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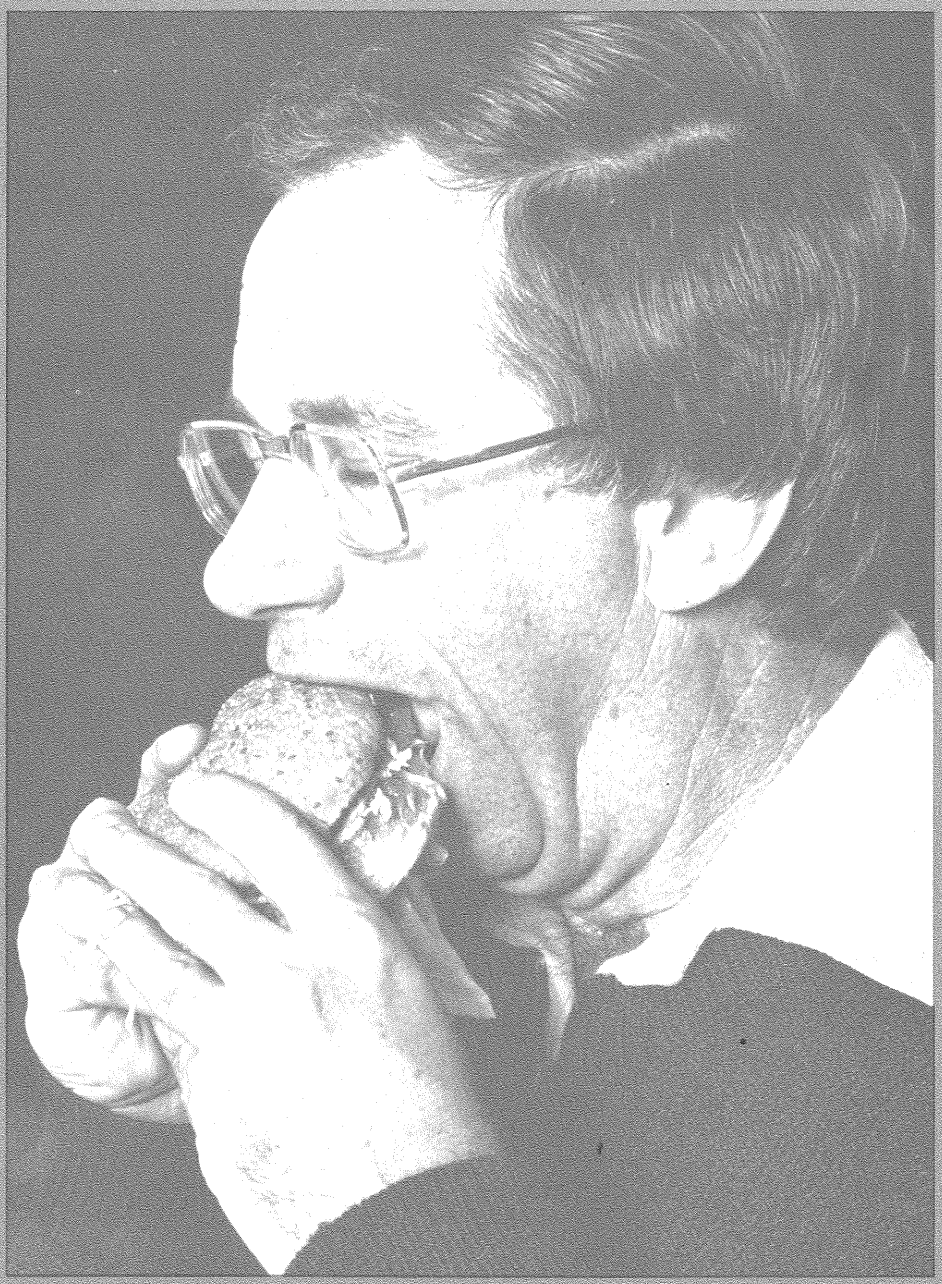

Take-away foods — microbiological aspects

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The term 'take-away food' can logically be applied to any food that is sold for immediate consumption. In practice, many such foods are excluded from this category, e.g. confectionery and most bakery products. In considering microbiological aspects, our concern is for the most part with prepared foods which are very perishable, i.e. those that will support relatively rapid growth of microorganisms when the environmental temperature is favourable. This discussion will concentrate on foods with a major meat component that are sold hot, and on salads that are sold chilled.

Factors affecting the microbiology of such foods include the quality of the raw material, the point of manufacture or preparation (i.e. in a factory or in a retail outlet), the process given, the opportunities for contamination and the conditions and length of storage before sale. The microbiological status of the food when finally retailed will reflect the effectiveness with which the principles of food hygiene have been applied.

Food hygiene is the sanitary science which aims to produce food that is safe for the consumer and of good keeping quality (Hobbs 1974). It has two main aspects: prevention of microbial contamination of foods and reduction to a minimum of the growth in foods of undesirable microorganisms. Sources of microbial contamination are the environment, the raw materials and the human handler, with cross-contamination of cooked food by raw being of particular concern with meat products. Even when contamination from external sources is prevented, action to minimize microbial growth will still be necessary, as many raw foods are commonly and unavoidably contaminated with pathogens. Multiplication of pathogens is controlled by maintaining the food at low or high temperatures, as appropriate.

Usually, food poisoning by take-away foods results from the presence of four types of bacteria. Briefly, their important characteristics are as follows.

Staphylococcus aureus. The most common source is man, since *S. aureus* is frequently present in nasal passages and on the skin. It is most likely to be a problem in cooked foods such as meat and poultry eaten cold and in prepared foods such as custards and creams, all of which are readily contaminated by hands. Growth of *S. aureus* does not occur below about 10 °C and although the organism is destroyed by cooking, the toxin it produces during growth in the food is quite heat resistant.

Salmonella. Bacteria of this group are quite common on raw meats and poultry, which are contaminated from animal excreta at the time of slaughter. They may also originate in human excreta. Salmonellosis is a true infection and the causal organism is not resistant to heat. Some strains of salmonellae will grow at 10 °C, but none at 5 °C.

Clostridium perfringens is common in raw meat and poultry. It grows only under anaerobic conditions and forms heat resistant spores, some of which survive boiling for hours.

Little growth occurs below 15 °C, but multiplication is rapid at temperatures up to 50 °C and proceeds slowly at even higher temperatures.

Bacillus cereus is a common contaminant of cereals. Its spores survive light cooking and it grows over the temperature range 10–48 °C.

Each of these bacteria can cause some form of gastroenteritis, with incubation periods that are short for *S. aureus* (2–4 h) and *B. cereus* (2–15 h) and longer for *C. perfringens* (12–18 h) and *Salmonella* (12–24 h).

From these brief descriptions it is clear that thorough cooking processes should destroy staphylococci and salmonellae in foods but may not eliminate spores of *Bacillus* or *Clostridium*, nor the staphylococcal toxin. Growth of all of these organisms may be prevented by holding foods at temperatures below 5 °C or above 60 °C. With the occasional exception of *Salmonella*, these organisms must usually be present in very high numbers (10^6 g^{-1} or more) to cause food poisoning.

