A HISTORY OF POMOLOGY AND VITICULTURE AT GENEVA

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The history of research in the Department of Pomology and Viticulture at Geneva is inextricably interwoven with the history of the Experiment Station itself. For this reason, we must first consider how the Station began and how horticulture became an important part of its research activities.

In the 1870's, New York State had a dozen or more very active farm organizations, many more than it now has in the mid-1980's. The leaders of several of those farm societies went to the state legislature and requested that an agricultural experiment station be established. Some of the societies encouraging this were the New York State Agricultural Society, the New York State Grange, the Central New York Farmers' Club, the Elmira Farmers' Club, the Western New York Horticultural Society, and Cornell University (Hedrick, 1933, p. 414).

On June 21, 1880, the New York State legislature enacted a law which stated:

"An institution is hereby established to be called and known as the New York Agricultural Experiment Station for the purpose of promoting agriculture in its various branches by scientific investigation and experiment." The word "state" was added into the Station's name in 1923.

A committee was appointed to decide where the new experiment station should be located. A hundred communities in the State made a bid to have

it located in their town. The chairman of the committee was Peter Barry, a fruit tree nurseryman in Rochester. At that time, there was also a strong fruit tree nursery business in the Geneva area and it was probably due to Barry's aggressive chairmanship of the committee that Geneva was selected as the site.

It was only the fourth state agriculture experiment station in the United States to be established by legislative action. Although the teaching of agricultural courses had begun at Cornell University in 1880, the experiment station at Ithaca was not officially initiated until 1903, more than two decades after the Geneva Station had begun (Colman, 1963).

The original mandate to the Station was to do applied research to help New York farmers. But some farmers thought it would be an excellent place for a demonstration farm where they could see the latest techniques in action. No state experiment stations had yet been sufficiently well established to show how agricultural research should be conducted. But the Geneva Station's first director, E. Lewis Sturtevant, had uncommon insight into what to do. After attempting to do some applied research, he very quickly discovered that it was first necessary to do basic studies before new information could be applied to farm use. Later in 1905, Director Jordan (Jordan, 1905) wrote, "the Station seeks to elucidate and establish on a scientific basis, principles and facts which have an important relation to agriculture as an industry and then to demonstrate how and to what extent these facts may be usefully applied to agricultural practice. Its function is greatly different from that of a model farm. The local name, 'State Farm', is an unfortunate misnomer. A large part of the work is done in laboratories, and the farm itself becomes a laboratory for demonstration and experiment".

In 1984, P. J. Chapman wrote a history of the Experiment Station (Chapman, unpublished). The reader is referred to Chapman's treatise for details about developments in the early years of the Station.

The present chapter addresses the history of just one of the Station's five research departments, Pomology and Viticulture. Also reviewed are the relationships between the development of the Department of Pomology and Viticulture at Geneva and the Department of Pomology at Ithaca.

During its first 41 years, up to 1923, the Station's operations were guided by a Board of Control consisting of the Governor of the State and the Commissioner of Agriculture as ex-officio members and nine other members appointed by the Governor. These nine appointees came from many different areas of the State. For example, in 1886, the Board of Control, in addition to Governor Hill, had members from the following New York cities: Geneva, Ogdensburg, Rochester, two from Elmira, Jamaica, Utica, Lockport and Corning.

On March 1, 1882, Dr. E. Lewis Sturtevant, the Station's first director took possession of the original 125-acre farm. The house on the farm had been built in 1850. The director lived on the second floor, while the first floor was used for offices and research laboratories. At the beginning, the staff consisted of the director, an assistant, a horticulturist, a chemist, and a male stenographer.

In 1923, the State Legislature transferred the administration of the Station from this Board of Control over to Cornell University. The Board was dissolved. The Cornell trustees placed the Station under the jurisdiction of the Dean of the College of Agriculture. In 1948 with the establishment of the State University, the College and the Station together

became a unit of the State University of New York, under contract with Cornell University.

Eleven Station Directors

During its first 102 years, the Station had eleven directors (Table 1). A brief account of the contributions made by the first nine directors was published by P. J. Chapman (Chapman, 1982). The following is a recapulation from Dr. Chapman's summary article.

Table 1. Eleven directors in the first 102 years of the New York State Agricultural Experiment Station, Geneva, NY.

Director	Period	Number of years as director
E. Lewis Sturtevant	1882 - 1887	5
Peter Collier	1887 - 1895	8
Whitman H. Jordan	1896 - 1921	25
Roscoe W. Thatcher	1921 - 1927	6
Frank B. Morrison	1927 - 1928	1
Ulysses P. Hedrick	1928 - 1938	10
Percival J. Parrott	1938 - 1942	4
Arthur J. Heinicke	1942 - 1960	18
Donald W. Barton	1960 - 1982	22
Alexander C. Davis	1982 - 1983	1
Lamartine F. Hood	1983 - present	

E. Lewis Sturtevant was the first director from 1882-87, 5 years. In 1984, 102 years later, the original farm house where Sturtevant lived and worked is still in good condition and is called the Parrott Hall of Science and is designated as a New York State Historic Site.

Sturtevant was born in Maine and as a child he moved to Philadelphia where his parents both died. He served in the Union army during the Civil War, where he became severely ill and returned home. He earned the M.D. degree at Harvard University but he never practiced medicine. Instead, he

and his two brothers bought a farm in Massachusetts where they did extensive experimenting in the growing of agricultural plants and animals. Ayrshire cattle were one of their specialities. Even while experimenting, the farm was operated as a financially profitable business. Sturtevant was a plant and animal scientist and a writer, lecturer and editor of subjects about agriculture. As the Station's first director, he started with a staff of five. In the third year, 1884, it had expanded to nine people (Fig. 1).

Because no other experiment stations had yet shown how to do agricultural research, Sturtevant had to rely on his experience at his own Massachusetts research farm to formulate a new research program at Geneva. He started with horticulture and dairy. He was quick to realize that it would not be possible to cover the entire field of agriculture and that he must concentrate on a few specific aspects. The 125-acre farm already had an orchard of over 1,000 fruit varieties including more than 600 apple, 200 peach and many varieties of several other fruits. Only 16 days after the Station began, Sturtevant hired Goff to be the first horticulturist (Table 3 and Appendix I). Early research included evaluation of fruit varieties for their usefulness in New York's commercial orchards. Studies on the chemistry of milk were begun. Sturtevant's peers had a very high regard for him. The budget for the entire Station was $20,000 annually for the first five years.

The original charge to the Station was to do applied research in agriculture. But after briefly attempting applied research, Sturtevant quickly discovered this was impractical; the science of agriculture must start with basic studies. This fundamental concept has now prevailed for

NEW YORK STATE AGRICULTURAL EXPERIMENT STATION, GENEVA, NY

STATION STAFF 1884

E.S. GOFF G.W. CHURCHILL E.F. LADD

J.C. ARTHUR S.M. BABCOCK. E.L. STURTEVANT

F.E. NEWTON C.S. PLUM M.H. BECKWITH

Fig. 1.

more than a century. Even now, in 1984, two-thirds of the Station's effort is still in basic research and only a third applied.

Although many New York agricultural leaders were delighted with the establishment of a new experiment station in their State, some farmers felt that they already knew how to farm and that they did not need anyone to research the subject for them. This attitude against the Station was reflected in an article published in the New York Sun, March 1887:

> "It is enough to make an earnest American despair of the future of democracy in America to see the ease with which a few men, hating to work for their own living and determined to live on the Government, succeeded in putting a law through our Legislature to set them up, with $22,000 a year income, in the fraudulent business of conducting agricultural experiment to improve New York farming. From top to bottom, the bill, the Station, and its operations have been a fraud on our farmers and taxpayers.....In the name of New York's insulted farmers and in the name of good government, we demand of the Legislature to abolish the Geneva Agricultural Experiment Station. It is a humbug." (Hedrick, 1933).

Even today, 1984, citizens in the City of Geneva sometimes teasingly refer to the Experiment Station as "the State Farm".

Peter Collier, M.D. and Ph.D., was director for 8 years, 1887-95 (Table 1). He was a chemist, as were Jordan, Thatcher and Morrison, the three who followed him as directors. Collier expanded programs in fruit variety, beef, poultry, and swine research. During his directorship, the

Station began to analyze feeds and fertilizers for their accuracy of analysis labeling. Collier built a cattle barn, the chemistry building, new greenhouses and a fruit storage (Appendix II). Under his direction, the Station made great progress; budgets were more than doubled to $50,000 per year.

Dr. Whitman H. Jordan had the longest term of any director, 25 years, 1896-21 (Table 1). Before coming to Geneva he had established the famous Jordan Fertility Plots at the Pennsylvania State College. He had also served as Director of the Maine Agricultural Experiment Station for eleven years. He was a dedicated scientist who had expertise and an obsession for agricultural research. He believed that research scientists should not be burdened with the job of teaching in a college. He often argued this thesis before the Association of American Agriculture Colleges and Experiment Stations in Washington, D.C. (Knoblauch, 1962).

Jordan increased the Station staff from 15 to 41. He built Sturtevant Hall, the director's residence (Appendix II) and Jordan Hall. Research programs expanded in bacteriology, dairy science, fruit, chemistry, plant diseases and insects. In 1909, a substation was established at Fredonia to do research on grapes (see discussion below). Under Jordan, Geneva became a leading agricultural research station. He successfully projected a pleasing father image toward his staff and his staff's families. Eighty Station babies were born during his tenure (Wellington, 1962).

Roscoe W. Thatcher, also a Ph.D. in chemistry, directed the Station for six years, 1921-27 (Table 1). Previous to coming to Geneva he had been director of agricultural experiment stations in Washington State and Minnesota. It was during Thatcher's tenure in 1923 that the Station became a part of the College of Agriculture at Cornell University (Appendix III).

When this merger occurred, Thatcher was also appointed director of the Cornell Agriculture Experiment Station at Ithaca.

Funds again doubled while Thatcher directed. Some of this additional money came as special grants from the State to establish a branch station for fruit research in the Hudson Valley (see discussion below) and to enlarge the research at Geneva in canning crops, fruit nursery studies and raspberry insects. After leaving Geneva, Thatcher became president of the Massachusetts State College at Amherst.

Frank B. Morrison was director for only one year, 1927-28. While at Geneva, he was also director of the Cornell Agricultural Experiment Station at Ithaca. Before coming to Geneva, he was professor of animal husbandry at the University of Wisconsin. Being an animal scientist, he really did not belong as a director of a horticulture station such as Geneva. He used Geneva as a stepping stone to become head of Animal Husbandry at Cornell. In 1936, he competely rewrote and edited the 20th edition of his famous book, Feeds and Feeding.

Ulysses P. Hedrick was director for 10 years, 1928-38. Previous to becoming director he had been the Station's horticulturist for 23 years, between 1905 and 1928 (Appendix I). As horticulturist, he had written six New York fruit books (Appendix III). Hedrick was the first Station staff member to be elevated to Director. As director, he terminated the Station's poultry research and moved it all to Ithaca. He established divisions (departments). Previous to that no clear-cut department administrative units had existed. Hedrick divided Horticulture into two Divisions, Pomology and Vegetable Crops. In 1936, he established a new Division of Seed Investigation. He built Hedrick Hall in 1930-31. During

the Depression in 1933-34, the State reduced Station funds by 10 percent but despite less money, the quality and quantity of research increased.

Hedrick's tenure was characterized by rather poor and competitive relationships with Cornell University faculty. Hedrick deliberately did nothing to try to improve these poor relationships. As director, he considered himself as a part of "Geneva high society" among the civic leaders in the city. He took pride in belonging to an elite clique of Geneva gentry. Despite these personal traits, he was an outstanding director for the Station.

Mr. Percival J. Parrott was formerly a Station entomologist and served as director for 4 years, 1938-42 (Table 1). He was personally very popular with his staff but he had a characteristic of being unable to make up his mind on matters of difficult decision. The end of the Depression and the beginning of World War II allowed little growth of the Station but research continued to be of a high caliber. Parrott tried heroically to improve the Geneva-Cornell relations which Hedrick had shamefully allowed to deteriorate.

Dr. Arthur J. Heinicke was director for 18 years, 1942-60. Previous to coming to Geneva he had been head of the Pomology Department at Ithaca for 23 years. Dean Ladd of the College of Agriculture chose Heinicke to be Geneva's director because of his long administrative experience at Ithaca. He was to be the strong arm to broaden the horticultural research at Geneva and to further bring Geneva back into the Ithaca camp. He did this very successfully and in 1984, most of the 65 Geneva professors felt that they were very much a part of Cornell University.

In the early 1940's, the administrators of state funds in Albany strongly questioned the wisdom of having dairy research both at Ithaca and

Geneva. Dairy research had been done at Geneva for 60 years but Heinicke moved the dairy cattle to Ithaca and discontinued the Dairy Department at Geneva. The dairy professors were reappointed to chemistry research. The Station was to become a horticultural institute with research emphasis on processed horticultural crops: (a) production methods, (b) pest control, and (c) processing of these crops.

Heinicke's approach toward Geneva's civic leaders was very different from what Hedrick's had been. Although he was sociable and belonged to the Geneva Rotary Club, he felt no obligation to cater to the whims of the townspeople in the management of the Experiment Station. They concluded that Heinicke was sent to dismantle the Station. Eventually, the chairman of the Board of Trustees of Cornell University came to speak to these leaders and assured them that the Station was not in jeopardy; in fact, programs would be expanded.

In 1942 Heinicke had the titles of Station scientists changed. The title of professor was given to those who previously had the title, chief in research and assistant professor to those who had been associate in research and instructor to those who had been assistant in research. In 1945 titles were changed again to professor, associate professor, assistant professor or research associate.

In 1950 Heinicke built the centralized heating plant which provided heat for the greenhouses and all of the office buildings (Appendix II).

In 1957 he upgraded the status of Geneva faculty so they became full voting members of Cornell University faculty.

In 1959 he built the Food Science Building. By combining the faculties of chemistry and bacteriology, he created the Department of Food Science and Technology.

Heinicke was a strong, dictatorial kind of leader. Control of the Station's activities were very much centralized. While other directors might relegate considerable authority to heads of departments, not so with Heinicke who attempted to oversee everything. Unannounced, he frequently approached any worker on the job, from carpenter to professor, and asked him or her to give a full account of what and how he or she was doing the job.

Dr. Donald W. Barton had the second longest tenure of the eleven directors, 22 years, 1960-82 (Table 1). He had been educated at the University of California, Davis. At Geneva he had been professor of Vegetable Crops and was head of that Department for one year before being promoted to Station Director. His regime contrasted with Heinicke's in that he decentralized authority to heads of departments. His was a strong growth period for the Station with large increases in grants received from federal, state, industry and foundation sources. During his tenure, Barton Laboratory for the Departments of Entomology and Plant Pathology was built (Appendix II). Also a new laboratory at Highland in the Hudson Valley was built as well as complete remodeling and refurnishing of Hedrick and Sturtevant Halls. During his directorship, the Station budget increased from $1.8 to $9 million, a phenominal period of growth.

Although Barton increased the professional staff by only eight faculty members from 60 to 68, he instigated a very significant increase of non-faculty workers from 200 to 300. This resulted from a strong new emphasis on the importance of support staff. In the 1940's a joke around the Station stated that there were too many chiefs and not enough Indians. Barton changed that. He provided one or two well trained technicians for nearly every professor. Accomplishments during Barton's rule of 22 years

were greater than the combined accomplishments for all the previous 78 years.

Dr. Alexander C. Davis, entomologist, was acting director for one year, 1982-83.

Dr. Lamartine F. Hood, food science professor and formerly associate director of Cornell Agriculture Experiment Station at Ithaca was appointed director of the Geneva Station, June 1, 1983.

Appendix II lists a chronology of some of the major events in the history of the Experiment Station.

Pomology Had Five Different Department Names

Table 2 lists the five department names under which fruit research has been conducted at Geneva. In the first 47 years there were no departments nor divisions because the Station was small. Financing and day-to-day management could easily be done directly from the director's office. In these early years the research in both fruits and vegetables was conducted under the leadership of the chief horticulturist. Although there was no formally organized horticulture department, indeed, the horticulture group did work together and they had their own designated land areas on the farms, as well as a common group of offices in the buildings.

Table 2. Five names for Pomology Department.

"Horticulture" (departments not yet formed)	1882-1929
Division of Pomology	1929-1953
Department of Pomology	1953-1972
Department of Pomology and Viticulture	1972-1984
Department of Horticultural Sciences	1984-present

Hedrick was promoted to Director in 1928 and one year later he initiated the formation of separate research units, divided according to research discipline. These were designated as divisions for a period of 24

years. Then, in 1953, Director Heinicke changed divisions to departments so that the titles conformed with those used at the Cornell campus.

