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Factors Affecting the Quality of Meat

By E. C. Bate-Smith
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Dr. E. C. Bate-Smith, one of the earliest research workers of the Low Temperature Research Station, Cambridge, has been its Superintendent (now styled Director) since 1947. He was a guest speaker at the recent Food Science Conference held at North Ryde, N.S.W., at which he gave the following opening lecture to a Symposium on Meat Quality.

IN the Annual Report of the Low Temperature Station for 1959 Dr. Lawrie and I, in an article on quality in meat, wrote: "Quality is a concept which by its very nature evades definition. It means different things to different people, and to the same people at different times". This can be seen in the contributions of the authors to the present symposium and, as I shall show, it is exemplified by the development of the work in laboratories throughout the British Commonwealth from the early days of the formation of the Food Investigation Board in England to the present time.

First place among the personalities associated with work on meat quality will be conceded by all who know him to Sir John Hammond. Hammond was already working in the School of Agriculture at Cambridge under Professor T. B. Wood when I first went to the Low Temperature Station in 1926, and this is only one of the influences which provided such a perfect setting for our early work on meat.

The Low Temperature Station in those days was a very small laboratory. When it was built in 1922 the scientific staff numbered only five, including the Director of Food Investigation, Sir William Hardy, who was also acting as Superintendent of the Station. Dr. T. Moran was in charge of research on meat. Drs. Kidd and West had already made a name for themselves by their work on the storage of fruits.

"Quality" in meat was then concerned only with the question of drip in frozen meat; and Hardy and Moran were studying the physics of freezing and thawing of collodial systems in an attempt to discover a truly reversible cycle of freezing and thawing. In the newly built Biochemical Laboratory was Sir Frederick Gowland Hopkins, who with Walter Morley Fletcher, had done such brilliant pioneer work on the production of lactic acid from glycogen in muscle. Hardy and Hopkins had worked alongside each other for many years in the Department of Physiology, and it was only natural for the biochemical work on muscle to be grafted on to the biophysical work, with what profoundly important consequences in the technology of meat processing we can now appreciate.

Dr. Vickery and I entered the Low Temperature Station almost on the same day, and we walked out of the Senate House together with our Ph.D. certificates three years later. This is symbolic of the collaboration on meat research problems which is found today between countries of the British Commonwealth. By this time we were becoming interested in many other aspects of meat quality, one being the problem of "bloom" on frozen lamb. To study this, a joint survey was carried out under the leadership of Dr. Ezer Griffiths of the National Physical Laboratory who specialized in refrigeration problems.

While these technical investigations were going on, John Hammond had been studying quite different aspects of quality in meat. He had been measuring the rates of growth of meat animals of different breeds, reared on

Dr. (now Sir John) Hammond, the international authority on livestock, and especially meat quality, measures the length of a pig carcass.

The author, Dr. E. C. Bate-Smith, pictured taking notes while Mr. N. E. Holmes, then C.S.I.R. research worker on food transport problems, checks the identity of a New Zealand lamb carcass being weighed to assess loss during shipment. Standing at the back of the scales is the late Mr. R. Forsyth, then Manager of the New Zealand Meat Producers' Board, and reading the weight is Dr. Ezer Griffiths of the National Physical Laboratory, leader of the survey.

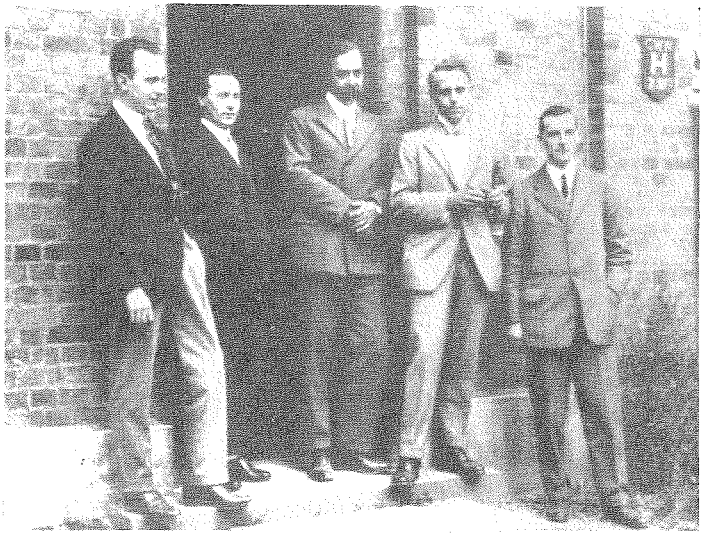
different planes of nutrition, and had made a special study of the differential growth rates of the different tissues of the body: bone, muscle, and fat. The measurements he made were related to the ultimate "quality" of the carcass as sold on the market, so that we had two entirely different criteria of quality developing side by side, the "quality" of the carcass and the "quality" of the meat from the point of view of the consumer. I shall now try to analyse these two aspects of quality, the first of which might be designated "extrinsic" and the second "intrinsic".

Extrinsic Factors

The first factor to be considered is the *conformation* of the carcass. This is primarily controlled by breeding, but can also be influenced by the plane of nutrition of the animal at different stages of its growth. The objective is, of course, to ensure the maximal yield of red meat from the better-quality cuts (the rib, sirloin, and rump) at the least cost in feed during raising.

The next factor is *finish*. This is, broadly, the ratio of fat to lean on the carcass when it is offered for sale. Overall, these two factors are represented in the *composition* of the carcass, in terms of bone, muscle, and fat, and, in greater detail, the composition and weight of the different joints or of the individual muscles as ascertained by anatomical dissection. A great deal of work has been done within Commonwealth countries and in the United States along the lines laid down by Hammond in his pioneer work, and in these studies the names of Callow of the Low Temperature Station and McMeekan of New Zealand are conspicuously associated.

A major objective of this work was to correlate the meat yield of a carcass with measurements of length, breadth, and thickness between defined points. I will do no more than make the point that these measurements are not of *quality* as such, but may be



In 1922 the staff of the Low Temperature Research Station, including its acting Superintendent, Sir William Hardy (Director of Food Investigation), Dr. T. Moran (meat research), and Drs. Kidd and West (fruit storage investigations), numbered only five. L to R: Dr. T. Moran, Mr. J. Pique, Sir William Hardy, Dr. F. Kidd, Dr. C. West.

more or less correlated with quality as judged by experts, or as it may be arbitrarily defined for particular purposes.

There is one other factor which is usually considered in relation to carcass quality, but which might equally be regarded as an intrinsic factor, and that is marbling of the lean meat. This is something more subtle than fat content of the joint when trimmed free from extramuscular adipose tissue, for it is concerned also with the scarcely visible network of adipose connective tissue associated with the fine subdivision of the muscle fibre bundles, and is probably better evaluated subjectively than by any objective method.

Intrinsic Factors

The starting point for the consideration of these factors is at the level of the ultimate molecules of which the meat is composed. In recent years research with the electron microscope has given us a new insight into the way these molecules are arranged, especially the beautiful studies by Hugh Huxley, in which the continuous strands of myosin were shown to be surrounded by broken strands of actin. It is the interaction between these two proteins which, in some way, brings about the contraction of the muscle; and in some other way, the stiffening of the muscle in rigor mortis. The shortening and the stiffening affect both the toughness and the water-holding property of the muscle fibre. What happens in any particular animal at, and immediately after, death can affect these properties to a considerable extent.

On another level, that of the optical microscope, the size of the muscle fibres and the amount and character of the connective tissue are important determinants of quality. The amount of white fibrous connective tissue is one of the most important factors also at the macroscopic level — it might be said, in fact, to be *the* most important factor determining the degree of toughness in different joints of the same animal, and in different animals. Toughness is also affected by physiological factors, especially the glycogen content of the muscle, the state of excitement, or fatigue, of the animal at death, and by the handling of the carcass immediately after death.

There are certain measurements which can be made as an aid to the evaluation of intrinsic quality. Of these the measurement of toughness by various instruments is the one most informative and most in use at the present time.

Although the quality of meat is difficult to define, and cannot be measured with precision, some of its aspects can be evaluated. Moreover, on a free market quality can always be measured by the yardstick of value for money.

Electrotinplate for Food Containers

PART I. THE GENERAL STRUCTURE OF TINPLATE

By E. G. Davis
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PRIOR to 1937, all tinplate for food containers was manufactured by the hot-dipped process in which individual sheets of steel were passed through a bath of molten tin. A limitation of this process is that it will not produce plate with a nominal tin coating weight of less than approximately 1·25 lb/base box. During World War II supplies of tin for tinplate became critically short, and this situation provided an incentive for developing the newer process of electro-depositing tin on steel with the possibility of greatly reducing coating weights. The subsequent success of electro-deposition is shown by the present position in the U.S.A. where over 90% of the tinplate is produced electrolytically. Only a small quantity of hot-dipped tinplate is produced for a few specific applications.

The Australian canning industry has not made wide use of electrotinplate, but in view of plans to make it here in 1962, it is felt an account of some of its properties and applications may be of interest to canners, canmakers, and manufacturers of food-can lacquers.

This article outlines briefly some of the more important properties of hot-dipped and electrotinplates and draws attention to those properties which contribute to the subsequent corrosion of containers fabricated from the two types. The corrosion performance of electrotinplates with local canned foods will be discussed in a subsequent article.