For several years, the NHMRC has funded a microbiological survey of prepared foods in most Australian capital cities. It may, then, be instructive to take several examples of take-away foods, consider their possible microbiological hazards and compare these with the findings of the survey.

Hot take-aways

Meat pies. The Australian meat pie is predominantly a mass-produced item, baked in factories, cooled, distributed at ambient temperature and heated in ovens for retail sale. It consists of pastry, meat and gravy. Consequently, the likely contaminants of the raw material that may survive baking are *C. perfringens* and *B. cereus*. Pies have had, in recent years, a very good public health record. Nevertheless, some hazard exists when, because of over-ordering, they are left to cool to ambient temperature overnight before being heated again for retail sale.

In the survey, 355 pies were examined in sets of five. The pies were rarely sterile, but three-quarters of them contained less than 1000 bacteria per gram. In contrast, 13 pies had counts above 10^6 g^{-1}, with one above 10^8 g^{-1}. *C. perfringens* was present in countable numbers in only 6%. *B. cereus* was found in 12% at concentrations up to 10^6 g^{-1} and in each instance this organism was a major component of the bacterial flora.

Rotisseried chicken. Salmonellae are common in raw poultry, and their detection in rotisseried chicken indicates either inadequate cooking or recontamination of the cooked bird by organisms from raw poultry being prepared for the spit. The two factors of most concern in this process are (*a*) handling by the same operator of both raw and cooked birds and (*b*) the long periods during which cooked poultry is held warm while awaiting sale. The latter may be conducive to growth of surviving spores of *C. perfringens* which are also common in raw poultry.

Seven of 373 subsamples yielded salmonellae and 3% had total counts above 10^8 g^{-1}. Staphylococci were detected in only 10 birds, but one carried more than 10^8 g^{-1}. One sample yielded more than 10^5 *C. perfringens* g^{-1}.

Deep fried chicken. Three of 390 subsamples yielded *C. perfringens* in numbers between 10^3 and 10^5 g^{-1}. Plate counts were generally low and there were few other pathogens.

Hamburgers. Of 330 subsamples, one yielded 200 *C. perfringens* g^{-1} and 10 had countable numbers of staphylococci, with one count exceeding 10^3. Total plate counts varied enormously, with 4% below 100 and 4% above 10^8 g^{-1}.

Stews and casseroles. Since they are held hot for long periods after cooking, these foods are potential growth media for spore-forming pathogens. Indeed, these organisms were found in about 10% of 345 subsamples, but generally at less than 1000 g^{-1}. An interesting exception was a set of five subsamples with a mean plate count of *c.* 2 x 10^6 g^{-1}, 0–10^4 *B. cereus* g^{-1} and *c.* 10^4 *C. perfringens* g^{-1}.

Batters. These are a well-known source of staphylococcal food poisoning. Many are held for long periods in continual use at ambient temperatures and any enterotoxin produced may not be destroyed by the subsequent cooking which kills the staphylococci. Battered foods were not included in the survey.

Cold take-aways

A growing section of the take-away trade includes salads and other chilled foods. These may be prepared from cooked or raw ingredients, but in either case contamination

is likely and a long shelf life is expected. The NHMRC survey included coleslaw and bean, potato and rice salads. All had a proportion of subsamples with more than 10^8 bacteria g^{-1}, but only rice salads contained appreciable numbers of potentially pathogenic organisms. Of 170 subsamples, 5% contained *S. aureus* (50–600 g^{-1}) and 8% *B. cereus* (50–14 000 g^{-1}).

The pH values of salads, while not greatly influencing the size of the total microbial populations that will develop during storage, affect the composition of the flora. The more acid types (e.g. coleslaw, fruit salad) provide unfavourable conditions for the growth of pathogens, but potato salads are frequently low in acid and have been incriminated in staphylococcal food poisoning in other countries. In the NHMRC survey, counts of *S. aureus* in potato salad were not excessively high, but several samples were heavily contaminated with *Escherichia coli*, a useful indicator of the standard of hygiene in many prepared foods.

It is probable that at some time or other all types of take-away foods have been responsible for cases of food poisoning. Firm epidemiological data are rare, because of the small numbers of people who consume food from a particular batch that may have been mishandled, and because of the geographical scatter of such consumers. Nevertheless, the following incidents, each involving only one case, have been reported in Australia recently:

Bacon burgers, *Salmonella typhimurium*
Banana custard, *B. cereus*
Chinese chicken dish, *S. aureus* and/or *B. cereus*.

Although sandwiches have not been discussed, they remain a major take-away food with an apparently good public health record. The greatest risk might be expected from those containing the cured meats, corned beef and ham. Both of these foods are readily contaminated by staphylococci from the hands of sandwich makers, and salted foods, even as mildly salted as these, offer some competitive advantage to *S. aureus*. The survey indicated that 8% of 365 samples of vacuum packed, sliced corned beef contained more than 10^3 staphylococci g^{-1}, in one instance exceeding 10^6 g^{-1}.

A dramatic and quite different situation arose in Melbourne in 1977 (Taplin 1978). Over 30 people contracted typhoid after eating chicken sandwiches. The chicken was prepared by a typhoid carrier. There was no suggestion, as far as I am aware, of any mishandling of the product – the infectious dose of *Salmonella typhi* is small and little or no multiplication of the initial contaminants may have been necessary to cause the infection. This case thus differs from most involving the common food-poisoning bacteria.

Safe take-aways

The survey data show that the general microbiological standard of the foods examined was good, but also that extreme variations occur. Where pathogens are present they are generally those that are normally expected to contaminate the particular raw materials. The exception is *S. aureus*, which is frequently of human origin, and hence its presence may indicate inadequate hygiene in the handling of prepared foods.

The importance of appropriate holding temperatures in controlling the numbers of pathogenic bacteria in prepared foods cannot be overemphasized. Cardinal temperatures for the growth of the food-poisoning bacteria that have been discussed are such that holding temperatures below 5 °C and above 60 °C will give adequate margins of safety. Such temperatures will, of course, not prevent the growth of other, non-pathogenic bacteria which may, when present in large numbers, degrade the organoleptic qualities of the foods. Such undesirable changes must be prevented by limiting the period for which food is held before consumption. This is particularly relevant with respect to prepared salads.

The problem of staphylococcal contamination has already been mentioned. Even more serious is the contamination of cooked meats, particularly poultry, by salmonellae present on raw meat. The operation of many retail rotisseries appears to be such that this type of cross-contamination is inevitable.

It should be pointed out that few, if any, of the foods tested in the survey would have given rise to food poisoning had they been eaten at the point of sale, and the assumption generally is that this would be the case. But many take-away foods are consumed much later, usually in the home, after a variable period during which they are held at uncontrolled temperatures. Hence, an

apparently safe product may become a substantial hazard by the time of consumption.

It should not be assumed from this discussion that take-away foods pose a greater risk than foods of the same genre prepared elsewhere. Sandwiches made in the home with fillings contaminated with salmonellae or staphylococci and held for hours before consumption would pose a far greater risk than similarly contaminated shop-made sandwiches eaten immediately after purchase. But, our brief is with take-away foods, not with the perils of the domestic kitchen.

Conclusions

What then are the steps which should be taken to ensure the microbiological safety and quality of take-away foods in the years to come?