Because of the large commercial grape industry in New York, the Experiment Station always had a strong viticultural research program. In order to most accurately reflect the types of research being done by the Department in 1972, Dr. Walter Kender, then head of the Department of Pomology, had the name changed to Pomology and Viticulture.

In the 1960's and 1970's, this was the smallest department at Geneva, having only eight research professors in it. Dr. David L. Call, dean of the College of Agriculture and Life Sciences considered this to be too small a unit for best administrative efficiency. When Dr. Roger D. Way, head, Pomology and Viticulture and Dr. Morrill T. Vittum, head, Seed and Vegetable Sciences both retired at the same time in May, 1983, Dean Call initiated procedures to join these two departments into a combined unit, Department of Horticultural Sciences. Thus, we have come full circle in names of the department, Horticulture to Horticultural Sciences.

Pomology Department Heads

Sixteen days after he became the first director of the Station, E. Lewis Sturtevant appointed the first horticulturist. Emmett S. Goff (Fig. 1 and Table 3 and Appendix I) began work on March 17, 1882.

Table 3. Pomology department heads.

Emmett S. Goff	1882-1889
S. A. Beach	1891-1905
Ulysses P. Hedrick	1905-1929
Richard Wellington-head	1929-1942
-assoc. head	1942-1953
Arthur J. Heinicke, Sr.	1942-1960
John Einset-assoc. head	1953-1960
-head	1960-1972
Walter J. Kender	1972-1982
Roger D. Way	1982-1983
Gary E. Harman	1983-present

Table 3 lists chairmen of the horticultural, pomological and viticultural research efforts. In the first 53 years, the work was led by horticulturists, Goff, Beach and Hedrick.

In 1929, one year after U. P. Hedrick became director, he formalized the formation of clear-cut sections. He divided horticulture into two divisions, pomology and vegetable crops. From 1929 to 1953 the fruit section was called the Division of Pomology. Hedrick appointed Richard Wellington to be its head.

In 1942, A. J. Heinicke was appointed director of the Station. Heinicke had been head of the Pomology Department at Cornell University for the previous 23 years and when he moved to Geneva, in addition to the Geneva directorship, he retained the headship of Pomology at Ithaca and also became head of the Pomology Department at Geneva. Wellington was demoted from head to associate head and he retained this lower title until he retired at age 68 in 1953 (Appendix I).

Dr. John Einset was appointed associate head of the Pomology Department in 1953. After Director Heinicke retired in 1960, Einset was promoted to head. In 1972 Einset stepped down from the Pomology headship but before retiring he continued for an additional two years in his grape breeding research.

Dr. Walter J. Kender was appointed Head of Pomology in 1972 and held the position for ten years until 1982. Like Heinicke, Kender served as head of Pomology both at Geneva and Ithaca.

In the 1970's, the College of Agriculture and Life Sciences changed its rules about the period of service by department heads. Previous to that, heads were appointed for indefinite terms, and could serve in that

position until they retired if they chose to do so. The new system required that a head be appointed for only a 5-year term, after which he must submit to a department and college review. Upon approval, he could be reappointed for a second 5-year term.

Kender completed his second 5-year term and then moved to Lake Alfred, Florida where he became director of the Citrus Experiment Station of the University of Florida.

Kender's regime was distinguished as a period of strong departmental leadership and new initiatives in fruit research. The professional support staff was expanded so that during several periods of a few months each, there were 15 professional staff members in the department.

The strong stature of Kender's leadership of the Pomology and Viticulture Department and the Ithaca Pomology Department is illustrated by his establishment of working groups among the scientists within the two departments. In 1978, working groups were formed to better coordinate the various academic activities. These groups were viticulture, fruit breeding, tree fruit culture, small fruits, extension, graduate studies and curriculum.

After Kender's resignation in 1982, Roger D. Way was first appointed acting head and then head. He retired in May 1983.

In May 1983, Morrill T. Vittum who had been head of the Seed and Vegetable Science department for 23 years, since 1960, also retired. Because the heads of two departments, Pomology and Viticulture and Seed and Vegetable Sciences both retiring in May 1983, Gary E. Harman, a vegetable seed microbiologist, was appointed acting chairman of both departments. He

served as acting chairman until July 1, 1984 at which time the two departments formally joined together into the Department of Horticultural Sciences and Harman was appointed as its first chairman.

Professional Fruit Research Staff at Geneva

During the first 102 years of the Geneva Station, 71 people had served on the professional staff to do fruit research. Appendix I lists the names of these people, as well as the years during which time they served, the professional title of each, and in most cases, the kinds of fruit research they did. No attempt is made in this Chapter to give a detailed account of the contibutions which have been made by all of these scientists. For most of them, Appendix I is the only place where they are mentioned.

The Geneva Experiment Station with its nine million dollar budget (1982) produces only two products: new fruit and vegetable cultivars and scientific publications which report new knowledge obtained from research. Perhaps, a third could be listed: teaching. Workers at the heating plant and elsewhere at the Station who stake out their own little kingdoms of influence in their daily work have very little concept that their efforts are for scientific publications, but that is what it is all about.

Generating this new knowledge does not come easily. It takes genuine skill and hard work. A deep interest and overtime effort on the part of many scientists and technicians is required. It is people who make the thing go. Because of this, any history about pomology must be a recognition of the people and how they performed in this setting. Any history must also tell of peculiar personal traits and how the various people interacted with each other during the course of their work. People are the most important aspect of past fruit research (Appendix I).

Of course, the people who have served on the support staffs have been equally interesting. For example, the decades of fully devoted effort

given by Mrs. Cecilia DeWall, head secretary of the Pomology Department is essential in any history. Then, there was the orchard manager, Tony Bruni, whose bullheaded, blustery manner fully exposed his lack of fruit knowledge and lack of interest in the management of the orchards. He was famous for his "Bruni rides". This meant that he would recruit one of his helpers and the two of them would jump in the truck and drive willy nilly from one farm to another, austensibly to review what job needed to be done next but in truth they were simply on a joy ride. Thus, a history such as this really should include the details of these support people.

Fruit Research Programs and Scientific Contributions

Pomological research over a period of a century obviously has gone through a tremendous change from the one-man operation at the beginning to a staff of over 40 people in the Pomology & Viticulture Department in 1984. To obtain a brief insight into some of the early approaches to pomological research the following is borrowed from Jordan's 1905 report (Jordan, 1905): "The Department of Horticulture" (including vegetable research in 1905) "pays most attention to those divisions of horticulture theory and practice which are commercially prominent and important under New York conditions. The Department of Horticulture has under its care and study several thousand varieties of large and small fruits which are growing on the Station farm. It is conducting breeding experiments with certain species of fruits. During several years it has made an important investigation of the self-fertility of grapes. It is now engaged in studying some of the business aspects of fruit growing, such as the management of apple orchards, the commercial value of dwarf apple trees, and the most desirable stocks for American grapes. The cold storage of fruits has received much attention".

The next several sections of this report will discuss some of the fruit research which the department has conducted for more than a century. Emphasis will be given to the people (Appendix I) who did the research and some of their accomplishments (Appendix III) which this writer thinks have been the most notable scientific contributions. Of course, it is dangerous for anyone to attempt to make judgments about what research is most notable. Any other author would make different judgments from those made by this writer.

Appendix IV compares the research projects conducted in 1930 with those conducted 40 years later in 1970.

Goff, the Station's First Horticulturist

Director Sturtevant hired Goff as the first horticulturist (Appendix I). Goff was a vegetable man and presumably he spent much of his efforts on vegetables. However, being the chief horticulturist, he also had responsibilities to do research on fruits. He directed the fruit research which was mainly carried on by his assistants. When the original Station farm was purchased, it had a thousand or more fruit varieties already growing on it. These included more than 600 apple and peach varieties. Consequently, one of the first jobs was to evaluate fruit varieties for their usefulness in commercial fruit growing in New York State. Later, even more fruit varieties were added to the Station's variety collections for evaluation.

Not according to 1st Ann. Rpt. 1882 p. 9 643 apples, 97 peach, 77 pear and 37 cherry trees

Fruit Books of New York

Major scientific contributions were made in th seven fruit books of New York as follows:

The Apples of New York. Vol. I, II. S. A. Be [illegible] Taylor. 1905.

The Grapes of New York. U. P. Hedrick, N. O. Booth, O. M. Taylor, R. Wellington, M. J. Dorsey. 1908.

The Plums of New York. U. P. Hedrick, R. Wellington, O. M. Taylor, W. H. Alderman, M. J. Dorsey. 1911.

The Cherries of New York. U. P. Hedrick, G. H. Howe, O. M. Taylor, C. B. Tubergen, R. Wellington. 1915.

The Peaches of New York. U. P. Hedrick, G. H. Howe, O. M. Taylor, C. B. Tubergen. 1917.

The Pears of New York. U. P. Hedrick, G. H. Howe, O. M. Taylor, E. H. Francis, H. B. Tukey. 1921.

The Small Fruits of New York. U. P. Hedrick, G. H. Howe, O. M. Taylor, A. Berger, G. L. Slate, O. Einset. 1925.

The fruit books were published as annual reports of the Experiment Station.

These fruit books of New York established the Pomology Department as a world authority on fruit varieties, a reputation it still enjoys in the mid-1980's. The Apples of New York, as well as some of the other books, is still (1984) a major source of information about the origin and fruit description of important varieties grown today. Varieties of peaches and small fruits have changed; these two books are less applicable to today's commercial varieties.

Fredonia Branch Station

Chautauqua and other western New York counties have grown grapes on a commercial scale since the early 1800's. In the early 1900's the grape growers of that area went to the state legislature and requested that a grape research station be established. It was started at Fredonia in 1909 and was made a branch station of the Geneva station. Its financing has

been administered through Geneva and its scientists and support staff are members of the Geneva Experiment Station staff.

In 1913 Fred E. Gladwin was hired as the first viticulturist at Fredonia, a position which he held for 28 years, until 1940 (Appendix I). Gladwin made his home in Fredonia and was superintendent of the branch station. He made frequent trips to Geneva to consult with the Geneva director and the chief horticulturist.

Through much of the history of the Fredonia branch station, an entomologist (Fred Taschenburg, until 1983) was also stationed at Fredonia. Research in grape pathology and air pollution have also been carried on there.

In 1941, Archie Merrill was hired (Appendix I) at Fredonia to conduct the viticultural research which Gladwin had been doing. But he stayed only two years and then moved to Washington State where he pursued a career with apples.

In 1944, Dr. Nelson J. Shaulis was appointed viticulturist at Geneva to do grape research at Fredonia and at Geneva. Shaulis elected to live and make his haedquarters in Geneva, instead of Fredonia, and from Geneva he managed the Fredonia viticultural research by making frequent trips there. He felt that it was more important to be in close contact with his administration, to have the stimulative interaction with his fellow fruit scientists and to have close accessibility to a good horticultural library than it was to be in daily proximity of his vineyards at Fredonia. Shaulis was in charge of viticultural research at Fredonia for 36 years, until his retirement in 1979.

In 1975, Dr. Robert M. Pool had been appointed grape breeder at Geneva but after Shaulis retired in 1979, Pool resigned the grape breeder position

and was transferred to the viticulturist position. Along with other viticultural research, Pool was assigned the management of the viticultural research at Fredonia which Shaulis had been conducting.

Hudson Valley Branch Station

Similar to the grape growers in western New York, in the late 1910's the apple growers of the Hudson Valley went to the New York State Legislature and requested that a research station be established in the Hudson Valley to address apple growing problems which were specific for their area. The work was begun in 1920 and Dr. Harold B. Tukey, Sr. was hired as the pomologist in charge of the research (Appendix I). At first there were no headquarters and Tukey rented an office at Vassar College, a women's college at Poughkeepsie. Through the next three decades, the research programs expanded from pomology to include fruit pathology, fruit entomology and the economics of fruit growing. Scientists in all of these areas have been stationed in the Hudson Valley.

Tukey was on the Geneva staff for 25 years, between 1920 and 1944 but he manned the pomology research in the Hudson Valley for only 8 years and in 1927 he elected to be transferred to Geneva to continue his pomology research here.

In 1927, Mr. Lester C. Anderson was hired as pomologist. During a period of about 20 years between about 1935 to about 1955, the Hudson Valley pathologists and entomologists rented an unused school house in Poughkeepsie for their headquarters. It burnt down about 1955. Until that time the Hudson Valley branch station owned no land of its own. The entomologists and pathologists went out to commercial orchards to conduct their research. But Anderson insisted that he needed his own orchards to do his fertilizer experiments. He rented his own orchard in Claverack to

the Geneva Experiment Station. Furthermore, he also rented a room of his own house which he used as his official office. He did not work out of an office at the old school house.

One of the orchards which Anderson owned had only two varieties growing in it, mostly McIntosh and then a few Delicious trees as pollenizers for the McIntosh. Thus, seeds of the McIntosh fruits were nearly all from the controlled cross pollination, McIntosh x Delicious. Soon after Dr. Arthur J. Heinicke, Sr. became Station director at Geneva, he encouraged the fruit breeders to expand their breeeding programs. In 1945, Heinicke ordered Anderson to harvest 20 bushels of apples from his McIntosh trees and take them to Geneva. The fruit breeders, Wellington and Oberle, removed the seeds and started thousands of seedlings from this cross. After a year of growth in the greenhouse, the seedlings were transplanted to the orchards where they began to bear fruits 9 years later. It was from this lot of seedlings that R. D. Way in 1954 discovered the NY 45500-5 selection which was named Empire in 1966 and became widely accepted as a good variety by the commercial apple growers of the Northeast in the 1980's.

Anderson retired in 1953. His position was then filled in 1954 by Dr. Chester G. Forshey (Appendix I). During the next 30 years and more, Forshey made tremendous contributions to pomological research for the Hudson Valley apple growers and for science.

After the Poughkeepsie school house office building burnt down about 1955, the Hudson Valley apple growers formed a corporation for the purpose of assessing themselves for the building of a new laboratory. They put their own money into it and bought a small farm a few miles north of

Highland and constructed an office-research laboratory on it. In subsequent years, they charged rent from Cornell University for use of the facility.

Forshey had a succession of research associates who helped to do research at the lab, including Wayne McKee and Dr. Lee Reich (Appendix I).

Geneva Pomological Facilities

During the entire 102 years of the Geneva Experiment Station, the pomology facilities have been closely tied to the available facilities provided to the entire experiment station. Allocations of land, offices, laboratories, operating funds and all available resources have always been tightly controlled by the Station's director. Throughout the history, pomology has been one of the biggest users of the available land at the Station. This has been because pomology has always had large collections of fruit varieties which require large acreages of land for orchards.

Station Farms, Pomology Nurseries and Orchards

When the Station began in 1882, it was a farm of 125 acres. Appendix II lists some of the additional land purchases. The Crittenden Farm was purchased in 1911. The Darrow Farm on Gates Road was purchased about 1947 and the Lucey Farm about 1960. About 100 acres of the Trickler Farm on Johnson Road was rented from the New York State Fruit Testing Association between 1955 and 1980. Apple seedlings were grown there. In 1983, Cornell University purchased 50 acres of the McCarthy Farm on Pre-emption Road which was rented to the National Clonal Germplasm Repository. In 1984, the Station owned or rented a total of about 700 acres. This included land at Fredonia and Highland. About half of the Station's lands were used for pomological and viticultural research, nurseries and orchards.

Much of the Station's land is poorly drained. This has presented perennial problems in researching the growing of fruit crops. However, administration did well in providing adequate acreage requests for scientists who did fruit research.

Cohn Farm

In 1960 Herman Cohn of Rochester gave a 250-acre farm to Cornell University. The farm is located on the shores of Lake Ontario, about five miles northwest of the village of Sodus. Abe McKee, a commercial apple grower, was engaged to operate it as a commercial orchard. Apples, tart cherries and pears were grown. But the farm was also used for fruit research by both Ithaca and Geneva scientists. Brase conducted long-term apple rootstock experiments. Way had apple selection and variety tests. Cummins had extensive tests of yellow apple selections and varieties on various rootstocks.

Pomology Offices and Laboratories

Fig. 2 shows a view of the Geneva campus about 1965.

In the beginning, the entire staff at the Station had its offices in Parrott Hall. Fruit research was managed there. Later in the late 1910's and 1920's, while Hedrick was writing his famous fruit books of New York, the pomology offices were housed in Sturtevant Hall.

