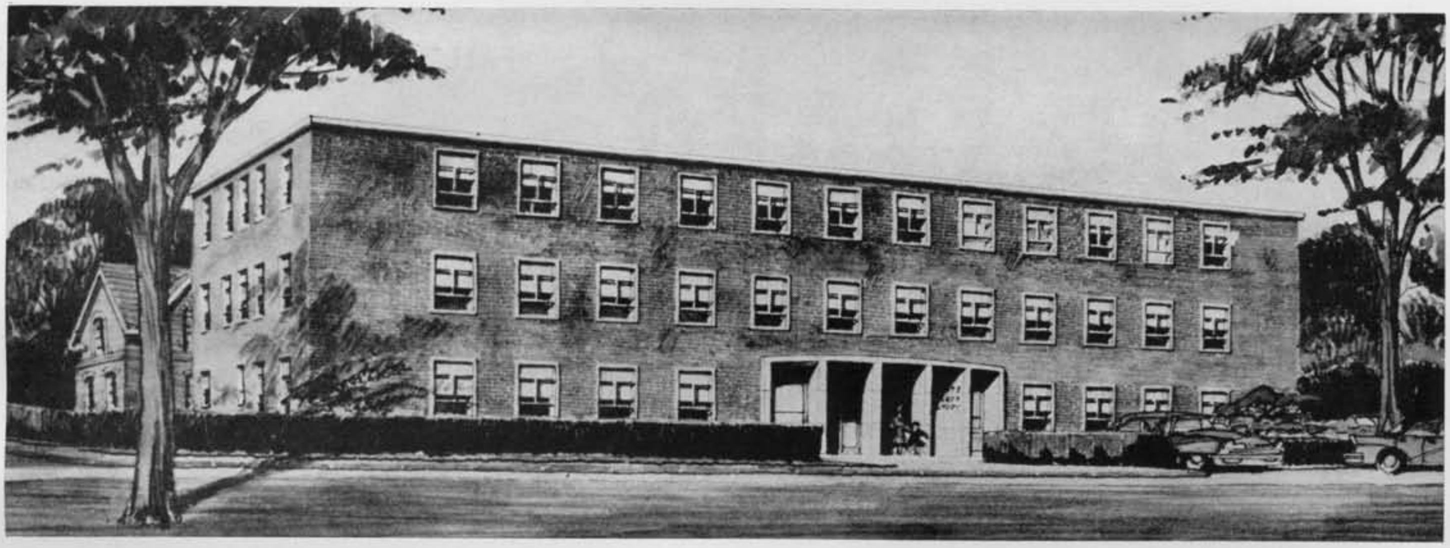
Frontiers
of PLANT SCIENCE

FALL ISSUE NOVEMBER 1957

The Tobacco Laboratory at Windsor

Why Field Days? . . . See Page 4

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION • NEW HAVEN



Slate Laboratory, now under construction, will provide facilities for research in soils and climatology, genetics, and forestry, offices for the Director and others concerned with general operation of the Station, and better service for those who seek soil analysis. Slate is the first laboratory building constructed at the Station since 1932. The new building occupies about the same site as that of the Whitney Building, a converted residence.

From the Director

To our friends everywhere we at the Experiment Station are proud to announce in this issue of FRONTIERS that Slate Laboratory is now under construction. It has been a long time coming, but coming it is. Slate Laboratory will be a wonderful addition to our physical facilities.

Scientific equipment becomes obsolete very rapidly—in fact probably more rapidly than manufacturing equipment. Since the war, completely new and different machines have been devised to improve our ability to sense natural phenomena.

Now we can "see" deep into a diseased elm tree with radioactive isotopes by listening to the clicks of a Geiger counter. Now we can "hear" the vibrations of an insect's wings by watching the wavy line on an oscilloscope, and now we can see new things in a living cell with a phase microscope.

Thus our arms are longer, our vision is wider, and our ears are keener than before the war. Slate Laboratory will bring our laboratory up to the level of our new vision. The title of a recent book on winning the West is "Men to Match My Mountains." In Slate Laboratory we are building a building to "match the men" of the Station.

