VOL. III NO. 1 SEPTEMBER, 1950

FRONTIERS of Plant Science

75TH ANNIVERSARY ISSUE 1875–1950

CONNECTICUT AGRICULTURAL EXPERIMENT STATION, NEW HAVEN

OLDEST EXPERIMENT STATION CELEBRATES FOUNDING

Anniversary Dates — September 28 and 29

Dr. James G. Horsfall, Director of the Station, pictured on the cover, opens the door in welcome to guests coming to the Station's 75th Anniversary Celebration on September 28 and 29. World-renowned scientists make up the list of speakers, and an open house gives visitors an opportunity to see this pioneer research institution in action. The official program, reproduced below, gives details. We hope that "FRONTIERS" readers will consider this their invitation to attend and that many of you will be with us on September 28 and 29.

PROGRAMME

Thursday

10-12:00 A.M.
1- 3:30 P.M. Open House

3:30 P.M. GREETING – Director James G. Horsfall

ADDRESS – "Why An Agricultural Experiment Station?" – Arnold Nicholson, Managing Editor, *Country Gentleman.*

4:45 P.M. UNVEILING OF COMMEMORATIVE TABLET

Presentation – State Development Commission.

Acceptance—John Lyman, Station Board of Control.

8:00 P.M. ADDRESS – "Science in a Democracy" – Detlev W. Bronk, President, Johns Hopkins University.

Friday

2:00 P.M. SYMPOSIUM – "The Research Institute in Modern Society."

Moderator, Edmund W. Sinnott, Director, Sheffield Scientific School, and Dean, Graduate School, Yale University.

"Industrial Research" – George O. Curme, Jr., Vice-president in charge of Chemical Research, Union Carbide and Carbon Corporation.

"Governmental Institutes" —Selman A. Waksman, Chief, Microbiology Dept., N. J. Agricultural Experiment Station.

"Endowed Institutes" – Alexander Wetmore, Secretary, Smithsonian Institution.

"Universities" – Edmund W. Sinnott.

6:30 P.M. DINNER FOR OFFICIAL DELEGATES
Toastmaster, Governor Chester Bowles, President, Station Board of Control.

WHO'S WHO AMONG THE SPEAKERS

Photograph courtesy Yale University News Bureau

Edmund W. Sinnott

Dr. Sinnott recently added Dean of the Graduate School to his list of titles at Yale University. He is also Director of the Sheffield Scientific School and of the University Division of Sciences. One of the nation's outstanding botanists, he is a past president of the American Association for the Advancement of Science, largest general scientific organization in the world. The Station can claim him as part of its official family, for three months ago, he was appointed a member of its Board of Control.

Detlev W. Bronk

President of Johns Hopkins University and recently-elected president of the National Academy of Sciences, Dr. Bronk has attained an international reputation as a biophysicist. His long list of national affiliations attest to the rank he holds among the country's scientists. The Navy, Army Air Forces, UNESCO, the Atomic Energy Commission and the National Committee for Aeronautics have all enlisted his aid and he is currently serving on advisory committees for all of these. He is also chairman of the National Research Council.

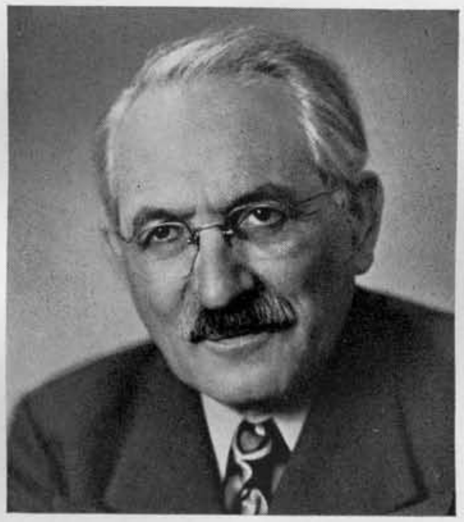
Arnold Nicholson

Mr. Nicholson lists his chief interest during his 26-year career as a reporter and editor as "scientific research in agriculture and its practical application to the problems of the farmer." He has been on the staff of *Country Gentleman* since 1927, and became managing editor in 1943. During this period, he has visited nearly all of the experiment stations in the 48 states. He is a member of the American Association for the Advancement of Science and a director of the National Flying Farmers Foundation.

