AGRICULTURAL RESEARCH IN THE ANNAPOLIS VALLEY AREA 1909/1960

J. Fred Hockey

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99442—1

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1967

THE EXPERIMENTAL STATION
KENTVILLE, NOVA SCOTIA

"Do not lose sight of this fact . . . that it is our Nova Scotia Experimental Fruit Station, not for Kentville or Kings County or even 'The Valley' so called, but for Nova Scotia. Let every loyal Nova Scotian show his and her interest in this Station. Expect great things from it and in every way possible encourage those who are in charge of its development. Do not be impatient of results. It takes time to make experiments of real value; but decades soon run off, and we are building for generations yet unborn."

Excerpt from the 1910 Report to the Nova Scotia Fruit Growers Association from the President, E. E. Archibald, on the founding of the Station.

99442—1½

CONTENTS

INTRODUCTION

This account of the activities of the Canada Department of Agriculture in the Annapolis and adjacent valleys covers the period 1909 to 1960. It tells of the establishment of the Experimental Station and the entomology, plant pathology and chemistry laboratories of the Science Service, and of their development as independent units which for many years functioned with separate headquarters in Ottawa. In 1959 they were amalgamated to form the Research Station at Kentville, Nova Scotia.

The research units were originally established to meet growers' requests for assistance in solving their problems in apple production, and in pest and disease control. For the first 30 years, the economy of the area depended on an expanding apple industry and the export of 85 percent of the crop to European markets. However, after the Second World War the economy of the importing countries and the rapid expansion of orcharding in Europe limited further profitable development for the Nova Scotia apple industry. By 1959 the orchard acreage had dropped to approximately one third the 1939 figure. Orchards were replaced by field crops, vegetables and other cash crops. At the same time there was an intensification of poultry and other livestock production. To meet this new situation the research organizations were called upon to enter new fields of study.

Investigations conducted 25 years ago may be considered 'water under the bridge' by those who are now chipping at icebergs or looking for hidden springs to feed the flowing stream of progress in scientific agriculture. However, this early work was of the utmost importance to the economy of the time, and pioneered the way for an appreciation and understanding of the scientific approach to agricultural problems.

During the early years of the Station many of the projects were planned by the chiefs of divisions of the Experimental Farm Branch at Ottawa. Some experimental work was done on general farming and livestock enterprises but the major emphasis was on horticultural problems. For many years the research laboratories were the field, the orchard or the barn, but as facilities improved and qualified staff became available, projects were amended to meet the changing agricultural production programs which have evolved through the years.

In this review an attempt is made to refer briefly to the fields of investigation explored since the inauguration of the Station. Many varieties of crop plants have been tested for their suitability. Field experiments on fertilizer practices and crop rotation have been conducted both at the Station and on commercial farms. Much study has been devoted to insect and disease problems. The results of experiments are not repeated here as they are available in the printed reports of the Experimental Station and the Laboratories.

It is hoped that this review will not only contribute to a limited collection of historical records of prominent Canadian agricultural institutions, but also provide further evidence of the interdependence of the agricultural industry and the staff of the Research Station in promoting agricultural development in the region.

LEADERSHIP

The accomplishments of the past half century are traceable in large part to the vision and leadership of its senior officers. It is appropriate, therefore, that their names be given a prominent place in this written record, before passing on to an account of the very considerable achievements which are the results of their unremitting labors. The success or failure of any undertaking depends primarily on the persons associated with it. Kentville has been fortunate in this regard. Without exception the senior officers have been men of proven ability, of high integrity, of supreme loyalty and of profound dedication to the common objective toward which they toiled.

R. W. Starr	Acting Superintendent	1911-1912
W. S. Blair	Superintendent	1912-1938
A. Kelsall	Superintendent	1938-1952
C. J. Bishop	Superintendent	1952-1959
T. H. Anstey	Exchange Superintendent	1958-1959
J. F. Hockey	Plant Pathology	1924-1960
R. G. Ross	Plant Pathology	1960-
F. A. Herman	Chemistry	1938-1954
R. F. Bishop	Chemistry	1954-
G. E. Sanders	Entomology	1915-1923
A. Kelsall	Entomology	1923-1938
A. D. Pickett	Entomology	1939-
R. A. Ludwig	Director Research Station	1959-1960
J. R. Wright	Director Research Station	1961-

In addition to carrying on their research, the members of the staff were required, during the formative years of the Station, to meet farmers and perform many other demonstration and extension activities. Although this personal work was time-consuming, it was distinctly profitable and has been of tremendous value in developing goodwill between the clientele and the employees of the federal department. This type of work gradually lessened as an adequate and qualified extension staff was provided by the provincial agriculture department. The two departments maintain excellent liaison. The staff, working with committees and individuals, give up-to-date information to growers and, at the same time, bring growers' problems back to the Station.

The early problems of agriculture were best answered by trial and error. As experience was gained, improved methods of experimentation were devised, and gradually the techniques of the basic sciences of chemistry, physics and biology were adapted to agriculture. Graduates

in entomology, plant pathology, agricultural chemistry, genetics, plant physiology and other disciplines became available. These men, building on the experiences and investigations of their predecessors, brought new methods of research to the more intensive study essential to the advancement of our knowledge of plants and their reactions to their environment. The scientist of today is building the foundations for the scientist of tomorrow, just as the scientist of yesterday created the background for today's investigations.

Modern disciplines have reached a stage of specialization where a team of men may approach and study a problem from many angles. With the national and local amalgamation of Science Service and Experimental Farm units in 1959 under the Research Branch, many groups became concentrated under the local administration of a new unit: the Kentville Research Station. The opportunities for more concerted investigations have been increased by this reorganization.

THE STATION PROPERTIES

It was on October 26, 1910, that W. T. Macoun, then Dominion Horticulturist, on behalf of the Dominion Department of Agriculture, received from the provincial government of Nova Scotia the first piece of land at Kentville for use as an Experimental Fruit Station. This event was the culmination of continued urging by the Nova Scotia Fruit Growers' Association.

The Fruit Growers' Association, organized in 1863, had always been active in promoting projects to assist the fruit growers of the province. In 1893 it established a horticultural school at Wolfville where young men could obtain practical training in horticulture. Among the early graduates who received diplomas in 1896 was W. S. Blair, later to become the first superintendent of the Kentville Station.

In 1895, the Association, not satisfied with a school alone, petitioned for a fruit station to be established in the Valley. The subject came before the Association annually, and in 1905, when the province decided to move the horticultural school to Truro, assurance was given to the Association that the province would buy a farm for experimental purposes to take the place of the school. It was 1910 before the farm was purchased. E. E. Archibald, president of the Association in 1910, and Ralph S. Eaton, founder of Hillcrest Orchards, were the leading personalities in the selection of the site.

The farm was known in 1910 as the Kenneth Sharp property but it had previously been in the hands of the Elderkin family for nearly 100 years. It originally formed part of the land granted to New England Planters in 1761 to help them resettle this part of Nova Scotia.

The area purchased in 1910 comprised 250 acres. It took in the lower part of the Elderkin brook and its associated ravine of approximately 125 acres. This includes a piece of intervale known by the French as the "Little Meadow." The upper part of the Elderkin brook

was added to the property later: 44 acres were purchased from Eugene S. Roy in 1912; and the remaining 7 acres were bought from Newton Bishop in 1913.

First picnic of fruit growers at Experimental Station, 1913.

A short distance up the ravine, near the point now crossed by an electric power line constructed in 1936, small dams were built to provide power for saw and grist mills. The mills were in operation from 1772 until the early 1900's. The most recently constructed dam was erected near the same site to provide water for a swimming pool just before the Second World War. This pool was successfully operated for about 20 years by the Canadian Red Cross and local groups of Kentville citizens.

In 1919 an adjacent farm of 130 acres was purchased from the John Tully estate and used as a training farm for returned soldiers of the First World War. The men were housed in huts erected in the wooded picnic ground area on the edge of the ravine. The Tully farm included 18 acres of bearing orchard, 11½ acres of dyked lands, 20½ acres of cultivated land and 80 acres of unbroken pasture land and woods, all of which has since been cleared. Three years later Edward Williams sold to the government 22 acres of his farm located between the Sharp and the Tully properties. The land had previously been under lease with an option to purchase. An additional block of 10 acres, purchased from the Williams estate in 1951, brought the Station to its present 463-acre size, with most of it situated within the boundary of

the town of Kentville. In 1957 a 190-acre farm was purchased at Upper Canard, a distance of 5 miles from Kentville. This has been called the Sheffield farm.