The Whitney Building, about 100 years old, was built by Eli Whitney II and acquired by the Station with adjacent land in 1882. Part of the building was for many years the Director's residence.

I don't want to discuss the Slate Laboratory, however. I want to discuss Slate. Slate was the fourth Director. He served the Station as bread winner, father confessor, and water boy for nearly 25 years between July 1, 1923 and December 31, 1947. Of course, Slate was more than that. Buildings are seldom dedicated to water boys.

Some people feel that a building should not be named for a man until after he dies. We here at the Station take a different view. We are not building a posthumous monument with a cornerstone full of newspapers and Station bulletins printed during Slate's regime. We are building a living laboratory that will do its part in the scientific life of our Station.

The building will not stand as a memorial to what Slate did during his 23 years as Director. It will rather reaffirm that Slate's policies "live and move and have their being" in the Station now.

Slate says that an Experiment Station should be a "comfortable place" to work. Slate Laboratory will be comfortable. Slate says that "overorganization breeds mediocrity." We promise that Slate Laboratory will not be overorganized. Slate says that a scientist goes farther with his feet on the table than with his feet under the table. He means that new ideas advance science, and new ideas often come at a conference table. We promise that Slate Laboratory will be provided with comfortable tables for feet.

By naming our new laboratory Slate Laboratory we hope to say to

(*Continued on Page 3*)

Wisdom Is Better Than Rubies

by Hubert B. Vickery . . . *Department of Biochemistry*

Citric acid is one of the commonest organic acids found in plants. It is produced commercially by the ton, for the most part by a fermentation process from sugar, but large quantities are also obtained from lemons and pineapples. It has many uses in industry. Citric acid is also found in the leaves of green plants, together with malic acid and small amounts of a number of less well-known acids, and the presence of these substances raises many questions perhaps the most important of which is what part do they play in the life processes of the cells of the leaf?

Photosynthesis and Respiration

It is known today that organic acids such as citric and malic acids are concerned in two of the most important chemical processes that go on in green leaves. These are photosynthesis and respiration. As a result of the complex series of reactions summed up under the broad term photosynthesis, plant leaves take up carbon dioxide from the air, convert it into such substances as sugar and starch and liberate oxygen. This is the fundamental process whereby the oxygen of the air used up in the combustion of fuels or by the respiration of animals and plants is restored for subsequent use. Energy required to drive these reactions is obtained from sunlight. Respiration consists, in broad terms, of the utilization by the plant or animal of sugar which is oxidized to carbon dioxide that is in turn liberated to the air. These two processes are thus complimentary to each other. The fundamental feature of the respiratory process is that the energy made available by the oxidation of the sugar can be used within the cells of the tissues of the plant or animal for the synthesis of all of the innumerable substances required by the organism for growth and reproduction.

A great deal has been learned in recent years about the details of the chemical reactions that are concerned in respiration, and perhaps the most striking fact is that organic acids are intimately involved in the process. An organic acid is a substance which contains, as part of its chemical structure, what is known to chemists as a carboxyl group. This is formulated COOH; that is to say, it contains one atom of carbon, two atoms of oxygen and one of hydrogen. This group is attached to any of a wide variety of more or less complex structures, and some of these structures have the ability to acquire or, to use the technical term, accept carbon dioxide (CO_2) from the surrounding medium and convert it into a second carboxyl group. There are a number of such reactions now known, and each of them normally takes place under the catalytic effect of a specific enzyme within the living cell. Such a reaction represents the "fixing" of carbon and, although this is one of the early steps in the process of photosynthesis, reactions of this kind are by no means confined to the cells of plants.

The converse reaction whereby a carboxyl group is detached from a complex chemical structure and the carbon is liberated in the form of carbon dioxide is known as a decarboxylation reaction. Reactions of this type are fundamental steps in the process of respiration which goes on in all living cells.