After Hedrick Hall was built in 1931, the pomology offices were moved there where they were housed for more than half a century. Hedrick Hall provided pomological laboratories for such research as taxonomy, cytology, fruit variety evaluation, freezing chambers for cold hardiness studies, tree physiology, tissue analysis for nutrition studies, and many others, even including genetic engineering studies.

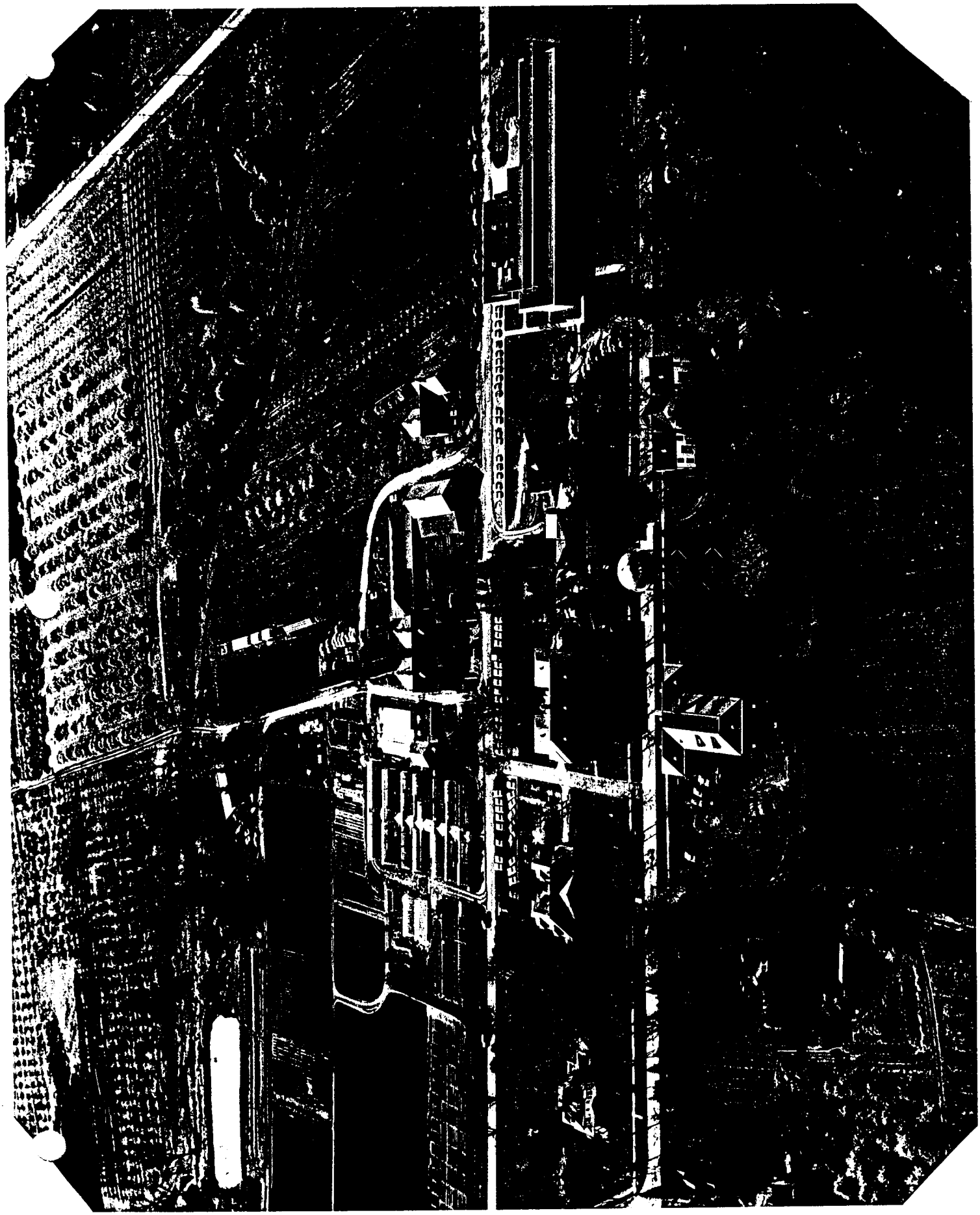

Fig. 2. Campus of the Geneva Station, about 1965.

Greenhouses and Growth Chambers

Throughout the history of the Station, pomology research made considerable demands of the available greenhouse space. Station greenhouses were built and expanded in 1893, 1897, 1931, 1949, 1953 and about 1960 (Appendix II). Pomology always used several houses for the starting of fruit plants in the spring. Large numbers of seedlings for the breeding programs of several kinds of fruit were annually started. Every spring, every square foot of greenhouse space was utilized for starting fruit plants. The houses were less utilized in late summer and in the fall.

Five walk-in growth chambers capable of accurate control of light, temperature and humidity were installed in the basement of Hedrick Hall about 1968. These were used for physiological, virus heat treatment and air pollution studies on fruit plants. However, the electronic control systems on these chambers were operable for only about three years and after that, the chambers fell into disuse.

Fruit Storages and Raw Products Building

A cold storage for fruit was constructed at the Station in 1895 (Appendix II). Hedrick Hall, built in 1931, was provided with a good cold storage (about 36°F.). This was used for many decades by all scientists, technicians and support staff in the department. About 1950, three large cold storage rooms were constructed in the lower floor of the cow barn. These were used for fruit storage until about 1970. After 1970, fruit was stored in the raw products building. Sophisticated equipment was able to accurately control temperatures at 31°F±1 with high humidities. It provided an excellent storage facility in which the storage life of samples of large numbers of second-test New York numbered apple selections could be evaluated.

Libraries, Interlibrary Loans

The library facilities at the Geneva Station have always been excellent. Equally important has been the attitude of the Station librarians. They have all gone out of their way to do what they could to obtain any book that any professor requested. This sort of personal service is not available in most university libraries. Such library facilities and personal attention enhanced the quality and quantity of research conducted in all departments at the Station. A good system of interlibrary loans was available. From Cornell University's Mann Library almost any title could be borrowed within a couple of days. The Station itself had a large library, including a large collection of old fruit books. Each department maintained a small library of its own. Pomology's library had a small collection of pomological books, many of which pomologists need to refer to frequently. Barton Laboratory housed a good collection of fruit pathological and entomological books and current journals to which pomologists needed to refer occasionally.

Computers

Hand cranked calculators were first acquired by the Station about 1948 and then in about 1950, electric calculators were obtained. About 1969, a Wang computer was installed in Hedrick Hall. It had a central control box with 3 terminals in professors' offices. About 1975, the Station hired Dr. John Barnard, a computer scientist, and a large centralized computer for the entire Station was housed in the Food Science Building. This computer was replaced and upgraded on several occasions between 1975 and 1984. In 1984 pomology had six terminals. Nearly every professor and technician was trained to operate the television screen and the print-out machines. Computer line and storage disk capacities were limited and competitive

between researchers. Professors contemplated purchasing their own individual desktop computers.

Fruit Crops Researched at Geneva - Which, Why?

In the early days, the Station researched poultry and dairy, as well as fruits and vegetables. For a while there were departments of botany and agronomy. When Heinicke came to Geneva in 1943, Dean Ladd at Cornell told him to get rid of dairy and to make Geneva into a horticulture institute. Western New York state had large industries in the growing of processing fruits and vegetables. Thus, it was logical that the Station should concentrate on solving the problems of these industries. Two departments researched the production and growing problems, two departments, pest problems and one department, the problems of commercial processing of fruits and vegetables.

The most research emphasis was placed on those fruits which were of greatest economic importance in New York State, viz., apples and grapes. But some effort was also spent on all fruit crops grown in the State and some effort even on crops which seemed to have commercial potential such as apricots, elderberries, jujube and others.

Geneva-Ithaca Pomological Interdepartmental Relationships

Between 1920 and 1923, W. H. Chandler who was then a professor of Pomology at Ithaca also had a courtesy appointment as pomologist at Geneva (Appendix I).

In the 1920's and 1930's relations between Geneva and Ithaca were somewhat less than cordial. At meetings of the New York State Horticultural Society, Hedrick sometimes contradicted statements which L. H. Bailey had just made to the meetings. Hedrick's noncooperative attitude resulted in considerable competitive spirit between Ithaca and

Geneva. However, in 1943 when Heinicke who continued as head of pomology at Ithaca, was also appointed head at Geneva, the two departments necessarily had to cooperate. Indeed, a very cooperative spirit between Geneva and Ithaca pomologists existed between 1943 and 1984. The families of pomologists at both stations held picnics and banquets together. But equally important, scientists at both campuses joined together to mutually determine which specific research projects each should study.

Cooperation was so good that there was deliberate avoidance of overlap in research efforts. Geneva scientists concentrated on research on fruit breeding, variety testing, herbicides, tree nutrition, cytology and many other subjects, while Ithaca pomologists concentrated on researching the post harvest physiology of fruits, growth regulator effects on fruits and many others.

Processed Fruit Research

In 1942, Dean Ladd at Cornell sent A. J. Heinicke to be director at Geneva and redirect the course of research here. The Geneva Station was to be made into a horticultural research institute. Most of the Station's effort was to be directed toward researching problems of production, pest control and processing of fruits and vegetables grown extensively in western New York. In 1959 Heinicke built a new Food Science building, but before it could be built he had to build a new heating plant in 1950 (Appendix II). More staff members were added to the Department of Food Science and Technology. Between 1950 and the mid-1980's it had the largest staff of all departments at Geneva.

Fruit breeders in Pomology established long-term fruit processing studies in cooperation with the food scientists. In these cooperative

studies, the breeders provided fruit of new varieties and unnamed selections of apple, peach, pear, apricot, grape and others. Food scientists canned the fruit as sauce, slices and juice. After processing, taste panels evaluated the processed products. This was a highly productive cooperative research undertaking. It was on the basis of the results of these evaluations that the Wayne apple, the Cayuga White wine grape and several other fruit varieties were introduced.

Fresh Market vs. Processing Fruit

For fruit grower economic returns, the fresh market price has nearly always been higher than that of fruit sold for processing. Half of New York's annual production of 26 million bushels of apples and nearly all of its grapes are processed. Fruit processing is a large industry and the Geneva research leaned heavily toward solving problems of the processing industry. However, Geneva fruit research was not exclusively for processing. For example, in apple growing, many of the same solutions to problems of tree fertilization, rootstocks and tree training apply to both the fresh and processing industries. Nevertheless, in conferences between Ithaca and Geneva pomologists, there was some trend toward assigning research on fresh market fruit to Ithaca and processing fruit to Geneva. In the Geneva fruit breeding, however, no distinction was made between fresh and processing. For example, Geneva bred fresh varieties, such as Empire and Macoun, as well as processing varieties, such as Wayne and Jonagold.

Fruit Breeding Research

Before a new fruit variety is introduced, its trees should be fruited for many years to make sure that it is truly superior to varieties we already have. This need for long-term testing is the most difficult concept about fruit breeding for most people to understand.

An example is appropriate, here. The cross which produced the Cortland apple (Ben Davis x McIntosh) was made in 1898. This was before the rediscovery of Mendel's Laws of Inheritance (1900) which are so basic to the development of today's science of genetics. Even at that early date, Geneva was actively engaged in an apple breeding program. Cortland was introduced in 1915. It increased in importance for 50 years until about 1965, at which time it ranked third among New York's important varieties. After 1965 it declined somewhat. Similarly, the Monroe apple required 39 years (1910 to 1949) from crossing to introduction.

Apple varieties, apple rootstocks and grapes have received the most intensive expenditure of the department's fruit breeding resources. Other crops also worked on intensely have been strawberries, raspberries and pears. Still other commodities which were bred to some extent included peaches, plums, cherries, apricots, nectarines, gooseberries, blackberries, and elderberries. In 1980 seven scientists were pursuing fruit breeding projects.

Some of the people who did fruit breeding research were as follows (Appendix I, IV). Hedrick (all fruits); Wellington (all fruits but most interested in grapes); Howe (apples, pears, cherries); Slate (small fruits); Van Alstyne (all fruits); Oberle (all fruits); John Einset (chiefly grapes but also apple); Lamb (disease resistant apple, pear, apricot, peach, nectarine); Klein (apple); Way (apple, cherry, elderberry); Kimball (grape); Watson (grape, plum); Hanson (peach, apple); Ourecky (small fruits); Cummins (apple rootstocks); Pool (grape); Sanford (small fruits, genetic engineering); and Reisch (grape).

Geneva pomologists introduced more than 200 new fruit varieties between 1894 and 1983 (Appendix V). Many Geneva introductions have been

widely planted by the commercial fruit growing industry. Look in any nursery catalog and you will find a list of nursery plants of Geneva varieties offered for sale.

Side by side with the fruit breeding programs were programs to test new fruit varieties which had been bred in other states or counties. Such testing of new varieties by the Geneva Station resulted in the widespread acceptance by New York growers of such apple varieties as Idared from the Idaho breeding and Mutsu from apple breeding in Japan.

Wilder Medals for Geneva Fruit Breeding

Beginning in 1873, the American Pomological Society at irregular intervals has awarded the silver and bronze Wilder Medals for outstanding achievements in fruit breeding. Geneva fruit breeding received the following Wilder Medals: 1923-Cortland apple; 1927-Sheridan grape; 1927-June red raspberry; 1929-U. P. Hedrick; 1947-Geneva Station; 1954-R. Wellington; 1958-New York State Fruit Testing Cooperative Association; 1968-G. L. Slate; and 1982-R. D. Way.

Apple Breeding Research

One of the Geneva Station's greatest claims to fame is the new apple varieties which it has introduced. These accomplishments did not come easily but required the intensive and concerted efforts of many scientists, or two or three generations of scientists. Apple breeding started soon after the Station started and has continued without interruption for nearly a century. All of this occurred at a time when most U.S. experiment stations who did apple breeding discontinued their efforts in this field. Geneva and Cornell administrators should be commended in their foresight and willingness to finance these long-term projects. We have not let them

down; they have been duly rewarded in the many excellent varieties which resulted, such as the Empire and Jonagold apples.

S. A. Beach worked mainly on the describing of apple varieties but he also helped start the apple breeding program. He made a few crosses and grew a few seedlings. Just before 1900 considerable apple crossing was done.

After Hedrick became horticulturist in 1905, he quickly became enamored with fruit breeding. He spent much of the department's resources on breeding and encouraged his staff to do the work. In fact, he became overly enthusiastic. He fell into the very tantalizing trap of naming varieties before they had been fully tested. Appendix V shows that Hedrick introduced 12 new varieties of apples in 1914 and in 1915 an additional 6 new apples. Most of these had fruited only a few years before introduction and even then only on their single original seedling tree. They had not been repropagated into second-test orchards for long-term evaluation. Today in 1984, our standards of evaluation before introduction are much more stringent.

During the 1920's and 1930's there were modest breeding programs in several kinds of fruits. These projects were directed by Professor Wellington. Professor Howe aided mainly in the evaluation of apple and pear varieties and seedlings. During this period two bulletins on apple breeding were published: Hedrick and Wellington (1912) An experiment in breeding apples, Bul. 350 and Wellington (1924) An experiment in breeding apples II, Tech. Bul. 106.

When Leo Klein came from Guelph, Ontario to join the pomology staff in 1949, he took charge of apple breeding and made great progress for 13 years until 1962 when he had a fatal heart attack while working in his garden at

home. Klein had taken time out to do an M.S. at Cornell. In his thesis he analyzed Geneva apple crosses. This was published in 1958, Proc. Amer. Soc. Hort. Sci. 72:1-14, The inheritance of certain fruit characters in the apple.

After Klein's death in 1962, Roger Way took charge of apple breeding. Apple breeding was well supported by John Einset, then head of pomology. He provided funds and labor to expand the program. A hundred acres of apple seedlings (more than 25 miles of rows of seedlings, spaced 3 feet apart) were planted on rented land on the Fruit Testing Association's Trickler Farm. (See Way, R. D. 1976. An expanded apple breeding program at Geneva. Farm Research 33(4):8-9). Ten varieties of apples were introduced during Way's tenure: Niagara, Wayne, Spigold, Empire, Jonagold, Spijon, Jonamac, Burgundy, Geneva Early, Early Cortland. In 1971, Way published Search Bulletin Vol. 1, No. 2 which described the 52 apple varieties which the station had introduced from 1914-68.

About 1950, Dr. Robert Lamb started a disease-resistant apple breeding program. He acquired pollen of scab resistant parents from Purdue University and other sources. After a quarter of a century of intensive effort and several generations of crossing and thousands of seedlings, he introduced the Station's first two disease resistant apples, Liberty (1978) and Freedom (1983) (Appendix V).