BUILDINGS

During 1912 and 1913 the main barn and the superintendent's house were erected and the original Sharp farmhouse moved and converted into a duplex. This house accommodated the herdsman and the caretaker of the horses until it was torn down in 1960. A house for the foreman was also built; and three small farm buildings were moved to other sites and connected for use as a carriage barn, a dairy and a poultry house. Several new buildings were constructed, including a barn for young cattle, an implement shed, a piggery and a horse barn. The poultry section had a main service building, a breeding house of twelve pens, two 100-hen houses, eight colony houses and five brooder houses. The Tully barns were converted to provide loose housing and feed storage for 30 to 40 head of steers. A common storage warehouse for fruits and vegetables was built in the year 1919-20.

All administrative and staff offices were originally in the superintendent's residence, but by 1924 this accommodation was overtaxed. Some of the desk work was done in shifts and it overflowed into the adjoining potting shed. An office building erected in 1925 provided what then seemed ample space for the Experimental Station staff. It housed a laboratory and offices for plant pathological work as well as offices for the seed potato inspectors who came that year. The attic was used as a library and general storage area.

Expansion continued and in 1936 a laboratory building was erected adjacent to the office, on the site of the former horse barn which was moved to a new location. This building provided greatly enlarged facilities with laboratories for plant pathology, cytology, physiology, chemistry and entomology. The chemistry laboratory was moved from Annapolis Royal to Kentville in 1938. However, the area set aside for an entomology laboratory was used as a seminar and assembly room. The physiology laboratory was adapted for food processing experiments, augmented by a pilot dehydrator built in a basement room. Soon after the Second World War the food processing facilities and staff were moved to new quarters in part of the apple warehouse, converted for the purpose. The space vacated in the laboratory building was immediately taken over for plant physiology and later for plant pathology.

One of the postwar developments of the federal Department of Agriculture was to bring together research staffs working in different fields, and in 1952 the Science Service Building was erected on the Station grounds to provide laboratory, greenhouse and office facilities for entomology and chemistry. This move brought the staff of the entomology laboratory from Annapolis Royal, their headquarters since 1915, and completed centralization of agricultural research in

99442—2

western Nova Scotia. Entomology, chemistry and plant pathology remained under the Department's Science Service until April 1959, although situated on property administered by the Experimental Farm Service.

Greenhouse facilities were limited to one small house adjoining the superintendent's residence until 1937 when two 50-foot houses were built adjacent to the laboratory building. Greenhouse expansion continued and by 1959 there were nine well-equipped units.

With the greatly increased mechanization of field work, facilities for the garage and machine shop, located in a corner of the implement shed, became exceedingly cramped. In 1956 a concrete and brick workshop, large enough to hold most of the Station vehicles, was provided. A new implement shed was also built for winter storage of sprayers, tractor-drawn equipment and large trucks.

The most recent buildings constructed at the Station are for poultry and provide the most modern experimental facilities.

LAND CLEARING

During 1911 J. R. Starr directed land clearing preparatory to planting the first crops. He also helped Prof. T. G. Bunting of the Ontario Agricultural College, Guelph, Ontario, plant the first 10 acres

Breaking land with oxen, 1914.

of orchard under the direction of W. T. Macoun. By 1920 there were 65 acres of orchard containing 3,489 fruit trees, including 227 varieties of apples, 55 varieties of pears, 92 varieties of plums, 54 varieties of cherries, 47 varieties of peaches and 12 varieties of quince and apricots. All the older orchard has now been removed and much of the suitable land replanted to fruit trees.

FARM OPERATIONS

The first farm foreman, Alfred Bishop, who handled men, oxen and horses with equal facility, had the original responsibility of clearing and preparing land for cropping. The power supplied by three pairs of oxen and three teams of horses was supplemented by hand-operated stump-pulling machines and, on occasion, by dynamite. By 1919 eleven heavy horses were needed on the farm and two driving horses were kept for horse-and-buggy visits to growers and for local duties. From 1912 until his retirement in 1956 George H. Chase was responsible for the care of the horses at the Station.

Aerial photograph, 1932. The large orchard tents were for pollination experiments. The small cages at the right were for swede breeding.

Charles J. Lockhart succeeded Mr. Bishop as farm foreman. By this time tractors and motor vehicles were rapidly replacing horses so that when he retired in 1952 there were few reins for his successor, Donald Patterson, to pick up. The horse had now become an antique with few reminders of its glorious past. Today the horse has gone from the Station and all field operations are motorized and mechanized.

99442—2½

Land breaking has continued from time to time and all the arable land at Kentville is now under cultivation except for a small demonstration woodlot.

LIVESTOCK

Dairy Cattle

In 1913 eleven Shorthorn cows and a bull of Scotch Foundation blood were obtained as a nucleus for a Station herd. The object was to develop a dual-purpose strain, suitable for both milk and beef, and to make superior breeding stock available to farmers. All milking females were entered in the Record of Performance test. The animals were put in the care of Spurgeon Rockwell until the next year when S. A. Porter was appointed herdsman. In 1945, three years after R. H. McDowell succeeded Mr. Porter, the Shorthorns were transferred to Nappan Experimental Farm and Guernseys brought from there to Kentville. This herd was maintained at about 45 head until 1950 when an outbreak of brucellosis, the source of which was never determined, caused the loss of the herd sire, 24 cows and six heifers. After the disposal of the remaining Guernseys, the barn was used for steer-feeding experiments until 1959 and now is used for general storage and poultry.

Steer Feeding

During much of the period covered by this review, annual feeding trials were conducted. The Tully barn, with four open pens on the south, each holding eight to ten animals, provided an early demonstration of the comfort and economy of loose housing.

Throughout years of shipping steers overseas, returns seldom covered costs, indicating that beef feeding could be recommended only to those buyers shrewd enough to secure their animals below the prevailing market prices. In 1924, 1925 and 1926 a total of 93 steers were shipped to Britain yet only one of these years showed a profit. Modern refrigeration methods have replaced this form of export.

Swine

Five registered Yorkshire sows and one boar were obtained in 1918 from the Central Experimental Farm, Ottawa. These animals formed the nucleus of a herd of swine kept at the Kentville Station for the next 16 years. As most of the young were sold for breeding stock, the herd played a prominent part in developing the high-quality bacon hogs for which the Maritimes have since become famous.

Poultry

Poultry buildings erected in 1913 to house the Station flocks of Barred Plymouth Rocks, White Wyandottes, Rhode Island Reds and White Leghorns were under the supervision of C. Eric Boulden until 1915. In these two years a careful study was made of artificial incubation. D. V. Cock and N. Swan cared for the Station flocks for a few years and did much of the early selection of 200-egg hens of White Leghorns.

Colony houses for poultry, 1914.

The first Nova Scotia Southern Egg-laying Contest was held at the Station in 1924 with accommodation in a new building for twenty pens of ten birds each. A Station pen, entered in the 1934-1935 contest, ranked first in egg production in all Canadian contests for that year.

For a short time prior to the appointment of B. F. Cheney in 1926, E. H. Dodge and William Lockley acted as poultrymen. The White Wyandotte flock was dropped in 1927. For the next ten years work was limited to Barred Rocks and White Leghorns and after that the Rocks were really "barred" and all research was concentrated on the Leghorns.

A review of the records of the Station flock shows that selection for egg productivity raised the average production per hen from 168 eggs in 1926 to 258 per year for the years 1941-1945. Production in 1946 averaged 292 eggs per hen from family lines selected for strength of shell as well as productivity.

On the retirement in 1959 of Mr. Cheney, F. G. Proudfoot took charge of poultry. New facilities provided for more critical investigations into some of the problems of this vastly expanded and highly competitive industry.

Apiary

Although bees were brought to the Station in 1914, the first apiarist, E. D. Craig, was not appointed until 1920. A rapid build-up of the apiary took place and was further strengthened during apple pollination experiments conducted from 1928 to 1932. An average of 65 to 70 hives kept at the Station during the years 1936-1947 was used for experimental and demonstration work. On the death of Mr. Craig in 1954, G. G. Smeltzer took charge of a reduced apiary.

FIELD HUSBANDRY

The Field Husbandry Section was under M. P. Pike from 1916 until 1936 when J. S. Leefe took charge. One of its early projects was the installation of meteorological instruments and the subsequent maintenance of weather records. Other functions included draining, road building, and land clearing and fencing to provide space for crop rotation studies.

A long-term experiment was set up in 1914 using ground limestone and commercial fertilizers in a rotation with cereals, hay and root crops. After 30 years the main conclusion was that limestone was a valuable soil dressing for cereals, hay and mangel crops, but of much less importance to the production of swedes and potatoes. However, these high-lime plots eventually showed boron deficiency symptoms, and the successful use of borax applications to the soil encouraged further studies in the use of trace elements.

Tests of many fertilizer treatments on a wide variety of crops at the Station have been supplemented by occasional trials on commercial farms to compare results on different soils. The conclusion has been reached that a general rate of application of one fertilizer formula can not be recommended for all farms. Both formula and rate must be varied to suit the crop, the level of soil fertility and other conditions peculiar to each soil type.

In a study of the economics of fodder crop production, cost figures were recorded for many years for sunflowers, corn, mangels, turnips and oats-peas-vetch.