Microbiological standards are not the answer, nor can they have more than a minor role to play. The foods we are concerned with are perishable and often prepared to order, or prepared in advance in relatively small batches. Even microbiological quality control, except of certain raw materials, may be inappropriate. Exceptions do exist — meat pies are produced on an industrial scale — but there are many opportunities for the subsequent mishandling of such products before consumption.

The training of food handlers in the elements of food and personal hygiene is essential. The ease with which both staphylococci from the nose and faecal organisms can contaminate hands, and hence food, must be impressed upon all involved in food preparation and handling. It is little realized that the dangers lie not only in transferring one's own faecal flora to the hands, but also bacteria from others who use the same facilities and in so doing contaminate door knobs, taps and other objects. The hazards of cross-contamination of cooked foods by raw materials through handling and by the use of the same cutting boards and implements must also be clearly understood. The requirements for the safe handling of food are not unique to the take-away food service, but the scale of operation often makes their implementation inconvenient. An understanding of the reasons behind such requirements would surely encourage their adoption.

The temperature appropriate for the holding of particular prepared foods should be made known to all operators, and suitable storage and temperature-measuring equipment should be insisted upon. Maximum temperatures for foods to be kept cold and minimum temperatures for those to be held hot must be publicized and adhered to. A few public health authorities have already produced codes of practice covering these aspects of food handling.

Ideally, instruction in food hygiene should be given in schools, but what of those in the present work force who have not had such instruction? The education of food handlers will succeed only if it becomes mandatory. Many courses are now being given in the elements of food hygiene but the coverage of the industry will be poor unless each outlet retailing such foods has a supervisor certified competent in this area. There are substantial problems because of the very small staffs employed in most such outlets. Nevertheless, as Richardson (1971) has pointed out, 'If people want to prepare and serve food to the public, they should have to satisfy a public health authority that they or their staff know how to look after that food'.

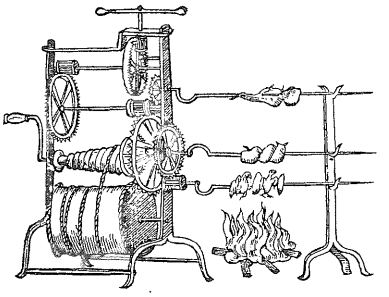
In summary, the microbiological quality of take-away foods is generally good but subject markedly to the knowledge or ignorance of the food handler. Improvements are most likely to be effected by training and licensing supervisory operators and introducing codes of hygienic practice for the preparation and retailing of ready-to-eat foods.

References

Hobbs, B. C. (1974). 'Food Poisoning and Food Hygiene'. (Edward Arnold Ltd: London.)

Richardson, K. C. (1971). Take-away foods. *CSIRO Food Res. Q.* **31**, 66–9.

Taplin, J. (1978). Typhoid and other overseas acquired infections. *Food Technol. Aust.* **30**, 466–9.



Control of bitter pit in early picked Granny Smith apples from Western Australia

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Introduction

Bitter pit (Bünemann 1972) is probably the best known and most extensively investigated physiological disorder of fruit. The distinctive name of the disorder was given in New South Wales by Cobb (1895). The disorder was known for several decades previously as Stippen. Bitter pit (Fig. 1) affects a number of important apple cultivars when they are grown under conditions of water stress or where strong competition exists between leaves and fruit for available nutrients. The fruit may develop pitting before harvest, 'tree pit', or apparently healthy fruit may develop 'storage pit' after a period of cool storage. Storage pit has been a major economic problem affecting the export of susceptible cultivars from Australia, New Zealand and South Africa for over a half century and has been subject to extensive investigation and review.

The mineral nutrition of susceptible cultivars has been suspected of being involved in the development of the disorder since De Long (1936) observed that ash derived from affected fruit contained less calcium than ash from unaffected fruit. It was not until Garman and Mathis (1956) sprayed a calcium salt onto the fruit during the growing season and reported good control of bitter pit that the importance of calcium was generally recognized. These findings were confirmed by Martin *et al.* (1960) in Tasmania and Baxter (1960) in Victoria and many other workers throughout the world.

The spraying of susceptible cultivars with calcium nitrate or chloride has become widely accepted as a standard practice for the commercial control of bitter pit — yet the disease has continued unabated as a major problem in the export of susceptible varieties. Carne *et al.* (1929) indicated that little progress had been made in controlling bitter pit in the previous 40 years. This statement would have been just as valid if it had been made nearly 40 years later as there was very severe bitter pit in fruit exported from Australia and New Zealand as late as 1978. There are several possible causes for the

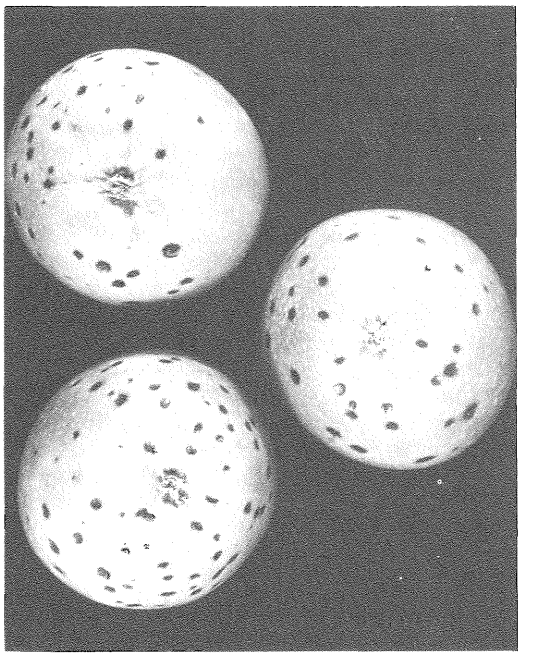

Fig. 1. Bitter pit in Granny Smith apples.

apparent failure of tree spraying to control bitter pit. These include failure by orchardists to apply the number of calcium sprays needed and the unwillingness of exporters to pay for the fruit on the basis of calcium content. Also, some unsatisfactory horticultural practices have continued, e.g. severe pruning which ensures the development of bitter pit even though calcium sprays have been applied.

Post-harvest application of calcium chloride to reduce bitter pit was probably first reported by Jackson (1962) who applied low concentrations of calcium chloride after harvest and reported a small improvement in control of bitter pit. Several unpublished reports, mainly from New Zealand, indicate that severe skin injury can occur when higher concentrations of the calcium salt are used to achieve a worth-while effect on bitter pit. The need to apply a scald inhibitor as well as the calcium salt to Granny Smith apples also caused difficulties in Australia as ethoxyquin, and sometimes diphenylamine (DPA), were incompatible with the calcium salt. Sandovski (1971) claimed that the combination of a scald inhibitor and a calcium salt produced a synergistic effect on the control of bitter pit. Martin *et al.* (1970) had also described this effect with Tasmanian apples, but subsequently it could not always be demonstrated. Scott and Wills (1975) reported a small improvement in the control of breakdown in Jonathan apples when DPA was added to the calcium chloride dip. Sandovski's finding appears to have been ignored and it is believed that the patent has been allowed to lapse. There would be many advantages in the use of a control treatment for bitter pit that relied mainly on a post-harvest dip treatment as such a process could be regulated more easily by exporting countries than by field spraying.