With this as an explanation of why the Department of Biochemistry is interested in the organic acids of plants, let us turn to the consideration of citric acid and its close relative isocitric acid. Citric acid contains three carboxyl groups in its structure together with a second group known as a hydroxyl group (formulated OH) which is placed in a symmetrical position, as it were in the middle of the structure. Under the influence of one of the enzymes present in cells, citric acid is induced to lose its hydroxyl group together with an atom of hydrogen which together form water (H_2O). The citric acid is thereby converted into a different organic acid called aconitic acid. This acid has the property of taking up water again, but when it does so the relative positions of the hydroxyl group and the atom of hydrogen that were lost from the citric acid are reversed so that the hydroxyl group now occupies an unsymmetrical position with relation to the three carboxyl groups. The substance thus formed is isocitric acid, and this curious loss and regain of water whereby citric acid is converted into isocitric acid is one of the fundamentally important steps in the process of respiration.

Organic Acids in Cells

It is clear, therefore, that both citric and isocitric acids must be present in all living and respiring cells whether of the plant or animal. However, the amount of isocitric acid present is usually so small as to defy detection. It is an extremely rare substance that few chemists have ever seen. Nevertheless, there is a group of plants commonly called succulents, of which the Bryophyllums and the common garden Sedums are examples, in which isocitric acid for some unknown reason accumulates in large amounts. Isocitric acid frequently accounts for a tenth or more of the dry weight of the leaves of these plants. This fact w discovered by the late Dr. George W. Pucher, formerly of this Department, in 1942, and a long and difficult method to prepare a crystalline derivative of the acid was worked out.

Within the past year a new method has been developed whereby isocitric acid can now be fairly easily isolated from the leaves and prepared in the form of a beautifully crystallized potassium salt that is a new compound never before known.*

It is impossible to place a monetary value on such a substance. Small quantities of it are needed in laboratories all over the world where investigations of respiration are going on, and the Department has had the privilege in the past few years of supplying tiny amounts to dozens of colleagues in such places. It is not as yet an article of commerce. The new method of preparation will, however, soon make isocitric acid a substance that can be isolated fairly readily in any properly equipped laboratory and presumably in time it will be obtainable commercially. At the present moment, however, the small bottles of isocitric acid in the Department vault are treated as if they were filled with rubies.

* The experimental work was carried out by Dr. David G. Wilson, aided by a grant from the National Science Foundation.

FROM THE DIRECTOR

(Continued from Page 2)

Bill Slate: "Thanks. Thanks for making the Station a comfortable place. Thanks for defending us all from the obfuscations of overorganization. Thanks for giving us tables to put our feet on."

We shall inscribe the name Slate on a huge piece of limestone and fashion it into a pillar to hold up the front entrance to a building where Slate's epigrams describe what we do.

Thus we shall state our affection for Slate.

Perhaps, who knows, on Slate's slate and in Slate's Laboratory will be written still newer chapters in the story of the conquest of the "Frontiers of Plant Science."

James G. Horsfall

First Station Field Day was held in 1910 at the "experiment field" in the Norwood section of Hamden. At left is Dr. E. H. Jenkins, Station Director, and Mrs. Jenkins. Man with straw hat, slightly left of girl, is E. M. Stoddard, then a newcomer on the staff, now completing 48 years of service. Others identified by Mr. Stoddard are Frank Platt, Will Platt, Herbert Hayes, Mr. Champlain, and W. E. Britton, Station entomologist, with flower in lapel.

Field Days Help Growers and Scientists

At 1957 Field Day, Harry T. Stinson, Jr., facing camera, explains how geneticists study corn.

Although this Station began to conduct field experiments on farmers' land in the 1880's, it was not until 1908 that an "experiment field" was rented in Centerville—"a very useful adjunct . . . not far from the Station offices and laboratories" and easy to reach by the Waterbury-New Haven trolley, with cars in either direction every 26 minutes.

At least one Field Day included a visit to this experiment farm on Whitney Avenue. George A. Hopson, secretary of the Board of Control, made this report: "On August 10, 1910 a field meeting was held at the Station, to informally dedicate the new laboratory building, at which more than 400 farmers and their wives were present. In the afternoon this company went from the Station to the field and inspected and informally discussed the work there. It is intended to hold this summer field meeting each year."

Three months later the Station acquired the first parcel of lands now comprising the Experimental Farm in Mt. Carmel, where more than 40 annual Field Days have been held. Breaks in the continuity of the event came in World War II and in other years when special events were held at the Station in New Haven.