Weed control, always of importance, early claimed attention and in 1930 copper sulphate in solution was sprayed on cereal crops at various rates. Small plots of king devil in pasture fields were sprayed with copper sulphate, sodium chlorate or gasoline in an effort to discover an

economical method of control. The introduction of selective herbicides advanced rapidly and today a wide assortment of these labor-saving materials is available to farmers for specific crops. Further investigation of the residual effect of these chemicals on both soil and plant are still necessary to evaluate their long-term value.

Grass, long considered a natural crop for dyke lands and many upland areas in Nova Scotia, has become popular for use as ensilage. Pasture improvement techniques and the fertilization of permanent pastures have achieved considerable prominence. Farmers have been quick to adopt the recommended procedures where they have lowered the cost of feed and prolonged the pasture season.

FIELD AND FORAGE CROPS

Potatoes

Forty-eight varieties of potatoes planted in 1913 in a comparative test yielded from 66 to 238 bushels per acre. It soon became evident that virus diseases were affecting potato yields and from then on certified seed potatoes were used in the various cultural and fertilizer experiments of the Station. An effort has since been made by the Seed Potato Inspection Service to plant some of the more desirable potato varieties in tuber units and to select virus-free stock. A few of these varieties were saved but most of them were discarded because of virus infection.

During the winter of 1924, W. K. McCulloch, in charge of the Seed Potato Inspection Service for Nova Scotia, indexed tubers of the Bliss Triumph variety in the greenhouse at the Kentville Station by planting a single eye from each potato. The eight virus-free tubers which he discovered, and then multiplied on the Station and on North Mountain farms, made it possible to plant 775 acres to this variety in 1937. This was the start of the tuber indexing method which has since been adopted across Canada and now forms the basis of Foundation Seed Potato production.

The 30-year fertilizer and ground limestone experiment started in 1914, referred to earlier, indicated that the rates of fertilizer application were too low for optimum yields and that ground limestone increased crop yields but encouraged potato scab.

Recent years have witnessed more intricate chemical studies using soil and plant tissue analysis. Their object is to find still more accurate methods of estimating the fertilizer needs of individual fields when planted to this staple food crop.

Potato variety testing at Kentville has recently been confined to seedlings originating elsewhere. Tests are made of their disease resistance, adaptability to local conditions, and ability to meet various market demands.

Cereals

During the early years of the Station, oats, wheat, and barley were raised for feed. Subsequently small plot tests of varieties of these cereals were conducted with seed obtained from the Central Experimental Farm, Ottawa. Field tests for yield followed the small plot tests in order to select those varieties best adapted to local farm rotations. Victory oats were multiplied and distributed by the Station, soon after the variety was introduced from Sweden. For several years Alaska oats were grown in the Valley area because this variety matured sufficiently early to be harvested before the start of apple picking. Both these varieties have since been superseded by new varieties with superior disease resistance.

Soya beans grown for hay, 1935.

Forage Crops

The main forage crops grown at the Station, aside from the old familiar timothy, have been alfalfa and clover, soybeans, swede turnips, mangels and corn. Yield tests were conducted for a number of years on the available varieties of these crops. Carrots, sunflowers for ensiling, various grasses and sugar beets have been grown for shorter periods.

Each year sugar beets were grown, samples were sent to the Chemistry Division at Ottawa for analysis. Kentville beets were found to equal, in sugar content, those grown in other parts of Canada. Lack

of a guaranteed acreage large enough to produce the tonnage of beets necessary to maintain a sugar factory discouraged further development of this crop.

MISCELLANEOUS CROPS

Hops

For several years mature vines of the variety Fuggles produced hops at the Station. Yields indicated that this plant was not suitable for economic production in the Annapolis Valley area of Nova Scotia.

Kok-saghyz

During the Second World War the Station cooperated in testing the production of kok-saghyz as a substitute source for rubber. It is interesting to note that A. Kelsall, superintendent of the Station; J. Gallaher, gardener; and J. F. Hockey, plant pathologist, who were involved in this project, were all veterans of the First World War.

J. Gallaher, A. Kelsall and J. F. Hockey examining kok-saghyz plants, 1941.

Tobacco

On several occasions tobacco of the burley or flue-cured types have been grown in the Annapolis Valley area under experimental conditions. It has been shown that this crop can be grown successfully.

99442—3

Turnip Seed

During the First World War turnip seed had to be produced in Canada to replace seed no longer available from Europe. During 1918 and 1919 over 25 tons of swede turnip seed were produced at the Station and on other land leased for the purpose. The varieties Canadian Gem, Corning Green Top and Ditmars Bronze Top were most popular. On a total area of 74 acres, over 15 tons of seed were produced in 1918, at a cost of 50 cents per pound. After the war, many growers stayed in the seed production business as long as it remained profitable. Swede turnip seed production in Nova Scotia requires the harvesting and storing of the stecklings in the autumn and replanting in the spring, whereas in many competitive seed producing areas the stecklings can be left in the field over winter.

Threshing turnip seed with flails, 1918.

Fiber Crops

In the Station report for the year 1923 may be found the first reference to the production of flax and hemp for fiber. Both crops gave satisfactory yields of fiber when well fertilized. However, tests of fiber crops were not continued at Kentville after 1929. The lack of a fiber processing plant in the Maritimes made it necessary to ship the raw

Harvesting flax.

Field of hemp, 1927.

99442—3½

materials to Quebec or Ontario points, thereby reducing the value of the crop to Nova Scotia growers. There has been no subsequent development of these crops in the Maritimes.

The early settlers regarded both these crops as important. One of the conditions imposed on New England Planters when they settled the Annapolis Valley was that each farmer should sow a specified acreage of hemp, and in many old attics may be found the hatchels used to comb the flax which later became the Sunday linen of milady and her spouse.

TREE FRUITS

During its fifty years of existence, the Kentville Station has been the center for fruit investigations in the Atlantic Provinces. Although experiments and studies have been carried on primarily for the benefit of local fruit growers, many of the results have been of value to orchardists who have never seen the Station.

An assistant in horticulture, J. Milton Robinson, carried out some of the first orchard spraying experiments in Nova Scotia. In 1913 he was assisted by M. B. Davis, later to become Dominion Horticulturist. When Mr. Robinson left for military service during the First World War, M. P. Pike assumed responsibility as assistant to the superintendent. He remained in this position until 1920 when R. D. L. Bligh was appointed assistant in horticulture and took charge of all fruit projects.

Apple Variety Tests

One of the first demands of Nova Scotia fruit growers was for a study to determine the comparative vigor, productiveness and usefulness of apple varieties under local climatic conditions. It is not surprising then to find that the first 21 acres of apple orchard planted at Kentville in 1912 and 1913 contained: Baldwin, Baxter, Banks Gravenstein, Ben Davis, Blenheim, Cox Orange, Crimson Beauty, Dudley, Duchess, Fallawater, Fameuse, Gano, Gravenstein, Hubbardson, King of Tompkins, McIntosh, Milwaukee, Nonpareil, Northern Spy, Ontario, Red Astrachan, Ribston, Rhode Island Greening, Wagener, Wealthy, Wellington, Wolf River, Yellow Belleflower (Bishop Pippin) and Yellow Transparent as well as two trees of each of 38 varieties brought from England for trial.

Two years later there were 227 varieties and 2,616 apple trees on the Station. In the report of the Experimental Station for the year 1923 is a table giving the origin, season, quality and a general assessment of 158 varieties that were distinct from the 46 varieties being grown commercially at that time. When a variety was found completely unsuitable, it was replaced by another for a fruiting test. Several hundred varieties of apples have fruited in the Station orchards through the years, and new introductions considered worth testing under Nova Scotia conditions are planted as rapidly as they become available.

The reputation of the Kentville Station as a producer of apples was recognized very tangibly by the winning of the Wilder Medal in 1920, 1922, 1930 and 1935. The Wilder Medal was awarded by the American Pomological Society at their annual convention. Displays of five apples per plate of at least 50 different varieties, were judged on their quality in relation to the area in which they were grown.

During the past 20 years, commercial orchard plantings in Nova Scotia have consisted predominantly of Crimson Gravenstein, McIntosh, Cortland, Red Delicious, Red Spy and Red Rome Beauty. Strains and mutants of these varieties have been propagated and evaluated at the Station over a period of years.

Red color is the current fashion in apples. Consumer demands for this must be met if the apple orchardist is to cater to the fresh fruit market. It seems unfortunate that the Gravenstein, with its aromatic flavor and exceptional cooking quality, has lost its popularity on the fresh fruit market outside the Atlantic Provinces. The Cox Orange Pippin, considered by many to be the highest quality dessert apple, and once keenly sought for export, can scarcely be found today in commercial orchards in Canada because it is no longer in demand.

