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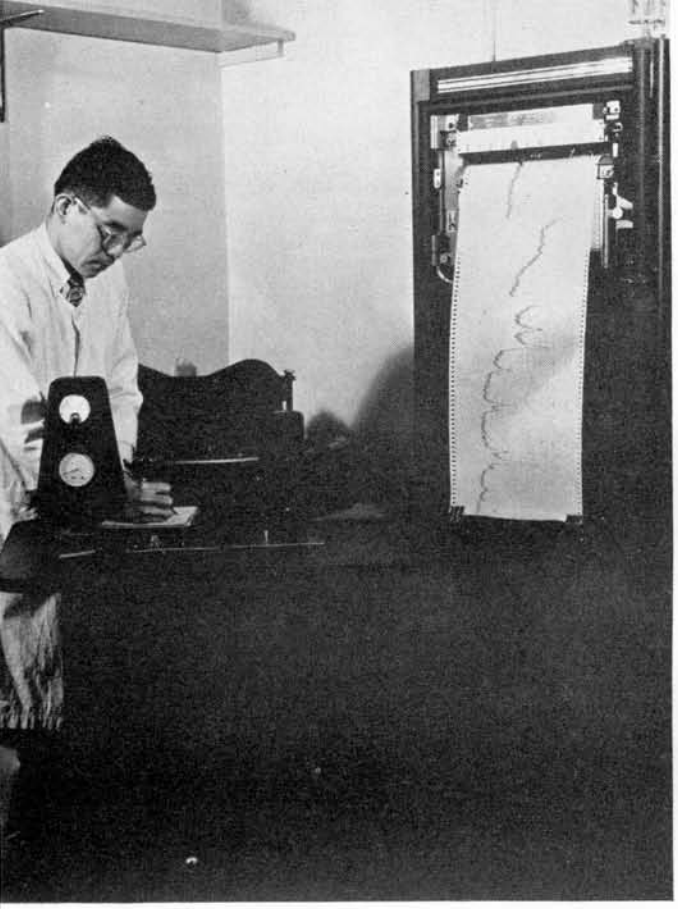
FRONTIERS of Plant Science

SPRING ISSUE

Dr. Lester Hankin prepares stab cultures of bacteria, as the first step in a microbiological assay for vitamin B_2 (riboflavin). Determining the contents of the various vitamins in human and animal foods is the primary function of the Station's new microbiological laboratory. See story on pages 4 and 5.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION, NEW HAVEN



Dr. Tamura notes results of an x-ray spectrometer analysis of a Connecticut soil. Before the use of this instrument, it was impossible to identify the clay particles of a soil, which are largely responsible for its chemical and physical properties.

Our Connecticut Soil Clays

by Tsuneo Tamura[1]

Standing on the second floor of the Soils Department Laboratory is an imposing piece of equipment called an x-ray diffraction spectrometer. The equipment consists of an x-ray generating unit, a counting unit, and a recording unit for permanent record keeping.

How does this instrument help soil scientists in their studies? How does this modern research tool benefit Connecticut citizens? Although applications of findings from this apparatus are varied and many, this report will be mainly concerned with the agricultural information derived.

For many years soil scientists have known that chemical and physical properties of mineral soils are largely controlled by the very fine soil particles called clay. These clay particles are generally less than 1/10,000 of an inch in diameter. Until x-ray diffraction techniques were developed, these particles could not be identified because of their small size. Previous to the use of x-rays, these fine particles were thought to be without definite structure; they were called amorphous. When the particles were exposed to x-rays, the atoms in the particles reacted with the x-rays in the same way that larger crystals did. This meant that the small particles were not amorphous; they possessed definite atomic arrangement capable of interacting with x-rays to produce what is termed diffraction. This instrument then allowed soil scientists to look deeper into the nature of soil clays.

Two Kinds of Clay Minerals

Two major types of clay minerals are found. Both have similar physical make-up; they are flat sheet-like layers resembling stacked dinner plates. In one variety the slice or plate is composed of one layer of alumina bounded on one side by a layer of silica. This type is commonly referred to as the 1:1 or 2-layer type. This clay mineral type is not found in appreciable quantities in our soils.

The other type is composed of one layer of alumina with a layer of silica on both sides of the alumina layer. This type is referred to as the 2:1 type or 3-layer type. The second silica layer gives this type of clay mineral an added characteristic of swelling between plates. The degree of swelling is dependent on the chemical make-up of the mineral. In our soils the fine particles consist of 2:1 type clays.