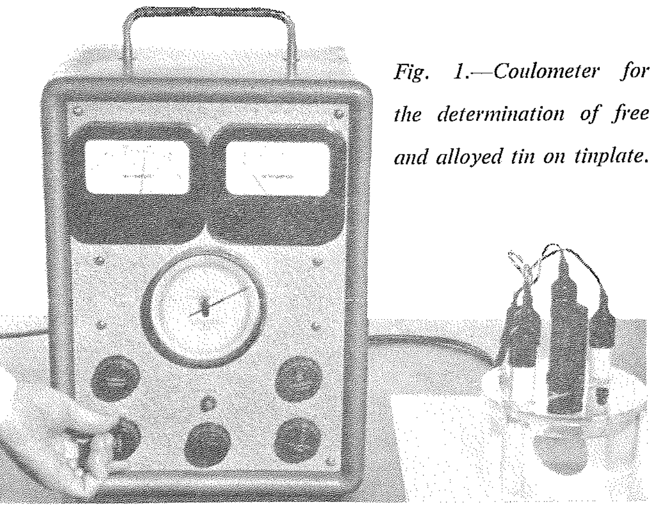


Fig. 1.—Coulometer for the determination of free and alloyed tin on tinplate.

MANUFACTURE

The main differences in the manufacture of hot-dipped and electrotinplates occur during the tinning and finishing treatments.

The hot-dipping process is carried out with individual sheets of steel which are first pickled in dilute acid. The sheets then pass by a series of guide rolls through a layer of molten flux and a bath of tin, and emerge through a layer of hot palm oil. Adjustable rolls in the oil bath regulate the final thickness of tin coating. The sheets are cooled on emerging from the palm oil, usually by an air blast, and finally cleaned and polished by washing with alkalis or detergents and dry-cleaning with bran or wood-meal.

The electrolytic process utilizes continuous steel strip through all operations. There are three main types of tinning line in use:

- Alkaline or stannate lines which use sodium or potassium stannate as the electrolyte
- Vertical acid or "Ferrostan" lines, in which the electrolyte is tin phenol disulphonate
- Horizontal acid or halogen lines which use tin halide as the electrolyte.

In Australia, a horizontal acid line will be used commercially for the production of electrotinplate.

Approximate Nominal and Actual Coating Weights and Minimum Average Coating Weight Test Values for Tinplate

Type of Tinplate	Line or Pot Yield (lb/b.b.)	Actual Coating Wt. (lb/b.b.)	M.T.V. (lb/b.b.)
Hot-dipped (common cokes)	1·25	1·10	0·85
Hot-dipped (standard cokes)	1·50	1·35	1·05
Electrolytic	0·29	0·25	0·22
Electrolytic	0·55	0·50	0·47
Electrolytic	0·81	0·75	0·70
Electrolytic	1·10	1·00	0·90
Electrolytic	—	0·75/0·25	0·70/0·20
Electrolytic	—	1·00/0·25	0·90/0·20

In a typical production line, the strip is electrolytically cleaned and lightly pickled prior to passing through the electrolyte. The tin coating is deposited on the strip from pure tin anodes suspended in the electrolyte. In the "as plated" condition it has a dull, matt finish and is flow-brightened by being momentarily melted. An electric current is conducted through the tinplate or a high-frequency discharge passed across the surface. The tinplate is then cooled and the coating is subjected to various finishing operations which include rinsing, chemically treating, and finally, oiling. Most plate is chemically treated to oxidize and stabilize the coating surface, and the operation may consist of immersion or electrochemical treatment in a solution of chromic acid, chromate, or dichromate.

There are many variations of the tinning processes, particularly for electro-depositing tin coatings. For instance an electrotinplate, known as differential tinplate, may be produced with a light coating on one side and a heavier coating on the other. Details of the manufacturing processes have been reported by Hoare and Hedges (1945), Meneilly (1951), Hoare (1955), and McArthur (1959).

STRUCTURE OF TINPLATE

Tinplate should not be regarded merely as steel covered on both sides with tin. It is a multi-laminate material, having a middle layer of steel, and consecutive layers of tin-iron alloy, free tin, tin oxides, and finally an oil film on both sides. Each of these layers is important and contributes to the final performance of tinplate.

A considerable volume of information has been accumulated on the influence of the steel base of tinplate on container corrosion. Some of this work has been reviewed by Hartwell (1951) and is not included in this discussion.

Oil Films

Palm oil is used in the manufacture of hot-dipped tinplate to prevent atmospheric oxidation of the molten tin, and to reduce the temperature of the molten tin on the sheets of steel before it is exposed to the atmosphere and air-blast cooling. The finishing operations remove most of the oil, but a small quantity remains. The amount varies considerably and cannot be accurately controlled because of the nature of the finishing operations. Amounts from 0·3 to 0·8 g/b.b. have been reported by Hoare and Hedges (1945) for commercial hot-dipped tinplate.

The final operation in the manufacture of electrotinplate is the application of an oil film, either by emulsion coating or electrostatic deposition. Both methods permit closer control over the resultant film weights than that used with hot-dipped plate. Cottonseed oil or, more commonly, dioctyl sebacate is used on electrotinplate and the film weights range from 0·1 to 0·2 g/b.b. (McArthur 1959).

The oil film on tinplates serves as a lubricant during handling and fabrication, and acts to some extent as a preservative during shipment and storage. Oil films are capable of adversely affecting the printing and lacquering properties of tinplate (Hanle and Gardner 1941; Britton 1952), but are not important in corrosion reactions.

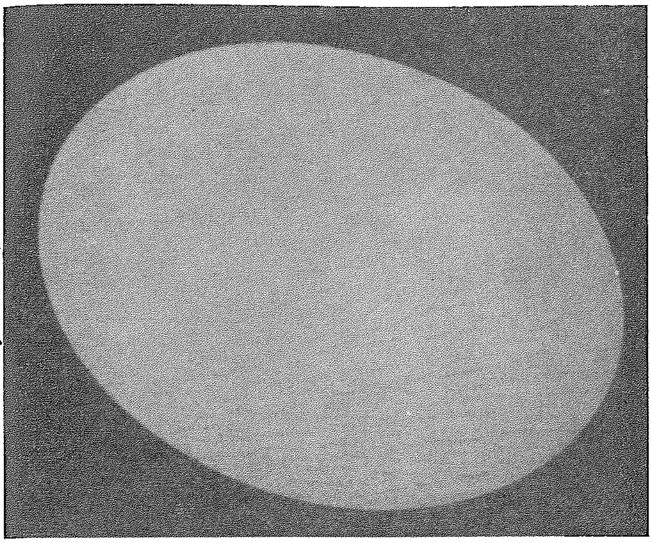


Fig. 2.—"Trees" on the surface of hot-dipped tinplate.

Oxide Films

The oxide film on hot-dipped tinplate is air-formed and continues to increase during storage, particularly under conditions of high humidity or high temperature. The film has been identified as stannous oxide (Britton and Bright 1957).

The composition of the oxide film on electrotinplate is uncertain, but it is thought to be a mixture of stannous and stannic oxides and some chromium has been detected (Britton and Bright 1957; Neish and Donelson 1960). Some of the film is probably formed during the flow-brightening process but the bulk is formed during the subsequent passivating treatment. Neish and Donelson (1960) have shown that, in order to obtain an oxide film on electrotinplate which will remain stable and not increase during storage or lacquer stoving, the natural oxide film must be removed prior to the passivating treatment. A process of cathodic reduction in sodium dichromate solution, followed by oxidation in the same solution, was found satisfactory and applicable on a commercial scale.

The most useful methods for the estimation of oxide films on tinplate are based on coulometric reduction (Britton and Bright 1957; Frankenthal, Butler, and Davis 1958; Willey and Kelsey 1958). Because of the uncertainty of the composition of the films, results from the reduction methods are expressed in electrical units for a given area, for instance, millicoulombs per square inch (mC/sq. in.). Reported values for oxide coating weights vary widely, since they are influenced by manufacturing and subsequent storage conditions.

Oxide films on tinplate, particularly the chemically produced films on electrotinplate, minimize sulphur-staining in cans packed with high-protein foods, and may provide some protection against atmospheric corrosion during storage. Excessively thick oxide films, however, may interfere with soldering and lacquering operations, and produce a discoloration on the surface of the plate. A discoloration, commonly known as "oven-burn", which occurs during the high-temperature stoving of lacquers, is probably the result of excessive oxide growth of film.

Tin Coating

The amount of tin on tinplate used for food cans is of fundamental importance since it influences the resistance of the container to internal and external corrosion. The tin coating weight, as normally specified, includes both the free tin and that bound in the alloy layer.