Viticultural Research and Grape Breeding

Some of the viticultural research and the people doing it were described above in the section about the Fredonia Branch Station. In addition to the grape research at Fredonia, for many decades, considerable grape cultural research was conducted at the Geneva Station and in commercial vineyards in the Finger Lakes area. These studies included such

experiments as balanced pruning, Geneva double curtain, rootstock tests, vineyard replant problems and site-microclimate relations.

Grape breeding was pushed forward by a large and long-term effort by the Department. Wellington had helped Hedrick write The Grapes of New York in 1908. As a result he developed a deep and life-long interest in grapes. There are many different species of grapes and there is a wide range of grape types and flavors, both table and wine. These features stimulate the fancy of anyone who does grape breeding. The challenge to combine characters by hybridization often becomes an obsession to the grape breeder. Since Wellington was department head, he had the power to funnel department resources into his grape breeding project. Hundreds of crosses were made and thousands of seedlings grown.

Many years before Wellington's retirement in 1953, John Einset had also become intensely interested in the grape breeding project and after Wellington retired, Einset headed the work. In 1966, after Keith Kimball came back to the Station for the second time (Appendix I), he was hired to assist Einset in the grape breeding. Kimball assisted for 16 years until his retirement in 1982. Kimball's line was downgraded and filled in 1983 by Mary-Howell Roberts.

After Einset's retirement in 1973, Dr. Robert Pool who had just completed his Ph.D. studies at Cornell was hired to take charge of the grape breeding. However, when Shaulis retired in 1979, Pool left grape breeding and shifted to Shaulis' line in grape culture research. In 1980 Dr. Bruce Reisch who had recently earned the Ph.D. at the University of Wisconsin was hired to fill the grape breeder's line that Pool had abandoned.

The grape breeding project was more fortunate than most research projects because it had not just one highly skilled research associate to

help but two. The second was in the person of John P. Watson. In addition to 70% of his time on grape breeding, Watson was assigned to the modest plum breeding project on which he spent 30% of his time. In addition to one professor and two research associates, grape breeding necessarily continued to require much of pomology's available labor. In the late 1970's large numbers of very highly rated selections had emerged from the program. Third-test vineyards were planted at Geneva and in commercial vineyards in the Finger Lakes Region. Appendix V lists the several dozen grape varieties which the Department introduced.

Rootstocks Research and Apple Rootstock Breeding

Research in fruit tree rootstocks is one of the areas for which Geneva Pomology has gained a world-wide reputation. Beginning about 1915, Geneva Pomology was one of the first to do rootstocks research in the U.S. and we have been a leader in rootstock studies ever since. By 1984, much of the U.S. apple industry had shifted to using size-controlling rootstocks. The techniques for using these stocks were first formulated by our Pomology research.

In 1915 Hedrick published Bulletin 406 reporting many years of work on rootstocks which his staff had done.

H. B. Tukey, horticulturist, was hired in 1920 and at first headed the Hudson Valley Branch Station. However, in 1927 he moved to Geneva where he took charge of the rootstocks research. Tukey wanted to be head of something, so he tried to establish a nursery department which would be separate from the Pomology Department. This antagonized Wellington, then head of Pomology, and he put a block to such a move (Wellington, 1962).

Karl D. Brase was a skilled propagator who had received his training in Germany. In 1930 he joined the staff and worked with Tukey as an assistant in rootstocks research. When Tukey left in 1945 to go to Michigan State University to become head of horticulture there, Brase was promoted to become the rootstocks specialist. After Tukey went to Michigan he wrote a book in 1964 Dwarfed Fruit Trees, Macmillan Co., which is a definitive work on the subject. In the meantime Brase had earned the M.S. degree at Cornell and was later promoted to Associate Professor at Geneva (Appendix I).

In 1967 Dr. James N. Cummins was hired to fill the Brase line. Cummins elected not to do rootstock technique research. Instead, he undertook an intensive, long-term apple rootstock breeding project. He considered the widely used Malling stocks as less than perfect for New York's soils and climate. So, he undertook to breed new apple stocks which could perform well under our environmental and biotic hazards.

Small Fruits Breeding

Almost from the beginning, the Station conducted breeding research on small fruits. Professor George L. Slate began working in Pomology in 1922. Although he at first helped with other projects, he soon became the leader of the small fruits project, a position which he held for 48 years until his retirement in 1969. Slate was the longest tenured person ever at the Station. His contribution to fruit breeding was truly remarkable.

A few years before Slate's pending retirement, Dr. Donald K. Ourecky was hired in 1963 to learn small fruit breeding from Slate (Appendix I). Ourecky resigned in 1979 in order to be able to spend full time on his lucrative oriental antique business. In 1980, Dr. John C. Sanford filled Ourecky's line. Sanford continued with the breeding of strawberries and raspberries. He developed a cooperative arrangement with Dr. Gene J.

Galletta, USDA, Beltsville in breeding for red stele resistance in strawberries. However, Sanford was even more interested in doing gene transfer studies and was able to attract large grants for this new type of genetic engineering research. Appendix V lists strawberry and raspberry varieties which have been introduced by Geneva pomologists.

Breeding Other Fruits

Above, we have discussed Pomology's programs in the breeding of apples, grapes, apple rootstocks and small fruits.

Smaller breeding programs were also conducted on several other fruits. Varieties which have emerged from these projects are listed in Appendix V. Peach breeding was done by Wellington, Oberle, Lamb and Hanson. Pear-Wellington, Oberle, Lamb. Plum-Wellington, Watson. Cherries-Wellington, Howe, Way. Apricot-Wellington, Oberle, Lamb. Nectarine-Oberle, Lamb. Elderberry-Slate, Way.

New York State Fruit Testing Cooperative Association, Inc.

As Pomology's fruit breeding research intensified in the mid-1910's, many new superior varieties were introduced. These created interest among commercial growers who wanted to obtain some trees or plants for trial in their own orchards. Pomology grew a few extra trees in its nurseries but never enough to supply such a big demand. For this reason, the Fruit Testing Association was organized. A nursery was developed to grow larger quantities of these new and noteworthy fruit varieties. The story of the Association's founding and its part in the promotion of new varieties was published by W. J. Kender (1980).

In 1918, through the efforts of U. P. Hedrick and other Station pomologists, as well as some commercial fruit industry leaders, the FTA was organized. It has always been a membership, dues paying organization.

Membership grew for 60 years and in the 1980's there were more than 5,000 members, some in all U.S. states and many foreign countries. The Association and the Pomology Department join together to annually display large exhibits of many kinds of fruits and to host the Association's annual business meeting and fruit growing talk sessions. The Association published annually a catalog of new and noteworthy fruit varieties.

The Association provided a tremendous extension function for the College. It extended the fruit breeding programs. After varieties were introduced by the pomologists, then the FTA took them over and sold plants and trees to amateur and commercial fruit growers. They had a positive and critical influence on the success of the Geneva fruit breeding. Only one other fruit breeding program (Harrow, Ontario) had a similar vehicle to get new fruit varieties into the hands of growers where they could be tested on a larger scale (Western Ontario Fruit Testing Association).

In addition to producing nursery trees of new fruit varieties, the College needs to thank the FTA for answering a tremendous volume of correspondence and questions on how to grow fruits, questions which otherwise the College would have had to answer.

Research in Fruit Nutrition and Physiology

In the 1920's the Station had an agronomy division. One of the chief agronomists was R. C. Collison (Appendix I). In 1930, when U. P. Hedrick was promoted to director, he dissolved the agronomy division and most of its work was shifted to Ithaca. However, Collison elected to remain with the Geneva staff and he was transferred to the Pomology Division. This transfer was the beginning of a long era of soils research with fruit crops. Collison's research dealt with the management of fruit soils so that the maximum yields of high quality fruit could be harvested. Collison

retired in 1945 and became a missionary in Africa where he served for 25 years.

Collison's line was filled by Dr. John C. Cain in 1946 (Appendix I). Cain became widely known for his outstanding contributions in the field of plant nutrition. He studied the uptake of nutrients in fruit plants and analyzed the interactive effect of one nutrient on another inside fruit plants. Cain also studied mechanical pruning and harvesting of trees, as well as orchard and tree designs.

Cain and one of his graduate students published the following milestone paper: Chan, B. G. and J. C. Cain, 1967. The effect of seed formation on subsequent flowering in apple. Proc. Amer. Soc. Hort. Sci. 91:63-68. They found that seeds, not fruits, inhibit flower initiation on apple spurs. Cain retired in 1973.

In 1973, this line was filled by Dr. Alan N. Lakso, a physiologist, trained at the University of California, Davis. Because of his training in plant physiology, Lakso did not do soil or mineral nutrition research but he studied water relations, light absorption and photosynthetic rates in apple leaves as affected by tree training systems. Also, in cooperation with agricultural engineers at Cornell, he studied tree training systems and their effects on the efficiency of mechanically harvesting apples.

Fruit Cultural Research

A distinction is often made between two types of fruit scientists, viz., those who are specialists and those who are generalists. A specialist is one who delves deeply into the science of a narrow area of research such as apple genetics or rates of photosynthesis in an apple leaf. The generalist tries to put the whole body of knowledge together and

then tries to integrate all of the parts into one to make the fruit crop perform its best.

Cultural research is frequently conducted by generalists. Dr. Nelson Shaulis referred to himself as a generalist. He grew the grape vine and then researched the areas where the grape vine seemed to be in most need of help to make it perform its best.

Collison, although a soils specialist was also a generalist and attempted to amalgamate into a single ball of wax, the whole process of growing a good crop of apples.

Pomologists at Ithaca have generally done more fruit cultural research than pomologists at Geneva.

Pomology's Relations with Other Departments

Vegetable Crops. In the first 47 years of the Station, research on both fruits and vegetables was conducted by scientists in the horticulture department (Table 2). In 1929, the horticulture department was dividied into the divisions of pomology and vegetable crops. Fifty-five years later in 1984, these two were brought back together again into the Department of Horticultural Sciences.

Pomology's relations with all other departments have almost always been very cordial, including Vegetable Crops. At such a large institution as this Experiment Station where boundaries of land or machinery were sometimes less than precise, it was inevitable that small disagreements did sometimes arise. However, vegetable research is so very different from fruit research that there was little reason for the two departments to disagree on research methods. Land assignment was another matter. After Heinicke became director, the vegetable scientists thought they were being short changed on good land. Also, there was a small spat about floor space

in the offices. Calculations were made of the economic importance of vegetables and of fruits in New York State. It was found that Veg Crops had proportionally less office floor space relative to pomology than the state's economic ratio of vegetables to fruits.

Relations with Food Science and Technology. Under the section on processed fruit research above, it was explained how Pomology grew 2-bushel samples of potentially new apple selections and Food Science processed and evaluated the canned or frozen products. Similar crop growing and processing evaluation were also done for cherries, pears, apricots, plums, raspberries, grapes, strawberries, and other fruits. The team combination between Pomology and Food Science can be cited as an ideal case of cooperative research.

Plant Pathology and Entomology. Dr. Herb Aldwinckle, chairman of Plant Pathology, worked closely with Dr. Robert Lamb, Pomology, in breeding apples for disease resistance. Lamb managed the making of crosses and starting the seedlings in the greenhouse; Aldwinkle and his technicians inoculated the seedlings with apple scab spores, cedar-apple rust spores, fire blight bacteria and powdery mildew spores. Together, they introduced new disease resistant cultivars, Liberty and Freedom (Appendix VI).

For decades, the Entomology Department applied the complete spray programs to Pomology seedling and variety test orchards. Fig. 3 shows Entomology spraying Pomology's orchards about 1925. In turn, entomologists conducted two-spotted mite studies on blocks of Delicious apples in Pomology orchards.

Integrated Pest Management (IPM) developed into an important Experiment Station effort in the late 1970's. IPM naturally interacted most with Entomology and Plant Pathology but Pomology and Viticulture also

Fig. 3. Entomology workers spraying the Pomology Department's orchards, about 1925.

had strong cooperative relations with the IPM group. College administrators contemplated expanding the concept to integrated production management. Production management, in addition to pests, would encompass the whole of pomology and viticulture, including rootstocks, tree training systems, herbicides, soils, varieties, and much more.

U.S. Dept. Agr. Plant Introduction. Although Plant Introduction was more active in acquiring new germplasm of vegetables than fruits, they also sometimes cooperated with Pomology to acquire propagating wood of new fruits from foreign countries.

National Clonal Germplasm Repository. Because Pomology and Viticulture had maintained a thousand varieties of apples (one of the largest collections in the U.S.) and a large collection of hardy grapes, the USDA selected Geneva to be the site for the National Clonal Germplasm Repository, started in 1983. Most of the apple and grape clones formerly maintained by the Experiment Station were transferred to the Repository for maintenance. In 1984, Mr. Philip Forsline, who had previously researched rootstocks, air pollution and winter hardiness in Pomology, was appointed curator of the Repository.

Financing Pomological Research

Central to any research program is the question of money. Research is not cheap. Well qualified research scientists and technicians are brilliant people and they can command high salaries. Competition between universities for excellent scientists helps to keep wages high. In addition to good salaries, laboratory equipment is generally highly sophisticated and costly.

In 1982, the Geneva Station had a total budget of $9,000,000. About 80% of this came from New York State taxes, appropriations to the Station

being made first to the State University of New York and then through the College of Agriculture and Life Sciences, then to Geneva. About 10% came from federal funds and about 10% from grants. Although money and where it comes from are central issues in making a research program function, no attempt will be made here to analyze Pomology and Viticulture's source of funds or how they were spent.

After Sputnik, the Soviet Union's first satellite, in the 1950's and 1960's expenditures for scientific research expanded dramatically throughout the U.S. Some of this increase trickled all the way down to Pomology and Viticulture. But in the 1970's and 1980's monies again became increasingly tight. For 10 years, the Department was too poor to buy a single new tractor and too poor to buy sufficient chemicals needed for good disease and insect control in their orchards. Personnel was reduced.

Before 1950, grants which were contributed by companies, fruit associations or the Government were not a large source of funds. But by the 1980's, administrators were demanding that scientists should apply for competitive grants to help supplement the funding of their own research.

Unfortunately, Pomology and Viticulture did not do the type of research which appeals to grantors of large sums of money. Who is willing to give a big grant to support a 50-year apple breeding project? Consequently, Pomology's grants were much less than the 10% which was the average for the Station. Most of Pomology's money came from State taxes.

Hatch Funds

Hatch Funds are federal monies which are distributed by the USDA to the 52 state experiment stations to aid in their agricultural research. The U.S. Congress established the Fund in the 1880's and it is increased

annually to approximately cover inflation. Hatch Funds have been tremendously helpful to state stations. However, in New York there was a formula for the distribution of Hatch Funds in which most went to Ithaca and very little to Geneva. So, only enough to support one technician was received by Pomology and Viticulture.

USDA Interregional Research Projects

These projects were established, beginning about mid-1950's, by the USDA to bring together into annual conferences a group of scientists from several states who were doing research in specific disciplines or commodities. For example, weed scientists of the Northeast might hold annual meetings in New York City. Or, agricultural engineers and pomologists who are doing research on the mechanical harvesting of apples might meet to discuss progress of their research. Some of these projects carried some funds with them, others had no funds except travel money. If funds for research were available, then the group would decide which of their members would receive the funding for his research. Geneva pomologists have been recipients of some, but very little, of these funds.

Salaries of Pomological and Viticultural Scientists

Salaries are always a point of contention in any business. However, because there is always a big demand for world renowned scientists such as those at Geneva, salaries have always been reasonably competitive with comparable positions elsewhere. For decades, the Geneva faculty made an annual exercise of comparing comparable rank salaries at Ithaca and Geneva. Almost always, they found the average salary at Geneva was lower than comparable rank at Ithaca. But administrators usually held fast and rarely gave special concessions. Yet, those scientists who did brilliant research were generally elevated in both rank and pay. The cost of living in Geneva

was lower than that in some sections of the county; professors tended to remain stable in their positions for many years. Station scientists' salaries were often about half that of comparable scientists' positions in commercial industry.

Notable Scientific Advances

Scientific advancement is what it is all about. Appendix III lists some advances. This list is not intended to be complete. What is judged to be notable by one observer may be ranked as second rate by another.

Suffice it is to say that Geneva Pomology and Viticulture always enjoyed a world-wide reputation for being one of the most notable. Three areas for which it has been credited with outstanding achievement are (a) more than 200 new fruit cultivars bred and introduced (Appendix V), (b) apple size-controlling rootstocks, and (c) Geneva double curtain pruning of grape vines and mechanical harvesting of grapes.