Scott and Wills (1977; 1979) showed that vacuum or pressure infiltration of calcium chloride to closed calyx varieties produced excellent control of bitter pit. When the fruit were rinsed with clean water after treatment, good control of the disorder was still obtained and skin injury was avoided. Moreover, by obviating corrosion of the grader, the water rinse after calcium infiltration would allow existing grading equipment to be used without modification. In addition, Scott and Wills (1979) showed that the use of a lower storage temperature (0 °C instead of 3 °C) further reduced the incidence of bitter pit in Cox's Orange Pippin and Twenty Ounce.

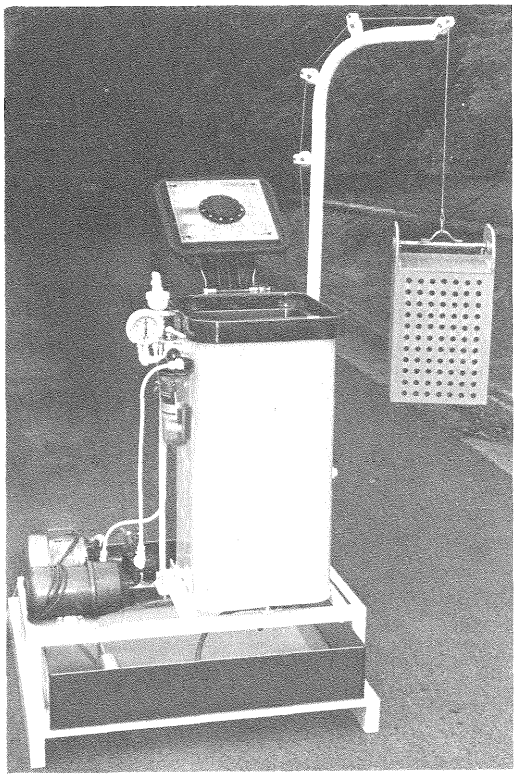

Fig. 2. The vacuum infiltrator.

Following the successful control of bitter pit in laboratory and pilot plant studies in New Zealand, the Australian Apple and Pear Corporation provided financial assistance to CSIRO to test the new treatment in Western Australia. This paper reports on the studies carried out in Western Australia in 1978.

Materials and methods

A hospital autoclave was modified to allow the application of reduced or increased pressure to apples submerged in a calcium chloride solution. This equipment was large enough to allow the treatment of a box of apples at a time (Fig. 2). The 'plumbing' of the equipment was arranged so that either 'vacuum' or 'pressure' could be selected by altering a single cock (Fig. 3). Pressure was applied to the liquid by means of a small pump after air was automatically eliminated from the system. This avoids the need for the vessel to be certificated as a pressure vessel

and simulates 'deep dipping' or the use of hydrostatic pressure to infiltrate calcium solution into the fruit.

Experimental units of 25 fruit were obtained from four orchards in Donnybrook and two from the hills district near Perth. Most of the orchard blocks had been heavily pruned the previous winter. The fruit from two of these orchard blocks was not sprayed with calcium nitrate during the growing season. A smaller experiment was carried out on two blocks of very heavily pruned Golden Delicious. All fruit was selected in proximity to vigorous vegetative growth close to a heavy pruning cut (made the previous winter). These measures had been shown by Hardisty (1973) to be critical in the production of a high incidence of bitter pit in Granny Smith apples grown in Western Australia. A calcium chloride solution containing 40 g calcium chloride flake per litre was used in the experiments. The fruit were submerged in the solution and

- the pressure above the solution was reduced to 60 or 30 kPa;
- the pressure of the solution was increased to 130 or 160 kPa;
- treatment was carried out at atmospheric pressure.

In each instance submersion was for 2 min and the pressure was modified for half this period.

As Granny Smith apples from Western Australia are highly susceptible to superficial scald it is necessary to apply a scald inhibitor after harvest. Both calcium chloride and the antiscald treatment can be conveniently applied at the same time. Unfortunately phytotoxicity occurs when ethoxyquin and calcium chloride are mixed in the same solution and similar effects occur with calcium chloride and a local formulation of DPA. Hardisty (unpublished data) introduced and tested an American source of DPA (Chemly no scald DPA liquid concentrate 160) which was found compatible with calcium chloride and used at the rate of 5 g per litre.

After the calcium treatments were applied, half of the replicates (4) were cool stored at 0 °C immediately, whilst the other four replicates were held at ambient temperatures of 20–25 °C for 10 days before storage at 5 °C. These two storage conditions would cover the range of storage conditions likely to be encountered by fruit for export.

The effect of rinsing fruit in water after treatment was also examined in case rinsing was found desirable to avoid skin burn or corrosion damage to the grader. After 14 weeks' storage, fruit was removed to ambient conditions for 1 week before being examined for bitter pit. The data for bitter pit given in this paper refer to apples with moderate–severe pit, i.e. those with more than two small pits per fruit. All fruit were examined internally as well as externally.

Results and discussion

When Granny Smith apples were stored promptly at 0 °C, the mean incidence of bitter pit in untreated fruit was 19.3% (range over six orchards 4–40%). Delayed storage followed by holding the fruit at 5 °C increased bitter pit considerably (mean 40.3%, range 12–80%).

The use of a calcium chloride dip reduced bitter pit at both storage temperatures. For 0 °C and 5 °C respectively the mean incidence of bitter pit was 8% and 10%.

Vacuum or pressure infiltration of calcium chloride further reduced bitter pit to 0.7% (0 °C) and 3.5% (5 °C).

Rinsing with water immediately after treatment markedly reduced the efficiency of the treatments. Fruit that was dipped at atmospheric pressure and then rinsed showed similar amounts of bitter pit as untreated fruit held at either temperature. When the fruit was treated at the lowest pressure (30 kPa) and then rinsed, good control of pit was achieved with storage at 0 ° (3.3%) but there was considerable pit at 5 °C (24%).

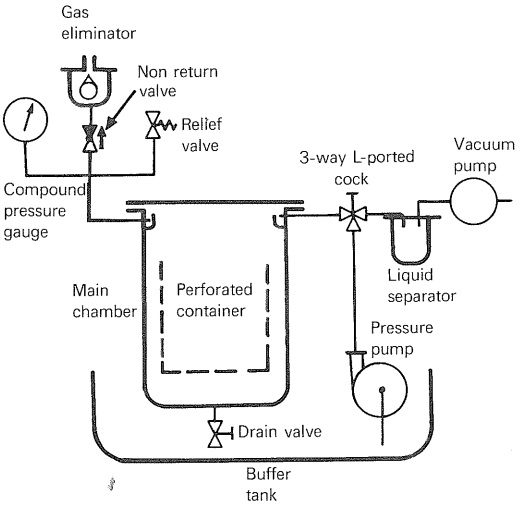

Fig. 3. Schematic diagram of the vacuum infiltrator.

Calcium chloride and DPA combined dip

When the combined dip of calcium chloride and DPA was used at atmospheric pressure, complete control of bitter pit was obtained for each of the six orchards under both storage conditions.

Injury

There was very little evidence of skin injury with any calcium treatment. A few fruits had slight internal damage near the calyx when the fruit were vacuum or pressure infiltrated. This slight internal damage was noted only by cutting into the core. The fruit should therefore be acceptable commercially.