There are a number of terms in common use for the specification of tin coating weights. For hot-dipped tinplate, the nominal coating weight or pot yield refers to the weight of tin used to manufacture one base box of tinplate. Nominal coating weights may be designated by variations of the terms "coke" or "charcoal" tinplate: these descriptive terms are not commonly used at present. Because of wastage from the tin pots and the build up of a thick coating on the trailing edge of the sheets, the average tin coating weight on the finished product is lower than the nominal coating weight. With electrotinplate the nominal coating weight represents the average actual coating weight on the finished product, and the line yield, which represents the amount of tin consumed during manufacture, is a little higher than the actual coating weight. There are coating weight tolerances laid down for tinplate, and these are referred to as minimum average coating weight test

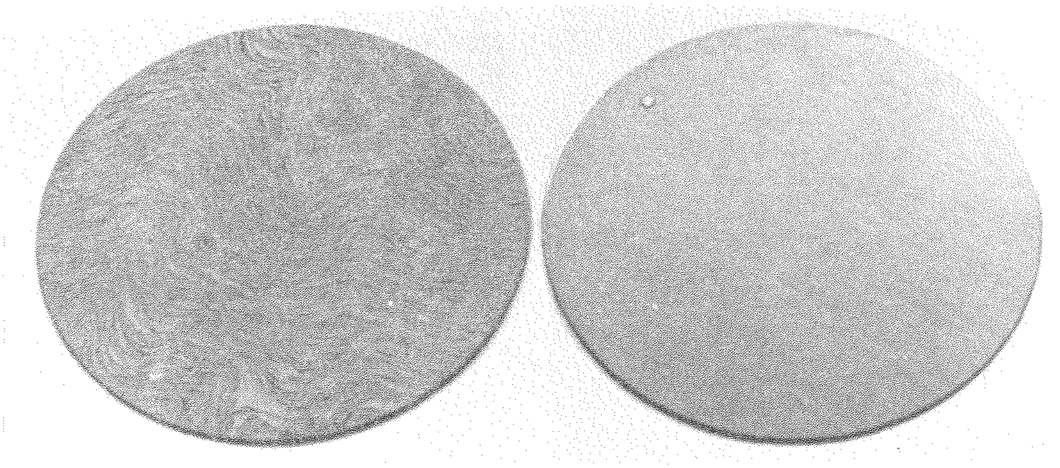


Fig. 3.—Appearance of steel baseplate of hot-dipped (left), and electrolytic (right), tinplate after removal of free and alloyed tin.

values (M.T.V.). The American Iron and Steel Institute (1954) recommends the following sampling procedure for estimation of the average coating weight test value: "One plate is taken at random from each 50 packages, with a minimum of three sample plates, each taken from different multipackage units from any one item of a specific shipment. Each sample is spot-tested at three positions taken on a diagonal across the sheet. Spot samples are customarily discs or squares, each of 4 sq. in. area. In order to secure representative samples they are taken so that the outer edge of the sample is at least one inch from any edge of the plate. The average value of all spot tests on all plates tested represents the average coating weight test value."

The approximate pot or line yield and actual coating weights, and the minimum average coating weight test values as specified by the American Iron and Steel Institute are given in the table on page 6.

The tin coating on electrotinplate is more uniform than on hot-dipped tinplate, and this is evident from the M.T.V. figures given in the table. Individual spot tests on hot-dipped tinplate may fall 0·25 lb/b.b. below those shown, which means that, for nominal 1·25 lb/b.b. hot-dipped plate, tin coating weight figures as low as 0·60 lb/b.b. may be observed.

Tin coating weights of tinplate may be determined by a number of methods. The chemical dissolution method developed by Clarke (1934) has been used in the C.S.I.R.O. Division of Food Preservation with satisfactory results, but more recently a rapid coulometric method using a commercial tin coating coulometer described by Hoare and Britton (1960) has been employed.

The coulometer illustrated in Figure 1 consists of a "Perspex" cell containing the electrolyte, lead cathodes, lead reference electrode, and the tinplate sample; and a case which houses the electrical equipment. The tin and alloy coatings on the sample are removed consecutively by anodic treatment at a constant current density. The end-point of the removal of tin and alloy are indicated on a microammeter by a rise in the current flowing between the sample and the reference electrode. The coating weights are read directly from the calibrated dial of the instrument.

Alloy Layer

When tin and iron, in intimate contact, are subjected to high temperatures, the two metals react to form an alloy. In the manufacture of tinplate, such conditions prevail, and an alloy layer is formed between the tin coating and the steel base. The composition of the alloy layer corresponds to the formula $FeSn_2$, and the approximate coating weight ranges are 0·13–0·25 lb/b.b. for hot-dipped tinplate, and 0·03–0·13 for electrotinplate.

The exact role of the alloy layer in corrosion reactions with canned foods is uncertain, but it has been shown that, in dilute synthetic media, it is cathodic to both tin and iron (Covert and Uhlig 1957; Bright and Britton 1958). In grapefruit juice media the potential of the alloy lies between those of tin and iron (Kamm *et al.* 1961). As suggested by Britton and Bright (1960) and Carter and Butler (1961), the alloy layer may act as an inert screen to the steel.

The alloy coating weight on tinplate may be determined by coulometric methods similar to those used for tin coating weights. The coulometer used in the Division of Food Preservation will estimate both free and alloyed tin. In estimating tin coating weights by methods which remove both free tin and tin-iron alloy, a correction must be applied for the iron removed. A correction of 0·063 lb/b.b. for hot-dipped tinplate, and 0·032 lb/b.b. for electrotinplate is generally deducted from the result (Liebmann, Price, and Thompson 1949).

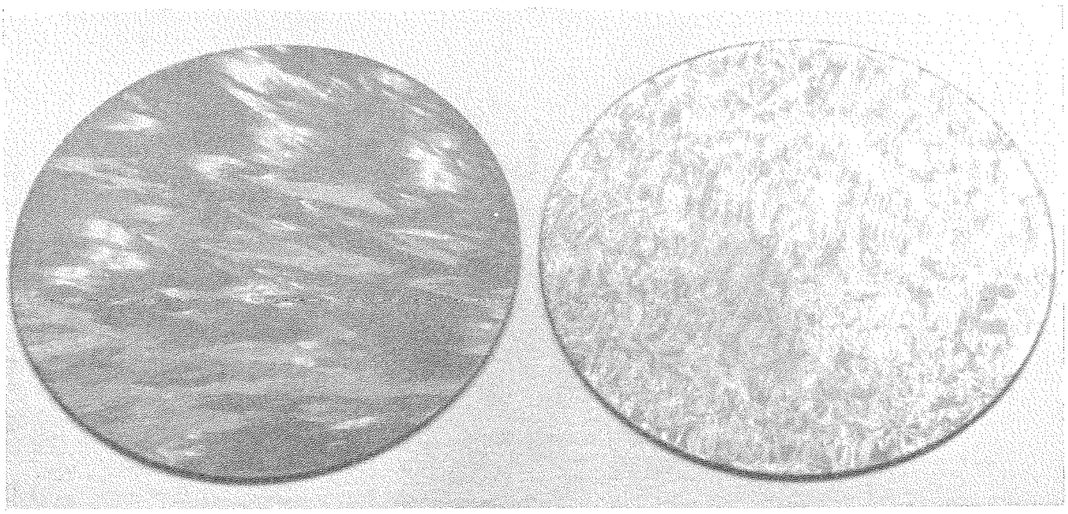
IDENTIFICATION OF TINPLATES

It is important to be able to determine whether a particular sample of tinplate is hot-dipped or electrotinplate, particularly in cases of canned food spoilage resulting from corrosion reactions. Estimation of the tin coating weight of suitable samples is the only way of differentiating between electrotinplates of different nominal coating weights, but it is not a reliable means of determining whether the sample is hot-dipped or electrotinplate. For instance, the actual coating weight of nominal 1·00 lb electrotinplate may be higher than that of nominal 1·25 lb hot-dipped tinplate, because of the greater variation in hot-dipped coating weights. In addition, when small samples only from partly corroded cans are available, the estimation should be made on the external surface of the sample except with differential tinplate, and this may introduce further variation in the result because of the reduced sample size.

It may be possible to identify hot-dipped tinplate by visual observation of the surface for "trees" or "tin ridges" which are small, branched lines running over the tin surface in the direction of tinning (Fig. 2). The "trees" are often obvious to the naked eye particularly if the sample is held so that light is reflected from it towards the eye. "Trees" are formed by the action of the rolls in the tinpot and are not found on electrotinplate, but they are sometimes hard to see on hot-dipped tinplate. If "trees" are present the samples may be positively identified as hot-dipped tinplate, but if they cannot be observed the identity of the sample must depend upon other techniques.

Examination of the steel baseplate for "mottle" pattern after the removal of the tin

Fig. 4.—Crystalline structure of partially de-tinned hot-dipped (left), and electrolytic (right), tinplate.



coating may provide a reasonably reliable guide for differentiating between hot-dipped and electrotinplates (Fig. 3). "Mottle" results from the reactions between flux, steel, and molten tin as the sheets pass through the tinpot. Hot-dipped tinplate generally shows some evidence of "mottle" whereas electrotinplate shows only the dull grey surface typical of a plain steel surface.

Finally, the crystalline structure of the tin coating is generally different for the two types of plate (Fig. 4). The individual crystal grains of hot-dipped tinplate are often of considerable size, whereas those of electrotinplate are much smaller. The crystal structure of tinplate is easily observed after the plate is lightly etched in acid solutions, and is referred to as "feathering". Feathering occurs in plain cans packed with mildly corrosive foods when some tin is dissolved from the can surfaces. Sulphur-staining on can surfaces with high-protein foods also reveals the crystalline structure of tin coatings.