Promising specimen of hybrid chestnut is examined by Ward E. Duffy, left, editor of the Hartford Times and 1957 speaker; John Lyman, Middlefield; E. R. Foster, Greenfield, Mass., and Donald F. Jones.

Board of Control member Thomas M. Burgess, Jr., right, and guests in soil-moisture study plot.

Typical Field Day weather has improved since 1910, as has way of getting from field to field on the Mt. Carmel Farm. But walking tours continue popular. Formal program is always brief.

Tobacco research men at a special Laboratory Field Day in Windsor on August 7, left to right, are Gordon S. Taylor, in charge at the Laboratory; A. Ward Spaulding, member of the Board of Control; William E. Colwell, former Assistant Director in North Carolina and Field Day speaker; H. C. Miller, Minister of Agriculture, Jamaica; Director Emeritus W. L. Slate, and Director J. G. Horsfall.

Ward E. Duffy, Hartford editor, was the principal speaker at the 1957 Field Day on August 14. In 1910 the speaker was W. H. Jordan, director of the New York State Station at Geneva. Down through the years the list of speakers includes other eminent men in varied fields, among them J. W. Alsop, G. F. Warren, W. H. Whetzel, E. W. Sinnott, Wilbur L. Cross, Mordecai Ezekiel, Henry G. Knight, W. H. Martin, John D. Black, Firman E. Bear, Henry A. Wallace, Paul B. Sears, Walter Stemmons, and the Station Director, Director Emeritus, and Vice Director.

At the first field meeting in 1910 Director E. H. Jenkins stated the policy that has since remained unchanged:

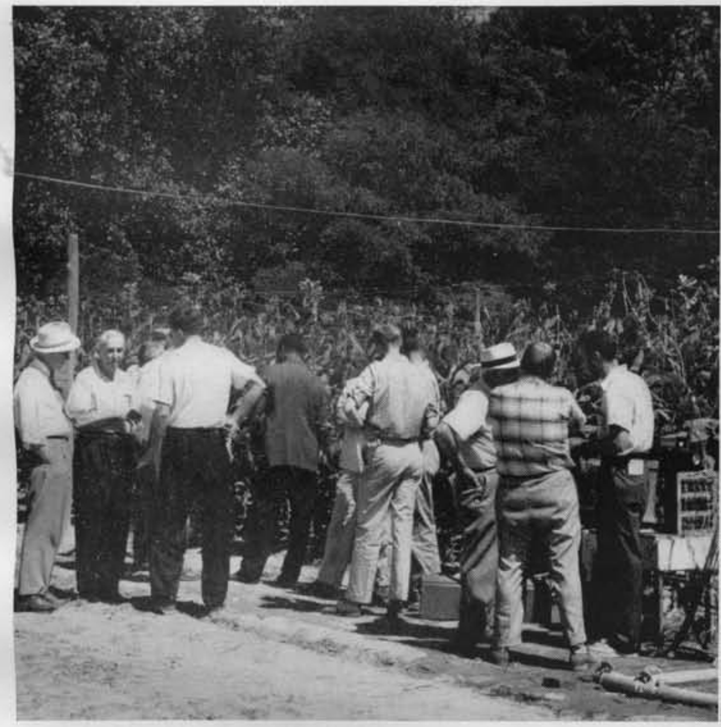
"The work of the Station should be distinctly research work . . . the learning of new truth. . . . we have asked you to gather with us and in a very quiet way to take a look at what you have done for us and what we in turn are doing for you.