Golden Delicious

The dipping of this variety in a calcium chloride solution at atmospheric pressure gave a very good control of bitter pit without skin injury. The control fruit showed 50% and 45% bitter pit when stored at 5 °C and 0 °C respectively, whereas only 5% and 7% of the treated fruit showed the disorder.

Conclusions

The results from this investigation were obtained with very susceptible fruit grown in the two main apple areas in Western Australia. They indicate that good control of bitter pit in Granny Smith apples can be obtained, without causing injury, simply by dipping the fruit in commercial calcium chloride flake at 40 g per litre. A smaller study with Golden Delicious produced similar results.

Further improvement in control of the disorder was obtained with Granny Smith apples when DPA was included in the dipping solution. As the combined treatment was superior to either vacuum or pressure infiltration of calcium chloride, was less costly to apply and did not cause injury, it was recommended to the industry for commercial trials. The United Kingdom (Anon. 1978) had recently approved the use of DPA on apples so it was possible to carry out commercial trials in 1979. These involved a high proportion of the fruit that was exported from Western Australia to the U.K. and have confirmed the laboratory studies reported above. It is clear that a post-harvest calcium chloride treatment is most likely to become a standard treatment for the export of Granny Smith apples from Western Australia.

References

Anon. (1978). Antioxidants in Food Regulations. Statutory Instrument 1978, No. 105, Great Britain.

Baxter, P. (1960). Bitter pit of apples. Effect of calcium sprays *J. Dep. Agric. Vic.* **58**, 801–11.

Bünemann, G. (1972). Annotated bibliography on bitter pit of apples. Berlin Tech. Univ. Bibliogr. Ser. No. 2.

Carne, W. M., Pittman, H. A., and Elliott, H. G. (1929). Studies concerning the so-called bitter pit of apples in Australia, with special reference to the variety 'Cleopatra'. CSIR (Aust.) Bull. No. 41.

Cobb, N. S. (1895). Diseases of plants and their remedies. II. Bitter pit of the apple. *Agric. Gaz. N.S.W.* **6**, 859–61.

De Long, W. A. (1936). Variations in the chief ash constituents of apples affected with blotchy cork. *Plant Physiol.* **11**, 453–6.

Hardisty, S. (1973). No pruning may reduce bitter pit in export Grannys. *J. Agric. West. Aust.* **14**, 146.

Garman, P., and Mathis, W. T. (1956). Studies of mineral balance as related to occurrence of Baldwin spot in Connecticut. Conn. Agric. Exp. Stn New Haven Bull. No. 601.

Jackson, D. I. (1962). The effects of calcium and other minerals on incidence of bitter pit in Cox's Orange apples. *N.Z. J. Agric. Res.* **5**, 302–9.

Martin, D., Lewis, T. L., and Cerny J. (1960). Bitter pit in the apple variety Cleopatra in Tasmania in relation to calcium and magnesium. *Aust. J. Agric. Res.* **11**, 742–9.

Martin, D., Lewis, T. L., and Cerny, J. (1970). Post-harvest treatments of apples for storage disorders, 1967. *Fld Stn Rec. Div. Pl. Ind. CSIRO Aust.* **9**, 25–36.

Sandovski, N. (1971). Prevention of bitter pit in apples. (Aust. Patent No. 405619) Israeli Patent No. 26740.

Scott, K. J., and Wills, R. B. H. (1975). Post-harvest application of calcium as a control for storage breakdown of apples. *HortScience* **10**, 75–6.

Scott, K. J., and Wills, R. B. H. (1977). Vacuum infiltration of calcium chloride; A method for reducing bitter pit and senescence of apples during storage at ambient temperatures. *HortScience* **12**, 71–2.

Scott, K. J., and Wills, R. B. H. (1979). Effects of vacuum and pressure infiltration of calcium chloride and storage temperature on the incidence of bitter pit and low temperature breakdown of apples. *Aust. J. Agric. Res.* **30**, 917–28.

Corrigendum

Composition of some Australian table margarines: a correction

By A. C. Fogerty and Denice Svoronos

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Following the publication of the article entitled 'Composition of Australian table margarines' in this journal by Fogerty *et al.* (1979), it was pointed out that the values presented for the fat contents of some Australian margarines were not as close as they should have been to the values expected on the basis of the manufacturing procedures employed.

Our values for the fat content of table margarines were obtained using a modification of the direct extraction method of Bligh and Dyer (1959), which has been used for many years in this Laboratory as a rapid method for determining fat in a range of materials. In this modification, the fat is determined in an aliquot of the lipid-containing bottom layer after the final centrifugation step. This procedure is satisfactory when tissue samples or small amounts of fat are being extracted, since the total volume of the final chloroform layer is virtually unaffected by the small amount of dissolved fat present, and may be assumed to be the same as the total volume of chloroform employed in the extraction. Two sources of

Table 1. Composition of table margarines, 1978

Component	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*
% fat	81.4	81.4	83.8	81.0	82.0	81.3	81.7	81.2	80.7
P/S ratio[A] – claimed	>3.0	n.s.[F]	n.s.	>3.0	>2.0	>2.0	>2.0	n.s.	>2.0
– found	3.4	2.6	1.9	3.2	2.2	2.4	2.6	2.1	2.6
cis, *cis* methylene interrupted[B] fatty acids	60.4	49.0	44.9	48.0	42.2	46.4	45.8	43.2	43.4
Polyunsaturated fatty acids[C]	61.3	49.4	43.1	54.0	44.5	47.9	47.0	42.5	46.8
Monounsaturated fatty acids[C]	20.5	31.7	34.3	29.1	34.9	32.0	35.1	37.6	35.5
Saturated fatty acids[C]	18.1	18.9	22.6	16.9	20.6	20.1	17.9	19.9	17.6
Polyunsaturated fatty acids[D] (g per 100 g product)	47.7	38.4	34.5	41.8	34.9	37.2	36.7	33.0	36.1
Conjugated dienes (% fatty acids)	0.54	0.29	0.33	0.59	0.36	0.32	0.37	0.40	0.47
trans-fatty acids – (% by i.r.)	3.8	11.9	14.1	10.8	13.6	9.2	18.2	11.9	17.0
– (% by g.l.c.[E])	6.2	12.4	14.5	11.1	15.0	11.9	18.5	13.4	15.5
Sodium chloride (%)	1.7	2.1	nil[G]	2.0	1.9	2.1	2.0	2.1	2.0

[A] P/S ratio values to be read as '3.0 to 1', etc.

[B] Estimated by the lipoxidase method and expressed as % fatty acids (comparable with the g.l.c. figures).

[C] Estimated by g.l.c. of methyl esters and expressed as % of fatty acid methyl esters.

[D] Calculated from fat content and g.l.c. analysis using an appropriate conversion factor since the fatty acids are present as triglycerides.

[E] % *trans*-fatty acids by g.l.c. was calculated by summing 16:1*t*, 18:1*t*, 18:2*tt*, plus 18:2*ct*(*tc*).

[F] n.s.: not stated on label.