Photograph by Bachrach

George O. Curme, Jr.

A top-ranking industrial chemist, Dr. Curme is vice-president in charge of Chemical Research for the Union Carbide and Carbon Corporation, New York City. He developed a basic new concept of industrial syntheses of commercially important chemicals from petroleum products, work which resulted in a new and rapidly expanding industry. In recognition of his contributions to science, Dr. Curme holds the Elliott Cresson Medal, the Chandler Medal, the Perkin Medalist, the National Modern Pioneer Award and the Willard Gibbs Medal.



Selman A. Waksman

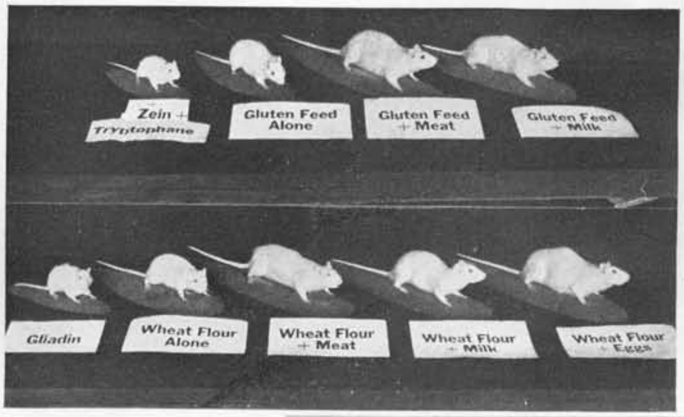
World-renowned as the discoverer of streptomycin, the "wonder drug" that has proved such a boon to sufferers from tuberculosis, influenza, meningitis, cholera, and many other diseases, Dr. Waksman has had innumerable honors bestowed upon him as a result of his researches in microbiology. Honorary degrees of Sc. D., M.D., and LL.D. from American and foreign universities are among them. The author of some 300 scientific papers, Dr. Waksman heads the Department of Microbiology at the New Jersey Agricultural Experiment Station.

Alexander Wetmore

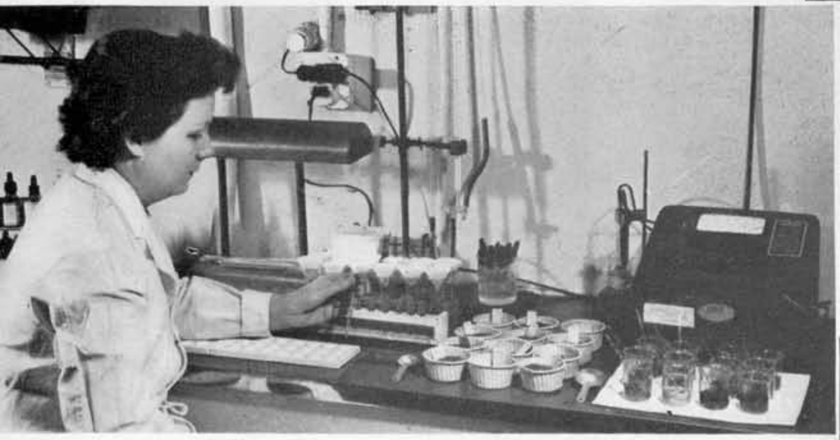
One of the world's authorities on birds and birdlife, Dr. Wetmore has held the post of secretary for the Smithsonian Institution since 1945, the sixth man to hold this position since the founding of the Smithsonian in 1846. His natural history explorations have taken him to many parts of the world and he holds membership in a long list of scientific organizations, here and abroad. In 1940 he served as secretary-general of the Eighth American Scientific Congress, largest conference of its kind ever held.