In our Wethersfield, a red soil with compact substratum, illite and vermiculite predominate. The chemical activity of these two clay minerals is different. Fortunately, as potassium is slowly released from the potassium-bearing illites, the vermiculite catches and holds the released potassium until the plant absorbs it. This mutual relationship is excellent for plants. Unfortunately, the amount of total clay present is small and the rate of release of potassium is slow so the amount of potassium available from these clays is insufficient for normal growth of most crops.

In the tobacco growing region of Connecticut, the soil clays contain a mineral called gibbsite. This mineral differs from the two major types of clay minerals in having no silica attached to the alumina layer; the formula for the mineral is $Al(OH)_3$ or aluminum hydroxide. In the soil acidity conditions under which tobacco is grown, this mineral releases aluminum which can be absorbed by plants. A high aluminum content in the tobacco leaves, however, lowers the quality. To alleviate this situation, the farmer can apply high amounts of phosphate fertilizers. The phosphate not utilized by the plant combines with the soluble aluminum to form insoluble aluminum phosphates. Aluminum is thus made unavailable to plants and better tobacco quality is maintained. Knowledge of clay minerals explains why high amounts of phosphate fertilizers are needed for Connecticut's tobacco.

By studying the soil down to depths of 30 inches or more, information of great value is obtained. The root development of tobacco is generally limited by a plowpan in the subsoil. In order to get deeper penetration of roots, subsoiling programs are being considered. Clay mineralogical investigation reveals that the gibbsite content of these soils is even higher in the subsoil. Consequently, any subsoiling program should include a fertilization plan that ties up alumina, reducing aluminum uptake by tobacco. Decreasing the soil acidity will also make aluminum less soluble; but until diseases associated with lower acidity are controlled, the phosphate treatment is more economical.

The use of liquid nitrogen is becoming more extensive. With nitrogen fertilization, leaching losses are of great concern. The nitrogen in liquid form will generally be ammonia which combines with water to form ammonium hydroxide (NH_4OH). When applied to soils, the ammonium ion will be attracted to the clays and retained until biologically converted to the nitrate form which is the form plants can absorb. If nitrate nitrogen is used exclusively, the loss from leaching will be excessive since the clays do not attract this form of nitrogen. Since the amount of clay will determine how much ammonium ion can be retained in the soil, too high applications will be wasteful and inefficient. Furthermore, as the ammonium ion is converted to the nitrate form, the latter form is susceptible to leaching and may never benefit the plants. The studies thus far on clay minerals have not only explained heretofore unknown causes for soil-plant relationships; but they have made it possible to improve soil amendment practices. As more information on the behavior of clay minerals is gained from research on soils with the x-ray diffraction spectrometer, we shall be able to make additional suggestions for the improved use and fertilization of Connecticut's soils.

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[1] Dr. Tamura is a soil scientist.

New Developments in Control of Vegetable Insects

by Neely Turner[1]

Experiments in control of insects attacking vegetables have been carried out extensively for the past 25 years. Satisfactory control measures have been worked out for many of the more destructive pests. However, there are some pests for which effective control measures have not been developed, such as cabbage maggots on radishes and turnips. In the case of at least two insects, cabbage worms and flea beetles, resistance to DDT has developed, and new materials are required. Finally, the control of the corn ear worm, which seemed adequate when the infestation was light, has failed when the pest has become very abundant.

This article is a report of progress made towards meeting some of the needs of vegetable growers.

Cabbage Maggot

This pest infests early cabbage, cauliflower and radishes, and later generations attack turnips. Use of 5% chlordane dust, applied around the stems of newly-set cabbage and cauliflower plants, generally provided good control of the pest. However, some growers reported unsatisfactory results. Recently, heptachlor and dieldrin dust have been used with excellent results. It has been necessary to apply the dust as soon as the plants are set, and leave it undisturbed for about three weeks.

Work by James B. Kring of our staff has demonstrated excellent control of maggots on both radishes and turnips. He applied the insecticides to the rows as a soil drench. Aldrin or heptachlor 25% wettable powder (6 ounces in 50 gallons of water) or dieldrin 50% wettable powder (3 ounces in 50 gallons of water) were highly effective. The drench was applied at the rate of 175 gallons per acre to rows 3 feet apart. The method has been used experimentally, but could easily be adapted to either broadcast or row culture of these crops.

Cabbage Worms

For the past two seasons, growers have had increasing difficulty with cabbage worms. Last summer Goeffrey Wheatley, working here, found definite evidence that 10 times as much DDT was required to kill cabbage worms in 1954 as in 1944. However, DDT still gave adequate control, and was more satisfactory than all but one of the new materials tested. This new dust must be tested further to determine its possibilities.

Since DDT still works, growers can probably "get by" with it for another season. However, it might be necessary to use rotenone or pyrethrum dusts late in the season, and especially on plants within two weeks of harvest.