[G] Label states 'salt-free'.

error arose when the table margarines were extracted: (*a*) the presence of the relatively large amount of fat in the chloroform layer led to a very slight but significant increase in the total volume of the chloroform layer, and (*b*) the larger than normal amounts of fat from the aliquots after evaporation led to retention of chloroform during the evaporation step. The first source of error produces low values for fat content, and the second produces high values. The resultant of these two sources of error was that the values for fat content were generally somewhat lower than they should have been.

We were able to reexamine the same samples of margarine which were purchased in 1978 and whose analysis was reported in Tables 2 and 3 of Fogerty *et al.* (1979). The fat contents have now been determined by three methods: two involving direct extraction of the sample with hexane–water mixtures, and one in which the water content and salt content of the margarines were first determined, using methods based on those of the AOAC (1975). In the latter procedure the fat content was determined subsequently either by extraction of the residue from the water content assay with diethyl ether (AOAC 1975), or estimated by difference after making a slight allowance (0.3%, unless otherwise known) for the presumed presence of milk solids.

The mean values for fat contents obtained by the three methods are given in Tables 1 and 2, which replace Tables 2 and 3 of Fogerty *et al.* 1979. The weight of polyunsaturated fatty acids in 100 g of each margarine has also been recalculated on the basis of the revised fat content, and the revised values are included in Tables 1 and 2. Values for salt content are now also included in these amended Tables.

References

Association of Official Analytical Chemists (1975). 'Official Methods of Analysis.' 12th Ed. Methods 16.187, 18.188 and 16.191. (AOAC : Washington D.C.)

Bligh, E. G., and Dyer, W. J. (1959). A rapid method for total lipid extraction and purification. *Can. J. Biochem. Physiol.* **37**, 911–17.

Fogerty, A. C., Ford, G. L. and Pearson, J. A. (1979). Composition of some Australian table margarines. *CSIRO Food Res. Q.* **39**, 38–43.

Table 2. Composition of table margarines, 1978

Component	*J*	*K*	*L*	*M*	*N*	*O*	*P*	*Q*
% fat	81.2	81.2	80.5	81.0	81.0	81.9	81.4	79.2
P/S ratio[A] — claimed	n.s[F]	n.s	n.s	n.s	n.s	>2.0	n.s	n.s
— found	1.0	1.0	0.4	0.3	1.0	2.4	1.0	0.3
cis, cis methylene interrupted[B] fatty acids	35.0	33.8	14.3	10.5	35.2	43.5	38.2	9.6
Polyunsaturated fatty acids[C]	36.3	34.5	16.3	11.8	35.4	46.7	33.3	11.1
Monounsaturated fatty acids[C]	26.5	29.4	43.8	45.9	30.8	33.5	32.7	45.6
Saturated fatty acids[C]	37.2	36.1	39.7	42.3	33.8	19.8	34.0	43.3
Polyunsaturated fatty acids[D] (g per 100 g product)	28.2	26.8	12.5	9.1	27.4	36.6	25.9	8.4
Conjugated dienes (% fatty acids)	0.54	0.33	0.79	0.90	0.46	0.28	0.41	0.94
trans-fatty acids — (by i.r.)	6.0	nil	4.9	3.9	10.8	13.8	1.4	2.6
— (by g.l.c.[E])	6.7	nil	2.9	3.1	12.3	14.8	0.6	3.6
Sodium chloride (%)	2.3	1.9	2.4	2.5	2.0	1.8	1.6	3.2

[A] P/S ratio values to be read as '1.0 to 1', '2.4 to 1', etc.

[B] Estimated by the lipoxidase method and expressed as % fatty acids (comparable with the g.l.c. figures).

[C] Estimated by g.l.c. of methyl esters and expressed as % of fatty acid methyl esters.

[D] Calculated from fat content and g.l.c. analysis using an appropriate conversion factor since the fatty acids are present as triglycerides.

[E] % *trans*-fatty acids by g.l.c. was calculated by summing 16:1*t*, 18:1*t*, 18:2*tt*, plus 18:2*ct*(*tc*).

[F] n.s., not stated on label.

Assessment of can double seams: metric tables and nomograms

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A new set of criteria for double seams of tinplate cans containing heat processed foods has been drawn up by a working party consisting of representatives of canmakers (Containers Limited and J. Gadsden Pty Ltd), the National Meat Canners' Association, the Australian Bureau of Animal Health and this Division. These criteria have recently been incorporated in the Manual of Instruction for Meat Inspection and Meat Handling Procedures (Second Edition, Vol. I) of the Australian Bureau of Animal Health (1976) and in the Manual for Inspectors and Quality Controllers in Australian Meat Canneries (1979).

According to the new criteria a double seam, shown in section in Fig. 1, will be classed as acceptable if:

it is free of defects visible to the eye;
the body hook length, percentage overlap, percentage body hook butting, percentage tightness rating and *percentage juncture rating* comply with the specifications supplied by the can manufacturer; and
the pressure ridge is visible to the eye, uniform and continuous.

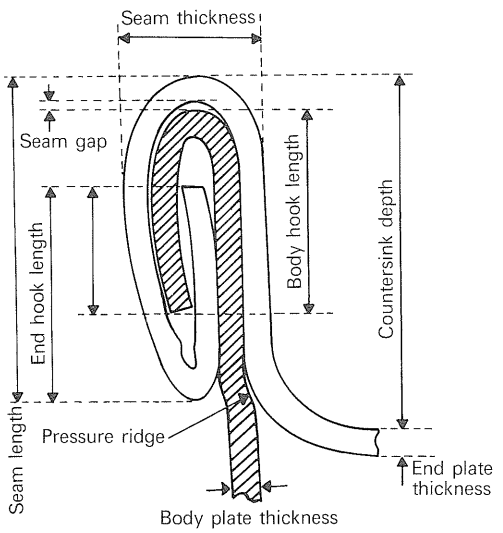


Fig. 1. The main components of a double seam.

Some of these attributes of a seam are assessed visually, while others are measured by means of specially designed microscopes or projectors or micrometer gauges. The optical instruments give direct measurements of *percentage overlap* and *percentage body hook butting*, whereas the determination of these attributes from micrometer readings involves calculations based on the following equations:

$$\textit{Percentage overlap} = \frac{EH + BH + 1.1t_e - SL}{SL - 1.1(2t_e + t_b)} \times 100 \qquad (1)$$

$$\textit{Percentage body hook butting} = \frac{BH - 1.1t_b}{SL - 1.1(2t_e + t_b)} \times 100 \qquad (2)$$

where EH is the *end hook length*, BH is the *body hook length*, t_b is *body plate thickness*, t_e is *end plate thickness*, and SL is the *seam length*.

Although these equations involve only simple mathematics they are tedious to use routinely during quality control operations in canneries and can manufacturing plants. Furthermore, it is easy to make arithmetical errors, especially when using these equations in noisy environments.

The Metal Box Company Limited recognized these difficulties and published a table (Metal Box 1965) and nomogram (Metal Box 1955) in imperial measurements to simplify the calculation of *percentage overlap*. We present here similar tables and nomograms in metric units for *percentage overlap* (Table 1, Fig. 2) and *percentage body hook butting* (Table 2, Fig. 3).