Fruit Growing Industry of New York

In 1980, New York grew the following acreages of fruits: apples 74,000 A (about 26 million bu.); grapes, 42,000 A (about 173,000 tons); tart cherries, 6000 A; pears, 4000 A; peaches 2700 A; sweet cherries 1700 A; plums 1300 A. Large acreages of strawberries were also grown, as well as lesser amounts of raspberries.

It is the growers of these fruit acreages for which the 40 people at Geneva did pomological and viticulture research. The over-all objective was to solve basic and growing problems and thereby enhance the fruit industry of the State.

In 1875, New York had 18,278,000 apple trees but just over a century later, in 1980, there were 4,554,000 which was less than a quarter. But, New York still produced about half as many apples it had produced a century

earlier. Way et al (1983) reported that in 1935 New York apple yields were 2.5 metric tonnes per hectare but in 1975 they were 16.5 tonnes, a phenomenal increase in per-hectare yields. We like to think that much of this increase in production efficiency was brought about by our research.

Relations With Farmers and Industries

In the early days of this Experiment Station, some farmers saw no need for research in agriculture. They thought they already knew how to farm (see beginning of chapter). But during most of the subsequent history of the Station, relations with farmers improved. Fruit growers who had an experimental inquisitiveness were always eager to try new fruit cultivars introduced from the pomology breeding and testing. Many fruit growers, but not all, have looked to pomology for advice on growing fruit.

U. P. Hedrick was an especially eloquent speaker. In 1919, the eastern New York and western New York fruit growers' societies merged into the New York State Horticultural Society and they elected Director Hedrick to be their first president. This is a good example of growers' confidence in fruit research.

Extension Efforts by Geneva Pomologists

Geneva pomologists have always had a 100% research assignment. Nevertheless, they have always willingly participated in extension efforts. Fruit extension agents throughout the State annually called on some of the Geneva faculty to participate in the winter fruit meetings. All faculty members constantly received a deluge of letters and visitors asking questions which must be carefully answered.

Teaching, Graduate Student Training

From 1950 onward, some of the Geneva faculty taught undergraduate courses in the Pomology Department at Ithaca. Cornell University courses taught by Geneva pomologists in 1983-84 were:

Pomology 302 - Fruit Tree Nursery Operation (J. N. Cummins).

Pomology 307 - Viticulture (R. M. Pool).

Pomology 315 - Fruit Variety Improvement (R. D. Way).

Pomology 402 - Special Topics in Experimental Pomology (A. N. Lakso).

Since 1950, some of the master and doctorate candidates in pomology at Ithaca came to Geneva to do their thesis research under a specific Geneva professor of their own choosing. At any one time in the 1980's, 4 or 5 pomology graduate students were doing their thesis research at Geneva.

Publications

"Publish or perish" was not just a joke; it was very real. If a professor was to obtain tenure and be promoted, he had to publish high quality research papers. Publication is what research is all about. Some scientists are leaches on the scientific community. They do good research but then their results stay in the notebook on the shelf and no one can ever see the information in print. A. J. Heinicke said, "Publishing is like the bitter end of a cigar, the researcher must persist to the end until his results are in print."

In the early years of the Station, research results were mostly published as Station bulletins. In the 1940's and 1950's there were three kinds of bulletins, viz., bulletins, technical bulletins and circulars. Farm Research was published quarterly by the Station between 1934 and 1967. Pomologists frequently prepared articles of general interest for it. Following 1971, the Station published two series of bulletins. The Search series was for technical reports about new scientific research and the New York Food and Life Sciences bulletin (both Geneva and Ithaca) were for

general and grower information. Pomologists published extensively in both of these series. But the most prestigious place to publish research papers was in refereed technical journals such as the Journal of the American Society for Horticultural Science, Plant Pathology, HortScience, Journal of Genetics or comparable journal and pomologists have generally preferred to publish in them.

Appendix VI lists publications which were available from the Pomology and Viticulture Department in 1983.

Pomological Incidents

Many human interest stories could be told about little things which happened in a department which has conducted pomological and viticultural research over a period of more than a century. To finish this report, I shall report only a few.

In 1924 Olav Einset had come from his native Norway to work in our Pomology Division. Then, during the Great Depression in the early 1930's, he made a family visit back to his homeland. Because there was an acute shortage of funds at the Station (the State had lowered everyone's salary by 10%), the director wrote to Einset in Norway and told him he need not return to work. Well, the chief horticulturist had to go to bat for Einset and told the director he must permit him to return, which he did.

Another noteworthy incident relates to the attitude which U. P. Hedrick took toward the use of fertilizers in orchards. Hedrick was a tremendous writer, as is evidenced by the six fruit books of New York and the many other excellent books which he authored. Spending so much time writing, he had little time to do field research. But he did conduct one clean cultivation experiment in the orchard. Most orchards had previously been grown in sod. His experiment showed that when these sod orchards were

clean cultivated, better apple crops were generally harvested. He concluded that tillage is superior. But his conclusions were wrong. After a few years, tillage reduced the soil organic matter and fruit yields then decreased again. In sod orchards, applications of inexpensive nitrogen fertilizers improved the growth and yields. But Hedrick still believed that fertilizers were not essential. He rebutted Geneva and Ithaca pomologists whose studies showed that fertilizers are most essential (Wellington, 1962).

In 1915, Hedrick made another serious error in his recommendations about the impracticalness of using dwarfing rootstocks in commercial apple orchards. His research again came up with the wrong conclusion. He published Bulletin 406 which presented extensive research results of trails using various size-controlling rootstocks on apples. His recommendation was that growers should not try them. How wrong he was! Today, in 1984, a major element of successful apple orcharding is the use of dwarf rootstocks. Efficient production of high-quality apples is greatly enhanced by the use of these size-controlling stocks. About 90% of all apple trees being planted in 1984 in New York are on size-controlling stocks.

Just prior to retirement in 1938, Hedrick's health began to deteriorate. Among other troubles his eyesight bothered him. He went to every eye doctor in Geneva. He thought that he was going blind. He kept his eyes shaded and he asked his wife to read to him at night. Finally, he went to an oculist in Rochester who gave him the right treatment and his eye troubles disappeared (Wellington, 1962).

Another amusing incident involved a 1947 mild confrontation which occurred between Director Heinicke and Dr. Oberle. Heinicke was a widely acclaimed pomologist; Oberle was just a young pomology professor. Heinicke

took it on himself to demonstrate to his entire pomology staff how to prune fruit trees. The demonstration was held in a peach orchard just north of Jordan Hall. With great self assurance, he carefully explained his reasons for every pruning cut. After the demonstration was over, Oberle walked up to the tree and said, "Director Heinicke, this is the way I would prune that tree." Oberle put his foot against the tree and pushed it over. The tree was dead. Oberle resigned to join the staff at Virginia Polytechnic Institute.

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Appendix I. Research scientists in the Pomology and Viticulture Department at the Geneva Station, 1882-1984 (71 people). Source: Station annual reports. Name; academic degree; highest title (to 1984); years on staff (to 1984); and area of research or administration.

Goff, Emmett S. No college degree. Horticulturist. 1882-87. Vegetable and fruit culture and variety tests.

Beckwith, M. H. No college degree. Asst. Horticulturist. 1883-86.

Hunn, C. E. No college degree. Acting Horticulturist. 1889-91.

Beach, Spencer A. M.S. Horticulturist. 1891-05. Wrote Apples of New York books; one of founders of Amer. Soc. Hort. Sci. in 1903.

Paddock, Wendell B.S. Asst. Horticulturist. 1893-99.

Close, Charles P. M.S. Asst. Horticulturist. 1896-99. Became horticulturist, U.S.D.A., Washington, D.C.

Hasselbring, Heinrich B.S.A. Asst. Horticulturist. 1900.

Booth, Nathaniel O. B. Agr. Asst. Horticulturist. 1901-08. Gathered information, helped write fruit books of N.Y.

Taylor, Orin M. No college degree. Foreman in Horticulture. 1901-25. Gathered information, helped write fruit books of N.Y.

Clark, Victor A. B.S. Asst. Horticulturist. 1901-04.

Hedrick, Ulysses P. Sc.D. Horticulturist 1905-28; Station director 1928-38. Author N.Y. fruit books: Grapes, Plums, Cherries, Peaches, Pears, Small Fruits; first president N.Y. Hort. Soc.

Wellington, Richard M.S. Professor and Head of Department 1906-13, 20-53. Fruit breeding; introduced Cortland apple; secretary Fruit Testing Association, 1923-53.

Dorsey, Maxwell J. M.S. Asst. Horticulturist. 1907-10. Became apple breeder at Univ. Ill.

Alderman, W. H. B.S. Agr. Assoc. Horticulturist. 1908-11. Became head, Hort. Dept., Univ. Minn.

Howe, George H. B.S. Assoc. Prof. 1910-55. Described fruit varieties and seedlings.

Tubergen, Charles B. B.S. Asst. Horticulturist. 1911-16.

Anthony, Roy D. M.S.A. Assoc. Horticulturist. 1913-19. Clonal selection of violets; became horticulturist at Penn State Univ.; elected mayor State College, PA.

Gladwin, Fred E. B.S. Chief in Research. 1913-40. Superintendent Fredonia Vineyard Lab; grape culture.

Wellington, Joseph W. B.S. Asst. Horticulturist. 1914-19.

Harlan, James D. B.S. Assoc. Prof. 1918-54. Orchard and small fruit soil fertility; high-nicotine tobacco for insecticides; hop varieties and culture.

Francis, Edward H. M.A. Asst. in Research. 1918-20.

Gaty, Theodore E. B.S. Assst. in Research. 1919-20.

Chandler, William H. Ph.D. Pomologist. 1920-23. Member of faculty of N.Y. State College of Agr. at Ithaca, affiliated with the Geneva Station; became head of Pomology Dept., Univ. Calif., Davis; authored books on fruit physiology and fruit growing.

Sprague, Thomas O. B.S. Asst. in Research. 1920-21.

Tukey, Harold B., Sr. Ph.D. Professor. 1920-45. Fruit rootstocks; became head Hort. Dept., Mich. State Univ.; editor and pres. A.S.H.S.

Clark, Fred R. M.S. Asst. in Research. 1921.

Slate, George L. M.S. Professor. 1922-69. Small fruit breeding; introduced 41 varieties; published 600 articles; longest tenured faculty member (48 yrs.).

Berger, Alvin Ph.D. Assoc. in Research. 1923-26.

Einset, Olav M.S. Assoc. in Research. 1924-39. Determination of cross- and self-incompatibilities in fruit varieties.

Van Alstyne, Lewis M. B.S. Research Assoc. 1926-48. Assisted variety testing and breeding of grapes, peaches, apricots.

Anderson, Lester C. B.S. Assoc. Prof. 1927-54. Fruit variety testing; orchard fertilizer and culture experiments.

Van Eseltine, Glen P. A.B. Assoc. in Research. 1927-38. Fruit taxonomy; breeding crabapple, squash, pumpkin.

Collison, Reginald C. M.S. Professor. 1930-45. Soil management for maximum fruit yields.

Nebel, Bernhard R. Ph.D. Asst. Prof. 1930-42. Fruit cytology.

Brase, Karl D. M.S. Assoc. Prof. 1930-66. Size-controlling fruit rootstocks; pome fruit viruses; virus-free certified fruit stocks.

Oberle, George D. Ph.D. Assoc. Prof. 1939-48. Fruit breeding; became horticulturist at VA Poly. Inst.

Nebel, Mrs. Mabel R. Ph.D. Asst. in Research. 1939-42. Aided Nebel in fruit cytology.

Merrill, Thais A. Ph.D. Assoc. in Research. 1941-42. Superintendent Fredonia Vineyard Lab.; grape culture.; became apple researcher in Wash. State.

Titcomb, Eunice B.A. Asst. in Research. 1941.

Sparrow, Arnold W. Ph.D. Asst. in Research. 1942.

Heinicke, Arthur J., Sr. Ph.D. Simultaneously Prof. and Head of Pomology Dept. at Geneva and Ithaca and Geneva Station Director, 1942-60; Fellow and president Amer. Soc. Hort. Sci.; fruit physiology.

Einset, John Ph.D. Prof. and Head of Dept., 1942-73. Cytogenetics; fruit breeding; Cayuga White grape; Fellow Amer. Soc. Hort. Sci.

Shaulis, Nelson J. Ph.D. Professor. 1944-79. Viticulture; Fellow Amer. Soc. Hort. Sci.

Hamner, Charles L. Ph.D. Asst. Prof. 1944. Discovered herbicidal action of 2,4-D.

Carlson, Robert F. B.S. Research Assoc. 1944-46. Assisted Tukey; became fruit rootstock authority at Mich. State Univ., founder (1958) and exec. sec. Intern. Dwarf Fruit Tree Assn.

Bennett, Henry O. No college degree. Pomology Investigator. 1944. Became manager of N.Y. Fruit Testing Assn. 1955-1980.

Bledsoe, Roger W. Ph.D. Asst. Prof. 1946-47. Cytology.

Curtis, Otis, F., Jr. Ph.D. Assoc. Prof. 1946-80. Fruit tree physiology; herbicides in fruit plantings.

Tomkins, John P. Ph.D. Assoc. Prof. 1946-49 and 1954-62. Small fruit culture; transferred to Dept. Pomology, Ithaca.

Cain, John C. Ph.D. Professor. 1946-73. Fruit plant nutrition; mechanical pruning and harvesting; orchard and tree design; pres. NE Amer. Soc. Hort. Sci.

Lamb, Robert C. Ph.D. Professor. 1948-present. Breeding disease resistant fruit varieties; pres. Amer. Pomological Soc., 1981-82.

Rodney, David R. Ph.D. Asst. Prof. 1948-53. Rootstocks; moved to citrus research, Univ. Arizona.

Klein, Leo G. M.S. Res. Specialist. 1949-62. Apple breeding.

Way, Roger D. Ph.D. Professor and Head of Dept. 1949, 1953-83. Apple and cherry breeding; introduced Empire apple; awarded Wilder medal.

Kimball, Keith H. M.S. Research Associate. 1950-57, 1966-82. Grape culture, breeding.

Forshey, Chester G. Ph.D. Professor and Super. Hudson Valley Lab., 1954-present. Orchard management practices for eastern N.Y.

Hanson, Kenneth W. Ph.D. Asst. Prof. 1954-60. Peach and apple breeding; became director Mountain Grove Fruit Expt. Sta., MO.

Powell, Loyd, E., Jr. Ph.D. Asst. Prof. 1955-61. Hormonal aspects of shoot development; transferred to Pomology Dept., Ithaca, 1961.

Pratt, Charlotte S. M.A. Senior Res. Assoc. 1951-81. Fruit anatonomy, cytology, genetics.

Dennis, Frank G. Ph.D. Asst. Prof. 1962-68. Growth hormones in fruits; became horticulturist at Mich. State Univ.

Ourecky, Donald K. Ph.D. Assoc. Prof. 1963-79. Small fruits breeding; introduced Heritage, Brandywine raspberries.

Cummins, James N. Ph.D. Professor. 1967-present. Breeding apple rootstocks.

Kender, Walter J. Ph.D. Professor and Head of Pomology, Geneva and Ithaca, 1972-82; Fellow Amer. Soc. Hort. Sci.

McKee, Merle W. M.S. Research Assoc. 1969-80. Assisted Forshey at Highland.

Lakso, Alan N. Ph.D. Assoc. Prof. 1973-present. Physiology and mechanical harvesting of apples.

Pool, Robert M. Ph.D. Assoc. Prof. 1974-present. Viticultural management.

Musselman, Robert C. Ph.D. Research Assoc. 1976-80. Air pollution injury on grape leaves.

Sanford, John C. Ph.D. Asst. Prof. 1980-present. Small fruit breeding; pollen-mediated gene transformation.

Reisch, Bruce I. Ph.D. Asst. Prof. 1980-present. Grape breeding.

Goffinet, Martin C. Ph.D. Res. Assoc. 1982-present. Fruit plant structure.

Reich, Lee A. Ph.D. Res. Assoc. 1982-84. Mycorrhizae and root growth of fruit plants.

Appendix II. Chronology of some major events at the New York State Agricultural Experiment Station, Geneva, NY.

1880 - New York State Legislature passed the law establishing the New York Agricultural Experiment Station to be governed by a 10-member Board of Control.

1882 - Station began operations on March 1.

1888 - Large cattle barn built.

1892 - Chemistry laboratory built.

1893 - Greenhouse built.

1895 - Fruit cold storages built.

1896 - Triple dwelling house on North Street built.

1897 - Poultry house and more greenhouses built.

1898 - Sturtevant Hall built.

1901 - Director's residence built.

1902 - Parrott Hall converted to administration building.

1902 - Fire destroyed three barns and two poultry houses.