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London Congress in September

THE 1ST International Congress of Food Science and Technology, to be held in the Imperial College of Science and Technology, London, from September 18 to 21, 1962, has its programme planned on a broad and comprehensive basis with the intention of attracting the fullest possible attendance by food scientists and technologists throughout the world. The programme, divided into four sections, covers: chemical and physical aspects; quality; analyses and composition; and manufacture. A number of periods will be devoted to plenary sessions and symposia. It is intended that the Congress should provide delegates with an opportunity, if desired, of forming a governing body to plan future international congresses and activities.

The Chairman of the Executive Committee is Dr. N. D. Kay, C.B.E., F.R.S. Full details of the programme, including organized visits and social events, and forms of application for membership are obtainable from the Hon. Secretary, Francis J. Griffen Esq. A.L.A., F.R.E.S., 14 Belgrave Square, London, S.W.1.

Refrigeration in the Retailing of Fruit and Vegetables

By E. G. Hall

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THE retailer, the last link in the long chain of handlers from the field to the table and the only person with whom the consumer has direct contact, plays a major part in the successful marketing of fresh fruits and vegetables. The appreciable losses which often take place at the retail level, due to loss of quality and outright waste, can be greatly reduced by the retailers' acceptance of proven storage principles.

The aging and deterioration of perishable produce proceeds continuously at a rate which is primarily dependent on the temperature at which the produce is held. Shelf life which may be very short under unfavourable conditions can usually be appreciably lengthened by cooling, which slows down the aging process and inhibits the development of decay. Refrigeration, while not essential for all produce, is of paramount importance in maintaining the quality and reducing wastage of the more perishable fruits and vegetables.

A small cool store attached to a retail shop makes possible the safe holding of many lines which in warm weather would rapidly become unsaleable. The quality of less perishable lines is better maintained if stocks are kept in the cool store and moved out as required for display and sale. The provision of cool storage may also effect savings by reducing the frequency of wholesale buying. This seems to be a common reason for the increasing popularity of small cool stores. Today, when a new fruit shop is being built provision is normally made for a cool store.

Refrigeration during display of highly perishable produce, e.g. by sale from a refrigerated display cabinet, usually proves well worth while, particularly in a self-service store, but as yet very few are found. Refrigeration of some kinds of prepackaged fruit and vegetables is essential to prevent their rapid deterioration, especially if the consumer is planning further storage in a domestic refrigerator.

COOL ROOM DESIGN

The size of the cool room or rooms for the storage of produce should be determined by the rate of turnover, any anticipated increase, and the periods for which it is desired to hold the fruits or vegetables. The designing and installation of the store should be placed in the hands of a firm of competent refrigeration engineers experienced in this type of work. There are two important points which should be kept clearly in mind by the owner and, if necessary, brought to the attention of whoever may be entrusted with the installation. Firstly, the cool store insulation should be at least equivalent in efficiency to 3 inches of cork. Secondly, the calculation of the amount of coil surface required in the evaporator should be based on a temperature differential between coil surface and the air in the storage room of *not more* than 7 °F (a differential of 4–5 °F would be ideal). This requirement means that the amount of evaporating coil surface installed in the cool room should be 2–3 times that usually installed for a butcher's shop. The importance of these two points lies in the need to achieve sufficiently rapid cooling and to avoid undue evaporation of water, with consequent shrinkage of the stored produce.

PREPACKAGED MATERIAL

Refrigeration is essential for prepackaged perishable produce which is being held for more than a day or two since high humidity in the package is conducive to decay. This is particularly important with green beans, peas, broccoli, silver beet, and soft fruits and berries. The value of refrigeration for prepackaged perishables has been clearly demonstrated by Schomer (1953) who investigated the effect of temperature on the shelf life of a large number of prepackaged lines of perishable vegetables. According to degree of perishability their shelf life ranged from 1 to 5 days at 80–85 °F, 2 to 21 days at 50 °F, and 6 to 30 days at 32 °F.

For retail display prepackaged produce can be kept cool with crushed ice, or it may be placed in mechanically refrigerated display cases. The latter should be run at 40–45 °F and the air temperature of the cabinet should not be allowed to fall below 35 °F or rise above 50 °F. If the use of a refrigerated display cabinet case is not feasible, overnight refrigeration in a special cold chamber would prove of value, since this should lower the daytime temperature of the produce by 10–20 °F. The various methods of cooling which can be adopted are discussed in detail by Lewis (1957).

When the produce is packaged at the shipping point, the use of refrigeration during transport is desirable, since a relatively long time may elapse before the produce reaches the retail store. Precooling before packing is essential for successful refrigerated transport since refrigerated vehicles are not designed as coolers and because packaging reduces the rate of cooling. To gain maximum benefit from refrigeration it should be employed throughout the shipping and marketing period.

TEMPERATURE AND STORAGE LIFE

In general it may be said that the life of perishable produce is approximately doubled by reducing the temperature by 15 °F, although this relationship will obviously vary with different products. The shelf life of peas in the pod, a very perishable commodity, is 1–2 days at a temperature of 80 °F, 5–7 days at 50 °F, and 14–21 days at 32 °F. Topped carrots will last about 4–5 days at 80 °F, 14–21 days at 50 °F, and more than 30 days at 32 °F. The life of most perishable products is only a very few days at temperature of the order of 70–80 °F, and about 7–14 days at temperatures of 40–45 °F. The latter range is accepted as suitable for refrigerated display or other short-term storage. Some kinds of produce are damaged by low temperatures, which means all produce should not be refrigerated to the same degree. Bananas, tomatoes, sweet potatoes, and a few others keep best at a temperature of 55 °F; on the other hand, a wide range of leafy and root vegetables, apples, pears, and most stone fruits, can be stored longest at temperatures around 32 °F.

SPECIFIC REQUIREMENTS

The various fruits and vegetables differ in their temperature requirements if they are to be held for any length of time. They can be grouped in the following broad categories:

(1) **Produce suitable for storage at 32 °F**—Apples, pears, peaches, plums, nectarines, grapes, berry fruits, oranges (2–3 weeks

A refrigerated display cabinet in a self-service store, Sydney.

only), mandarins (1–2 weeks only), root vegetables, leafy vegetables, peas, and beans.

(2) **Produce requiring a temperature of approximately 45 °F**—Oranges, mandarins, ripe pineapples, coloured tomatoes, passionfruit, potatoes, cucumbers, and melons.

(3) **Produce requiring a temperature of approximately 55 °F**—Lemons, grapefruit, green bananas, green pineapples, green tomatoes, sweet potatoes, and pumpkins.

If two chambers can be made available for cool storage, one should be run at 32–34 °F for produce listed under (1), and the other at 49–51 °F for produce listed under (2) and (3). This should permit reasonably long storage for most items.

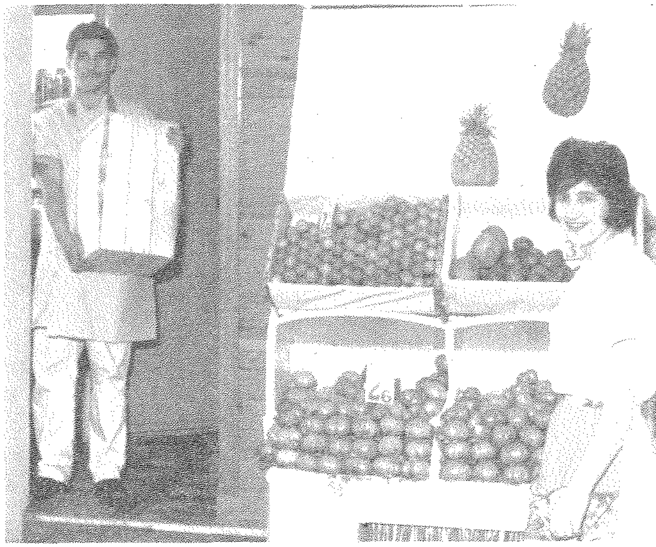
If only one room is available for all fruits and vegetables, it should be held at a temperature of 38–40 °F, which would allow of the inclusion of oranges and, for short periods of less than 3 weeks, of other citrus fruits, coloured tomatoes, ripe pineapples, and potatoes.

If only short-term storage of the order of a week is required, it would be better to run the room at a temperature of about 45 °F. All types of fruits and vegetables could be stored in this one room. Because of the higher temperatures, "sweating" (condensation of moisture on the produce after removal from store) would be reduced.

The storage life of the various fruits and vegetables at their optimum temperatures differs greatly. The highly perishable types, with a maximum safe cool storage life of only 1–3 weeks, include apricots, most varieties of peaches, early plums, berry fruits, cherries, bananas, green vegetables, bunched root vegetables, peas and beans, cauliflower, green corn, cucumbers, water melons, rock melons, rhubarb, coloured tomatoes, and mushrooms.

Less perishable kinds, with a life of 4–6 weeks, include grapes, nectarines, late peaches, most plums, mandarins, green pineapples, passionfruit, avocados, cabbage, peppers, and mature-green tomatoes.

Semi-perishable lines with a maximum cool storage life of 7–12 weeks include some late varieties of grapes and oranges, persimmons, celery, marrows, squash, and early onions.



A small cool store attached to a fruit shop at Double Bay, Sydney.