Table 1. Percentage overlap

$$\text{Percentage overlap} = \frac{EH + BH + 1.1t_e - SL}{SL - 1.1(2t_e + t_b)} \times 100$$

Sum of end plate and body plate thicknesses (mm)								Seam length (mm)							
0.30	0.35	0.40	0.45	**0.50**	0.55	0.60	0.65	3.16	3.21	3.26	3.31	3.36	3.41	3.46	3.51
								3.11	3.16	3.21	3.26	3.31	3.36	3.41	3.46
								3.05	3.10	3.15	3.20	3.25	3.30	3.35	3.40
								3.00	3.05	3.10	3.15	3.20	3.25	3.30	3.35
								2.95	2.99	3.04	3.09	3.14	3.19	3.24	3.29
								2.89	2.94	2.99	3.04	3.09	3.14	**3.19**	3.24
								2.83	2.88	2.93	2.98	3.03	3.08	3.13	3.18
								2.78	2.83	2.88	2.93	2.98	3.03	3.08	3.13
								2.72	2.77	2.82	2.87	2.92	2.97	3.02	3.07
								2.67	2.72	2.77	2.82	2.87	2.92	2.97	3.02
								2.61	2.66	2.71	2.76	2.81	2.86	2.91	2.96
								2.56	2.61	2.66	2.71	2.76	2.81	2.86	2.91
								2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85
Sum of body hook and end hook lengths (mm)															
3.45	3.51	3.56	3.62	3.67	3.73	3.78	3.84	56	52	48	45	41	38	35	32
3.50	3.56	3.61	3.67	3.72	3.78	3.83	3.89	58	54	51	47	44	41	38	35
3.55	3.61	3.66	3.72	3.77	3.83	3.88	3.94	61	57	53	49	46	43	40	37
3.60	3.66	3.71	3.77	3.82	3.88	3.93	3.99	63	59	55	52	48	45	42	39
3.65	3.71	3.76	3.82	3.87	3.93	3.98	4.04	66	62	58	54	51	47	44	41
3.70	3.76	3.81	3.87	3.92	3.98	4.03	4.09	68	64	60	56	53	49	46	43
3.75	3.81	3.86	3.92	3.97	4.03	4.08	4.14	71	66	62	59	55	52	48	45
3.80	3.86	3.91	3.97	**4.02**	4.08	4.13	4.19	73	69	65	61	57	54	**51**	47
3.85	3.91	3.96	4.02	4.07	4.13	4.18	4.24	76	71	67	63	60	56	53	49
3.90	3.96	4.01	4.07	4.12	4.18	4.23	4.29	78	74	70	66	62	58	55	52
3.95	4.01	4.06	4.12	4.17	4.23	4.28	4.34	81	76	72	68	64	61	57	54
4.00	4.06	4.11	4.17	4.22	4.28	4.33	4.39	83	79	74	70	66	63	59	56
4.05	4.11	4.16	4.22	4.27	4.33	4.38	4.44	86	81	77	73	69	65	61	58
4.10	4.16	4.21	4.27	4.32	4.38	4.43	4.49	88	83	79	75	71	67	64	60
4.15	4.21	4.26	4.32	4.37	4.43	4.48	4.54	91	86	81	77	73	69	66	62
4.20	4.26	4.31	4.37	4.42	4.48	4.53	4.59	93	88	84	80	76	72	68	64
4.25	4.31	4.36	4.42	4.47	4.53	4.58	4.64	96	91	86	82	78	74	70	66
4.30	4.36	4.41	4.47	4.52	4.58	4.63	4.69	98	93	89	84	80	76	72	69
4.35	4.41	4.46	4.52	4.57	4.63	4.68	4.74	—	96	91	87	82	78	74	71
4.40	4.46	4.51	4.57	4.62	4.68	4.73	4.79	—	98	93	89	85	80	77	73
4.45	4.51	4.56	4.62	4.67	4.73	4.78	4.84	—	—	96	91	87	83	79	75
4.50	4.56	4.61	4.67	4.72	4.78	4.83	4.89	—	—	98	94	89	85	81	77
4.55	4.61	4.66	4.72	4.77	4.83	4.88	4.94	—	—	—	96	91	87	83	79
4.60	4.66	4.71	4.77	4.82	4.88	4.93	4.99	—	—	—	98	94	89	85	81

						Sum of two end plate thicknesses and one body plate thickness (mm)
3.56	3.61	3.66	3.71	3.76	1.05	
3.51	3.56	3.61	3.66	3.71	1.00	
3.45	3.50	3.55	3.60	3.65	0.95	
3.40	3.45	3.50	3.55	3.60	0.90	
3.34	3.39	3.44	3.49	3.54	0.85	
3.29	3.34	3.39	3.44	3.49	**0.80**	
3.23	3.28	3.33	3.38	3.43	0.75	
3.18	3.23	3.28	3.33	3.38	0.70	
3.12	3.17	3.22	3.27	3.32	0.65	
3.07	3.12	3.17	3.22	3.27	0.60	
3.01	3.06	3.11	3.16	3.21	0.55	
2.96	3.01	3.06	3.11	3.16	0.50	
2.90	2.95	3.00	3.05	3.10	0.45	

30	27	25	22	20
32	29	27	24	22
34	31	29	26	24
36	33	31	28	26
38	35	33	30	27
40	37	35	32	29
42	39	37	34	31
44	41	39	36	33
46	43	41	38	35
48	45	43	40	37
51	47	45	42	39
53	49	47	44	41
55	52	49	46	43
57	54	50	48	45
59	56	52	50	47
61	58	54	51	49
63	60	56	53	50
65	62	58	55	52
67	64	60	57	54
69	66	62	59	56
71	68	64	61	58
73	70	66	63	60
75	72	68	65	62
78	74	70	67	64

How to use the tables

Values for the *body plate thickness, end plate thickness, seam length* and *body hook length* are required for both tables and, in addition, the *end hook length* must be known to use the table for *percentage overlap*. The calculation of *percentage overlap* from Table 1 involves the following five steps; to demonstrate the procedure we have taken as an example a double seam in which the:

body plate thickness is 0.20 mm,
end plate thickness is 0.30 mm,
seam length is 3.20 mm,
body hook length is 2.00 mm, and
end hook length is 2.00 mm.

Step 1. Add the values for two *end plate* and one *body plate thicknesses* and find the appropriate value in the column at the top right hand corner of Table 1. For the example this value is 0.80 mm.

Step 2. Look to the left from this value until the measured value for the *seam length* is found. In this example 3.19 mm is the nearest tabulated value. Identify this column of the table for later use.

Step 3. Add the values for the *end plate* and *body plate thicknesses* and find the appropriate value across the top of the left hand side of the table; the value is 0.50 mm for the example.

Step 4. Add the values for the *body hook* and *end hook lengths* (in the example this value is 4.00 mm) and find the appropriate value in the left hand side of the table in the column identified in step 3; in this example the column is headed 0.50 mm and the nearest tabulated value is 4.02 mm. Identify that line for the next step.

Step 5. Look to the right from the value (4.02 mm) obtained in step 4 into the main part of the table until the column selected in step 2 is found. The value in the body of the table, 51% in this example, is the *percentage overlap*. (The corresponding value obtained using equation 1 was 48.7%.)