1903 - Cattle barn built.

1904 - Horse barn built (torn down in 1983).

1904 - Fire protection system installed.

1905 - Storage building built.

1907 - Five dwelling houses built on Castle Street.

1909 - Fredonia grape branch station established.

1911 - Crittenden Farm purchased.

1918 - Jordan Hall built.

1920 - Hudson Valley branch station established.

1923 - Station's administration transferred to Cornell University; Board of Control dissolved.

1929 - Horticulture research divided into Divisions (departments): Pomology and Vegetable Crops.

1929 - Poultry research discontinued at Geneva; moved to Ithaca.

1931 - Hedrick Hall built.

1931 - Greenhouse range built.

1936 - Division of Seed Investigations established.

1943 - Cornell Fruit Breeding (Darrow) Farm purchased.

1949 - Loomis Farm, 75 acres, purchased.

1949 - Greenhouses built.

1950 - Heating plant built.

1953 - Greenhouses built.

1957 - Geneva professors became full voting members of Cornell University faculty.

1958 - Chemistry building torn down.

1959 - Food Science Building built.

1960 - Lucey Farm on Sutton Road purchased.

1962 -
1977 - Half of Trickler Farm on Johnson Road rented from Fruit Testing Association.

1968 - Growth chambers installed in basement of Hedrick Hall.

1968 - Barton Laboratory (Entomology, Plant Pathology) built.

1970 - Raw Products Receiving Center and cold storages built.

1971 - Refurbishing Hedrick, Sturtevant, Jordan Hall.

1976 - General service office, carpenter shop, vehicle repair garage built.

1982 - Farm services building built.

1983 - National Clonal Germplasm Repository farm on Pre-Emption Road purchased.

1984 - National Clonal Germplasm Repository offices, laboratories and greenhouses built.

Appendix III. Some fruit research accomplishments at Geneva.

1882 - Orchard purchased containing 600 cultivars apples; fertilizer and thinning experiments begun.

1894 - 'Hunn' strawberry, first fruit cultivar named.

1900 - 700 apples in collection.

1906 -
1912 - Bulletins on fruit growing.

1909 - Fredonia Substation begun by Legislative action.

1914 - 12 apples named.

1915 - 6 apples, including 'Cortland' named.

1914 -
1919 - Grape rootstock research.

1918 - Fruit Testing Association formed.

1923 - Hudson Valley Substation begun by Legislative action.

1921 -
1927 - Fruit breeding expanded.

1926 - 'Stanley' plum introduced.

1932 - 'Indian Summer' raspberry introduced, first fall-bearing.

1934 -
1940 - Pollination studies.

1942 - 2, 4-D selective herbicide discovered (Tukey, Harman paper).

1942 -
1949 - Fruit cytology research, spontaneous triploidy discovered.

1953 - 'Geneva' strawberry introduced, first everbearer.

1955 - Discovery of pollen transmission of viruses (Way, Gilmer paper).

1950 -
1960 - Mineral nutrition studies (Cain papers).

1920 -
1960 - Apple rootstock research (Tukey, Brase).

1955 -
1960 - Balanced pruning of grapes (Shaulis).

1960 - Geneva double curtain training of grape vines (Shaulis).

1960 -
1970 - Expanded facilities and personnel.

1963 - Psylla resistance in pears (Lamb, Harris).

1960 -
1970 - Grape mechanical harvesting (Shaulis).

1964 - 'Heritage' red raspberry introduced, fall-bearing, widely grown (Ourecky).

1966 - 'Empire' apple introduced, widely grown (Way).

1971 -
1984 - Apple rootstock breeding.

1975 - 'Liberty' apple introduced, first disease resistant cultivar (Lamb).

1977 - 'Cayuga White' grape introduced, first Geneva white wine grape (Pool, et al).

1975 -
1982 - Air pollution research (Kender, Musselman, et al).

1975 -
1982 - Apple mechanical harvesting (Lakso, et al).

Appendix IV.

A. Research projects conducted by the Pomology Division, 1930.

Orchard response to nitrogenous fertilizers.

Factors affecting fruit tree yields.

Nitrogen and water relations in legume and non-legume crop rotations.

Nitrogen relations in unproductive soils.

Soil profile studies.

Variety tests of fruits.

Fruit breeding: apple, grape, cherry, pear, plum, peach, nectarine, apricot, strawberry, raspberry.

Pollination experiments.

Cytological methods and chromosome morphology of fruits.

Xenia and metaxenia in apple.

Distinguishing mazzard and mahaleb cherry stocks.

Grape culture studies.

Nursery investigations.

B. Research projects conducted by the Pomology and Viticulture Department, 1970.

Virus diseases of deciduous fruit trees and their control. (J. N. Cummins)

Production and maintenance of virus-free foundation stock of commercial fruit varieties for the nursery trade. (J. N. Cummins, in cooperation with Plant Pathology at Geneva and Ithaca)

Detection of latent viruses of apple and pear. (J. N. Cummins, in cooperation with Plant Pathology at Geneva)

Histological, cytological and genetic problems in the breeding of fruit plants. (D. K. Ourecky, C. S. Pratt, and J. Einset)

Nutritional interactions in fruit trees. (J. C. Cain)

Grape response to leaf area, leaf exposure, and temperature. (N. Shaulis)

Weed control in fruit plantings. (O. F. Curtis, Jr.)

Improvement in efficiency in harvesting apples. (J. C. Cain)

Development of flowering in fruit plants. (W. J. Kender and O. F. Curtis, Jr.)

Breeding disease resistant tree-fruit varieties. (R.C. Lamb, in cooperation with Plant Pathology at Geneva)

Variety test of fruits. (J. Einset)

Breeding and variety testing of minor fruits and nuts. (D. K. Ourecky)

Apple breeding. (R.D. Way, J. Einset and D. K. Ourecky)

Breeding improved varieties of apricots, nectarines, peaches, and pears. (R.C. Lamb)

Cherry breeding. (R.D. Way)

Plum breeding. (J. P. Watson)

Grape breeding. (J. Einset and D. K. Ourecky)

Strawberry, raspberry, and blackberry breeding. (D. K. Ourecky)

Elderberry breeding and variety testing. (R.D. Way)

A test of American grape varieties grafted on resistant rootstocks. (N. Shaulis)

Growth and yield of apple trees as influenced by the rootstock. (J. N. Cummins)

Studies on vineyard tillage. (N. Shaulis)

Spacing of vines in the vineyard. (N. Shaulis)

Development and testing of virus-free cherry rootstocks which are hardy, uniform in plant characters, long-lived, and compatible with sweet and sour cherry varieties. (J. N. Cummins)

The effect of red currant cultural practices on cluster size. (N. Shaulis)

Crop size and growth regulator effects on grape maturity. (N. Shaulis)

Apple fruit growth and prediction of harvested crop. (O. F. Curtis, Jr.)

Seed propagation in small fruits. (D. K. Ourecky)

Mechanical pruning of apples. (R. D. Way)

Mechanization in the vineyard. (N. Shaulis)

Cultural factors in mechanical harvesting of cherries. (J. C. Cain)

Fertilization effects on yield, quality and fire blight in pears. (C. G. Forshey)

Chemical thinning of apples in the Hudson Valley. (C. G. Forshey)

Advanced field testing of new fruit varieties. (R. D. Way, J. Einset)

Extension demonstration and study of weed control measures for fruit plantings. (O. F. Curtis, Jr.)

Cultural factors in mechanization of peach production. (J. C. Cain)

Mechanical pruning of apple trees. (C. G. Forshey)

Nitrogen metabolism of B-9 treated apples. (C. G. Forshey)

An investigation of the nitrogen-potassium relationship in apple trees. (C. G. Forshey)

Fruit size in apple. (C. G. Forshey)

Internal bark necrosis of Delicious apple trees. (C. G. Forshey, in cooperation with Pomology at Ithaca)

An analysis of the practice of interplanting old apple orchards. (C. G. Forshey)

Non-Concord grape management. (N. Shaulis)

Physiology and culture of small fruit plants. (W. J. Kender)

Nutritional problems of fruit trees in eastern New York. (C. G. Forshey)

Responses of fruit trees to growth regulators and other chemicals. (C. G. Forshey)

Appendix V. Fruit varieties introduced by the Department of Pomology and Viticulture, Geneva, 1894-1983.

Apples (59 introduced)

Alton (1938), Barry (1957), Broome (1914), Burgundy (1974), Carlton (1923), Chautauqua (1915), Clinton (1914), Cornell McIntosh (1956), Cortland (1915), Dunning (1938), Early Cortland (1982), Early McIntosh (1923), Empire (1966), Freedom (1983), Geneva Early (1982), Geneva McIntosh (1959), Geneva Ontario (1964), Greendale (1938), Herkimer (1914), Jonagold (1968), Jonamac (1972), Kendall (1932), Liberty (scab resistant) (1978), Lodi (1924), Macoun (1923), Medina (1922), Milton (1923), Monroe (1949), Montgomery (1914), Nassau (1914), Newfane (1927), Niagara (1962), Novole (rootstock) (1982), Ogden (1928), Onondaga (1915), Orleans (1924), Oswego (1915), Otsego (1914), Redfield (Ornamental) (1938), Redford (Ornamental) (1938), Redhook (1938), Red Jacket (Ornamental) (1938), Red Sauce (1926), Rensselaer (1914), Rockland (1914), Saratoga (1914), Schenectady (1915), Schoharie (1914), Spigold (1962), Spijon (1968), Sweet Delicious (1922), Sweet McIntosh (1922), Tioga (1915), Ulster (1914), Van Eseltine (Ornamental) (1937), Wayne (1962), Webster (1938), Wellington (1955), and Westchester (1914).

Peaches (2 introduced)

Brighton (1972), and Eden (1972).

Pears (14 introduced)

Aurora (1964), Canadice (1920), Cayuga (1920), Caywood (1938), Chapin (1945), Clyde (1932), Covert (1935), Early Seckel (1935), Gorham (1923), Highland (1974), Ovid (1931), Phelps (1925), Pulteney (1925), and Willard (1931).

Plums (8 introduced)

Albion (1929), American Mirabelle (1925), Hall (1923), Iroquois (1966), Mohawk (1966), Oneida (1966), Seneca (1972) and Stanley (1926).

Cherries (7 introduced)

Gil Peck (1936), Hudson (1964), Kristin (1982), Oswego (1927) Seneca (1924), Sodus (1938) and Ulster (1964).

Apricot (3 introduced)

Alfred (1965), Geneva (1934) and Farmingdale (1965).

Nectarine (3 introduced)

Hunter (1924), Morton (1965) and New Yorker (1967).

Grapes (47 introduced)

Alden (1952), Athens (black) (1938), Bath, (1952), Brocton (white) (1919), Bronx Seedless (red) (1937), Buffalo (black) (1938), Canada Muscat (1961), Canadice (seedless) (1977), Cayuga White (1972), Dunkirk (red) (1920), Eden (black) (1938), Erie (black) (1932), Fredonia (black) (1927), Glenora (seedless) (1977), Goff (red) (1906), Golden Muscat (white) (1927), Hanover (red) (1928), Hector (red) (1937), Himrod (seedless) (1952), Horizon (white) (1982), Interlaken Seedless (white) (1947), Kendaia (black) (1939), Keuka (red) (1923), Lakemont (1972), Melton (white) (1923), Naples (1952), New York Muscat (1961), Ontario (white) (1908), Pontiac (black) (1922), Portland (white) (1912), Remaily Seedless (1980), Ripley (white) (1912), Romulus (seedless) (1952), Ruby (red) (1938), Schuyler (black) (1947), Seneca (white) (1930), Sheridan (black) (1921), Steuben (black) (1947), Stout Seedless (white) (1930), Suffolk Red (1972), Urbana (red) (1912), Van Buren (black) (1935), Watkins (red) (1930), Wayne (black) (1927), Westfield (red) (1912), Westfield (black) (1935), and Yates (red) (1937).

Gooseberry (1 introduced)

Fredonia (1926).

Raspberries (34 introduced)

Allen (black) (1963), Amber (yellow) (1950), Brandywine (purple) (1976), Brant (purple) (1926), Bristol (black) (1934), Cayuga (red) (1922), Clyde

(purple) (1961), Donboro (red) (1908), Dundee (black) (1927), Evans (black) (1935), Heritage (red) (1969), Hilton (red) (1965), Huron (black) (1965), Jewel (black) (1973), June (red) (1909), Indian Summer (red) (1936), Louboro (red) (1908), Marcy (red) (1936), Marion (purple) (1937), Marlative (red) (1908), Marldon (red) (1908), Milton (red) (1942), Monroe (red) (1932), Naples (black) (1931), Newburgh (red) (1929), Ontario (red) (1918), Owasco (red) (1922), Royalty (purple-red) (1982), Seneca (red) (1922), September (red) (1947), Sodus (purple) (1935), Taylor (red) (1935), Ulster (red) (1933), and Webster (purple) (1926).

Strawberries (36 introduced)

Addison (1918), Alden (1918), Angola (1918), Arcade (1918), Argyle (1918), Ashton (1918), Athens (1918), Aurora (1918), Beacon (1923), Bliss (1923), Boquet (1923), Caledonia (1931), Camden (1931) Canoga (1979), Cato (1931), Catskill (1933), Clermont (1931), Culver (1931), Dresden (1939), Empire (1951), Erie (1951), Essex (1951), Eden (1952), Fletcher (1959), Frontenac (1959), Fulton (1959), Fortune (1961), Gala (1966), Garnet (1965), Geneva (1961), Holiday (1972), Honeoye (1979), Hunn (1894), Magnus (1910), Prolific (1908) and Quality (1910).

Blackberries (3 introduced)

Bailey (1950), Hedrick (1950) and Darrow (1958).

Elderberries (1 introduced)

York (1964).

Total Named = 218 Corrected to September, 1983

Appendix VI. Available Publications September 1983

Department of Pomology and Viticulture
N.Y.S. Agricultural Experiment Station
Geneva, N.Y. 14456

APPLE

Burgundy, an early fall, dark red apple. R.D. Way and R.C. Lamb. New York's Food and Life Sci. Bull. 47. 1974.

'Early Cortland' and 'Geneva Early' Apples. R.D. Way, K.G. Livermore, and H.S. Aldwinckle. New York's Food and Life Sci. Bull. 99. 1982.

Empire - a high quality dessert apple. R.D. Way, N.Y. Food and Life Sci. Bull. 53. 1975

'Freedom' - a new disease-resistant apple. R.C. Lamb, H.S. Aldwinckle, D.E. Terry. New York's Food and Life Sci. Bull. 103. 1983.

Jonagold and Spijon, two new apples from Geneva. R.D. Way, R.L. LaBelle, and J. Einset. N.Y.S. Agr. Exp. Sta. Circular 12. 1968.

Jonamac, a new apple from Geneva. R.D. Way. N.Y. Food and Life Sci. Bull. 25. 1972.

Liberty, a new disease resistant apple. Robert C. Lamb, Herb S. Aldwinckle, Roger D. Way and David E. Terry. N.Y. Food and Life Sci. Bull. 73. 1978.

Growing and processing the Wayne apple. R.D. Way, J.N. Cummins, R.L. LaBelle and J. Einset. N.Y. Food and Life Sci. Bull. 32. 1973.

My favorite dessert apples. R.D. Way. Fruit Var. and Hort. Digest 20(1):18-19. 1966.

Apple varieties grown in New York State. R.D. Way. N.Y.S. Coll. of Agr. and Life Sci. Bull. 78.

Early apple varieties. R.D. Way, N.Y.S. Agr. Exp. Sta. Spec. Rpt. 7. 1972.

The largest apple variety collection in the United States. R.D. Way. 1976. New York's Food and Life Sci. Quarterly Vol. 9(4):11-13.

APPLE: DISEASE RESISTANCE

Fire blight in the Geneva apple collection. H.S. Aldwinckle, R.D. Way, K.G. Livermore, J.L. Preczewski and S.V. Beer. Fruit Varieties Journal 30(2):42-55. 1976.

Disease resistant apple varieties. R.C. Lamb. 1976. (single page mimeo).

Controlling apple diseases without chemicals. H.S. Aldwinckle and Robert C. Lamb. New York's Food and Life Sci. Quarterly. Vol. 10(2):12-14. 1977.

APPLE: MANAGEMENT

The planting and early care of the apple orchard. C.G. Forshey and D.C. Elfving. N.Y.S. Coll. of Agr. and Life Sci. Inf. Bull. 65. 1973. SALE PUBLICATION - $1.50.

Training and pruning apple trees. C.G. Forshey and D.C. Elfving. N.Y.S. Coll. of Agr. and Life Sci. Inf. Bull. 112. 1977. SALE PUBLICATION - $1.00.

