	272.58	741.64
Publications	755.46		924.77	42.87	73.54	282.38	2,079.02
Heat, light, water, and power	700.00	.18	55.47	.56		21.38	777.59
Contingent expenses			10.45			594.70	605.15
Equipment	1,652.83	272.94	1,702.64	1.60	907.39	2,673.45	7,210.85
Buildings and land		156.12	623.75		467.90	3,559.10	4,806.87
Balance						9,712.29	9,712.29
Totals	$15,000.00	$15,000.00	$60,000.00	$ 6,267.90	$ 6,267.90	$51,312.43	$153,848.23

*This fund includes expenditures from the following sources:

State appropriations	$ 6,267.90
Sales and miscellaneous income	45,044.53
	$51,312.43

New Hampshire Agricultural Experiment Station Staff

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Albert D. Littlehale, *Shepherd*
Helen H. Latimer, *Gas Analyst*
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Kenneth Anderson, B. S., *Graduate Assistant in Bacteriology*

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Elinor T. Robinson, B. S., *Assistant Bacteriologist and Technician in Poultry Pathology*
Morris S. Cover, V. M. D., *Assistant Poultry Pathologist*
Samuel Stevens, *Laboratory Technician in Poultry Husbandry*

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*On leave of absence