Flea Beetles

In many sections of the State, flea beetles are resistant to DDT. These insects may cause serious injury to newly-set tomatoes. Before DDT was introduced, rotenone dust was the material most useful. Rotenone is probably the most satisfactory material for use if DDT is ineffective. It must be remembered that two or three applications of 1% rotenone dust may be needed to protect the young plants.

Corn Ear Worm

The corn ear worm has long been a serious pest on sweet corn. Studies made many years ago established the fact that the corn ear worm seldom survives the winter in Connecticut. The cold weather does not kill the larvae, which burrow into the soil, but alternate freezing and thawing closes the hole through which the moth must escape in the spring. The time corn is infested and the severity of the infestation depend on how near Connecticut the larvae did survive the winter.

If the winter is mild, the moths have to travel only from Long Island or New Jersey, and corn may be infested as early as July 15. Such early infestation is usually followed by an "outbreak" in August and September. If the winter is severe, the first moths may not reach Connecticut before August 15, and the infestation cannot be severe before late in September.

The mild winter of 1952 was followed by one of the worst infestations of ear worms in recent years. Damage was less severe in 1954. The winter of 1954-55 has been relatively mild, and some trouble from this insect may be expected.

For several years, growers have depended on DDT dusts to control corn ear worms. The first treatment was made as soon as silks appeared, to kill the larvae which hatch from eggs laid on the silk. Two additional treatments were suggested at intervals of three or four days. This treatment has given fairly good results in light infestations. It has been entirely inadequate when "outbreaks" occur.

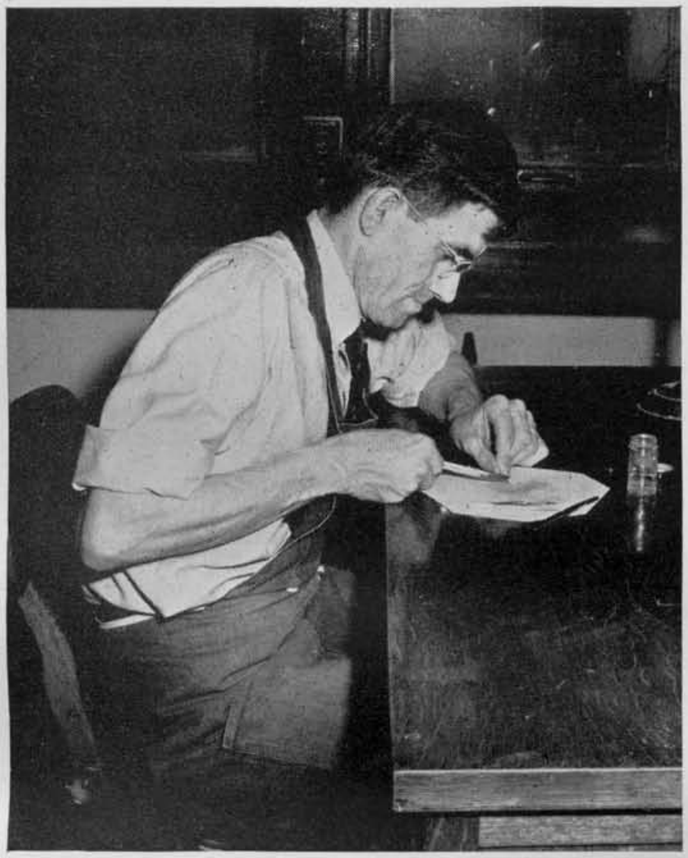
Last season Dr. Kring started tests with some new materials. These results were very encouraging as far as control was concerned. However, five applications of spray at three-day intervals were required. Only the stalks and ears were sprayed. At the usual level of infestation, this sort of treatment may be too costly for general use.

[1] Mr. Turner is head of the Entomology Department.

Cabbage maggot injury on turnips. A single application of insecticide to the soil may prevent this damage.

Cabbage worms. These pests are becoming resistant to DDT, but it is still adequate for control.

Corn ear worm. New materials offer promise in controlling this perennial pest.



George Smith is preparing a rat leg bone for staining and microscopic examination for healing. The rat was placed on a rickets-causing diet before being fed the milk under test, and the extent of the healing of the bone is a measure of the Vitamin D content of the milk.

Bread, Milk and

New lab

As soon as one more piece of scientific equipment is received (perhaps by the time this issue of FRONTIERS OF PLANT SCIENCE reaches you), the Station's new microbiological laboratory will be functioning.