Cultural practices in the bearing apple orchard. C.G. Forshey. Information Bulletin 160. SALE PUBLICATION - 1.75*.

Tree spacing in relation to orchard production efficiency. J.C. Cain. N.Y. Agr. Expt. Sta. Res. Circ. 15. 1969.

McIntosh apple crop prediction, grower sampling instructions. C.G. Forshey. N.Y. Food and Life Sci. Bull. 65. 1977.

Factors affecting chemical thinning of apples. C.G. Forshey. N.Y. Food and Life Sci. Bull. 64. 1976.

Changing technologies and orchard design. J.N. Cummins. 1971. Proceedings Ohio State Hort. Soc. 124:21-23.

The use of Ethephon on apples. C.G. Forshey and L.J. Edgerton. 1974. Cornell Information Bulletin 57.

Hedgerow orchard design for most efficient interception of solar radiation. Effects of tree size, shape, spacing and row direction. J.C. Cain. N.Y.S. Agr. Exp. Sta. Search Vol. 2, No. 7. 1972.

Slotting saw pruning of hedgerow apples improves production and quality. J.C. Cain. N.Y.S. Food and Life Sci. Bull. 15. 1972.

APPLE: ROOTSTOCK

Apple rootstock problems and potentials. J.N. Cummins and R.L. Norton. N.Y.S. Agr. Exp. Sta. Bull. 41. 1974.

Objectives of apple rootstock breeding projects and the needs of the North American Industry. James N. Cummins. Reprinted from Compact Fruit Tree 19:13-16. 1977.

Progress in breeding apple rootstocks. J.N. Cummins, H.S. Aldwinckle, and P.L. Forsline. 1979. Proceedings of Eucarpia Fruit Section Symposium.

Making the rootstock decision. J.N. Cummins. 1971. Proceedings Ohio State Hort. Soc. 124:24-27.

Multiple-stock apple trees. James N. Cummins and P.L. Forsline. Reprinted from 1977 Transaction of Illinois State Hort. Soc. Vol. 110.

Breeding apple rootstocks. J.N. Cummins and H.S. Aldwinckle. HortScience. Vol. 9(4):367-372. 1974.

CHERRIES

Cherry varieties for New York State. R.D. Way. N.Y.S. Agr. Exp. Sta. Food and Life Sci. Bull. 37.

Exotic rootstocks for cherries. J.N. Cummins. 1979. Fruit Varieties Journal 33(3):74-84.

Interspecific hybrids as rootstocks for cherries. J.N. Cummins. 1979. Fruit Varieties Journal 33(3):85-89.

'Kristin' sweet cherry. R.D. Way, J. Ystaas, K.G. Livermore, and R. C. Lamb. New York's Food & Life Sci. Bull. 98. 1982.

FRUIT NURSERIES

List of nurseries selling old apple varieties.

List of grapevine nurseries in New York State.

List of nurseries selling blueberry plants.

List of nurseries selling nut trees.

GENERAL

Fruit Research: Department of Pomology and Viticulture. 1980. Department Brochure. W.J. Kender.

Weed control for small-scale fruit plantings. O.F. Curtis, Jr. 1973. (single page mimeo).

Bird damage to fruit crops. R.D. Way and J.A. Sherburne. Plants and Gardens 27(3):79-83. 1971.

The New York State Fruit Testing Cooperative Association - 60 years of new fruit varieties. R.C. Lamb. Reprinted from Fruit Varieties Journal Vol. 33, #3, July 1979.

The importance of Pomological Research, Teaching, and Extension to the New York Fruit Industry. W.J. Kender. 1980. Proc. N.Y. State Hort. Soc. 125:53-66.

Pomology Graduate Student Manual and Pomology Student Manual are available from: Dept. of Pomology, Plant Science Building, Cornell University, Ithaca, NY 14853. This is a field publication.

GENERAL: TREE FRUITS

1983 Cornell Recommendations for Commerical Tree-Fruit Production. SALE PUBLICATION - $2.25.

Tree Raising on the Fruit Farm. J.N. Cummins. N.Y. Food and Life Sci. Bull. 19, 1972.

Future Germplasm Reserves of Pome Fruits. 1974. R.C. Lamb. Fruit Var. Journal Vol. 28(4):75-79. 74.

New York tree fruit pest management project 1973-1978. J.P. Tette, E.H. Glass, D. Bruno, and R.D. Way. N.Y. Food and Life Sci. Bull. 81. 1979.

Systems for producing multiple stock trees in the nursery. J.N. Cummins. Plant Propagator 19(4):7-11. 1974.

Propagating fruit trees in New York. R.D. Way, F.G. Dennis, and R.M. Gilmer. N.Y.S. Agr. Expt. Sta. Bull. 817, 1967.

Pollination and fruit set of fruit crops. R.D. Way. 1978. N.Y. Food and Life Sci. Bull. 76.

GRAPES

Grape varieties for New York State. R. Pool, K. Kimball, J. Watson, and J. Einset. N.Y. Food and Life Sci. Bull. 80. 1979.

Cultural practices for commercial vineyards. T.D. Jordan, R.M. Pool, T.J. Zabadal and J.P. Tomkins. CHARGE PUBLICATION. Ext. Misc. Bull. S-111. Color: $3.00, Black & White: $2.00

Canadice and Glenora seedless grapes named. R.M. Pool, J.P. Watson, K. Kimball and J. Einset. N.Y. Food and Life Sci. Bull. 68. 1977.

Cayuga White, the first of a Finger Lakes series of wine grapes for New York. J. Einset and W.B. Robinson. N.Y. Food and Life Sci. Bull. 22. 1972.

Lakemont and Suffolk Red seedless grapes named. J. Einset. N.Y. Food and Life Sci. Bull. 21. 1972.

Remaily Seedless Grape. R.M. Pool, G. Remaily, B.I. Reisch, J.P. Watson, and K.H. Kimball. N.Y. Food and Life Sci. Bull. #89. 1981.

Remaily Seedless Grape. R.M. Pool, G. Remaily, B.I. Reisch, J.P. Watson and K. Kimball. HortScience 16(2):232-233. 1981.

Horizon Grape. B. Reisch, W.B. Robinson, K. Kimball, R. Pool, and J. Watson. New York's Food & Life Sciences Bull. 96.

The top 10 table grape varieties. R.M. Pool, 1978. Proceedings of the 29th Annual Finger Lakes Grape Growers' Convention.

Minimizing the hazard of cold in New York vineyards. N. Shaulis and B. Dethier. N.Y. Coll. of Agr. and Life Sci. Bull. 1127. Reprinted 1974.

Vine hardiness a part of the problem of hardiness to cold in New York vineyards. N.J. Shaulis, Proc. N.Y.S. Hort. Soc. Vol. 116:158-167. 1971.

New York site selection for wine grapes. N. Shaulis and B. Dethier. Proc. N.Y.S. Hort. Soc. 288-294.

Grapes - their growth and development. N. Shaulis and C. Pratt. 1965. Farm Res. Reprint No. 401. N.Y.S. Agr. Exp. Sta.

Resistant rootstocks for New York vineyards. N. Shaulis and L. Lider. N.Y. Food and Life Sci. No. 45. Reprinted 1974.

Converting mature Concord vineyards to other varieties by means of grafting. Keith Kimball and John Einset. 1971. Proceedings of the New York State Horticultural Society. Vol. 116.

Factors affecting sugar accumulation in New York grapes in 1976. N. Shaulis. N.Y.S. Hort. Soc. Proc. Vol. 122. 1977.

Grape pest control guide. Cooperative Extension leaflet (issued each year for the current season).

1958-1973 Vineyard and Cellar Notes. R. Pool, J. Einset, K. Kimball, J. Watson, W. Robinson and J. Bertino. N.Y. Agr. Exp. Sta. Spec. Rpt. 22A. 1976.

A publication entitled "Converting Mature Vineyards to Other Varieties" by Keith H. Kimball, N.Y.S. Agr. Exp. Sta., Special Report 22, 1976, is available at a cost of $1.00 from: Publications Office, N.Y.S. Agr. Exp. Sta., Geneva, NY 14456.

GRAPES: AIR POLLUTION

Air pollution injury to grapevines. R.C. Musselman. 1980. N.Y. State Hort. Proc. 125:129-137.

Damage to grapevines by fossil fuel wastes and pollutants. R.C. Musselman, N.J. Shaulis and W.J. Kender. Search Agriculture No. 3, 1980.

GRAPES: WINE

List of suppliers of home winemaking materials.

PEACH

Peach and nectarine varieties for New York State. R.C. Lamb, D.E. Terry. N.Y. Food and Life Sci. Bull. 34. 1973.

Brighton and Eden, two new peach varieties. R.C. Lamb. N.Y. Food and Life Sci. Bull. 23. 1972.

Peach growing. R.C. Lamb and L.J. Edgerton. N.Y.S. Coll. of Agr. and Life Sci. Inf. Bull. 44. 1972. SALE PUBLICATION - 50 cents*.

Peach varieties and rootstocks. R.C. Lamb. Proc. N.Y.S. Hort. Soc. Vol. 120. 1975.

PEARS

Highland, a new winter pear. R.C. Lamb. N.Y. Food and Life Sci. Bull. 48. 1974.

Pear culture. G.H. Oberly, R.C. Lamb and C.G. Forshey. 1977. N.Y.S. Coll. of Agr. and Life Sci. Information Bull. 126. SALE PUBLICATION - $1.00*.

PLUMS/PRUNES

Seneca plum named. J.P. Watson. N.Y. Food and Life Sci. Bull. 26. 1972.

SMALL FRUITS: BERRIES AND MINOR FRUITS

Fruit varieties in New York State - Berries. D.K. Ourecky. N.Y. Food and Life Sci. Bull. 39. 1974.

Minor fruits in New York State. D.K. Ourecky. N.Y.S. Coll. of Agr. and Life Sci. Inf. Bull. 11. 1971. SALE PUBLICATION - 50 cents*.

Blackberries, currants and gooseberries. D.K. Ourecky. N.Y. Coll. of Agr. and Life Sci. Inf. Bull. 97. Revised 1975. SALE PUBLICATION - 30 cents*.

Small fruits pest control and culture guide. Blueberry, bramble, currant, gooseberry, strawberry). Cooperative Extension (published each year for use in current season). SALE PUBLICATION - 50 cents*.

SMALL FRUITS: BLUEBERRIES

Highbush blueberry culture in New York. D.K. Ourecky and J.P. Tomkins. N.Y.S. College of Agr. and Life Sci. Inf. Bull. 151. SALE PUBLICATION - 75 cents*.

SMALL FRUITS: NUTS

Prospects for producing own-rooted nut trees. J.N. Cummins. 1970. 61st Annual Report, Northern Nut Growers Association, Inc. pp. 90-94.

Screen-girdling of trench-layered black walnut trees. J.N. Cummins. 1970. Plant Propagator 15(4):14

SMALL FRUITS: RASPBERRIES

Raspberry growing in New York State. J.P. Tomkins and D.K. Ourecky. N.Y.S. Coll. of Agr. and Life Sci. Bull. 155. SALE PUBLICATION - 80 cents*.

Brandywine purple raspberry. D.K. Ourecky. N.Y. Food and Life Sci. Bull. 61. 1976.

Heritage, a new fall-bearing red raspberry. D.K. Ourecky. N.Y.S. Agr. Exp. Sta. Res. Circ. 19, 1969.

Jewel black raspberry. D.K. Ourecky and G.L. Slate. N.Y. Food and Life Sci. Bull. 35. 1973.

Royalty - a purple-red raspberry. John C. Sanford and Donald K. Ourecky. New York's Food & Life Sci. Bull. 97.

SMALL FRUITS: STRAWBERRIES

Growing strawberries in New York State. J.P. Tomkins and D.K. Ourecky. N.Y.S. Coll. Agr. and Life Sci. Inf. Bull. 15. SALE PUBLICATION - 50 cents*.

Holiday strawberry. D.K. Ourecky. N.Y. Food and Life Sci. Bull. 24. 1972.

Honeoye and Canoga strawberry cultivars. D.K. Ourecky. New York State Food and Life Sci. Bull. #83. 1979.

New York State College of Agriculture and Life Sciences
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Cornell University

Department of Pomology
Plant Science Building, Ithaca, N.Y. 14853
Telephone: 607-256-5438

June 19, 1984

Dr. Roger Way, Professor Emeritus
Department of Horticultural Science
Geneva Experiment Station

Dear Roger:

Thanks very much for the MS on the history of horticulture at the Geneva Station. After a preliminary reading, I think it contains the information and analysis needed for a very strong section of the general history, and I will take advantage of your request for specific suggestions about length, organization, and subject matter. When I have those editorial suggestions I will come to see you with the marked copy in hand.

You are to be congratulated on the thorough handling of the subject and I appreciate your devotion of time and effort to it.

With kindest regards,

Damon Boynton
Professor Emeritus

DB/ob

Cornell University

Cornell University Libraries

Department of Manuscripts and
University Archives

John M. Olin Library
Ithaca, NY 14853-5301

607/256-3530

September 19, 1986

Roger Way
Professor Emeritus
Horticultural Sciences
105 Hedrick Hall
Geneva Experiment Station
Box 15 Roberts Hall Mail Room
Cornell University
Ithaca, New York 14853

Dear Professor Way:

Last year when Damon Boynton's eyes had failed to the point where he could not continue the history of horticulture at Cornell that he had undertaken I assured him that I would endeavor to get the job done. Yesterday when Mary Boynton gave me his manuscript I noticed your contribution about pomology at Geneva. If the idea of my pulling together the information from the various contributors that Damon lined up is acceptable to you, I'll hold on to your manuscript with the understanding that you will have a chance to go over it again before a final typing.

Bill Kelly and Carl Gortzig each expect to have a history of his department in hand this fall.

Sincerely,

Gould P. Colman
University Archivist

GPC:jp
cc:William Kelly
Carl Gortzig

POMOLOGY AND VITICULTURE AT GENEVA

Roger D. Way, Professor of Pomology, Emeritus

History of the Department of Pomology and Viticulutre

From its very beginning, the New York State Agriculutral Experiment Station at Geneva (Fig. 1) has been a horticulutral research station, with strong emphasis on fruit and vegetable research. One of the first projects was to collect hundreds of apple, grape and other fruit cultivars for testing in Station orchards and vineyards to determine which were most suited for use by the commercial fruit growers of New York State. Later, horticultural research was expanded into genetics and breeding of new fruit cultivars, chemistry and processing of fruits and vegetables, fruit cultural techniques, fruit tree rootstocks, tree physiology, genetic engineering and biotechnology, and many other disciplines.

Through the 1930s the Station conducted some research on dairy cattle and poultry, but in the early 1940s under Director A.J. Heinicke, a pomologist, the Station was changed to an exclusively horticulutral research institute with emphasis on processed horticultural crops, including production methods, pest control and processing methods.

Tree fruit and vine research at Geneva has been conducted within a department which has had five different names: "Horticulture", 1882-1929 (departments not yet formed); Division of Pomology, 1929-53; Department of Pomology, 1953-72; Department of Pomology and Viticulutre, 1972-84; and Department of Horticultural Sciences, 1984-present (fruits and vegetables combined).

Included in the pomology and viticulture programs are grape research conducted at the Vineyard Laboratory, Fredonia (established in 1909) and apple research at the Hudson Valley Laboratory, Highland (1920).

Major research programs have been the breeding of new fruit cultivars, tree fruit rootstock evaluation and breeding, fruit plant nutrition, tree and vine physiology, and cultural methods.

Pomological research at Geneva has always had close interactions with other research units, including the Department of Pomology at Ithaca, the other three Geneva research departments, the New York State Fruit Testing Association, the National Clonal Germplasm Repository for Apples and Eastern Grapes at Geneva, and the U.S. Dept. Agr. Plant Introduction Station at Geneva.

During the first 104 years of the Geneva Station, 73 scientists held positions to do research in the Department of Pomology and Viticulture. Some of the key actors among these were: S.A.Beach (author of Apples of New York); U.P. Hedrick (station director and author of fruit books of New York); R. Wellington (fruit breeder); W.H. Chandler (pomologist); H.B. Tukey, Sr. (apple rootstocks); G.L. Slate (small fruits breeding); G.P. Van Eseltine (fruit taxonomy), K.D. Brase (apple rootstocks); A.J. Heinicke (station director, fruit tree physiology); J. Einset (head of department, fruit plant cytology, grape breeding); N.J. Shaulis (grape vine training, physiology, vineyard management); J.C. Cain (fruit plant nutrition); R.C. Lamb (apple genetics, disease resistance apple breeding); R.D. Way (apple, cherry breeding); C.G. Forshey (orchard management); C.S. Pratt (fruit anatomy, cytology, genetics); J.N. Cummins (apple rootstocks breeding); W.J. Kender (head of department, air pollution effects); A.N. Lakso (apple, grape physiology); R.M. Pool (vine management); J.C. Sanford (genetic engineering); and B.I. Reisch (grape breeding, tissue culture).