First project of the new Station in 1875 was the analyses of fertilizers for farmers of Connecticut. In those days the Station agent made collections of fertilizer samples by bicycle and is shown here ready to start on his rounds. This photograph, taken in 1898, is of Virgil Churchill, sampling agent at the time.

A major contribution was made in 1913 when Dr. Thomas B. Osborne of the Station and Prof. Lafayette B. Mendel of Yale found that different proteins differ in food value. The white rats at right are their original test animals and the effect of different diets on growth can clearly be seen.



Thirty-three years after his famous "double cross" which made hybrid corn production possible, Dr. Donald F. Jones is still busily making more and better hybrids. The photograph shows him inspecting one of his newest experimental varieties.



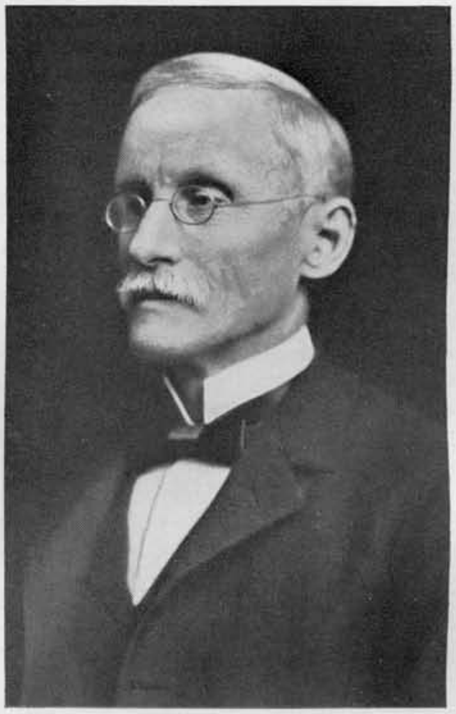
The technician can test 10 soil samples in half an hour with the Morgan method which she is using here. If she'd been on the job prior to 1924, when this method was developed by the Station's Dr. M. F. Morgan, it would have taken her a whole week to do the same chore.

Newest tool used by Station scientists is atomic energy. Here, Edward S. Pniewski of the Plant Pathology Department takes the count on "hot" tomato plants to see how the radioactive materials with which they've been treated have been distributed.

Seventy-five Years of Scientific Discovery

In 1875, an institution which had long been in the minds of a group of progressive Connecticut farmers, sparked by the writings and speeches of an agricultural chemist from Yale, at last saw the light of day. Its beginnings were humble—to the young Connecticut Agricultural Experiment Station, which they set up as itself an experiment, the Connecticut Legislature allotted the sum of $700 per quarter for two years to "carry on the appropriate work of an Agricultural Experiment Station". It was housed in one room at Wesleyan University at Middletown and to carry on the "appropriate work", four men were appointed.

To Samuel W. Johnson, chemist at the Sheffield Scientific School of Yale University, and, since 1857, chemist to the Connecticut State Agricultural Society, the establishment of the Station represented the culmination of 20 years of lecturing, writing and crusading for the idea that science should be put to work for the farmer. For the Connecticut Station was the forerunner of all institutions of its kind in the Western Hemisphere.



Samuel W. Johnson, father of experiment stations.

'Experiment' Becomes Permanent

The beginnings were humble but the new station quickly proved itself. In 1877, the "experiment" was voted a success when the Legislature moved to make it a permanent institution, with headquarters at New Haven, and named Professor Johnson Director.

During its first five years in New Haven, the Station was quartered in an office and laboratory in Sheffield Scientific School and its work was limited to the inspection of fertilizers, seeds and feeding stuffs. It quickly outgrew its temporary quarters at Yale, however, and its fields of activity widened by leaps and bounds during those first years.

In 1882, the Station was moved to its present headquarters at 123 Huntington Street. A second department was established in 1888—economic botany, they called it then; today it's the Department of Plant Pathology and Botany.

Investigations of proteins began in 1890, the foundation-stone upon which the Department of Biochemistry was laid. Horticulture, soon to become the Department of Entomology, was the next, established in 1896. Two other departments followed quickly: forestry in 1901 and plant breeding (now the Genetics Department) in 1905. Department-wise, there was then a gap until 1923 when the Department of Soils was established. The last department, to date, was added in 1921 when the Tobacco Laboratory was set up at Windsor.