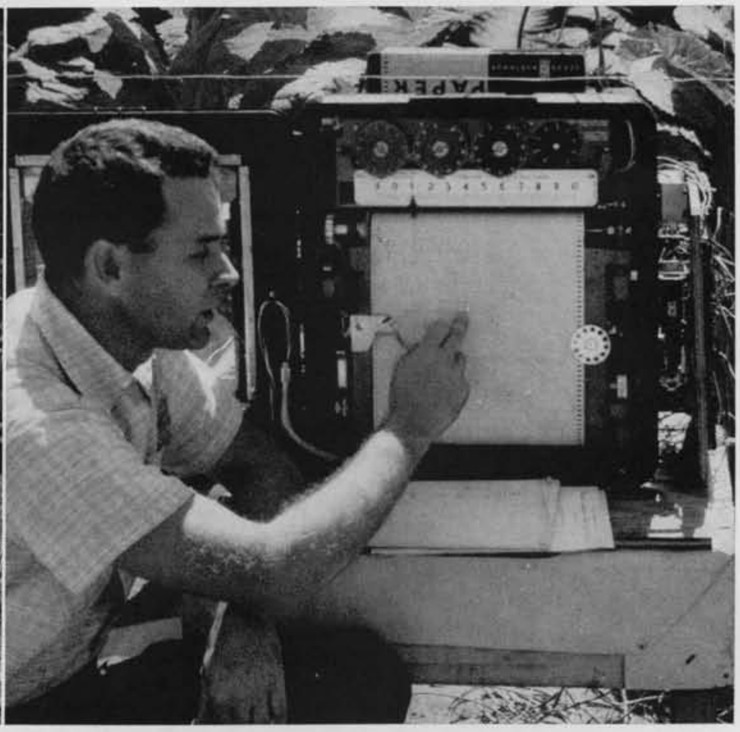
"This is not a model farm, but a place for experiment; not so large that failures mean disaster, but where nothing is too valuable to destroy if anything can be learned by its destruction."

The experimental work, he said, "is there for your criticism and approval. This is your institution, for you to support or to condemn."

The 47 years since that first Field Day have brought a succession of new questions to be answered by science, new tools of science, new uses for old knowledge painstakingly gained by Jenkins and his contemporaries.

But nothing has replaced or seems likely to replace the mutual value of the scientist-layman discussion of research in the field, a "quiet way" to gain understanding sorely needed in the search for truth.





At left, Tobacco Laboratory Field Day guests discuss research on soil moisture needs of tobacco throughout the growing season. Other related research has to do with "shadeless" shade tobacco, grown under intermittent fine spray. At right is Paul E. Waggoner, head of the Department of Soils and Climatology, explaining measurement of changing moisture and temperature in plants and soil under different controlled micro-climatic conditions.

Work on forage insects in 1953 showed that some of our native pests were causing damage to forage crops. At the same time two introduced species, the alfalfa weevil and the spotted aphid, were spreading toward Connecticut. Dr. Richard Quinton was appointed in 1955 to study the pests already here and to obtain the information needed to control these new pests if and when they arrived. His work on insecticides has provided the necessary background to prevent serious losses if these pests like our climate.

New Alfalfa Pest Arrives

by Richard J. Quinton . . . *Department of Entomology*

The alfalfa weevil, a native of Europe, has been known in this country since 1904. The extension of the original infestation in Utah was restricted for a long period to states west of the Rocky Mountains. In 1952 infestations were discovered in Maryland. From this point the weevil has gradually spread to other eastern states and on May 10, 1957, the first recorded specimen was collected in Connecticut. Subsequently, a survey revealed a general, although light infestation throughout the state with greatest numbers appearing in towns along the western border.

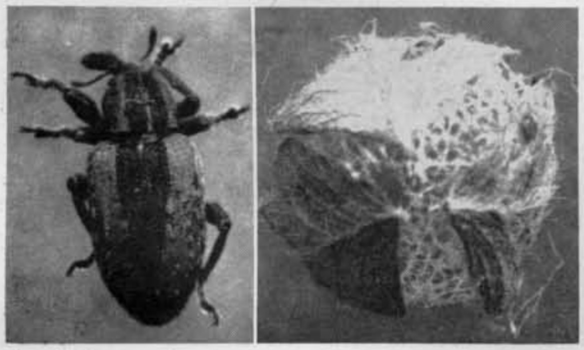
The adult weevil is somewhat less than one-quarter of an inch long. It is brown with darker markings forming a distinct pattern on its upper surface. Older individuals, because of loss of some of the scales which produce the color pattern, often appear darker and less distinctly marked.