Plums

The interest of Station horticulturists in plums has been confined to testing varieties. The report of the Station for 1923 lists 74 of the 92 varieties planted in 1913 with notes on their season, color and quality as grown at Kentville. In 1951 a further report was made of the varieties then grown at the Station and many of the newer sorts are listed with those that have continued to find local favor. From more than a hundred varieties tested at the Station, the present recommendations for a seasonal succession of this fruit are: June Blood, Becky Smith, Early Saxton, California Blue, Clyman, Santa Rosa, Burbank, Mallard, Street, Washington, Peters Golden Gage, Albion, Shropshire Damson, Stanley and Grand Duke.

Cherries

The 1923 report of the Station lists the season, color, quality and yield of 48 of 54 cherry varieties planted in 1913. There were many additional sweet, sour and hydrid varieties tested through the years from which growers could choose. The semisweets or Dukes have Brassington and Royal Duke as their selected representatives, and the recommended sweet cherries are now Hedelfingen, Gil Peck, Bing and Lambert.

During the past 10 years the presence of virus disease has necessitated the removal of affected trees and has thus eliminated some varieties from the test orchard.

Peaches

Of 47 varieties of peaches planted in 1913, 29 remained alive in 1921 and produced some fruit. Several subsequent plantings of newer varieties were made with more satisfactory results. Because low winter temperatures frequently kill the blossom buds, peach growing is quite marginal in most of Kings County but more favorable in much of Annapolis and Digby counties, particularly in the vicinity of the basin of the Annapolis River. As a result of the tests conducted at the Station, the varieties now recommended for favorable locations in Nova Scotia include Marigold, Oriole, Jerseyland, Dixigem, Redhaven, Golden Jubilee and Vedette.

Pears

When the first pear orchard was planted at the Station in 1913 it contained 55 varieties. Others were subsequently tried, and in 1945 there were still about 50 under test. As with other tree fruits, some have been found satisfactory for home use or roadside stands, but even today the commercial plantings in the Annapolis Valley district are mostly Clapp's Favorite and Bartlett, with a sprinkling of Beierschmidt, Cayuga and Ewart and the older d'Anjou and Sheldon.

Until good storage and marketing systems for fresh fruit are developed, the bulk of the pear crop will continue to go to the processing industry. Fire blight has not affected the production of pears in Nova Scotia.

Quinces and Apricots

Quince and apricot trees were also planted in 1913 for test. Apricots have seldom fruited at the Station but quinces have given very satisfactory crops. A choice of Van Dieman, Pineapple or Orange is now offered on the recommended list of quinces. It is thought that fruit set is heavier if more than one variety is grown.

Orchard Survey

A survey of commercial orchard practices conducted in 1913 indicates the cultural methods in vogue at the time. Fall plowing was done in 85 percent of the orchards. Afterwards they were cultivated until July, then covercropped. Annual cover crops were mostly buckwheat, but a few orchards were seeded to clover and common vetch. In some orchards the alternate strips between tree rows were planted to clover in a two-year rotation method in which the second-year clover growth was mowed and later plowed under. In many orchards annual weeds later became a self-sown cover crop.

About half the orchards visited during the survey received stable manure as the principal source of fertilizer. The remainder received part stable manure and part commercial fertilizer, or commercial fertilizer alone. Muriate of potash was used at 100-500 pounds per acre; nitrate of soda at 50-200 pounds per acre and phosphate fertilizers at 250-1000 pounds per acre. Best results were obtained where moderate annual applications of fertilizer were made.

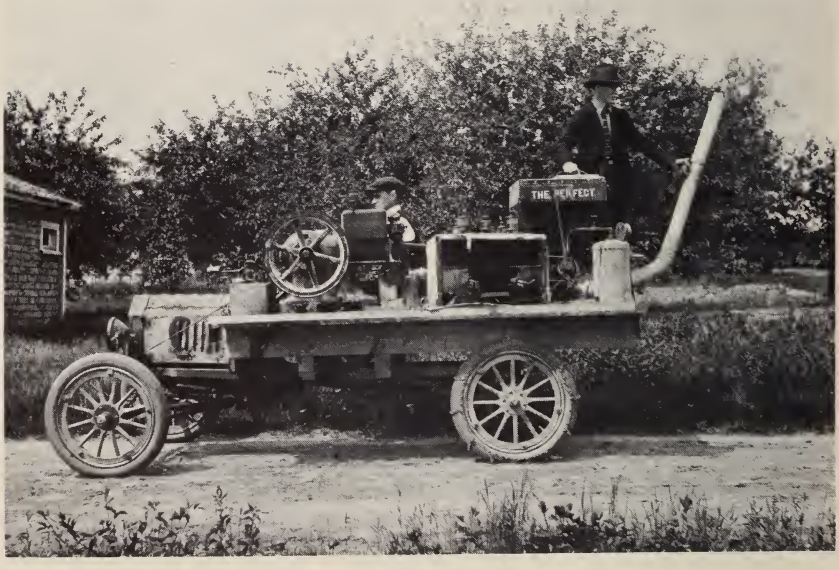
Spraying for disease and pest control was done in 84 percent of the orchards, with the majority receiving three or four applications. Lime-sulphur and Bordeaux mixture, with lead arsenate as an insecticide, were the materials commonly used. Infestations of scab in the tops of trees were as much of a problem in 1913 as they have been with some operators since.

Orchard Spraying

At the time of the opening of the Kentville Station there was an urgent need to develop new methods of growing fruit free from blemish. Apple scab was reducing the quantity and quality of fruit. Aphids and other pests also frequently reduced fruit quality. It is not surprising to find that in 1913 some fairly extensive tests were made in commercial orchards to compare the effectiveness of Bordeaux mixture, lime-sulphur and home-boiled lime-sulphur in preventing scab, while various forms of nicotine and soaps were used to control aphids. For several years spraying experiments were continued in commercial orchards, with emphasis on scab control and the avoidance of fruit russeting from Bordeaux.

As soon as bearing orchards became available, the spray plots were moved to the Kentville Station and continued there until 1925. Dusting was compared with spraying and for several years was the more popular method of applying fungicides and insecticides. During the 12 years of operating spray and dust plots of apples, a large number of schedules, materials and methods of application were tried. The results of these experiments were conveyed to fruit growers in the annual reports of the Station and in those of the Nova Scotia Fruit Growers' Association. They formed the basis for recommending spray practices which were quickly accepted. After 1925 the work was taken over by plant pathologists at Kentville in cooperation with the entomologists at Annapolis Royal. Department of Agriculture officers have maintained a constant, progressive surveillance of disease and pest control practices through the years and have given leadership to the fruit industry in this field.

Small power duster, 1924.



The "Perfect" power duster, 1922.

Spraying with bamboo rod and hand pump.

Mist blower concentrate sprayer.

Thinning Apples

Thinning of apples has been under constant experimental observation in Nova Scotia since 1912. The first thinning experiments in commercial orchards were confined to leaving one apple in a cluster. By 1921 it had been found in the Station orchard that apples thinned by hand to an average of 6 to 8 inches apart gave the largest and most profitable yield of the highest grade fruit. Hand thinning remained common until the appearance of naphthalene acetic acid and naphthaleneacetamide. The use of these chemicals in sprays has largely replaced hand thinning as it is much less expensive. Since spraying is done early in the season it has the added advantage of encouraging fruit bud formation to stimulate annual bearing in many varieties. A 30 percent increase in yield of McIntosh was obtained during a four-year period by applying a chemical thinner during the years of heavy bloom.

Orchard Heating

An experiment in orchard heating was conducted in a commercial orchard in the spring of 1915 to determine whether oil heaters could be used economically to protect trees from frost. Fifty-four cylindrical sheet iron cans were used in an orchard with trees planted 20 x 20 feet apart. The cans held about 2 gallons of crude oil, which was ignited by a little gasoline. Half an hour after the oil was lighted the temperature of the air had risen five degrees. The cost of the operation was $8.70 per acre.

Fertilizer Experiments

Soon after the first apple trees were planted at the Station a comprehensive series of fertilizer plots was laid out to test the use of materials then commercially available: nitrate of soda, sulphate of ammonia, acid phosphate, muriate of potash, basic slag, bonemeal, manure and ground limestone. After 25 years of treatment, all plots receiving no nitrogen lacked productive vigor. Single element plots could be continued as long as the natural supply of other elements in the soil was not exhausted. Heavy applications of nitrogen gave excessive vegetative growth and produced fruit with poorer color and keeping qualities than trees receiving all three major elements. Heavy applications of limestone caused symptoms of boron deficiency in the trees.

In these early experiments the shortage of uniform trees for planting, the lack of uniform depth of A horizon layers in the soil profile, the rates of treatment, the number of replicates and many other factors may have been unsatisfactory according to today's standards for experimental design and procedures. However, it must be remembered that today's method's have profited from previous experiments and are planned to avoid the errors of the past, just as tomorrow's methods will be planned to avoid the errors made today. While it seems easy to criticize work initiated 25 years ago, it may be simple in 25 years' time to find similar fault with the efforts of today.