Research Achievements in Pomology and Viticulture

Because apples and grapes are the two most important fruit crops grown commercially in New York State, the Department of Pomology and Viticulture has spent a major portion of its research resources on them.

Fruit breeding has been an outstanding success story for the Department. During the 1930s to the 1950s, at a time when most other state experiment stations were reducing their fruit breeding efforts, Geneva expanded its efforts and has created many new, superior fruit cultivars which are being grown world-wide for commercial fruit production.

Because of their long life cycles, fruits require many years for the breeding of a new cultivar. Before a new cultivar can be introduced, it first must be fruited for several years on its own roots, then later tested as budded trees to make certain that is is truly superior to existing cultivars.

Although apple scion cultivars, apple rootstocks and grapes have received the most attention, considerable breeding has also been done on strawberries, raspberries and pears and with lesser expenditures in peaches, plums, cherries, apricots, nectarines, gooseberries, blackberries and elderberries. Between 1950 and 1986 approximately six scientists were engaged in fruit breeding projects.

During the Station's 104 years, Geneva pomologists and viticulturists introduced 222 new cultivars of fruits: 59 apple, 3 apricot, 3 blackberry, 7 cherry, 1 elderberry, 1 gooseberry, 49 grape, 3 nectarine, 2 peach, 14 pear, 8 plum, 35 raspberry, and 37 strawberry.

Side by side with the fruit breeding programs were programs to test new fruit cultivars which had been bred in other states or countries. Such testing of new cultivars by the Geneva Station resulted in the widespread acceptance by New York fruit growers of such cultivars as the 'Idared' apple from breeding in Idaho and the 'Mutsu' apple from the breeding program in Japan. The apple cultivar collection at Geneva is probably the largest in the United States and large collections of cultivars of many other fruit species of fruits have also been maintained.

This Department produces only two products: new fruit cultivars and new knowledge through scientific investigation. Progress in scientific research is best illustrated by the quantity and quality of scientific publications which the research generates. For example, apple breeding has resulted in dozens of significant scientific publications widely cited by researchers throughout the world.

In 1949, R.C. Lamb started a disease resistance apple breeding program. He acquired pollen of scab resistant parents from Purdue University and other sources. After a quarter of a century of intensive effort and several generations of hybridizing and then growing thousands of seedlings, he introduced the Station's first two disease resistant apple cultivars, 'Liberty' (1978) and 'Freedom' (1983).

This Department is world famous for its pioneering efforts in researching dwarfing and size-controlling rootstocks for apple trees. About 1918, pomologists in England identified a series of apple rootstocks and then classified them according to their degree of size-controlling influence on apple trees. Professors Tukey, Brase, and Cummins at Geneva conducted long-term tests of these dwarfing apple rootstocks. As a consequence, the apple growing industry in the entire northeastern U.S. adopted recommendations which came from this reasearch.

None of the European apple rootstocks is perfectly suited to endure the environmental and biotic hazzards which exist in this part of North America. For this reason, Professor James Cummins undertook a lifetime of research in apple rootstock breeding in order to create a superior new, more disease resistant and more winter-hardy, size-controlling rootstock for commercially grown apple trees.

Grape breeding has also been a major research effort in this Department (Wellington, Oberle, Einset, Pool, Reisch). New York State has a large wine industry. New grape cultivars

were bred for the making of superior quality wines, e.g., 'Cayuga White' (1972). Also excellent seedless table grape cultivars were introduced, e.g., 'Canadice' (1977) and 'Einset Seedless' (1985).

The breeding of small fruits, especially strawberry and raspberry, has been a major research effort, as is illustrated by the 77 small fruit cultivar introductions listed above. Breeding efforts to create superior new cultivars have also been significant on other fruit commodities, including apricot, cherry, nectarine, peach, pear, and plum.

Although fruit breeding has been a major research effort of this Department, many other pomological and viticultural problems have also been addressed, including fruit soils, nutrution for fruit crops, tree and vine physiology, tree and vine training and pruning systems (e.g., the Geneva Double Curtain system of training grape vines), rootstocks for grape vines, fruit pollination and crop set, cytology of fruit plants, virus transmission through pollen, psylla resistance in pears, mechanical harvesting of grapes, air pollution effects on grapes, fruit tree nursery techniques, weed control in fruit plantings, taxonomy of fruit plants, and many others.

Between 1905 and 1925, a series of fruit books were published that established this Department as one of the world's most competent centers of excellence in the field of fruit cultivars: S.A. Beach, Apples of New York, 1905; and six thick volumes by U.P. Hedrick, et al., Grapes of New York, 1908; Plums of New York, 1911; Cherries of New York, 1915; Peaches of New York, 1917; Pears of New York, 1921; and Small Fruits of New York, 1925.

Impact of the Pomology and Viticulture Department on the World

A lasting influence from the Geneva fruit research on world fruit growing has developed through the many new and superior fruit cultuvars created and introduced from extensive fruit breeding programs. For example, in 1986, 'Jonagold', an apple cultivar introduced by Geneva

in 1968, is being planted in new orchards in western Europe more than any other cultivar, including Europe's own 'Cox's Orange Pippin' and 'Belle de Boskoop'. Similarly, in northeastern United States, Geneva's new apple, 'Empire' (Fig. 2), ranked third in new orchard plantings (but still surpassed by 'McIntosh' and 'Delicious'). The 'Stanley' plum, selected from a family of eight seedlings and introduced in 1926, is the most widely grown plum cultivar in the world. Many other examples of the success of Geneva fruit cultivars could be cited. Look in any commercial fruit plant nursery catalog and you will find a list of several Geneva fruit cultivars for sale.

The apple rootstocks which are now used extensively in commmercial apple growing were originally researched in the United States by this Department. Also, advances in tree and vine field culture now used by the fruit growing industry have emerged from this Department's research.

Geneva pomology and viticulture research has attracted gradate students from around the world and consequently, has had a significant influence on the training of these students. From 1950 onward, some of the masters and doctorate candidates in pomology at Ithaca came to Geneva to do their thesis research under specific Geneva professors of their own choosing. At any one time in the 1980s, half a dozen pomology graduate students were conducting their thesis research at Geneva.

After 1950, some of the Geneva faculty taught courses in the Pomology Department at Ithaca, including courses in Fruit Tree Nursery Operation (J.N. Cummins); Viticulture (R.M. Pool); Fruit Variety Improvement (R.D. Way); and Special Topics in Experimental Pomology (A.N. Lakso).

Fruit extension has always been a significant activity of Geneva pomologists and viticulturists. Although their assignments were 100% research, they always willingly participated in fruit extension efforts. Fruit extension agents throughout the State annually called on some of the Geneva faculty to participate in the winter fruit meetings. Furthermore, all faculty members constantly received a deluge of letters and visitors asking questions which must be carefully researched and then answered.

Because the Department of Pomology and Viticulture had maintained a thousand cultivars of apples and a large collection of hardy grapes, the Agricultual Research Service of the U. S. Dept. of Agric. selected Geneva to be the site for its National Clonal Germplasm Repository which was established on this campus in 1983. Most of the apple and grape clones formerly maintained by this Department were transferred to the Repository for maintenance, evaluation and distribution.

Geneva fruit research has been repeatedly recognized nationally. Beginning in 1873, the American Pomological Society at irregular intervals awarded the silver and bronze Wilder Medals for outstanding achievements in fruit breeding. Geneva fruit breeding received the following silver Wilder Medals: 'Cortland' apple (1923); 'Sheridan' grape (1927); 'June' red raspberry (1927); U.P. Hedrick(1929); the Geneva Station (1947); R. Wellington (1954); New York State Fruit Testing Cooperative Association (1958); G.L. Slate (1968); and R.D. Way (1982).

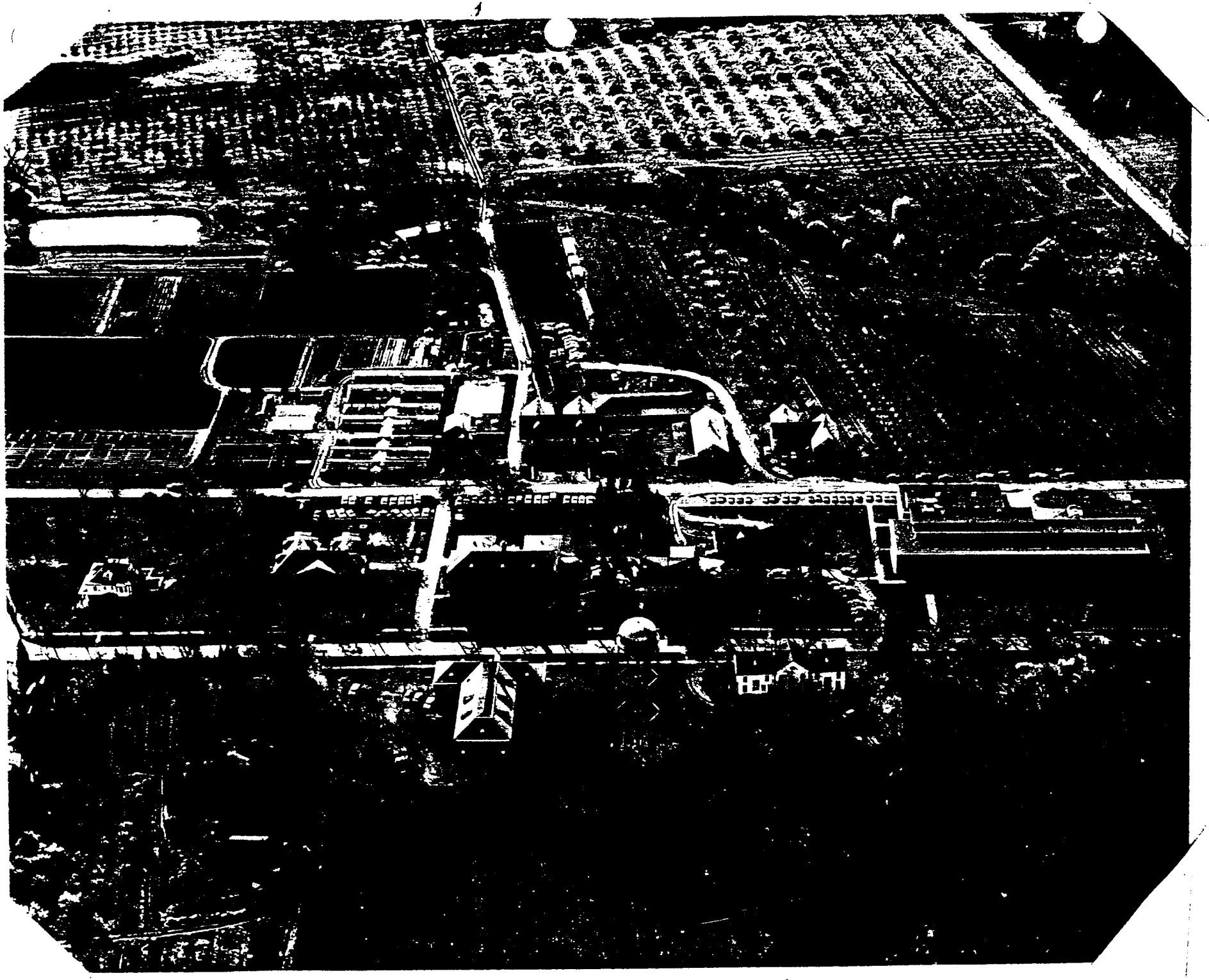

Fig. 1. Campus of the Geneva Station, about 1965.

Fig. 2. Empire cultivar (Delicious x McIntosh) developed at the Geneva, N.Y. Experiment Station.

Cornell University
Cornell University Agricultural Experiment Station
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April 10, 1986

Roger
Here is the info on Centennial. I'll get back to you for a meeting w/ MVT & me after 5/1
5/1
4/22

To: Deans, Human Ecology and Veterinary Medicine
Chairmen and Section Heads, Ithaca & Geneva
Program Directors, CLEARS, AIP, IPM, ICET,
Plantations, and Ornithology

From: James J. Zuiches, CUAES

Subject: Departmental Histories for Hatch Centennial Publication

In anticipation of the Centennial in 1987 of the passage of the Hatch Act, we have begun to plan a number of Centennial activities. One valuable product would be a synthesis and historical documentation of 100 Years of Research in the departments and programs associated with the Agricultural Experiment Stations and the Hatch Act. Such a volume would update the report prepared in 1937, Fifty Years of Research, and provide a truly significant Centennial publication.

We would like each department to identify an author, probably a senior faculty member or emeritus member, who would be interested in contributing to this Centennial volume of departmental histories. I have attached for your background information the 1937 chapter on your department, if it existed then. Please do not model the 1987 statement on the 50-year history; however, this document should provide you with some background material that might be updated.

The target audience is colleagues, graduates of programs, legislators, other land-grant institutions, and the general public with an interest in agricultural research. You may also find an extraordinary interest on the part of new faculty and students in such a historical document. The volume will be published as a soft-cover, perfect bound report, comparable to the CALS Annual Report. Off-prints of individual department histories will be available. The style of such a history should be informational, and technical only in the context of scientific advances.

General Trends in Apple Growing in the 20th Century

Relieving Major Limitations to Tree Growth and Productivity. A general trend in apple production has been the continued elimination or amelioration of limiting factors. Many limits of cold temperatures or poor soil drainage were overcome by improved site selection (or conversely, removal of orchards from poor sites) or active site preparation by drainage tiling or fumigation for replant problems. Better understanding of mineral nutrient needs of apples, and the development of tissue nutrient testing greatly reduced problems of nutrient deficiencies. Improvements of floor management with herbicides has led to improved soil stability between rows, yet less competition from weeds within tree-row herbicide strips *(Otis Curtis contributor)*. Improved pest management led to fewer losses due to pests, although current IPM practices may again allow somewhat more injury than in the days of excessive pesticide use.

Reduction in Tree Size. The most obvious trend has been the reduction in the size of commercial apple trees and the increase in tree numbers per acre. This has been due to the selection of dwarfing rootstocks onto which desired cultivars could be grafted. The initial selections were made many years ago (1920's??), but this technology did not develop widely until the 1960's and 1970's when the need for higher production efficiencies encouraged consideration of smaller trees and the knowledge of management of dwarf trees was adequate. Besides the clear advantage of ease of picking, pruning and spraying dwarf trees, dwarf rootstocks made orchards bear crops much earlier in the orchard life, reduced total pesticides and drift, increased labor efficiency, and encouraged better tree management for optimal yields and fruit quality. *(Brase and Cummins major contributors in rootstock breeding).*

Canopy Mangement and Crop Control to Optimize Yields and Quality. Although the concepts of proper pruning of apple trees are quite old, the demand for high quality fruit that first evolved in Europe in the 60's and continues today led to an increase in the intensity and quality of pruning. This trend was greatly aided by the reduction in tree size that made pruning much easier. There was a temporary interest in mechanical hedging in the 60's and early 70's, but this only served to point out the need for proper selective pruning. With improved understanding of the physiology of pruning and sunlight utilization starting in the late 60's *(John Cain, Chick Forshey and Alan Lakso contributors)*, there was an explosion of experiments and commercial trials of all shapes, forms and spacings of trees and orchards. Today the NY industry is a myriad of different training and pruning systems. These improvements have increased yields along with fruit quality above and beyond improvements due to relieving limiting factors.

Even healthy, well-pruned orchards may have erratic cropping with excessively large crops of small fruit in one year followed by very light crops of large fruits. Removal of fruit by hand was found to stabilize cropping and fruit quality but was expensive, so widespread commercial thinning depended on the discovery of chemicals that could be sprayed. Current chemical thinning with plant hormones such as auxins and cytokinins had helped greatly to reduce yield variations although erratic chemical response and weather-induced variation are still problematic *(Chick Forshey contributor).*

Apple Cultivar Improvement. The improvements mentioned above applied to all cultivars, whether 200 years old like McIntosh or a new release. There has been a gradual, but intensifying, turnover of apple cultivars as new cultivars that had more annual cropping, better fruit quality and longer storeability, such as Cortland, Empire or Jonagold, became available *(Wellington, Way, Lamb contributors)*. These improvements have been step-wise changes imposed over the gradual improvements described above.