Fruit and vegetables with a relatively long cool storage life of more than 12 weeks include apples (excepting early varieties), pears, grapefruit, lemons, topped root vegetables, onions, potatoes, sweet potatoes, and pumpkin.

HUMIDITY AND OTHER FACTORS

Humidity.—In general, the relative humidity of the air in the storage room should be high enough to minimize wilting, but not to encourage mould. For most fruits the relative humidity should be about 90%. Leafy vegetables and bunched roots, which wilt very readily, require a humidity of about 96%. If this is not attainable, wrapping or lining the containers with waxed paper, moisture-proof cellulose, or other plastic film material is well worth while, unless only short storage is involved.

Some produce requires a lower humidity for the best results. Except for short periods of storage, of up to 3 weeks, onions, melons, marrows, and squash require a dry air with a relative humidity of 70–75%.

Sweating.—When cold produce is removed from the cool store to ordinary room temperatures, especially in a humid climate, it will become wet ("sweat"). This is due to the condensation of atmospheric moisture on the cold produce. Unless on removal, the packages are well ventilated, to allow the moisture to dry off quickly, rotting may ensue. Sweating may be avoided by warming the produce gradually in a room at an intermediate temperature. This is usually not economic. Where short storage of a few days only is required it is advisable to store perishables at a higher temperature than that recommended for longer storage, thereby reducing the amount of sweating. For such short-term holding of fruits and vegetables a temperature of 45 °F is satisfactory.

Over-storage.—For most items over-storage is indicated by gradual loss of quality, and by decay, which may not be apparent until *after* removal from the cold store. Stone fruits, pears, and some other fruits, such as bananas and most tropical fruits, should be placed in the cool store in an unripe condition when longer-term storage is planned. If these fruits are cool stored for too long they will fail to ripen normally after removal from cool storage, even though they may appear normal in every respect. Under no circumstances, therefore, should the recommended storage times be exceeded.

Ventilation in the store.—To ensure a satisfactory rate of cooling and maintenance of required temperature conditions in the store, proper ventilation is needed. Packages should be stacked 3 in. away from the walls, with 1-in. vertical gaps between them. The bottom layer should be raised off the floor on 2-in. timbers. The commonly used forced-draught coolers should have sufficient fan capacity to circulate the air at a rate of not less than 30 changes of the room volume per hour.

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Commercial Canning of Fruit Pie Fillings

CANNED ready-to-use pie fillings reduce the work involved in the preparation of fruit pies, cakes, and tarts, and may also be used as flavouring for ice cream, or as fruit desserts. From the standpoint of the canner, they appear to provide a profitable means of utilizing other than the best grades of fruit.

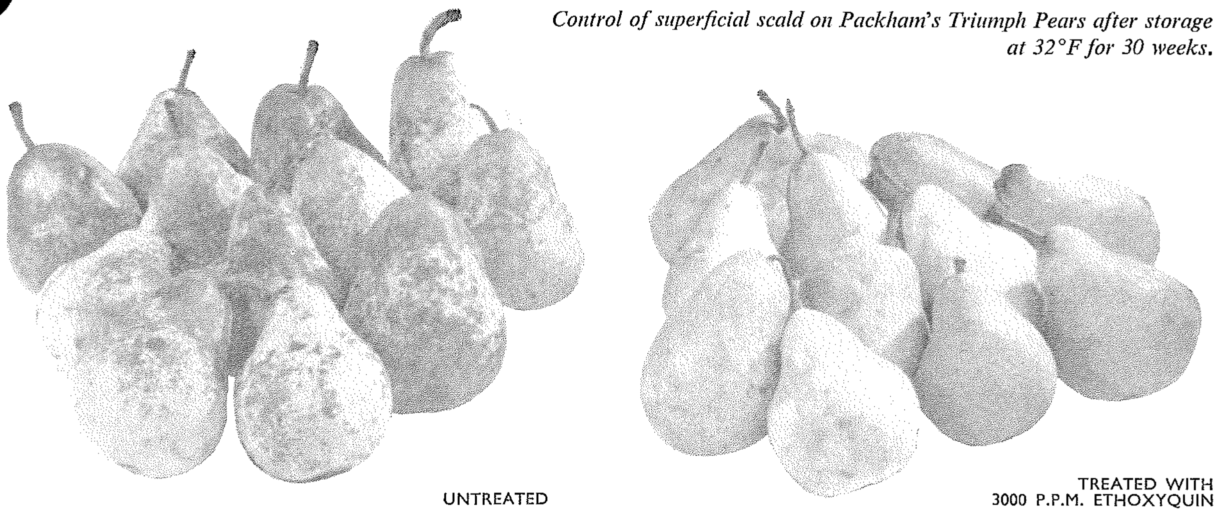
Canned pie fillings have been available to the North American housewife for several years, but there has been much variation in quality, and some of the commercial products do not store well, primarily because of unsuitable ingredients. These factors have been the subject of exhaustive study at the Fruit and Vegetable Processing Laboratory of the Summerland Research Station, British Columbia, Canada. Dr. C. C. Strachan, its former Director, in collaboration with F. E. Atkinson and others, has published an informative bulletin embodying the results of this work and recommendations arising from it. (Publication 1062: "Commercial Canning of Fruit Pie Fillings"—24pp., April 1960).

The bulletin sets out in some detail requirements, processing methods, and quality criteria (including testing methods), for high-quality canned fruit pie fillings containing 70–80% fruit. The formulae given, all of which have been thoroughly tested at the Summerland Fruit Processing Laboratory, are based on a wide range of fruits, suitable varieties of which are also listed. Although relatively few of these fruit varieties are grown commercially in Australia, the data on storage characteristics of the various types of pie fillings tested may interest local canners. The bulletin includes a brief but useful account of the properties of various stabilizing and thickening agents used to modify the consistency of the pie fillings in the finished product.

Copies of the publication (Cat. No. A73–1062) may be obtained from the Information Division, Canada Department of Agriculture, Ottawa, Ontario (Canada), but the bulletin would probably be available for reference at most agricultural libraries in Australia.

G.E.C.

Control of superficial scald on Packham's Triumph Pears after storage at 32°F for 30 weeks.



UNTREATED

TREATED WITH 3000 P.P.M. ETHOXYQUIN

Control of Superficial Scald on Packham's Triumph Pears

By E. G. Hall,*K. J. Scott,† and T. J. Riley*

PACKHAM'S TRIUMPH, in common with William Bon Chretien and several other varieties of pears, will develop a senescent skin disorder, generally known as pear scald, when kept too long in cool storage (Fisher, Palmer, and Porritt 1953; Hall and Sykes 1957; Marcellin and Leblond 1957). Affected fruit, usually rather yellow when removed from cool storage, fails to ripen normally and remains inedible. Packham's pears frequently develop a different type of scald which, unlike the senescent one, may develop rapidly after removal from cool storage on fruit which is still green in colour. This condition, which will be called superficial scald because of its similarity to that on apples, may develop after comparatively short storage and, at least for some time, affected fruit ripens normally.

Rose, McColloch, and Fisher (1951) and Fisher, Palmer, and Porritt (1953) reported that oiled wraps, which have long been the standard treatment for control of superficial scald on cool stored apples, were effective in controlling a superficial scald on cool stored Beurre d'Anjou pears which otherwise ripened normally on removal to higher temperatures. Oiled wraps did not control senescent pear scald. Recent work by Smock (1957) and Hall, Scott, and Coote (1961) has shown that superficial scald of apples can be controlled by treating the fruit with either diphenylamine or "Ethoxyquin" (6-ethoxy-1,2-dihydro-2,2,4-trimethylquinoline). The latter is the active ingredient in the preparation marketed overseas by the Monsanto Chemical Co. as "Stop Scald". The effects of oiled wraps, diphenylamine and Ethoxyquin on the development of superficial scald on cool-stored Packham's Triumph pears were studied in the Division's laboratories in the 1961 season.

METHOD

Fruit of normal maturity for cool storage was picked on March 22, 1961, from a number of trees in an orchard in the Central Tablelands of New South Wales and then divided systematically into 40 units, each of 50 fruits. Random groups of eight units were treated as follows:

(1) Untreated, no wraps
(2) Wrapped in plain tissue wraps
(3) Wrapped in oiled wraps
(4) Dipped in a solution of 1500 p.p.m. diphenylamine in 50% aqueous alcohol, no wraps
(5) Dipped in a solution of 3000 p.p.m. Ethoxyquin in 50% aqueous alcohol, no wraps.

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The fruit was placed in storage at a temperature of 32 °F on March 24, four units from each group being held in unlined boxes and four units in boxes lined with thin polyethylene sheeting. It had previously been observed that, in common with apple scald, superficial scald on Packham's pears was increased by storage in unsealed polyethylene box liners. A unit of each fruit treatment-storage method combination was removed to a temperature of 68 °F after 24, 27, 29, and 30 weeks as determined by the behaviour of pilot samples stored in the usual way in plain wraps in unlined boxes. The incidence of superficial scald was assessed after a further 7 days ripening period.