When fertilizer experiments were started at Kentville the orchards were under clean cultivation. Later sod strips were planted between tree rows and the rate of application of nitrogen fertilizers had to be increased to compensate for the nutrients required by the grass. In recent years sod mulch has replaced sod strip in the bearing orchards. In this system the grass is cut and left as a mulch, and additional straw or hay is sometimes spread under the trees. These changes in cultural methods have necessitated changes in fertilizer practices.

When deficiency symptoms were observed, corrective treatments using boron, magnesium and other elements were developed and some of these materials are now included in commercial fertilizers. A study of tree nutrition by means of tissue analysis has recently pointed the way to using fertilizers to meet more closely the needs of trees. This system embraces the concept of using only enough of each chemical plant food to assure the optimal yield and growth of a tree. Since 1953 a chemist, D. C. MacKay, has cooperated in the fertilizer projects at the Station.

Rootstocks for Apples

The advisability of having uniform rootstocks for experimental purposes has encouraged the Station's pomologists to propagate apple

stocks by the stool method used in Europe. The stool beds of various Malling-type stocks planted in 1923 soon provided material for experimental orchard plantings.

In 1934 a replicated experiment to compare rootstocks was initiated by planting an orchard with McIntosh and Fameuse trees grafted on Malling types I, II, IX and XII and two seedling rootstocks, Anis and Beautiful Arcade. The Malling IX trees became scion rooted in 10 or 12 years and were discarded. The most satisfactory trees for vigor and production were those propagated on Beautiful Arcade seedlings. These have been recommended recently for commercial rootstocks in Nova Scotia.

Frameworking

A frameworking experiment with 12-year-old Stark trees on three types of rootstocks was initiated in 1942. There have been significantly lower yields from the frameworked trees than from trees of the same variety propagated in the nursery on comparable rootstocks.

Stembuilding

In one of the Station's orchards, five varieties of apples grafted on trees with Haas, Hibernal and Virginia Crab as intermediate stem pieces were compared for winter hardiness and tree type. The Haas stem gave poor crotches. The Virginia Crab caused dwarfing, attributed to the stem pitting virus. The Hibernal stem pieces gave the most satisfactory trees.

Since the appointment of R. P. Longley as pomologist in 1947, variety tests and cultural studies have been enlarged to include the care of all breeding stock and progeny, and the evaluation of seedlings for fruit and other qualities.

STORAGE AND TRANSPORTATION

Fruit storage investigations in Nova Scotia, which have been under the direction of C. A. Eaves since 1934, have provided leadership in the use of the various forms of common, cold and controlled-atmosphere storage. Work at the Station has centered around apples in all three types of storage and modifications of these storage conditions. In addition to warehouse ventilation studies, some of the early investigations dealt with types of container, as well as methods of handling, packing and transporting fruit to overseas markets. Linings for controlled atmosphere storage rooms have been modified: galvanized sheets that need laborious soldering are being replaced by plastic films. The chemical scrubber for maintaining CO_2 levels has been replaced by regulated amounts of hydrated lime. Gas concentrations and temperatures for optimum storage of leading commercial varieties have been recommended.

Studies on the keeping qualities of apples in storage first prompted interest in the effects of orchard nutrition on fruit quality. Fruit from various fertilizer plots showed consistent differences while in storage, indicating the need for changes in fertilizer practices. Growers have since been shown how correct fertilizer practices can improve storage quality and reduce losses.

Surveys of fruit handling methods have shown that picking bruises are caused by the human element but subsequent damage can be reduced by improved grading.

FRUIT BREEDING

Apples

The first apple-breeding work at the Station was done by plant pathologists who wanted to find seedlings with improved resistance to apple scab. Between 1928 and 1932, with the assistance of C. C. Eidt, the station geneticist, a large population of open-pollinated seedlings was planted and also some seedlings from controlled crosses. By 1935 there were over 30,000 seedling trees growing in the Station orchards. The fruit from most of the trees was sampled for size, quality, or scab resistance. Few of the trees were retained after preliminary testing. However, it was found that both McIntosh and Cox Orange progeny were susceptible to scab, and the Cox Orange progeny tended to produce small fruit.

Apple breeding was discontinued during the Second World War. It was resumed in 1948, following the appointment in 1947 of C. J. Bishop who introduced new breeding techniques. The finding of tetraploid forms in other plants prompted a similar search for these variants in apples and it met with some success. The frequency with which color sports or mutants were found under natural conditions encouraged experiments to induce mutation by means of radiation and chemical treatments. The study of resistance to apple scab was revived and, with the cooperation of the plant pathologists, many thousands of seedlings have now been given greenhouse tests for susceptibility. An appreciable population of resistant or immune seedlings has been obtained from open-pollinated resistant female parent material and from a few controlled crosses. These are to be carried through to fruiting either on their own roots or as scions grafted on established trees.

Other Tree Fruits

Although seed from tree fruits other than apples has been collected and planted and the trees brought to fruiting, no systematic breeding program has been undertaken. One short project was carried out with a native *Prunus avium* known as the "Bear River Cherry" but no progeny with commercial promise was obtained.

SMALL FRUITS

The Station's projects with small fruits have been devoted mainly to the testing of varieties for suitability to the Annapolis Valley district and to comparisons of cultural methods. Until 1947, when D. L. Craig was placed in charge of all small-fruit work, the projects were under the Station pomologist.

Strawberries

During the past 10 years much attention has been given to plant improvement of accepted varieties through a plant certification program conducted jointly with the Nova Scotia Department of Agriculture and Marketing. Foundation stock, tested at the Station for freedom from virus, has been multiplied in an isolation area. The increase has been distributed to nursery operators to propagate and sell as improved stock. Fruit yields have been significantly increased.

A breeding program has also been carried on in cooperation with L. E. Aalders with the object of producting fruits of higher quality which mature through a longer season. Selections have been made from these crosses for further testing in the field but no new varieties have yet been introduced.

All variety testing is now done with virus-free plants. The varieties Sparkle, Catskill, Premier and Senator Dunlap dominate in commercial plantings.

Experiments to control weeds and nematodes are continuing.

Raspberries and Blackberries

In addition to the continuous testing of varieties, crosses have been made in a search for greater winter hardiness. Sawdust mulching of raspberries has been found to give the highest yield of fruit but it has also encouraged grey mold wilt disease, resulting in the weakening or death of some new canes each year. The varieties Newburgh and Viking are recommended for commercial plantings.

Currants and Gooseberries

In variety testing plots, gooseberries and red currants fruit freely under local conditions. It is difficult, however, to obtain satisfactory yields of black currants.

Grapes

The variety testing of grapes has shown the need for an earlier-maturing sort, and breeding work is devoted to that objective.

Highbush Blueberries

In the spring of 1926 the first planting of varieties of the highbush blueberry was made at Kentville. Most of these plants are still fruiting. A combination of sawdust mulch; chemical fertilizer and cultural treatment has been adopted as the most successful for good annual crops. The variety Kengrape was selected for introduction. Several better selections made from the many seedlings raised at the Station are under observation.

Crosses between highbush and native lowbush blueberries have produced progeny intermediate in type with few desirable characters.

The highbush blueberry bids well to increase steadily in acreage, as once it is established the productive life of plants continues for many years. The greatest fruit loss is from birds. Diseases and insect pests are not a problem.

Native Blueberries

Work with highbush blueberries has been concentrated largely on the Station property. The native lowbush blueberry has been studied mainly in commercial fields. The Station specialist in native fruits, E. L. Eaton, appointed in 1939, has cooperated with the Fredericton Station in horticultural projects at the Blueberry Sub-station, Tower Hill, N. B. Here weed control, time of burning, methods of propagation and other cultural practices have been under study.

Elderberries

Seedlings obtained from the Adams variety have produced fruit at Kentville, and four varieties, Victoria, Kent, Nova and Scotia, have been introduced to replace the native elderberry. The fruits of these varieties are much larger than the native strains and are earlier maturing than Adams. Present local demand for this fruit is limited.

Cranberries

Testing of varieties and desirable plants collected from wild areas has been conducted on a commercial bog as there is no suitable land at the Station. Beaver, an attractive early variety with excellent keeping qualities, has been named and released. Breeding has been directed to the production of an early variety of equal quality that will be resistant to false blossom disease. Crosses between Beaver and Early Black offer promise.

FRUIT AND VEGETABLE PROCESSING

Evaporation methods were standard commercial practice for drying apples until late in the 1920's when dehydration tunnels were found

to be quicker and to give a more uniform product. The first pilot plant dehydrator at the Station was built in 1929. Successive alterations were made until a model called the Eidt dehydrator became the pattern for commercial use. The pilot plant at the Station was employed during the Second World War, to determine the quality of many varieties of dried fruits and vegetables.