Buildings Added

All of this increase in scope of work meant that the Station was growing in other ways as well. More buildings, better laboratory facilities, field plots and a bigger staff are some of the indications that are easiest to see. The original two buildings on Huntington Street still stand (now housing only the administrative offices and the Library rather than the entire laboratory facilities of the Station), but they are now surrounded by Johnson Laboratory, Thaxter Laboratory, Jenkins Laboratory and Britton Auditorium. Field work is no longer carried on in the "backyard", but on the 49 acres of the Experimental Farm at Mt. Carmel. Tobacco research goes on in the several laboratories and 20 acres of field plots at Windsor. The original staff of four has been multiplied more than 30 times—there are now 125 carrying on the work of the Station.

Buildings and people are a measure of progress but buildings and people alone do not make a top-rank scientific institution. The Connecticut Station has called research its business, discovery its product. Measured by this standard, its success is great for some of the discoveries of its scientists have won national acclaim and the production of its laboratories and field plots has been steady and abundant.

Hybrid corn is one jewel in its crown. The "double cross" method of seed production, developed by Dr. Donald F. Jones almost 35 years ago, is used every year to plant the rows of some 67 million acres of corn fields. The product of these corn fields outyields many times the open-pollinated corn grown before Dr. Jones began his corn-crossing experiments.

Ranked alongside Dr. Jones in the Station's Hall of Fame is the name of Thomas B. Osborne who, working with Lafayette B. Mendel of Yale discovered the fundamental fact that one protein differs from another in nutritional value. Later they found a hitherto unknown food substance, without which animals refused to grow. The unknown substance turned out to be Vitamin A.

Morgan is another name which belongs in any list of the Station's great. Dr. M. F. Morgan, late head of the Station's Soils Department, was the man who developed the first "quick" method of soil testing, thus bringing this service within the reach of the ordinary farmer.

Every day the business of research goes on at the Connecticut Station. To pick one project from its current list that looks the most productive of discovery is impossible. A good example of its present-day work, however, is that newest field of scientific investigation — atomic energy. The Station has its finger in the field of "peacetime uses" about which we hear so much. Curing plant ailments is its particular "baby", the application of radioactive materials to plants for this purpose growing out of its pioneer research on chemotherapy.

'Inside Out' Treatment

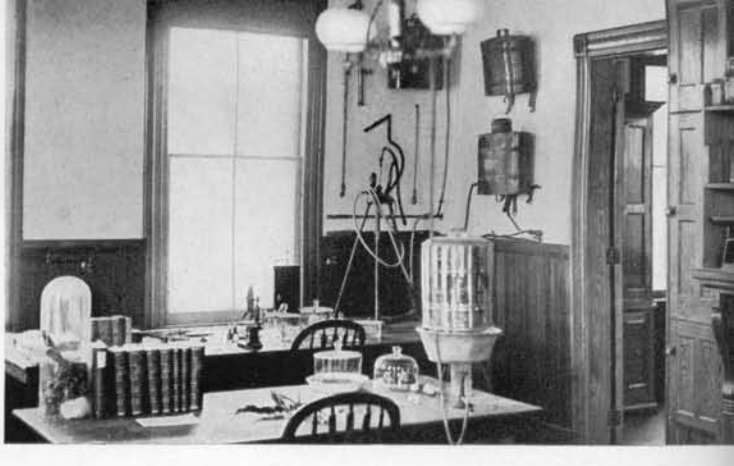
Treating plants from the "inside out" by getting corrective chemicals into the innermost portions of the plant, rather than spraying them on the outside, is now a seven-year old story at the Station. It offers promise of checking several hitherto unsolvable plant disease problems and its commercial use is growing slowly but surely. Now, the Connecticut scientists are finding out what radioactive materials will do to plants, as well as using radioactive isotopes as "tracers" to see where chemicals go when they enter a plant.