The eggs are small, oval, and yellowish, and are deposited in small groups inside the stems of the host plant. The legless larvae eat their way out of the stems and move to the growing tips of the plants. Young larvae are pale yellowish-green to tan with black heads. When fully grown they are about one-quarter of an inch long, green, and retain the black head. They are marked with a wide white stripe running down the center of the back which is flanked on either side by a faint white line.

When they have finished feeding the larvae spin their characteristic silken cocoons either among the surface litter or in the plants. The cocoons are roughly spherical and often contain one or more dead leaves in the enveloping mesh. They are formed of an irregular open weave through which the insect can be readily seen.

The transformation from larva to pupa to adult takes about two weeks. After emerging from the cocoon, the adults feed throughout the remainder of the season and finally hibernate in sheltered situations about the fields to overwinter. The weevils become active in early spring and, although a few overwintering eggs may have been laid in the fall, they soon begin depositing the bulk of their eggs. In warm weather these hatch in about 10 days and the developing larvae pass through three molts to reach maturity in three or four weeks. Cocooning and pupation then occur and the cycle is complete.

Under our conditions alfalfa usually produces two or three crops in a season, the times of harvest being based on a particular stage of plant development, usually during the first two weeks in June. In cases of heavy larval population, it has been amply demonstrated in other areas that the timing of the first cutting can be very important in reducing the destructiveness of the weevil. The significant change is that the time of cutting is based on the state of the insect population rather than the stage of plant development. Weevil larvae appear in April and are most abundant during May and June. Thus it often occurs that they reach their peak before the usual time of harvest. By cutting at the peak a large fraction of the population may be destroyed. Removal of the food supply causes starvation of many larvae and in warm, clear weather also allows surface temperatures to rise sufficiently to kill many others. If, on the other hand, adverse weather prevents cutting, the delay greatly increases the injury both by extending the feeding period and by permitting many larvae to complete their development and pupate.



The alfalfa weevil is brown with darker markings, the adult somewhat less than 1/4 inch long. Silken cocoon, which is white and irregularly woven, is shown in photo at right.

In areas where it has become established, the weevil has been the most destructive of all forage insect pests. Although capable of completing its development on several legumes, alfalfa is the only crop seriously effected. The leaf feeding of the larvae and adults can cause heavy damage to the first crop, and later by attacking the new growth may seriously retard the second crop.

Probable Damage Unknown

From what is known of the habits of this insect, the alfalfa weevil, in areas where it has become established, is likely to be destructive where winters are long and severe. These conditions are found in much of the Great Plains and higher sub-Pacific elevations where damage has been heavy, and, although there are notable differences, this aspect of their climate fits the general pattern of our own conditions. There is now little comfort in earlier statements that the alfalfa weevil is apparently excluded from the east because of our climate. The weevil is here and it seems quite likely that it will cause some damage, possibly extensive, to our alfalfa. The climatic limitations of the alfalfa weevil are not the same as for other insects, however, each type having its own optimum and limiting factors. Thus it remains to be seen whether we will be subject to continuous, heavy attack or whether our conditions are such that damage will be infrequent or less severe.

Besides modifying the cropping schedule as mentioned, a high degree of control may be obtained by the judicious use of insecticides. It is fortunate that a control schedule directed against the alfalfa weevil will also control a number of minor pests which in themselves are damaging. A number of materials, including heptachlor, malathion, and methoxychlor have been found effective. Appropriate application schedules have been developed to assure maximum effectiveness while avoiding any residues which might possibly contaminate the crop. Details may be obtained from County Agents or the Extension Entomologist.

Food Labels—Fads and Facts

by Harry J. Fisher . . . *Department of Analytical Chemistry*

The May 1955 issue of Frontiers of Plant Science carried an article on the microbiological laboratory that had just been opened by the Station to check the vitamin contents of food for man and beast. That article mentioned that "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." In the two years since the appearance of this notice numerous brands of enriched bread, macaroni, and spaghetti have been so analyzed, but recent developments in food advertising have required the Analytical Chemistry Department to go farther.