Briefly, the purpose of this laboratory is to test for vitamins. Work with vitamins is not a new field for the Station, because as far back as 1913 Dr. Thomas B. Osborne of the Station, working with Prof. Lafayette Mendel of Yale, discovered Vitamin A in the course of his studies on protein nutrition. Vitamin A was then called the "fat-soluble vitamin", and it was not until considerably later that it became known that there were at least three vitamins in the fat-soluble group: Vitamin A and the two so-called "sunshine vitamins", D_2 and D_3. Because Osborne and Mendel's nutrition studies required the use of animals for feeding tests, they purchased a few white rats and raised their own colony. This Station colony has continued to be bred from the original stock up to the present day, with no new acquisitions since about 1918, and has become famous in nutrition circles as the "Yale strain".

Vitamin D-Fortified Milk

After the retirement and death of Osborne and Mendel, the research of the Station's Biochemistry Department took paths not requiring the use of animals, but simultaneously a need for the colony arose in another quarter. The discovery by Hess and Steenbock that vitamin D prevented rickets in young children had led to the appearance on the market of milk fortified with Vitamin D, and the State Dairy and Food Commission (now the State Dept. of Agriculture) wanted to have a place where this fortified milk could be tested to be sure that its Vitamin D content was always up to strength. Since the Station had the rats and the personnel trained to work with them, it was inevitable that the Station should go into the business of checking the Vitamin D content of the Connecticut milk suply. Since 1935 the Vitamin D milk of every Connecticut producer has been tested at least twice a year by feeding to rats, and it is probably because these producers know that their milks are being checked that 85 per cent of them have been found to be up to standard over the years.

Vitamins in Poultry Feeds

At a later date the Station started assaying poultry feed supplements for Vitamin D at the request of Connecticut poultrymen. There are several D vitamins, but the two most important are Vitamin D_2 and Vitamin D_3. Both are probably equally effective in preventing rickets in rats and man, but only Vitamin D_3 has any appreciable effect on birds. For this reason the rat cannot be used as a test animal in assaying Vitamin D supplements for poultry; birds must be used. The Station therefore had to set up a new laboratory of baby chicks to use in testing the Vitamin D oils and other concentrates that were needed for the State's important broiler-raising industry. Brooders were acquired and placed in an air-conditioned room, and at intervals day-old White Leghorn chicks were obtained from a Connecticut poultryman who specialized in producing this strain for laboratory use; these chicks were fed for 21 days on a diet to which the oil under test was added, after which they were killed and their leg bones analyzed for their mineral content. Comparison with other birds fed a diet deficient in Vitamin D then indicated the Vitamin D content of the material under test.

Thus, the Station has for many years been conducting Vitamin D assays of foods destined for human and animal use. It was felt that the field should be expanded to take in other vitamins; hence the need for a microbiological laboratory. There are chemical methods for analyzing for some vitamins, but not for all of them (vitamin D can still be assayed only by tests on animals), and where chemical methods do exist they are not always the shortest or the most reliable methods. The microbiological methods depend on the fact that bacteria and other minute forms of plant life, like other larger living things, require vitamins to grow. Portions of a bacterial culture are placed in several test-tubes, each containing the same quantity of a medium containing everything the bacterium needs to grow except the vitamin under test; when various quantities of the material being tested are added to different tubes, the rate of growth of the bacteria in the tubes is proportional to the amounts of vitamin that have been added.

Thousands of Test 'Animals'

In effect, a microbiological vitamin assay is like an animal assay conducted on a colony of thousands (or millions) of animals; the only difference is that the "animals" are microscopic plants. Because so many bacteria are used, and because it is feasible to run more tests on each sample, microbiological assays are theoretically capable of being more accurate than animal assays (as well as much less expensive and less space-consuming). It is for this

itamin Pills - - -

ill check their vitamin content.

by Harry J. Fisher[1]