RESULTS

Superficial scald developed on the pilot fruit from the first removal early in August, after 19 weeks' storage, and was extensive on unwrapped fruit and fruit in plain wraps when the first removal of all lots was made after 24 weeks, and severe on fruit from later removals (see table p. 17). There was no development of senescent scald at low temperatures up to the time of the last removal, after 30 weeks. All fruit ripened satisfactorily although eating quality declined with longer storage. The superficial scald mainly developed after removal from low temperature and first showed as spots around the lenticels. As it developed and became more severe the spots frequently coalesced (see photograph, p. 15). It was darker in colour than the senescent scald which is usually tan to brown on the Packham's variety.

Treatment with Ethoxyquin completely inhibited scald at all removals and treatment with diphenylamine or the use of oiled wraps significantly reduced scald and gave good commercial control of the disorder after cool storage for six months (see table). There was no effect from the use of plain wraps but lining the boxes with polyethylene film increased superficial scald after storage for 29 and 30 weeks. The fruit was not injured by the experimental treatments.

DISCUSSION

As the superficial scald which occurs on Packham's Triumph pears was controlled by treatments effective with superficial scald on apples and developed mainly after removal from low temperature, it resembles that recorded by Hartman (1931) on the pear variety Beurre d'Anjou. As it showed comparatively early in storage, and the affected fruit ripened normally, it is different from the normal senescent scald on pears (Rose, McColloch, and Fisher 1951) which is not controlled by oiled wraps and is associated with over-storage and failure to ripen. With Packham's pears superficial scald develops mainly on the neck of the fruit after removal, whereas senescent scald occurs mainly towards the calyx end and increases little after removal to higher temperatures. Senescent scald is always associated with yellowing in storage. Although superficial scald increases with longer keeping it is clearly not a disorder of over-storage.

A disorder termed lenticel scald, and probably similar to superficial scald on Packham's, was observed by Huelin and Tindale (1942) on William Bon Chretien pears which had been stored in air for several weeks before being gas stored. It occurred on early-picked fruit while still hard and green, and showed as somewhat diffuse brown spots around lenticels which tended to merge during subsequent normal ripening. In our experience superficial scald has been observed only on the Packham's variety of pears. Since a solution of 1500 p.p.m. diphenylamine gave incomplete control whereas 3000 p.p.m. Ethoxyquin, which has generally been less effective than the former on apple scald (Smock 1957; Hall *et al.* unpublished data), gave complete control, it is probable that complete control of superficial scald on pears could be obtained with diphenylamine used in higher concentration.

In the 1961 season superficial scald was severe on both apples and Packham's pears in New South Wales and was noticed on the latter in retail shops as early as the end of June, i.e. after about 3 months' storage. In seasons of lower susceptibility the use of good-quality oiled wraps should give a satisfactory commercial control. It should be pointed out that, since the effectiveness of oiled wraps in controlling scald depends solely on the amount of oil in the paper around each fruit, the use of paper conforming to the Australian Standard Specification for Oiled Wraps for Apples (N29–1959) of 200 mg oil per 100 sq. in. of paper is necessary

Superficial Scald on Packham's Triumph Pears — 1961

(a) Per cent. Scalded Fruit

Treatment		Storage Period (Weeks) 24	27	29	30
(1) 3000 p.p.m. Ethoxyquin dip	no liner	0	0	0	0
3000 p.p.m. Ethoxyquin dip	polyethylene-lined cases	0	0	0	0
(2) 1500 p.p.m. diphenylamine dip	no liner	9	5	7	12
1500 p.p.m. diphenylamine dip	polyethylene-lined cases	3	0	10	15
(3) Oil wraps	no liner	7	—	20	28
Oil wraps	polyethylene-lined cases	6	7	9	45
(4) Control, plain wraps	no liner	39	80	61	64
Control, plain wraps	polyethylene-lined cases	49	68	90	98
(5) Control, no wraps	no liner	24	47	60	77
Control, no wraps	polyethylene-lined cases	57	83	87	—

(b) Treatment Mean for Scald, Adjusted to the Common Storage Time of 27·5 Weeks by the Mean Regression of Scald on Storage Time*

Treatment:	2		3		4		5	
	Angle (°)	%	Angle (°)	%	Angle (°)	%	Angle (°)	%
No liner	16·5	8·1	24·1	16·0	51·6	61·1	46·2	52·1
Liner	12·8	5·0	22·3	14·4	63·4	80·0	63·9	82·5

*For tests between mean angles, no S.E. of a difference between means is greater than ±6·0 on 21 degrees of freedom (5% L.S.D. = 12·4).

for consistently good results. Although Ethoxyquin is allowed in U.S.A., Canada, and New Zealand for use with apples it has not yet been approved in Australia. (While the use of diphenylamine on fruit is not permitted in any country its approval is under consideration in U.S.A.).

Considerable quantities of Packham's pears are now cool stored in polyethylene bag box liners, which may be folded, punctured and tied, or sealed. Since polyethylene liners increased superficial scald in the experimental fruit and it is known that their use may increase scald on apples (Hall and Scott, unpublished data), Packham's pears stored in polyethylene need to be protected against scald. Storage in modified atmospheres in sealed polyethylene bags can increase storage life and thus delay the appearance of scald, but the ultimate development of the disorder may be severe.

RECOMMENDATIONS

Because of the apparent similarity between superficial scald on Packham's pears and that on apples, the use of good-quality oiled wraps when the pears are intended for long storage can be recommended to growers. Since early-picked pears may be more susceptible to the disorder, growers are advised to see that fruit intended for storage is well matured before picking. Wrapped and packed fruit cools more slowly than loose unwrapped fruit, so it is important that the fruit be promptly stored, quickly cooled by open stacking in containers, and held at a temperature of 30 °F.

Particular care should be taken in seasons when the weather for the last few weeks before harvest is warm and dry, since it is known that such conditions are conducive to increased superficial scald on apples in cool storage.

ACKNOWLEDGEMENTS

The assistance of Mr. R. B. Wills in carrying out the experimental work is gratefully appreciated. The analysis of the data was carried out by Mr. G. G. Coote, C.S.I.R.O. Division of Mathematical Statistics.

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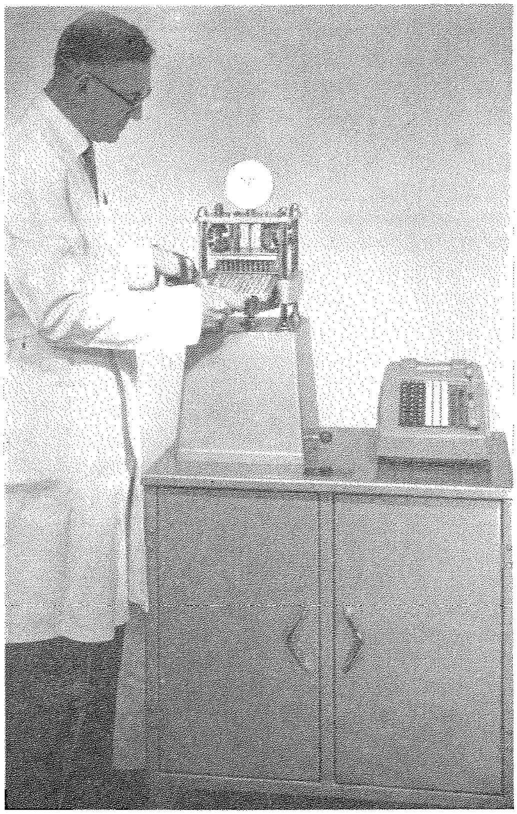
Improvements to the Maturometer

IN 1945 the Division of Food Preservation commenced an investigation (Lynch and Mitchell 1950) into means of improving the quality of canned peas. The need arose for a rapid, precise method of measuring the maturity of green peas for processing, and defining and predicting the optimal time for harvesting pea crops. The research culminated in the development of the "Maturometer", covered by Australian Patent 143316, which has been described by Lynch and Mitchell (1950). The instrument is essentially a device for measuring the resistance to puncture of a numerical sample of peas.



The operator (Mr. R. S. Mitchell) is placing the loaded sampler plate into position beneath the puncturing pins. The pins are attached to, and laterally stabilized by, the ring-spring sandwich (visible beneath the dial). The knob engaging the single revolution clutch is visible on the right-hand side, while to the right of the maturometer is the calculator for recording test results on tape.

The original maturometer used the compression of four helical springs to measure resistance to puncture, but in the first commercial model, made in 1951, resistance was measured by the distortion of a diaphragm spring mounted integrally with a displacement gauge. In each case a riding pointer gave the maximum thrust developed when the peas were punctured.

Various minor modifications were made to the instrument between 1951 and 1959. These included an increase in the length of the pins to 1 inch and the use of polytetrafluoroethylene for the platen bearings. Unfortunately, the latter did not entirely eliminate friction from the measuring system. Experience gained from commercial usage showed that friction between the sliding platen and pillars varied because of misalignment of the pillars and changes in surface characteristics. Also the load of the riding pointer on the indicator needle was not constant, and it became appreciable because of magnification through the gauge mechanism. Modification of the measuring system has eliminated frictional error, and static and dynamic testing procedures allow instruments to be readily calibrated and compared (Mitchell, Casimir, and Lynch 1961).