It would appear that advertisers believe that a large proportion of the American public is worried about gaining weight. At least—whether this is the correct explanation or not—it is a fact that suddenly all sorts of starchy foods have burst out with labels claiming that they are low in calories and high in protein. This sort of labeling has probably reached its limit in the case of a brand of potato chips now being advertised as "Starch Free as a Chip Can Be"; since potato chips contain little but starch, oil, and salt, it is obvious that "Starch Free as a Chip Can Be" cannot be starch-free enough to matter.

Federal Requirements Apply

Since the Station has the duty under the Food, Drug and Cosmetic Act of advising the Food and Drug Commission in protecting the truthfulness of food labeling and advertising in this State, these recent claims have confronted us with the necessity of determining the protein and calorie contents of a large number of foods. Another recent advertising tendency has required us to run sodium determinations also: Claims that bread, macaroni, etc., are "low in sodium" or "salt-free." The intent of such advertising no doubt is to appeal to those persons suffering from high blood pressure who have been put on salt-free diets, but apparently some bakers have seized on "salt-free" claims as a selling point for their products without appreciation of the difficulties they could get into producing a really salt-free bread and without knowledge of the Federal requirements for the labeling of low-sodium foods. U. S. Government regulations spell out quite specifically that the label of any food sold as "low in sodium" or "salt-free" must declare the number of milligrams of sodium both in 100 grams of the food and in an ordinary serving.

During the past year our laboratory analyzed 35 samples of macaroni, 22 of bread, 8 of spaghetti and 2 of egg noodles for water, protein, ash (mineral matter), fat, fiber, available carbohydrates, and sodium, and calculated their calorie contents, in order to check their claims to be high in protein, low in calories, and free of salt. In addition, all of those sold as "Enriched" were assayed for riboflavin (vitamin B_2) and niacin (another B vitamin). Following are some examples of contrasts between what the label said and what analysis showed:

1. Bread A, a nationally-distributed loaf of "Unsalted Enriched Bread," which was guaranteed to contain only 11 milligrams of sodium in each 100 grams, was shown by analysis to contain 100 milligrams of sodium per 100 grams of bread—almost ten times the claim.

2. Bread B, a "Fancy Honey Bread" labeled "Salt Free," contained the highest proportion of sodium of any of the breads tested: 148 milligrams per 100 grams.

3. A macaroni product sold as "20% Protein Macaroni Soupettes" was labeled: "Higher in Protein lower in starch—Calorie Content approx. 35 per oz. Sodium Content less than 0.1 mg. per 100 g." Analysis showed 19.67 per cent of protein, which was very close to the 20 per cent of protein that was claimed, but the calories per ounce were not 35 but 106, and the sodium content was 112 milligrams per 100 grams, which is over a thousand times as much as was claimed.

4. Another brand of enriched macaroni bore statements that it was "Low in Calories, Starch Reduced, High Protein, Salt Free." Analysis revealed, however, that it contained only 11.79 per cent of protein, which is a low rather than a high value for macaroni, whose average protein content is 13.4 per cent. Spaghetti from the same manufacturer failed equally to live up to its high protein claims, the actual protein content of 11.40 per cent being 0.7 per cent below the average for spaghetti.

5. A third brand of enriched macaroni labeled "High in Protein Low in Calories—No Salt Added" proved to be neither high in protein nor low in calories; its protein content of 11.84 per cent was below average for macaroni, and the 359 calories per 100 grams that analysis showed actually exceeded very slightly the macaroni average of 358 calories per 100 grams.

The "Starch Free as a Chip Can Be Barbecue Chips" have already been referred to at the beginning of this article. Such labeling is an example of a type of advertising that is cleverly designed to give a false impression without making any false statement: It does not actually say that these potato chips are starch-free, but only that they are starch-free "as a chip can be"; what it fails to mention is that a starch-free potato chip is an impossibility. Analysis of this product showed 46.79 per cent of available carbohydrate, which is about normal for potato chips.

While our investigation did show that many manufacturers were inclined to be careless in their protein and calorie claims, we would not want to leave the impression that there were no correctly labeled products on the market. A pleasant contrast to the comparisons above was a brand of crackers labeled as follows: "Salt (sodium chloride) free, baking soda (sodium bicarbonate) free. These crackers should satisfy anyone requiring sodium free diet, as there is no sodium added in any form." Analysis of these crackers showed only 10 milligrams of sodium per 100 grams, a value so low as to be negligible.