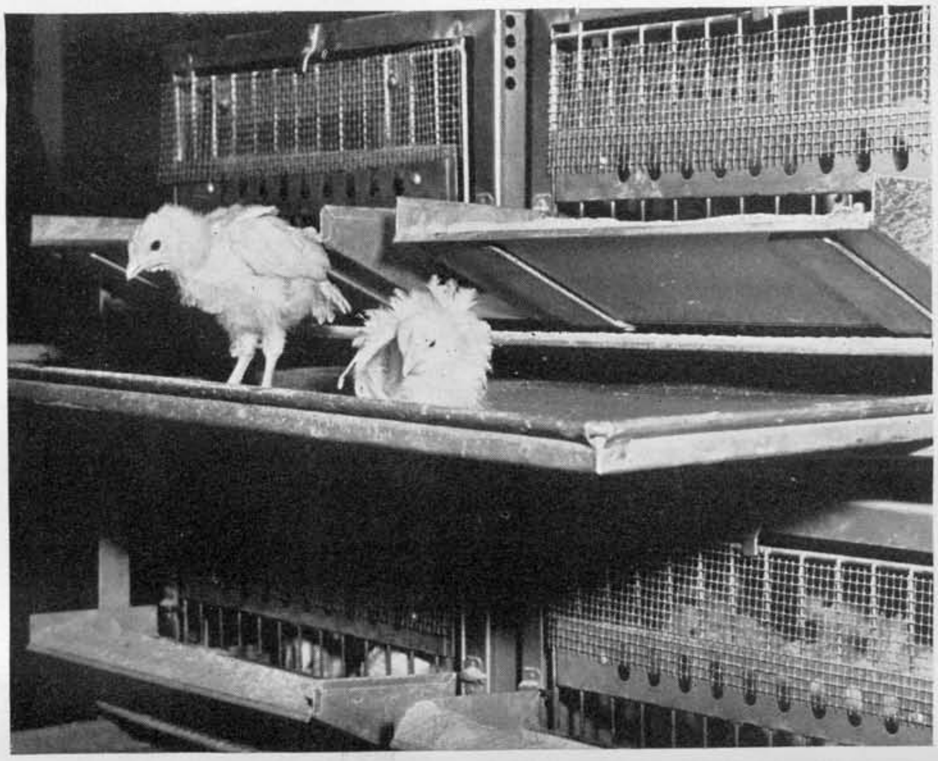
reason that microbiological methods have so largely supplanted animal-feeding methods for testing for those vitamins to which they are applicable.

When the new microbiological laboratory is ready, the Station will be equipped to assay for any vitamin in any type of material, using the most appropriate method (whether chemical, microbiological or animal-feeding) in each case. Among the things that we will do first will be the following:

(1) Vitamin A and D skimmed milk will be assayed for Vitamin A (by a physical-chemical method), as well as for Vitamin D.

(2) Vitamin-and-mineral-fortified milk will be assayed not only for Vitamins A and D but also for thiamine (Vitamin B_1), riboflavin (Vitamin B_2), niacin, iron and iodine.

(3) Bread will be analyzed by a combination of microbiological and chemical methods to assure that it is properly enriched with thiamine, riboflavin, niacin and iron.



Chicks and brooders used in assaying Vitamin D oils for poultry.

At a later date it is planned to check on the vitamin contents of the numerous multivitamin capsules and tablets that are sold in such quantities in the modern-day drugstore.

Research Problems, Too

Besides these more obvious services to the health and well-being of the Connecticut public, the microbiological laboratory will be put to work on such research problems as studying the variation of the vitamin contents of fruits and vegetables with variety, conditions of fertilizing, time of harvesting, etc. It will even make itself useful in as apparently unrelated a field as entomology, because the Vitamin B_{12} content of insects has a bearing on control measures for the insects that are so destructive to our crops.

The resources of the microbiological laboratory can and will also eventually be put to other uses than the assay of vitamins. Of recent years, the addition of small proportions of aureomycin, terramycin and other antibiotics to commercial animal feeds for the purpose of stimulating growth has increased enormously. Because no chemical methods exist for the determination of minute quantities of antibiotics in feeds, methods depending on their power to prevent the growth of bacteria must be used. Since the microbiological laboratory will already be equipped with all the facilities for making such tests, it will work in very handily for checking market feeds to be sure that the antibiotics they claim to contain are really present.

1 Dr. Fisher is head of the Station's Analytical Chemistry Department.

Cages of rats being fed various brands of fortified milk undergoing tests for their Vitamin D content.

From the Director

The most famous prayer in Christendom contains the supplication, "Give us this day our daily bread." And the old adage goes that "God helps those who help themselves." How can we in America help ourselves to assure the continuance of our daily bread?

The hard core of the problem lies in the simple statistic that the population is rising almost 2 per cent per year. Thus, we must soon ask for twice as much daily bread as we eat now.

Scanning the broad reaches of history, we can see that the problem has had harsh answers in the past. War, pestilence, and famine have kept the population down. Since these answers are unthinkable for the future, we must find another solution. One is to seek more land. But, experience in the recent past shows that land in crops has been declining. A short Sunday drive will show that factories, houses, outdoor theatres, and thruways are gobbling land at a fantastic rate. Such needs have increased by 9,000,000 acres in the last 20 years.

Our frontier is gone. We can irrigate more desert, or denude more of our "wooded hills" but good land from those sources is relatively scarce. During the past 30 years, we have gained for our own food some 65,000,000 acres of land formerly used to feed the horses that provided the power when horsepower came from horses. If every horse left were converted to glue, however, the land gained would not equal that spent on the New Jersey Turnpike.