The "appropriate work" has changed a lot since the Station started inspecting fertilizers 75 years ago—but the purpose still remains the same—to put science to work on the problems of agriculture.

SCIENCE: 1875-1950

What were the problems confronting an experiment station worker in 1875? What was the state of our scientific knowledge? The contrast in the facts known to science then and now is very sharp and will serve as a measure of the intellectual tools an experiment station worker had at his disposal 75 years ago and today.

In 1875 it was well known that plants require certain nutrients for normal growth. Liebig had shown that phosphorus and potassium were essential for the growth of plants and Gilbert and Lawes had set up their famous experiments on fertilizers. These experiments demonstrated the value of balanced fertilizers in plant nutrition. It was only in the years which followed, however, that we were to learn that plants and animals require many other elements for normal growth: copper, zinc, magnesium and iron, to name a few. We were to see how plants can be grown on simple nutrients to maturity and can even be made to produce seed as a result of the knowledge gained from these studies. Diseases of plants and animals arising from the deficiency of specific elements have been recognized and corrected in the intervening years.



The experiment station scientist had a much different workshop in the 19th century than he does today. The picture above shows the first botany laboratory at the Connecticut Station, contrasted with the newest laboratory of the Plant Pathology Department. Dr. Richard Chapman shown in the lower picture.

Pasteur's Discoveries

By 1875 a great beginning had been made on the germ theory of disease. Pasteur had finally shown that spontaneous generation of microbes did not occur, that wine could not ferment without yeast and that yeast had to arise from other yeast cells. Similarly with microbes that produced disease in animals and plants, he demonstrated repeatedly that where there was no microbe, there was no disease. In this same period Koch set up his famous postulates by which the scientists who followed him could tell with certainty whether a particular microbe caused a disease.

Seventy-five years ago a few plant diseases had already been described, and the microbes which caused them were also being studied. But at this time there were very few ways of fighting plant diseases. A few keen observers had noticed that insoluble copper salts, dusted on wheat seed, prevented seed borne diseases, but all too little could be done to prevent leaf spots and the many other troubles that attack plants. It was not until 1882 that Millardet, in France, noticed that grapes, painted with a poisonous-looking paste of copper sulfate and lime to ward off thieves in the vineyards, did not suffer from mildew, whereas plants farther from the roadside, which were not painted with this paste, were heavily mildewed. This became the first foliage fungicide and, in the years which followed, Bordeaux mixture reigned supreme. Then followed sulfur, lime-sulfur, and the insoluble copper sprays. Most recently the organic fungicides which have resulted from modern research in the laboratory have brought under control a number of diseases whose existence was not even recognized in 1875.

Our 1875 counterparts had noticed the depredations of insects upon crop plants for a long time, but methods of controlling these insect pests were very unsatisfactory. Nicotine was known and used to some extent and oil emulsions were also used. Pyrethrum, known as an insecticide since 1800, was not used agriculturally until the 1920's. The arsenic compounds came into use in the 1890's with the development of lead arsenate. Today there is a wide range of synthetic organic insecticides, and their place in the national economy is indicated by the fact that DDT has become a word used by every housewife. With them, levels of insect control previously unknown have become possible. Newest of all are the systemic insecticides which are absorbed by the plant and kill only those insects which feed on it, leaving the natural enemies of these insects alive to prey upon them.

Genetics in 1875

In 1875 genetics was in its infancy. Then and for many years thereafter a farmer could improve his seed stocks only by saving seed from the tallest plants or those which yielded best. Gregor Mendel had already performed his world famous experiments which demonstrated that such factors as flower color and shape of peas are inherited as unit characters. He showed that when plants differing in flower color were crossed with one another, the offspring will divide as to flower color in a simple and predictable way. These experiments, however, were not generally known in 1875; "hidden" in an Austrian journal, Mendel's writings on the subject were not re-discovered until 1900. Ths research was highly important and the science of genetics arose rapidly from an appreciation of this discovery. In the years which followed, the geneticist learned that most living things are a polyglot mixture of genetic characters. To make predictable progress, the geneticist had to learn to inbreed his material and thus to purify it. With purified inbreds, he could make crosses or hybrids which frequently had characteristics far superior to the parental stock. Improved techniques, such as the double cross, made possible hybrid corn. All of these techniques developed rapidly in the first half of the twentieth century, and with them came rapid improvement in the plants and animals which a farmer could grow.