Dehydration work was later supplemented by canning trials under H. C. Aitken, to determine the most suitable methods for processing the varieties of fruits and vegetables available in the area. Juice was extracted from low-grade and surplus apples which, with carefully controlled blending, found a ready market. Canned apple juice continues to meet a steady demand.

After the War the processing field was enlarged under G. W. Hope to include frozen fruits and vegetables. A study has been made of old and new varieties to learn which are most suitable for processing and which methods are best for each.

A bland apple syrup has been developed by using the "ion-exchange" technique to eliminate acidic and metallic ions. This syrup is now being produced and marketed by a commercial firm.

The new and rapidly-expanding potato chip industry has required and received considerable attention. Both dry matter and reducing sugar content have been found to be critical for a good quality potato chip. The industry has been assisted in developing techniques for storing and conditioning and in selecting varieties.

The fruit and vegetable processing section of the Station staff has been closely associated with the processing industry, has devoted a great deal of attention to their problems, and has provided much valuable assistance.

VEGETABLES

There has been a vegetable garden at the Station since 1913 when the first variety tests were planted with seed supplied by the Central Experimental Farm, Ottawa. During the First World War vegetable projects were limited. Immediately afterwards, culture and testing of varieties were intensified under the direction of J. Gallaher, and the vegetable garden became one of the centers of attraction for both rural and manured, with no special applications of fertilizer for the heavier-perennials as asparagus and rhubarb were tested and a herb garden was maintained. The land for the testing of varieties was uniformly prepared and manured, with no special applications of fertilizer for the heavier-feeding crops—a management which could be followed on any farm. The use of special fertilizers for selected crops was a natural sequence in later experimental work, as information became needed by more specialized crop farmers.

Sunrise rhubarb, Kenearly onion and Kenearly Yellow Eye beans were three Kentville selections which rapidly won popularity when released to the public.

Since 1946, when J. Gallaher retired and E. W. Chipman took charge, breeding work has been concentrated on tomatoes and some attention has also been paid to onions. A tomato that is more resistant to late blight, and of earlier maturity than most present varieties, is being sought. One of the tomato progeny, introduced to the trade under the name of Scotia, is highly productive under local conditions although susceptible to late blight.

Variety trials and cultural experiments with vegetables have been highly valuable to commercial interests and have given farmers and gardeners many object lessons in the choice of suitable varieties and improved cultural practices.

More people are interested in annual crops than in trees. This is undoubtedly one reason why so many visitors will remember the plants seen in a vegetable garden more clearly than the trees or the bush fruits. Those who were privileged to see "Gallaher's onions" in the 1930's will never forget their firmness and immense size.

Vegetables have been grown on peat and muck soils, where satisfactory yields followed the addition of lime and fertilizer. The general requirement for these soils is a fertilizer high in nitrogen and medium to low in phosphorus and potash, supplemented by heavy and deeply incorporated dressings of lime.

ORNAMENTALS

The first superintendent of the Station, W. S. Blair, was an enthusiastic landscape and ornamental horticulturist. His masterly skill transformed the rough, unsightly hillside facing the highway into a park of unusual beauty. This park was the envy of visitors from other stations where, so often, stark utility alone met the first glance. Native trees were interplanted with various species of ornamental shrubs and trees to make the entrance to the grounds an appealing landscape.

A summary of much of the early work with ornamentals was presented in the report of the Station for 1931-1936, published in 1938, which lists many desirable species and varieties of plants for ornamental and landscape use.

A large number of shrubs and herbaceous perennials have been planted in groups or beds to test their hardiness and suitability. Residents who have visited the Station have found many plants to admire and have obtained helpful ideas for landscaping their home grounds.

The Station has not been aloof from the popularity cycles that encourage the collection of varieties of dahlia, gladiolus, peony, iris, delphinium and other flowers, as each increased in popularity. Roses

have come and gone and come again. Variety trials of these and other plants have been of great interest to garden lovers and, although of no economic value, they contribute to the enjoyment of living, have won support and praise from a host of large and small taxpayers.

Work with ornamentals was under the direction of W. T. Blair until his retirement in 1958. Since then G. S. Swain has been in charge and has given special attention to breeding azaleas, rhododendrons and hardy chrysanthemums to develop varieties suitable to the prevailing climate of the district. Many varieties of annual plants in ornamental beds add interest and charm to the spacious lawns.

Nut Trees

The Station report for the 1914 season contains a brief reference to the planting of filberts, Paragon chestnuts and English walnuts in a small nut orchard. The chestnuts and walnuts grew poorly and many died. The filberts appeared to have greater promise. As an orchard project, the growing of these nuts proved a disappointment, but a few filberts, butternuts and walnuts have been preserved as specimen or landscape trees. A new orchard planting of nut trees made in 1957 by D. L. Craig included new selections for trial.

ILLUSTRATION STATIONS

In 1920 six private farms were selected in various districts of Nova Scotia for use as illustration stations, with F. B. Kinsman as supervisor. The purpose of these farms was to demonstrate the most useful cropping and fertilizer practices found on the Experimental Station. Crop rotations, fertilizer experiments and crop variety tests formed a large part of the work. People living in the vicinity of each farm were invited to attend annual field days when the various plots were inspected and discussed. As the number of stations increased because of their popularity, they were divided between eastern and western Nova Scotia sections in 1936. An officer stationed at Nappan supervised the work on the eastern illustration stations. The officer at Kentville continued to supervise six stations in western Nova Scotia.

The activities of the illustration stations have changed as crops and practices in the area have altered. Fertilizing of pastures has been emphasized and this, with studies of hay and cereal crops, has dominated the work in recent years. The experimental plots have been correlated with cost records in order to encourage better business management of farm operations. Since 1952, G. G. Smeltzer has supervised these stations which, with the advent of the Research Branch, have become project farms. To these have been added other leased agricultural areas where specialized crop studies are in progress.

ENTOMOLOGY

Federal participation in entomological work in Nova Scotia began around 1909 but it was another two years before a small laboratory was established at Bridgetown. A laboratory with improved facilities was opened at Annapolis Royal in 1915 and developed considerably before the staff was transferred to Kentville in 1952.

Entomological Laboratory, Annapolis Royal, Nova Scotia, 1917.

The initial problem at Bridgetown and Annapolis Royal was brown-tail moth, which had recently become established at several sites in western Nova Scotia. Winter nests were collected; the more seriously infested areas were sprayed at appropriate times; parasites were liberated at many locations; and other studies were conducted which together led to the extinction of this insect from the province. The San Jose scale was first discovered in Nova Scotia about 1911. The apple maggot, also found about this period, was confined to a few areas in the western part of the province. However the San Jose scale, found on newly planted apple trees imported from Ontario, was distributed throughout the orchard areas of the province. An eradication campaign against the scale was successful in eliminating this potential pest. No steps were taken against the apple maggot but studies were conducted on its habits and life history, and control measures were worked out. The methods of control suggested in 1914 have since become generally

accepted. Essentially the same methods were recommended in 1960. It is interesting to speculate on what the apple maggot picture might have been today if eradication measures had been undertaken at that time with the same concerted efforts as were used in eliminating brown-tail moth and San Jose scale.

G. E. Sanders was a pioneer in this early work. His special interest in chemical methods of controlling insects led to the Annapolis laboratory becoming the headquarters for "insecticide investigations" for Canada. Working with Mr. Sanders from almost the beginning, on a temporary and intermittent basis, were F. C. Gilliatt, A. G. Dustan, A. Kelsall, S. H. Payne and others. Mr. Kelsall joined the staff permanently in 1918.

From 1917 until 1938 the laboratory at Annapolis Royal divided its operations into several more or less different types of work.

Biological studies

The life history and habits of the more prevalent fruit insect pests were under continuous study during this period. Three or more years were devoted to each insect, although more than one species was under close study at any given time. Bud moths, leaf rollers, fruit worms, bugs, aphids, red mites and other insects were studied and the findings published. In some cases attention was also given to predators and parasites.

A. G. Dustan and F. C. Gilliatt found that the European apple sucker was parasitized quite effectively by a fungus. Although the apple sucker caused no serious injury to apple fruits, it did produce a sugary exudate which dissolved the copper from bordeaux mixture, causing a severe burn on apple foliage.

Control measures

In addition to the biological studies at the Annapolis laboratory, experiments were conducted to devise control measures. Some of these experiments gave quick results. But it sometimes took several years to find a reasonably satisfactory control for a given species. The results were subsequently published and the recommendations incorporated in spray calendars.

Chemical investigations

Chemical investigations were begun at Annapolis Royal in 1918 and augmented in 1923 by the seconding of F. A. Herman from the Chemistry Division, Ottawa, to supervise laboratory work.