As a result, we shall be faced with the problem of producing a rising food supply on a declining supply of land. When this big squeeze is discussed with the man in the street, he is inclined to say that the scientists will rescue us. The staff of the Experiment Station comprises a significant portion of the plant scientists of America who are expected to pull this rabbit from the hat.

The challenge for the future is impressive. We at the Station must add one sentence to our prayer, "Give us the courage, the enthusiasm, and the imagination to do our part."

James G. Horsfall

75 YEARS AGO

by Ruth Giandonato[1]

Samuel W. Johnson, founder of this Station, in 1877 hired two very competent and experienced chemists in the persons of Ernest H. Jenkins and Henry P. Armsby. This illustrious trio began work on the chemical analysis of commercial fertilizers. In the Annual Report for 1877, Johnson says "Naturally, the Analysis of Fertilizers has been our chief occupation, because the advantages of that kind of work are widely appreciated by the citizens of the State, and the necessity for continued vigilance in respect to fraudulent or worthless articles, is liable to be illustrated anew every season."

During the first six months, fifty-one analyses were made, consisting of the following samples:

2 Pollard's compositions for grass and vegetables	1 hair manure
2 peat and bog ashes	1 horn shaving
3 peats or swamp mucks	2 blood fertilizers
1 pond mud	4 guanos or substances so-called
3 native phosphates from South America	4 superphosphates
7 bone manures	15 dried fish scraps or fish guano
2 tankings	4 potash salts

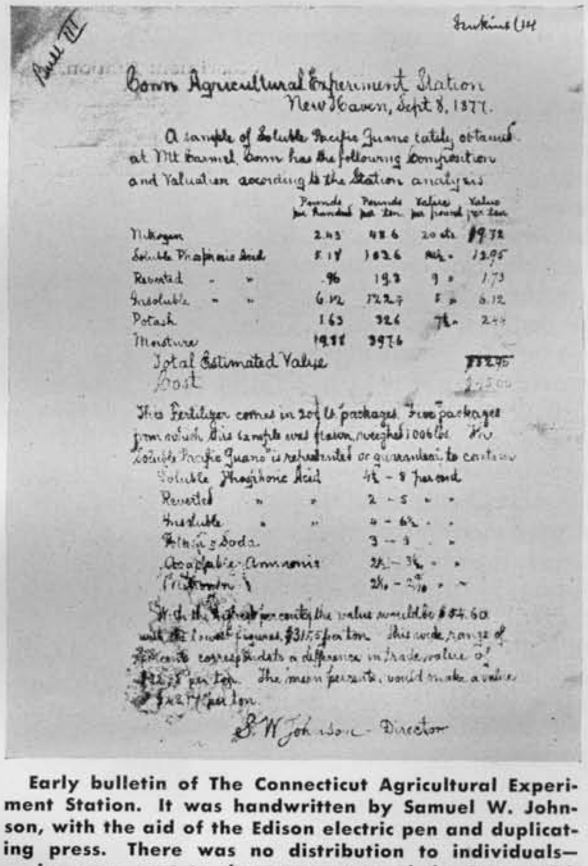
The first item concocted by H. M. Pollard, self-styled agricultural chemist, was a "prescription" fertilizer. Pollard, who professed to analyze soils by smell and taste, as well as by chemicals, visited farmers and wrote "on the spot" prescriptions to make their soils more productive.

Mud-Seller Jailed

On analysis, Pollard's compositions proved to be on a par with a sample of harbor mud dredged up off Long Wharf, New Haven, which fact closed up Pollard's fertilizer establishment, located between the Depot and Meadow Street. Johnson's "last intelligence" of his operations came from the Springfield, Mass., jail.

The sample of pond mud compared favorably with a soil sample from Seymour, and a wheat soil from Illinois. It was found rich in nitrogen and uniformly rich in plant food, with the exception of phosphoric acid and sulphates.

In the samples of blood fertilizers it was estimated that the cost of nitrogen was 15 cents and that of phosphoric acid, 5 cents; nitrogen in hair manure cost 10 cents, and in horn shavings, 7½ cents per pound. In guano, the cost of nitrogen was 20 cents per pound, and phosphoric acid, 5 cents. Surprisingly enough, these prices are not too far removed from today's.



Bull III

Conn Agricultural Experiment Station
New Haven, Sept. 8, 1877.