These typical advances in the past 75 years will indicate how great the steps have been along the frontiers of our knowledge and how each step has led the way to further discovery. Truly science is the endless frontier!

U. S. AGRICULTURE
1875-1950

Mechanization is one of the most striking advances in American agriculture over the past three-quarters of a century. Just one example is the modern hay baler—quite a contrast with the old method of making hay. *Upper photo from The Bettman Archive.*

Agriculture in 1875 was witnessing the closing of one frontier and stood on the threshold of another. The land frontier was almost gone and the frontiers of scientific agriculture and mechanization of the land was just beginning to be glimpsed.

Up until the middle of the nineteenth century, farming was the country's main industry and the American farmer was blessed with a seemingly inexhaustible supply of new land to the West. The self-sufficient family farm was the usual unit and most of its produce was for home consumption and not for market. New land was cheap, plentiful and fertile and the farmer found it easier to move on to new land when he'd worn out the old than to take care of what he had. The situation was anything but conducive to good farming methods and old-fashioned and wasteful practices were the rule of the day.

Migration to Cities

By 1875, things had begun to change. The land frontier was disappearing and ever-increasing numbers of the population were engaged in other occupations than agriculture. The industrial revolution had begun, bringing with it improved transportation and more cities, containing more industrial workers to be fed with the products of the land. Agriculture, for the first time, was becoming the concern of all of society. The first agricultural experiment station had just been established by a group of far-sighted farmers who could see the shape of things to be.

With the passing of the frontier, it was obvious that farmers had to take better care of their land. The shift in population to the cities and the building of the railroads meant more markets and the means of getting produce to these markets. These same factors meant that competition with other farm areas was increasing. Higher yields and improved quality took on new significance.

The farmer began to look upon his land with more respect as he expected it to do more for him. He began to replace the things he had taken from it and the commercial fertilizer industry, founded in 1850, began to grow. He became interested in better crop varieties and better breeds of livestock that would bring him bigger and surer returns. Machines began to appear in ever-increasing numbers on the farm. And the farmer began to specialize. No longer self-sufficient, he produced the things best suited to his particular farm and market, and bought other agricultural products from other areas.

Machines and Science

For these just-beginning trends to come to fruition, the farmer needed help. Probably two groups did more to bring agriculture from its 1875 status to the place it enjoys today than any others. Inventors of the last century gave the farmer almost every conceivable kind of machinery — improved plows, threshers, reapers, binders, harvesters poured from the brains of these men in profusion. Secondly, scientists for the first time began to devote their full attention to the problems of agriculture and led the way to more efficient farming methods which made higher yields and more economical production possible.

The fruits are more than evident 75 years later. The power tractors and huge combines of today would appear unbelievable to the farmer of 1875. With the amazing improvements in cultivating and harvesting equipment have come other types of machinery—rising from the discoveries of science. Findings in insect and disease control, developed almost entirely within the past 75 years, have resulted in a need for a new type of farm machinery which industry was quick to supply. The hydraulic sprayer, the mist blower, and aircraft adapted to crop protection have all evolved from the first sprayer, devised by an experiment station scientist in 1888, a wash boiler serving as the spray tank.

Marketing, too, has been revolutionized since the first railroads started the trend in this direction. Modern refrigerator cars and trucks make it possible to ship meats and fresh produce long distances with no loss in quality. Canning and quick-freezing have opened new markets.