In the early days of spraying, phytotoxic materials caused many foliage injuries. These arose partly from the nature of the insecticides then in use, and partly from faulty manufacturing techniques. A method was worked out for predetermining whether any given arsenical would

cause injury when used alone or in combination with a fungicide. A service was then established that offered to examine all materials prior to use in the area. This not only prevented much damage but led to the standardization of arsenical insecticides.

Some pure chemicals were made—in some cases for the first time—and many of their physical and chemical constants were determined. Considerable analytical work was done to study spray residues on fruits in relation to the dates and dosages of spray applications. The effect on human safety of arsenical dusts inhaled during dusting or dust mixing, was studied.

It had generally been presumed that nicotine sprays remained toxic for only a short period after application, but a study showed that a residual toxicity remained for weeks. On the undersides of leaves and in similar locations it might continue for months.

Fundamental studies were made on the chemistry of arsenicals and particularly on the absorption of soluble arsenicals by basic iron and copper compounds. From these studies it was deduced that sodium arsenite and arsenate, white arsenic, calcium arsenate, etc., could be safely used in certain fungicide mixtures under appropriate conditions. The Annapolis laboratory was the first to offer a safe method for using calcium arsenate on fruit trees, and also to urge the adoption of acid lead arsenate for orchard spraying.

Insecticide-Fungicide Investigations

Insecticide-fungicide investigations at Annapolis have generally entailed a combination of laboratory and field projects. Until about 1918, Bordeaux mixture was universally made from stock solutions. A project to speed up this tedious process led to the present-day method of dissolving finely crystallized or pulverized copper sulphate directly in spray tanks and adding hydrated lime after the copper is in solution. This procedure was first known as the "quick time" Bordeaux. In the "quick time" method some crystallized copper sulphate was dehydrated to the monohydrate form, then mixed with hydrated lime and put into a spray tank. The resulting Bordeaux mixture was very satisfactory, but soon after a similar material was tried as a dust. First used in a greenhouse during the winter of 1917-18, it was tried extensively in 1918 in both apple orchards and potato plantings with satisfactory results. Thus was born Bordeaux dust, then known as copperlime dust, shortly to be made and used in large tonnage all over the world.

A number of other dust mixtures were devised and tested, and for many years tests were run to compare the advantages of dusting and spraying for field crop pest and disease control.

Some attention was devoted to dusting equipment, and a fan, reconstructed to give a greater air blast, was subsequently adopted by most manufacturers.

Until about 1919 the Bordeaux mixture used in apple orchards was of the 4-4-40 formula, but it caused much foliage yellowing and defoliation. A chance observation led to a series of experiments on copper-lime ratios which culminated in the adoption of a formula containing three times as much hydrated lime as copper sulphate, nontoxic to apple foliage.

Lime sulphur was a popular fungicide at the time but had disadvantages. The first report from Annapolis, that lime sulphur not only damaged foliage but in some cases caused a serious drop of fruit, was considered rank heresy by most authorities in North America. Similar reports from England later confirmed these observations and led to their general acceptance. Following these observations, attempts were made to continue the use of lime sulphur by devising various ways of minimizing or eliminating the bad features. The aluminum sulphate—lime sulphur and the iron sulphate—lime sulphur mixtures emerged from this investigation. The "iron mixture" was widely used for some years. Incidental to this, it was found that calcium arsenate was a necessary part of the iron mixture from a fungicidal standpoint—an observation also made with other arsenicals in spray mixtures.

Many experiments on the compatibility of various insecticides and fungicides followed. Sulphur was tested in many forms, as were several cupric and cuprous compounds. The fungicidal value of a number of materials based on cobalt, nickel, tellurium, selenium, silver, the halogens, coal tar and other oils was studied in the orchard.

Insecticide Investigations

Studies on insecticides embraced a combination of chemical investigations, laboratory testing and field trials. For a considerable period the laboratory staff acted as a consultant agency to other insecticide workers in Canada.

For two years members of the staff worked seasonally in Western Canada on chemical control of grasshoppers and gophers. In 1920 the use of chlorine gas was recommended for gopher control. An alternative method was the piping of carbon monoxide from the exhaust of a motor vehicle, but by 1921 the use of calcium cyanamide was found most satisfactory.

Apparatus for laboratory and field testing of a variety of insecticides was devised and constructed as required and included vaporizers and several types of olfactometers.

When soil insecticides and fumigants were studied in efforts to control wireworms, it was found that allyl isothiocynate worked well in sandy soils but was ineffective in others. Mosquito control was found to be more satisfactory with derris or pyrethrum dusts than with oil sprays.

A systematic study was made of a great many chemical compounds, plant materials, etc., reputed to be poisonous, to determine their possible value as insecticides. Most of them proved of little practical value. Among those considered unusable at the time, because of hazardous properties, was a material either identical to or closely related to parathion.

During a study of oils as insecticides it was found that after proper emulsification saturated oils were safe on foliage, but unsaturated oils were more toxic to both insects and foliage and hence could be used only in dormant sprays.

A successful method was found for treating Nova Scotia hardwood lumber with either zinc chloride or sodium fluoride to protect it from termites in tropical countries.

About 1923, work with derris was undertaken following reports on the material from a Malay rubber planter. The finely ground roots were found highly toxic to many insects, but comparatively nontoxic to higher forms of life. Some work was also done on the physical and chemical properties of the active principle—a phase later followed up by F. Tatterfield at Rothamstead and others. The work led to the rapid commercialization of derris and of its active ingredient rotenone.

Mr. Kelsall accepted the position of superintendent of the Experimental Station, Kentville, in 1938, and A. D. Pickett took charge of the Annapolis laboratory in 1939. A few years later the entomological research program was altered and focused entirely on ecological studies of apple pests in relation to their total environment.

Insecticide investigations were supervised by N. A. Patterson while F. T. Lord, A. W. MacPhee and H. B. Specht specialized in ecological studies; H. T. Stultz followed the bionomics of apple insects; H. J. Herbert, C. R. MacLellan and C. D. Dondale devoted their attention to mites, codling moth and spiders respectively. Other orchard insects were allotted to K. H. Sanford, whereas R. P. Jaques studied the diseases of insects.

Ecological studies with fauna in their natural environment are complicated by many factors. When it was found that some spray materials were toxic to the parasitic and predaceous insects and mites affecting orchard pests, investigations were amplified to determine the influence of climate, birds, and other fauna on the presence and prevalence of insects and mites in orchards. The studies were further stimulated by the availability of a great variety of organic pesticides which have appeared on the market in recent years, making possible the choice of selective insecticide applications where required. Many of the newer fungicides have been found to interfere much less with beneficial insect populations than some of the older materials. These investigations are harmonizing chemical and biological control methods and making possible a more judicious and selective use of insecticides. They are also cutting the costs of pest conrol borne by growers.

Due to a great reduction in apple acreage in the Maritimes since the Second World War, other agricultural crops have taken the place of many orchards, and the damage to field and vegetable crops by wireworms has demanded attention. A field crop insect unit was added to the laboratory in 1950 with C. J. S. Fox appointed to tackle the wireworm problem from both the biological and chemical control points of view. As chemical control recommendations are now reasonably satisfactory, more attention is being devoted to ecological studies on these pests.

The practical results from these many studies through the years have appeared in papers presented at fruit growers' meetings and have been published in the annual reports of the Nova Scotia Fruit Growers' Association and other journals. They have led to improved standard farm practices in the Maritimes, and have been closely followed by research workers elsewhere. The papers provide a most interesting history of pest control in Nova Scotia apple orchards.

PLANT PATHOLOGY

After several years of prompting from the fruit growers of the Annapolis Valley, the plant pathology laboratory was established at Kentville in 1924 with J. F. Hockey in charge. Its immediate problems were the control of apple scab, bitter pit and limb cankers of fruit trees. In 1926 K. A. Harrison was appointed assistant and took over a share of the projects. Further requests for studies on diseases of vegetable and other crops increased the load on the staff. This was eased when a new laboratory was built in 1936 and further staff and greenhouse facilities were added.

Apples were then the most important crop in the Valley and apple scab was the first problem to be investigated. The life history of the fungus, infection periods and timing of fungicide applications were of immediate importance to orchardists. As soon as the need for earlier and more thorough spray applications was established, a spray bulletin service was inaugurated to supplement the information given in published spray calendars.

From 1925 to 1938 spray plots for testing fungicides and insecticides were established at the Station and in commercial apple orchards in cooperation with the entomological laboratory at Annapolis Royal. Records of the many materials and schedules employed may be traced through the reports of the Nova Scotia Fruit Growers' Association during that period. Lime sulphur was succeeded by the lime sulphur—aluminum sulphate mixture. The iron sulphate-lime sulphur mixture followed, and the gaps in its black spray deposit were a painful demonstration of the results of faulty spraying techniques. Next came flotation sulphur which rivaled the iron mixture in popularity until sulphur fungicides were gradually crowded out of the picture by organic fungicides.