A sample of Soluble Pacific Guano lately obtained at Mt Carmel, Conn has the following composition and Valuation according to the Station analysis

	Pounds per hundred	Pounds per ton	Value per pound	Value per ton
Nitrogen	2.43	48.6	20 cts	$9.72
Soluble Phosphoric Acid	5.18	102.6	12½ .	12.95
Reverted " "	.96	19.2	9 "	1.73
Insoluble " "	6.12	122.4	5 "	6.12
Potash	1.63	32.6	7½ .	2.44
Moisture	19.88	397.6		
Total Estimated Value				[illegible]
Cost				[illegible]

This Fertilizer comes in 200 lb packages. Five packages from which this sample was taken weighed 1006 lbs. The "Soluble Pacific Guano" is represented or guaranteed to contain

Soluble Phosphoric Acid	4½ – 8 per cent
Reverted " "	2 – 5 " "
Insoluble " "	4 – 6½ " "
[illegible] Soda	3 – 4 " "
Available Ammonia	2½ – 3½ " "
[illegible]	2½ – 2⁹⁄₁₀ " "

With the highest percentages the value would be $54.60 with the lowest figures, $31.75 per ton. This wide range of percents corresponds to a difference in trade value of $[illegible] per ton. The mean percents would make a value of $[illegible] per ton.

S. W. Johnson – Director

Early bulletin of The Connecticut Agricultural Experiment Station. It was handwritten by Samuel W. Johnson, with the aid of the Edison electric pen and duplicating press. There was no distribution to individuals—copies were sent to the newspapers of the State, with the request that they publish the information.

In the fish manures, a cheaper fertilizer was found than in the superphosphates. The menhaden, long used as a fertilizer by the Indians and the coast farmers who applied it fresh to maize, or in composts, now was converted into fish guano, by extracting the oil and leaving the coarse "half-dry scrap" or guano. Analyses were made of the nitrogen content, without regard to the phosphoric acid value. In 1877 it appeared that the fish yielded a richer "scrap", but were poorer in oil content.

By way of contrast, in 1954, more than 800 samples of fertilizers were analyzed by the Station, in an annual report of approximately 60 pages.

[1] Mrs. Giandonato is Station librarian.

HEREDITY AND ENVIRONMENT:

Short-cut study shows how both affect hemlock growth

by Hans Nienstaedt and Jerry S. Olson[1]

Dr. Nienstaedt goes to the top on a seed-collecting ladder strapped to a hemlock.

In an earlier issue of FRONTIERS, it was pointed out that eastern hemlock is one of the most important trees in Connecticut. It is quite free of insects and diseases and produces good yields of softwood timber, which is increasingly in demand. It forms excellent cover for wild life, and its evergreen foliage and graceful form add much to the beauty of the Connecticut landscape. Currently there are extensive areas where earlier poor cutting practices followed by fire have kept hemlock out of the stands. It is quite desirable that hemlock be re-established in these locations by making numerous small plantings which will in time become seed sources for the surrounding areas. These plantings should be made from stock which is not only superior in growth and form, but is also adapted to local climatic conditions.

To improve hemlock stock by plant breeding, we must first find out how much natural hereditary variability is available for the tree breeder to select from. One way to do this is to make plantings of seed from different sources in the field and compare their growth. However, under field conditions, the amount of variation may be so large that only the extreme differences can be demonstrated. Moreover, such experiments take years for completion, during which weather or other accidents may partially destroy the experiment or complicate the interpretation of its results.

Northern Seed Grows Less

This Station's study of genetic variation of eastern hemlock has attempted to supplement long-term field plantings by quicker studies of first-year tree seedlings grown indoors under controlled conditions of light and temperature. Within a year's time, this experiment not only demonstrated that there were striking differences between different seed sources, but also indicated how these differences adapted the plants of each seed source to the climate of the area from which it came.

New England collections were made by this Station with the aid of a special 63-foot ladder adapted to climbing into the lower limbs of unusually well-formed trees. The ladder permits picking cones just before the seed is lost without having to cut the superior trees. Other seed was obtained from the extremeties of the natural range—from Nova Scotia to Minnesota to the southern Appalachians.

Measurements of experimental seedlings from 30 selected sources showed that, for any given daylength and temperature treatment, plants from northern seed sources and high elevations naturally go dormant earlier than those from southern sources and low elevations. Thus, trees in cold climates harden off for winter earlier, but they also have a shorter season of growth and hence shorter total annual height growth.

It will, of course, still be necessary to check these conclusions in field plantings of trees grown to a more advanced age. But the tentative results of this first study suggest that trees from northern seed sources would not make as much growth in Connecticut as stock which is grown from Connecticut seed. Such stock is generally available for forest planting in lots of 100 or more seedlings from the State Forest Nursery in Pleasant Valley.