Ice Milk Analyzed

Among the foods analyzed were two brands of ice milk, the frozen dairy product resembling soft ice cream in appearance that is largely sold in the summer from special outdoor stands. Both brands were advertised as "Low in Calories—High in Proteins," and since ice milk is by legal definition low in butter fat, and weight for weight, fat contains two and one-fourth times as many calories as does either protein or carbohydrate, it might have been expected that there would be some substance to these claims—that is, if they were interpreted as implying a comparison with ordinary ice cream. Our analyses of four different ice milks and two ice creams actually showed an average fat content of 4.33 per cent in the ice milks as against 10.75 per cent in the ice creams, an average protein content of 4.75 per cent in the ice milks and 5.07 per cent in the ice creams, and respective calorie contents per 100 grams of 161 for the ice milks and 224 for the ice creams. Somewhat unexpectedly, therefore, while the ice milks were indeed lower in calories on a weight basis than ice cream they turned out to be lower rather than higher in protein. The calorie comparison was valid on a volume basis also, since the number of calories per

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Editor, BRUCE B. MINER

Food Labels

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pint averaged 608 for ice cream and only 515 for ice milk. This was scarcely low enough to put ice milk in the category of a really low-calorie food, however.

Other types of foods analyzed were baby foods (whose analyses closely checked their declared composition) and cottage cheese.

Examination of these foods with special dietary claims is continuing at the Station, and recently the U. S. Government has been interesting itself in the problem and taking steps through its Food and Drug Administration to control the more flagrant misrepresentations.

A Michigan State University authority says that 5 per cent of the nation's total cropland has been converted to residential, commercial, and industrial uses since 1941. Highways, airports, and other public uses have taken up the equivalent of thousands of other farms.

A. Ward Spaulding, representing the Station Board of Control, presents congratulatory letter from Governor Abraham Ribicoff to Owen L. Nolan, left, first to complete 50 years on the Station staff.

Owen Nolan Honored

Last May 13 Owen L. Nolan, chemist, completed 50 years of service on the staff, a record unequalled in Station history.

Guest of honor at a tea held by the Station, he received a gold service pin with diamond, the first such award made by the Station Board of Control.

A. Ward Spaulding spoke for the Board:

"It takes men like Mr. Nolan, quiet and reserved, who are determined to give their best, to make for the success we have had here."

Governor Abraham Ribicoff, in his letter of appreciation for Mr. Nolan's faithful service, said:

"Few men have the distinction of serving a single agency for half a century. . . . On behalf of the State of Connecticut as well as myself, personally, please accept my warmest congratulations and heartfelt thanks for your loyal, efficient service."

Two of the directors under whom Mr. Nolan has served, W. L. Slate and James G. Horsfall, commended Mr. Nolan. H. J. Fisher, head of the Department of Analytical Chemistry, gave a biographical sketch of Mr. Nolan. He pointed out that Mr. Nolan has "made his reputation most of all in the field of Kjeldahl nitrogen determinations. It has been many years now since we have thought of entrusting a nitrogen or protein determination to anyone else unless he were out sick or on vacation, and almost never has a protesting manufacturer or a feed or fertilizer we reported deficient in protein or nitrogen failed in the end to admit that our figures were correct."

Mr. Nolan came to the Station in 1907 as laboratory assistant to Thomas B. Osborne, then working on protein studies which were to make him famous. In 1920 Mr. Nolan began his long period of service in the analytical laboratory where his work has covered a wide range of investigations.

New Publications

The publications listed below are now available, without charge unless otherwise indicated, to those who apply for single copies to Publications, The Connecticut Agricultural Experiment Station, Box 1106, New Haven 4, Connecticut.

Insect Pests and Plant Diseases

B 604 Apple Maggot Control Studies

Soils

B 606 Soils and Land Use in Hartford County

Reports on Inspections

B 605 Commercial Feeding Stuffs, 1956

THE CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN • CONNECTICUT

JG Horsfall
Director

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