When a number of diaphragm gauge type maturometers, which had been in commercial use for periods of up to 6 years, were tested for instrumental error it was concluded that this type of maturometer required constant maintenance for efficient performance. Investigations undertaken to find a more reliable measuring system resulted in the development of a ring-spring maturometer (see photograph). Measurements have shown that the rings return to their initial diameters after repeated compression by 0·100 in. (2·54 mm). Springs for this maturometer were machined from solid steel bar, containing 0·6% carbon and 0·6% chromium, and were heat treated to 45 Rockwell C. They were ground to give 0·001 in. compression for each 1·25 lb (0·567 kg) increment in diametrical load. The ring-spring sandwich, when assembled in the maturometer, gave correct registration and lateral stability without dependence upon guide bearings.

It is of interest to note that pieces of asbestos sheet $\frac{1}{16}$ in. thick were used for test purposes in these investigations. The use of peas for instrumental test involved a large number of measurements, and tests were restricted by the availability of fresh material. Statistical analysis of the readings obtained with asbestos pieces showed neither observer nor machine effect. Between readings variation was found to be due to differences within the asbestos sheet and the cause of variation was ascertained.

In the 1957 and 1958 seasons samples of ungraded and size-graded peas were tested by the ring-spring maturometer; parallel samples were canned, and the percentage of alcohol-insoluble solids (an accepted measure of maturity) determined. The regression equations, together with those from the original maturometer, did not differ significantly, from which it was concluded that the ring-spring maturometer gave the same maturity relationship as the original instrument, which used four helical springs.

Motorized maturometers have been used experimentally since October 1957 and the first commercial model was made in September 1961.

In the motorized maturometer (see photograph) the platen holding the sampler plate is driven vertically upwards to effect penetration of the peas, and then returned to the original position by a cam connected to an electric motor through a single-revolution clutch. The clutch is manually engaged after the loaded sampler plate is locked in position. The instrument is fitted with an overload device, which prevents damage to the driving mechanism should the sampler plate contain foreign material or be incorrectly positioned by the operator. The addition of a raised edge to the two sampler plates supplied with the motorized maturometer facilitates loading and increases the rate at which readings may be obtained.

D.J.C.

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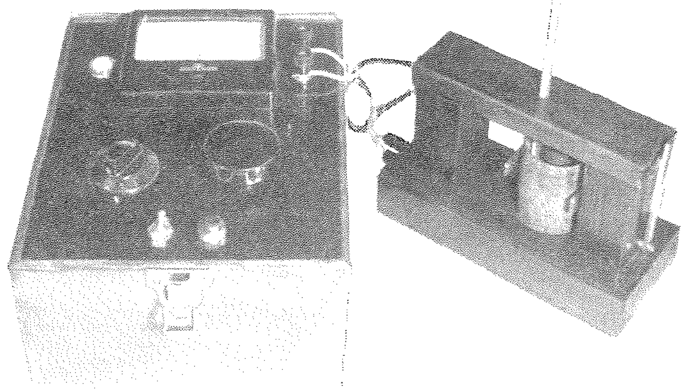
The prototype Stowell Meter with the cell and electrode unit attached. A single determination including sample preparations can be made in a few minutes.

Moisture Meter for Dried Apples



A NEW METER for the rapid estimation of moisture in dried apples has been designed and constructed by members of the Division of Food Preservation at the C.S.I.R.O. Tasmanian Regional Laboratory, Hobart. It is based on the "Calipco" meter, originally developed in 1933 for the Californian Dried Fruits Association by C. Fisher, which has been in use with dried grapes in Australia for a number of years. Both meters make use of the fact that the electrical conductivity of dried fruit is directly related to its moisture content.

Several modifications have been incorporated in the new instrument. A microammeter with a scale reading of 500–0–500μA, mounted on the panel to indicate the point of balance, replaces the audio signal of the "Calipco" instrument. A resistance and fine adjustment switch protect the microammeter when the resistances and sample are grossly out of balance.

The fixed and variable resistances have been altered to give a wider range of moisture content and temperature for measurements on dried apples. The cell and electrode assembly is constructed as a separate unit, which can be connected to the main instrument when in use or clamped into the lid for transport.

The procedure for measuring the moisture content of dried fruit is as follows:

- An adequate number of samples is taken from the bulk lot to be tested.
- Each sample after mincing in a household machine is placed in the test cell, a thermometer is inserted, and the electrodes are brought into contact with the sample.
- The microammeter reading is brought to zero by adjustment of the two controls on the panel of the instrument.
- A reading (0–100) is taken on the indicator dial, the temperature read from the thermometer, and the moisture content denoted by the reading found by consulting a set of tables.

A single determination—including mincing—should not require more than a few minutes.

The use of the new instrument has been thoroughly investigated on a wide range of Tasmanian dried apples processed under commercial conditions. It has provided an answer to the industry's need for a rapid and inexpensive method which can be used with accuracy by factory workers. The average standard error for single determinations on samples in the moisture range 11–28% was ±0·4%. Although the meter has been designed for determining moisture in dried apples it should be equally suitable for use with other dried fruits.

Commercial manufacture of the instrument, which will be known as the Stowell Meter, has been undertaken by the firm of Telecomponents Pty. Ltd., Brookvale, N.S.W.

S.M.S.

Book Review

Food Technology Review

"ANNUAL REVIEW OF FOOD TECHNOLOGY." Vol. 2 (for 1960) — Published by the Indian Association of Food Technologists. 154 pages (with index) — Mysore, 1961. Price Rs.7.50 or 15*s*. stg.

VOLUME 1 of this praiseworthy new publication was reviewed in *Food Technology in Australia* (Vol. 13, No. 7) and much of the general comment, then made, is equally applicable to this new volume. Although its cost, designated by the previous reviewer as "refreshingly cheap", has been increased by 50% the book is still excellent value for the food technologist.

The new volume like its predecessor covers a wide field of topical interest, especially to the food processor. Each review, which it is claimed "covers scientific and technological development during the past 10 years", again carries an extremely well prepared and full bibliography which is truly international in its scope.

As in the previous volume some of the reviewers have probably attempted to cover too many aspects of their subject in the comparatively short space allocated for articles which, this year, are seven in number compared with four in the first volume. The use of up to a page and a half of text for a subject index at the beginning of each article hardly seems justified in view of the adequate subtitling and the good author and subject indexes furnished at the back of the publication.

Turning to the contents of the articles, the subject of "Bakery Fats" is well reviewed by Varadarajan, Pai, and Hattiangdi of Hindustan Lever. They assert that, while recent studies on the influence of fats in baking have provided the baker with a great choice and variety of products, the knowledge of baking techniques, and of the changes in the physical structure of dough leading to a more porous and tender product, is still very incomplete. They stress that their review shows much remains to be done in the development of reliable instruments for the measurement of rheological properties of doughs and baked goods, and consider that significant advances may be expected in the production of new synthetic emulsifiers.

The article on "Fish Hydrolysates, Pastes and Sauces" by Lakiry and Sen should prove of interest in countries, besides India, where a protein deficiency is found in the diet and there is scope for developing the fishery industry to improve the dietary of the masses. The review is confined to products involving enzymatic and autolytic degradation of proteins, fish peptoses, proteolysed fish liver and extracts, and those involving acid and alkaline hydrolysis of proteins. Their concluding section, discussing the scope for developing the fish hydrolysate industry in India, is worthy of reading.

Ramachandra and Kalbag deal with "Heat Transfer in Food" in a lucid and comprehensive manner, clearly indicating the major problems involved. They rightly point out that in the food industry a high rate of heat transfer improves the process, and may give a better product. Bains contributes an interesting review of "Cereal Gums" and states that our present understanding of their role marks but the beginning of a new chapter in cereal chemistry and technology. The review by Chandrasekhasa on "Infant Foods" is well written and should be appreciated by persons with a wide range of interests. His comparisons of fresh milks, derived from different animal sources, the amino acid contents of these milks, and of proprietary infant foods should form a useful source of information for the dietitian. Rassganna's review of the "Analysis of Fresh and Processed Fruits and Vegetables" shows wide reading and he need make no apology, as he does, for not covering all procedures. The list of references he gives should be found especially valuable. Pruthi on "Thermal Processing of Canned Foods" writes with considerable authority and presents an admirably prepared review of the subject.

H.H.

Pitting Corrosion in Food Cans

THE DIVISION OF FOOD PRESERVATION is investigating an unusual form of pitting corrosion encountered sporadically by several Australian canneries in recent years, usually in cans of pears. Members of the canning industry are invited to send information about recent outbreaks of spoilage in canned pears. A number of cases of pitting corrosion have already been reported, and the research team investigating this problem is anxious to have details of other outbreaks that may have occurred. Pitting corrosion in the cases investigated has resulted in hydrogen swells after cans have been stored for about 12 months. The interiors of the affected cans usually show partial detinning with numerous minute pits in the base steel, particularly on expansion rings and codes. The pits are often just visible to the naked eye; they may be detected by probing or scratching with a needle. Pitting corrosion has also been observed in isolated batches of canned vegetables and meat.