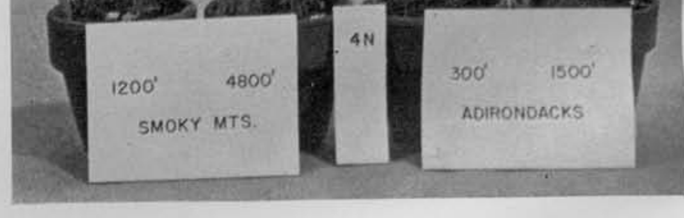
Best Growing Conditions

Earlier results, suggesting that increasing nightlength in late summer helps control the timing of terminal bud formation and hardening off, were confirmed in detail. In a series of seven nightlength treatments, plants subjected to nine hours or more of darkness out of each day stopped growth much earlier than those with eight hours or less of darkness. Out of a series of 14 combinations of day and night temperature, it was again shown that an alternation of cool (62°) nights and warm (80°) days was generally best for growth. Thus, a single brief experiment was able to show a great deal about the effects of both heredity and environment on the seasonal growth of eastern hemlock.

Although seed germination and seedling and transplant survival are favored by partial shade, best growth of established plants will take place in full sunlight. However, hemlock will endure shading for a longer time than any other conifer and generally responds quickly when relieved of competition. A higher yield and better form is attained on moist sites, but hemlock may grow better than hardwoods on dry, sandy, or rocky sites, if it can get established in non-drought years or in moist niches.

[1] Dr. Nienstaedt is a geneticist; Dr. Olson, a forest ecologist.

Seedlings grown with fewer hours of darkness (N hours during a 24-hour span) made more growth than those grown on longer nights.



Seedlings grown the same nightlength from different seed sources vary in height. Seed of parent trees from high latitude and high altitude where the growing season is short, stopped growing earlier.

NEW INSECTICIDES CONTROL APHIDS, SCALES AND MITES

by John C. Shread[1]

Everyone who raises plants has had experience with aphids. In fact, there are very few plants that do not serve as host to one or more species of these sucking, soft-bodied insects.

Aphids may occur on any part of a plant, tree or shrub. Their color may be green, yellow, red or black. Certain species transmit plant diseases, and all species are capable of causing untold injury to plant life by their feeding habits. Our remarks will be limited to several of the most important species.

Although a number of horticultural varieties of viburnum are grown, only a few are noticeably injured by aphids. Among the most seriously affected is the European cranberry bush *Viburnum opulus sterili.*

Viburnum aphids overwinter in the egg stage. Hatch commences about April 1 and feeding begins at the apex of the buds. Hence, the expanding leaves are injured before the buds are open. Later the foliage appears curled and stunted. Injury may include all of the leaves on a bush, thus checking its growth.

Our experiments show that control of viburnum aphids and prevention of curled leaves may be obtained by spraying with malathion emulsion or wettable powder (2 teaspoons per gallon of water) between April 1 and 15. Treatments made later kill aphids, but do not prevent curling of leaves.

One of several species of aphids attacking hawthorn causes curling of leaves. In addition, the trees become unsightly when sooty fungus grows in the honeydew secreted by the insects. Affected trees, however, do not die. Several generations of aphids occur annually. Malathion will keep hawthorn aphids under control when applied several times during spring and early summer.

Scales

A new scale insect is damaging hemlocks in the southwestern area of Connecticut. The needles of infested trees may be yellowish and stunted. Vigor is impaired and when infestation continues a tree may shed its needles and die. One or two malathion treatments in August should give good control.

The European elm scale is an old pest which appears to be more common today than formerly. A whitish ring surrounding a dark center will identify maturing and adult scales. A single annual brood may be controlled in mid to late August with malathion at twice the strength suggested for viburnum aphids.

Mites

The spruce mite and two-spotted mite injure arborvitae, hemlock, spruce and yew. Some of the mite damage in recent years has arisen as a result of the use of DDT to control plant pests. The insecticide kills the natural enemies of insects and mites. Hence, injurious species of mites are now more of a problem than heretofore.

Ineffective control measures in the past have resulted in the presence of off-color foliage during the summer. Recently, specific miticides have been developed which are remarkable in checking mites. Aramite, Ovotran, Dimite, chlorobenzilate and Chem-Mite are a few.

They may be used as emulsions or wettable powders at the rate of 1 to 2 teaspoons in 1 gallon of water; the lesser dosages for light infestations and the stronger dose for heavy ones.

Miticide treatments should be made during the growing season, and repeated in the fall when necessary. When a miticide is combined with DDT, both insects and mites can be controlled.

[1] Mr. Schread is an entomologist.

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BULLETINS

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