Each new change has brought with it new problems to which science has been asked to find the answers. For example, the rise of the canning and quick-freezing industries has brought a need for new fruit and vegetable varieties, suited to such processing. Specialized farming has made efficient methods and superior crops and livestock essential. Selection of the best lands for each purpose and the proper treatment of these premium fields are subjects on which much research has been done. The closing of the frontier brought new problems of land use to which science gave such answers as conservation, erosion control, irrigation and dry farming. The development of new crops has been another field in which science has been called in. Soybeans are one such contribution.

Work of the Stations

The progressive farmer today is well aware of the work the scientists in experiment stations and elsewhere are doing in soils, pest control, plant and animal breeding, agricultural engineering and so on down the list. Years ago, the founder of the first experiment station said that his aim was to make agricultural science practical and practice scientific. In 1950, it would appear that this purpose has been fulfilled.

CONN. AGRICULTURE: 1875-1950

Seventy-five years ago the average Connecticut farmer was in the main a livestock producer. Around the three-quarter mark of the last century, in fact, the livestock population on farms ran a close second to the total human population of the State—there being well over 400,000 horses, cattle, sheep and hogs and only 600,000 people. Along with producing beef, mutton, pork and wool, the Connecticut farmer of the 1870's was raising grain to feed his animals. The U. S. Department of Agriculture reported in 1875 that he produced 2 million bushels of Indian corn, 1 million bushels of oats, 350 thousand bushels of rye, a good many thousands of bushels of buckwheat, wheat and barley, and 570,000 tons of hay in that year.

Aside from grain, the only principal crops listed by the U.S.D.A. are potatoes and tobacco. There was no mention of fruits and vegetables. Poultry, too, was considered too unimportant to rate a listing.

292,000 Scythes

The use of machinery is indicated by the fact that in 1880 Connecticut farmers had on their farms 292,000 scythes—but no mowers or hay loaders. Labor was cheap – the average monthly wage without board was $28.50.

In the 1870's, however, the East was beginning to feel sharply the competition from the great agricultural areas of the West. Lower cost products from those regions were being brought within easy reach of the Eastern markets by the expanding railroads. Connecticut was also becoming industrialized and the competition with industry for labor was growing.

In a fairly short time, the early type of livestock industry here was almost abandoned. With it, went the grain fields and pastures. Farmers began to concentrate on perishable products for the near-by market, where they had the advantage, and on specialized crops particularly suited to their land.

Rise of Dairying

Fresh milk became the chief product of the dairy industry, and the production of butter and cheese, at one time important manufactures, disappeared almost entirely. Dairying grew steadily and today ranks first among the State's farm operations, with an annual value of 50 million dollars a year. Skimming over the years until 1950, today we find the poultry industry in second place. High grade eggs for local consumption became important in the last century when farmers switched to perishable products for which there was little competition from other areas. The broiler and baby chick businesses are of fairly recent origin.

One of the few crops for which we can directly compare 1875 with 1950 is tobacco. Connecticut farmers have always grown this crop and it is interesting to note production in 1875 was 10 million pounds, with the crop bringing 22 cents a pound. In 1948, production had jumped to 27 million pounds, bringing an average price of $1.22 a pound.

Taking a quick look at the other important agricultural industries of today, we find greenhouse and nursery products, vegetables, fruits and potatoes ranked in order.

Today, the number of Connecticut farmers has decreased one-third since 1875. Using one-third of the land tilled in that year, they are producing crops valued at three times as much, on a corrected dollar basis.

How have they accomplished this? Like farmers the country over who were experiencing some of the same problems in the last part of the last century, they looked to technology and science for the answers. Two of the best examples in our own state of the answers science gave them show up in the poultry and tobacco industries. When experimenters in Connecticut found for the first time that chickens could be raised in confinement, they paved the way for the *modern multi-storied poultry house.* Other researchers in the State found the answer to poultry disease problems which threatened the industry.

Still other Connecticut researchers grew the first tobacco under cloth in the Connecticut Valley, laying the first stone from which rose today's multi-million dollar Shade tobacco operations.

The benefits of science lie close to home in Connecticut, and the successors of those early Connecticut farmers who agitated for the founding of the first experiment station owe much to their farsightedness.

FRONTIERS
of Plant Science

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J G Horsfall, Director

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