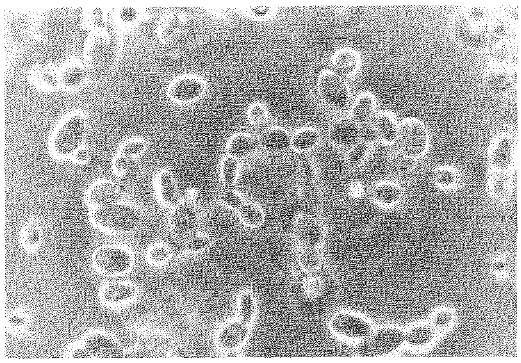
Where possible food processors are asked to send samples of swollen and normal cans (preferably at least two dozen cans of each type) for investigation. Information about the raw materials used in the pack, the cans, the processing procedure, the storage history, and the incidence of hydrogen swells should also be sent, if it is available. All information will be treated as confidential. The packages should be addressed to Mr. P. W. Board, Division of Food Preservation, Box 43, Ryde Post Office, N.S.W.

NEWS FROM THE DIVISION OF FOOD PRESERVATION

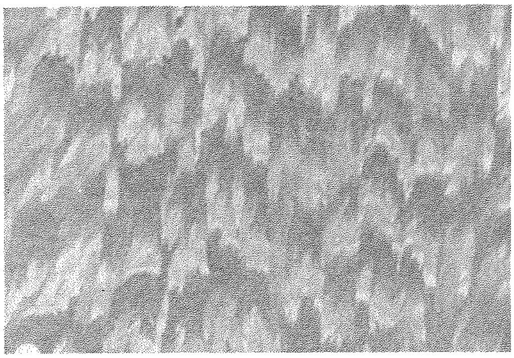
THE PHOTOGRAPHIC UNIT

In the Division of Food Preservation the following technical services are available to the scientific staff through centrally administered units: library, editorial service, taste testing, engineering and workshop services, glass-blowing, and photography. The last mentioned was one of the earliest services in the Division, for it was made a part-time activity of Mr. P. R. Maguire in 1938, and became his full-time responsibility in 1953. In the former laboratories of the Division of Food Preservation at Homebush the extremely limited facilities made photographic work most difficult, but in the Division's new headquarters at North Ryde the photographic unit is accommodated in spacious quarters with an area of approximately 800 sq. ft. The area is subdivided into a projection room, a workroom, and a dark room, entry to which is made through a light lock. The dark room, which has a number of special facilities, is fully air-conditioned, while in the projection and workrooms temperatures may be controlled through a ventilation system.

The unit provides a photographic service for technical and illustrative purposes, and it is equipped for micrographic work and colour photography. An important part of the work is the recording in colour of disorders encountered in research on the storage of fresh fruit and vegetables. The unit maintains a collection of transparencies of these disorders, and the Division is the centre for the collection and dissemination of the



A young culture of yeast cells, viewed under phase-contrast.



A specimen of tinplate, from which some of the tin has been removed with acid. The light-coloured parts of the pattern are tin crystals, and the dark parts the tin-iron alloy exposed by corrosion.

material in Australia. Photomicrographic techniques are applied to problems in microbiology, the elucidation of features of plant and animal cells, and to investigations on the corrosion of tinplate in food cans. Photomicrographs of biological materials are made under bright-field conditions, or in phase contrast.

STAFF CHANGES

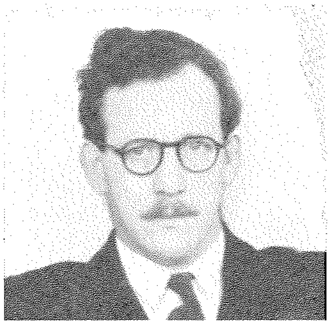
Dr. K. S. Rowan resigned from the staff of the Division's Plant Physiology Unit at Melbourne University on June 1, 1961, at the end of a period of research on growth substances in fruit tissue at the University of California, Davis, U.S.A. He is now senior lecturer in Botany at the University of Melbourne.

A number of appointments have been made to the staff of the Division's Plant Physiology Unit at Sydney University since October 1960, when Dr. D. D. Davies* assumed, with Dr. F. V. Mercer, joint leadership of the Unit. Mr. E. S. Blanch was appointed as an Experimental Officer in October 1960 to carry out analytical work in biochemistry, in which he had gained experience at the Veterinary Research Station of the New South Wales Department of Agriculture at Glenfield, N.S.W. The team of research officers working on biophysical investigations was strengthened in March 1961 by the appointment of Dr. G. P. Findlay, a graduate of the University of Tasmania. Two plant physiologists were appointed shortly afterwards—Dr. D. Graham, a graduate of the Universities of Durham and Cambridge, and Dr. T.ap Rees, an Oxford graduate with post-graduate experience in research at Purdue University, Lafayette, Indiana, U.S.A.

Mr. R. A. B. de Fossard, a graduate in forestry and botany from the University of Edinburgh, reached Sydney in December 1961 to commence research on physiological aspects of fruit storage and ripening at the Divisional headquarters at North Ryde. Mr. de Fossard gained experience in agricultural research in Jamaica, and as an officer of the Citrus Research Station, Nelspruit, South Africa.

Dr. A. R. Johnson arrived in Sydney at the end of October 1961 to join the research group at North Ryde, who are investigating the preservation of meat, fish, and eggs. Dr. Johnson is a graduate of the University of Leeds, where he studied chemistry, physiology, and biochemistry. Since his graduation Dr. Johnson has been lecturer in biochemistry at the University of Adelaide, leader of the Commonwealth Anti-oxidant Research Project, Adelaide, and research officer in the Fats Research Laboratory of the New Zealand Department of Scientific and Industrial Research.

Dr. A. R. Johnson



Dr. R. W. Burley, who took his degrees at the Rhodes University, South Africa, and the University of Leeds, has joined the Division's Physical Chemistry Unit at the University of Sydney, where he will work on the physical chemistry of proteins. From 1959 to 1961 Dr. Burley held a post-doctoral fellowship with the Canadian National Research Council for research into the physical chemistry of lipo-proteins.

*See *C.S.I.R.O. Food Pres. Quart.* **20**: 75.

Mr. K. E. Murray joined the General Chemistry Section of the Division at North Ryde in May 1961. Mr. Murray was on the research staff of the C.S.I.R.O. Chemical Research Laboratories, Melbourne, for over 20 years, being a foundation member of the Division of Industrial Chemistry. A graduate

Mr. K. E. Murray

in chemistry from the University of Western Australia, he did notable work on the chemistry of waxes, notably wool wax, and the wax of the tubercle bacillus. In the Division of Food Preservation he is leading a small group investigating the chemistry of flavours in foods.

Dr. G. C. Walker, a graduate of the Universities of Nottingham and Bristol, joined the Frozen Foods Section of the Division in December 1960. Trained as a chemist and enzymologist, Dr. Walker is investigating the causes of off-flavours in frozen peas.

Two appointments have been made to the Meat Research Laboratory at Cannon Hill, Queensland. Mr. M. K. Shaw, a graduate of the University of Queensland, has been appointed as an Experimental Officer to take part in investigations on the bacteriology of meat. Dr. F. Grau, formerly a Technical Assistant at the Meat Research Laboratory, has rejoined the Division as a Research Officer. He will engage in basic studies on the physiology of meat spoilage bacteria.

The position of Divisional Editor is now occupied by Mr. H. Hirst, who has had long experience in the administration of agricultural research and as an editor of agricultural journals. Among the positions formerly occupied by Mr. Hirst are Acting-Director of Agriculture in Malta, Assistant and later Deputy Director of Agriculture in Cyprus, adviser for the Food and Agriculture Organization in Ceylon, and Director of the Kimberley Research Station, W. A.

OVERSEAS TRAVEL

Several senior members of the Division's research staff went on missions overseas during 1961. Miss Joan Bain was absent from Australia from April 15 to November 29, 1961, mostly in the United Kingdom, where, at the East Malling Research Station, she studied the development of apples from the blossom stage. Miss Bain attended an Electron Microscope Conference at Nottingham in July 1961, and made visits to a number of laboratories in Europe and U.S.A. where electron microscope studies of the fine structure of plant and animal tissues are in progress. In the course of her return she visited the Fruit Research Division of the New Zealand D.S.I.R., Auckland.

A Colombo Plan assignment took Mr. R. S. Mitchell to Indonesia from June 27 to July 25, 1961. He visited the Food Technology Laboratories at Pasar Minggu to report and advise on laboratory premises, equipment, staff, and the present research programme.

Dr. D. L. Ingles left Sydney on August 13, 1961, to take up a post-doctoral fellowship in carbohydrate biochemistry with Professor R. L. Whistler, Department of Biochemistry, Purdue University, Lafayette, Indiana, U.S.A.

Mr. A. Howard, Officer-in-Charge of the Division's Meat Research Laboratory at Cannon Hill, Queensland, attended the Tenth Pacific Science Congress at Honolulu in August, and the seventh meeting of European Meat Research Workers at Warsaw in September 1961. He also visited meat research institutions, abattoirs, meat works, and cold stores in Denmark, Sweden, U.S.S.R., Poland, Czechoslovakia, Germany, France, Belgium, Holland, Finland, Canada, U.S.A., and New Zealand, and arrived back in Australia on December 13, 1961.

Dr. J. F. Turner and his wife, Dr. Donella Turner, returned to Australia on October 21, 1961, after attending the International Biochemical Congress in Moscow in August, and visiting research institutions in Finland, Sweden, Denmark, France, England, and Scotland.

R.B.W.