The timing of fungicide applications in relation to the infection periods of fungi has always been of major interest to pathologists and growers alike. With the advent of the organic mercury fungicides a new tool for the control of apple scab became available. Kentville was the first laboratory in Canada to recommend the use of the organic mercuries for the control of scab after infection periods. An assortment of protectant and eradicant fungicides has made possible more effective control of apple scab than ever before. However, thorough investigations on the response of apple varieties to the application of many organic fungicides under different climatic conditions are still needed. There are indications of selectivity in the effectiveness of the newer materials. It is apparent that the same empirical knowledge will have to be secured as for Bordeaux mixture and lime sulphur. Unexplained injuries to fruit and foliage still occur in orchards, and the control of many minor fungus diseases of apples has not been obtained. The field is wide open to the student of fungi and fungicides.

Breeding apples for scab resistance was started by Kentville plant pathologists in 1928, but it was soon found that future Burbanks were not to be encouraged outside the discipline of plant breeding, and so the work was dropped. It is interesting to note that this phase of apple breeding was revived 20 years later!

Flat limb of Gravensteins and false sting of apples were found by Hockey to be of virus origin. The latter disease made the fruit worthless, but a successful campaign eliminated affected trees from Nova Scotian orchards. Mosaic still remains but has not seriously reduced the production of fruit of most varieties. Moldy core of apples was found to be the result of a structural weakness in the calyx end of susceptible varieties.

Storage diseases of apples have taken their toll of fruit in the past. Recent investigations have pointed the way toward cultural and handling methods that reduce these losses. Some fungal rots of apples in storage have been suppressed by fungicide treatments applied to the orchard.

Diseases of several other fruit crops have been investigated in an effort to find the best time for fungicide applications. Black knot of stone fruits was affecting peach trees and its control was improved by the use of thiram. Captan was found to be a better remedy for brown rot of strawberries than sulphur. The severe defoliation of currants by blister rust was largely prevented by applications of dichlone before the liberation of aeciospores from the fungus lesions on white pines.

A gray mold wilt of raspberry canes was found to be caused by a strain of *Botrytis cinerea* particularly prevalent in sawdust-mulched plantings. Sanitation and applications of ferbam at the time of fungus sporulation in the spring reduced losses from this organism.

The early testing of the club-root resistance of swede turnips in Nova Scotia was done by the laboratory staff until the Herning strains of Bangholm swede and the Wilhelmsburger were recommended and

introduced to growers. Swede turnips had other problems. Rhizoctonia and virus diseases seriously interfered with seed production in the Deep Brook area. Control methods were worked out, but grass ensilage had largely replaced swedes for winter stock feed, and seed production disappeared in the area.

The *Sclerotinia* wilt organism has been a consistent fungus parasite affecting many crops. First encountered in hemp and sunflower plantings at the Station, it has since appeared in beans, peas, carrots, lettuce, tomatoes, cabbage, squash and turnips, and most recently in apples where it has caused a calyx-end rot.

Tomatoes are subject to several fruit and foliage diseases that reduce the yield of marketable fruit. The organic fungicides have been used in various combinations to provide better control, and a newly recommended spray schedule has materially reduced the loss of tomatoes from late blight, anthracnose and Botrytis diseases.

Losses from diseases of ornamentals and other crops have been reduced by seed treatments or cultural and fungicidal treatments recommended as a result of studies conducted at the laboratory. A severe blighting and cankering of willows was identified and recommendations were made for preventing the two fungus diseases present.

Recent years have witnessed a rapid increase in the culture of the native lowbush blueberry. A team of a botanist and a pathologist, working in cooperation with horticulturists, greatly increased our knowledge of this important native plant and the diseases attacking it. Blueberry investigations are still in their infancy, and techniques must yet be devised to cope with many disease problems. Red leaf, a common systemic fungus disease, is one of those awaiting a satisfactory remedy. The many types of leaf spot have not been assigned to causal factors. Since this crop is of increasing importance to the agricultural economy of Eastern Canada its problems cannot be denied serious attention.

Mention should be made of the studies made by K. A. Harrison of the fleshy fungi found in the Annapolis Valley area. He has developed a herbarium of indigenous species, unequalled outside of national organizations, and a collection of transparencies of many of them in their natural habitat. His recent publication on the Hydnums of Nova Scotia has placed him in a small group of authorities in that field.

The laboratory has continually maintained a herbarium of plants and plant diseases found in Nova Scotia, which is of constant value in identifying specimens collected or sent in.

Relations with university staffs have been most profitable in advancing the understanding of plant problems. The published works of H. P. Bell and K. von Maltzhan of Dalhousie University have increased our knowledge of the histology of both apples and blueberries from fruit bud development to fruit formation. Recent studies on seed development in the blueberry have supplemented our previous work.

Acknowledgment should be made of the excellent cooperative assistance in blueberry studies given by the Nova Scotia Research Foundation through the provision of student assistants to the laboratory staff. The Foundation has also strongly supported blueberry research conducted by the Dalhousie University staff.

Laboratory building from rear, showing station greenhouses, 1940. Station office building at the left.

Entomology-Chemistry Laboratory Building, Kentville, Nova Scotia, 1953.

Assistance has been given by the Station plant pathologists to horticultural plant breeders in greenhouse testing of apple seedlings for susceptibility to scab, tomato seedlings to late blight, gooseberry seedlings to mildew, and minor lots of other plants for their disease reactions. The techniques developed have become routine operations and many thousands of seedlings have been tested in the greenhouse. Susceptible seedlings have been eliminated, greatly reducing the time and space required for further testing in the field nursery.

Mention should be made of the advisory services given to farmers, greenhousemen and home gardeners in answer to their many enquiries. These efforts have been time-consuming but they have paid large dividends to the Department in obtaining the goodwill of the taxpayer and his sympathetic interest in the research projects carried on by the staff. Facing farmers in Nova Scotia are many plant pathology problems for which there are no satisfactory solutions. Still others require further investigation to improve the inadequate control recommendations now practised.

The War years witnessed the depletion of the staff as K. A. Harrison, J. A. Boyle, D. W. Creelman and R. J. Baylis took leave of absence to don uniform. On their return Messrs Boyle and Baylis accepted employment in Ottawa, and more recently Mr. Creelman was transferred there. Their places were filled by R. G. Ross who worked on apple diseases and fungicides, C. O. Gourley who studied stone and small fruit diseases, C. L. Lockhart who investigated blueberry problems, and a botanist, I. V. Hall, appointed for ecological and botanical studies with blueberries.

CHEMISTRY

In 1923 F. A. Herman of the Chemistry Division, Department of Agriculture, Ottawa, was seconded to the entomological laboratory, Annapolis Royal, to conduct chemical studies on insecticides and fungicides. He found that there were variations of considerable magnitude in the active ingredients of a number of insecticidal and fungicidal preparations. This led to the passage of the Agricultural Pests' Control Act.

In 1938 Mr. Herman moved to Kentville and took charge of the chemistry laboratory at the Experimental Station. Here, with an enlarged staff, including C. R. MacEachern, D. Chisholm and L. R. Townsend, he continued studies on pesticides and the chemical aspects of various soil fertility and food processing problems. When Mr. Herman retired in 1954 he was succeeded by R. F. Bishop, a member of the staff of the Soil Chemistry Section, Chemistry Division, Department of Agriculture, Ottawa. Under the direction of Dr. Bishop, soil fertility investigations were expanded, and in 1957 the addition of D. K. R. Stewart to the chemistry staff made it possible to initiate additional research on problems arising from the increased use of pesticides.

Although the chemists at Kentville have often assisted the entomological laboratory at Vineland Station, Ont. They have been primarily concerned with problems in the Atlantic Provinces, especially those connected with food processing, soil fertility and pesticides.

Food processing investigations have included studies on the relationship of chemical composition of fruits and vegetables to maturity, flavor and food value; the utilization of immature windfall apples for processing; the vitamin C content of potatoes; the color of potato chips; and methods for appraising apple concentrate. In addition, the chemists have assisted with regulatory work to maintain the quality of processed foods under the Processed Fruit and Vegetable Regulations of the Meat and Canned Foods Act.

Studies in fertility and the closely allied field of plant nutrition have been concerned with changes in the chemical composition of soils. These depend on cropping practices; the use of soil amendments and fertilizers; the relationship between soil composition and productivity; the correlation of soil test values with fertilizer response; the effect of time and rate of nitrogen application on yield and protein content of herbage; lime-potash relationships in soils and plants; and the influence of soil reaction on fertilizer response and on soil productivity.

A major part of the work with pesticides has dealt with their residues, permissible tolerances on agricultural products, and effect on soil productivity and on plant and animal life. Arsenic and DDT were found to accumulate and persist in soil and by so doing became detrimental to the growth of many crops. Some of these substances may be translocated in plants; some leave residues exceeding established tolerances; and for many there is a relatively rapid decrease in pesticide deposits the first few days after spraying.

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