Percentage body hook butting is similarly calculated using Table 2 except that in the left hand side of the table the measured values to be found are *body plate thickness* (Step 3) and *body hook length* (Step 4). The seam dimensions used to demonstrate the

Table 2. Percentage body hooking

Percentage body hook butting

$$= \frac{BH - 1.1t_b}{SL - 1.1(2t_e + t_b)} \times 100$$

Body plate thickness (mm)								Seam length (mm)							
								3.16	3.21	3.26	3.31	3.36	3.41	3.46	3.51
								3.11	3.16	3.21	3.26	3.31	3.36	3.41	3.46
								3.05	3.10	3.15	3.20	3.25	3.30	3.35	3.40
								3.00	3.05	3.10	3.15	3.20	3.25	3.30	3.35
								2.95	2.99	3.04	3.09	3.14	3.19	3.24	3.29
								2.89	2.94	2.99	3.04	3.09	3.14	**3.19**	3.24
								2.83	2.88	2.93	2.98	3.03	3.08	3.13	3.18
								2.78	2.83	2.88	2.93	2.98	3.03	3.08	3.13
								2.72	2.77	2.82	2.87	2.92	2.97	3.02	3.07
								2.67	2.72	2.77	2.82	2.87	2.92	2.97	3.02
								2.61	2.66	2.71	2.76	2.81	2.86	2.91	2.96
								2.56	2.61	2.66	2.71	2.76	2.81	2.86	2.91
0.10	0.15	**0.20**	0.25	0.30	0.35	0.40	0.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85
Body hook length (mm)															
1.50	1.56	1.61	1.67	1.72	1.78	1.83	1.89	69	68	66	65	63	62	60	59
1.55	1.61	1.66	1.72	1.77	1.83	1.88	1.94	72	70	68	67	65	64	62	61
1.60	1.66	1.71	1.77	1.82	1.88	1.93	1.99	74	73	71	69	68	66	65	63
1.65	1.71	1.76	1.82	1.87	1.93	1.98	2.04	77	75	73	71	70	68	67	65
1.70	1.76	1.81	1.87	1.92	1.98	2.03	2.09	79	77	76	74	72	71	69	68
1.75	1.81	1.86	1.92	1.97	2.03	2.08	2.14	82	80	78	76	74	73	71	70
1.80	1.86	1.91	1.97	2.02	2.08	2.13	2.19	84	82	80	78	77	75	73	72
1.85	1.91	1.96	2.02	2.07	2.13	2.18	2.24	87	85	83	81	79	77	75	74
1.90	1.96	**2.01**	2.07	2.12	2.18	2.23	2.29	89	87	85	83	81	79	**78**	76
1.95	2.01	2.06	2.12	2.17	2.23	2.28	2.34	92	90	87	85	83	82	80	78
2.00	2.06	2.11	2.17	2.22	2.28	2.33	2.39	94	92	90	88	86	84	82	80
2.05	2.11	2.16	2.22	2.27	2.33	2.38	2.44	97	94	92	90	88	86	84	82
2.10	2.16	2.21	2.27	2.32	2.38	2.43	2.49	99	97	95	92	90	88	86	85
2.15	2.21	2.26	2.32	2.37	2.43	2.48	2.54	—	99	97	95	93	90	89	87
2.20	2.26	2.31	2.37	2.42	2.48	2.53	2.59	—	—	99	97	95	93	91	89
2.25	2.31	2.36	2.42	2.47	2.53	2.58	2.64	—	—	—	99	97	95	93	91
2.30	2.36	2.41	2.47	2.52	2.58	2.63	2.69	—	—	—	—	99	97	95	93
2.35	2.41	2.46	2.52	2.57	2.63	2.68	2.74	—	—	—	—	—	99	97	95
2.40	2.46	2.51	2.57	2.62	2.68	2.73	2.79	—	—	—	—	—	—	99	97
2.45	2.51	2.56	2.62	2.67	2.73	2.78	2.84	—	—	—	—	—	—	—	99
2.50	2.56	2.61	2.67	2.72	2.78	2.83	2.89	—	—	—	—	—	—	—	—

3.56	3.61	3.66	3.71	3.76	1.05	Sum of two end plate thicknesses and one body plate thickness (mm)
3.51	3.56	3.61	3.66	3.71	1.00	
3.45	3.50	3.55	3.60	3.65	0.95	
3.40	3.45	3.50	3.55	3.60	0.90	
3.34	3.39	3.44	3.49	3.54	0.85	
3.29	3.34	3.39	3.44	3.49	**0.80**	
3.23	3.28	3.33	3.38	3.43	0.75	
3.18	3.23	3.28	3.33	3.38	0.70	
3.12	3.17	3.22	3.27	3.32	0.65	
3.07	3.12	3.17	3.22	3.27	0.60	
3.01	3.06	3.11	3.16	3.21	0.55	
2.96	3.01	3.06	3.11	3.16	0.50	
2.90	2.95	3.00	3.05	3.10	0.45	

58	57	55	54	53
60	59	57	56	55
62	61	59	58	57
64	63	61	60	59
66	65	63	62	61
68	67	65	64	63
70	69	67	66	65
72	71	69	68	67
74	73	71	70	69
77	75	73	72	71
79	77	75	74	73
81	79	77	76	74
83	81	79	78	76
85	83	81	80	78
87	85	83	82	80
89	87	85	84	82
91	89	87	86	84
93	91	89	88	86
95	93	91	90	88
97	95	93	92	90
99	97	95	94	92

estimation of *percentage overlap* are also used here to show how to determine *percentage body hook butting* from Table 2.

Steps 1 and 2. As for *percentage overlap.*

Step 3. Find the value for the *body plate thickness* across the top of the left hand side of the table; 0.20 mm in this example.

Step 4. Find the value for the *body hook length* in the left hand side of the table in the column identified in step 3. In this example the nearest tabulated value is 2.01 mm. Identify that line for the next step.

Step 5. Look to the right from the value obtained in step 4 (2.01 mm in this example) into the body of the table until the column selected in step 2 is found. The value in the body of the table, 78% in this example, is the *percentage body hook butting.* (The corresponding value obtained using equation 2 was 76.7%.)

How to use the nomograms

Values must be known for the *body plate thickness, end plate thickness, seam length* and *body hook length* for both nomograms (Figs 2 and 3) and, in addition, the *end hook length* must be known for the nomogram for *percentage overlap.* The nomograms were constructed for *body* and *end plate thicknesses* of 0.25 mm so the values obtained from the nomograms for *percentage overlap* and *percentage body hook butting* must be corrected if the plate thicknesses differ from this value. The corrections are easily determined from the tables in the lower right hand corner of the nomograms.

The seam dimensions listed above are used to demonstrate how to use Fig. 2 to calculate *percentage overlap.*

Step 1. Add the values for the lengths of the *end hook* and *body hook*, 4.00 mm for this example, and find the corresponding point on the left hand axis of the nomogram.

Step 2. Look to the right from this point into the body of the nomogram to the point of intersection with the sloped line corresponding to the value of the *seam length*; for this example the *seam length* is 3.20 mm.

Step 3. Look down from the point of intersection to the horizontal axis of the nomogram to find *percentage overlap.* In this example the result is 45.5% for assumed

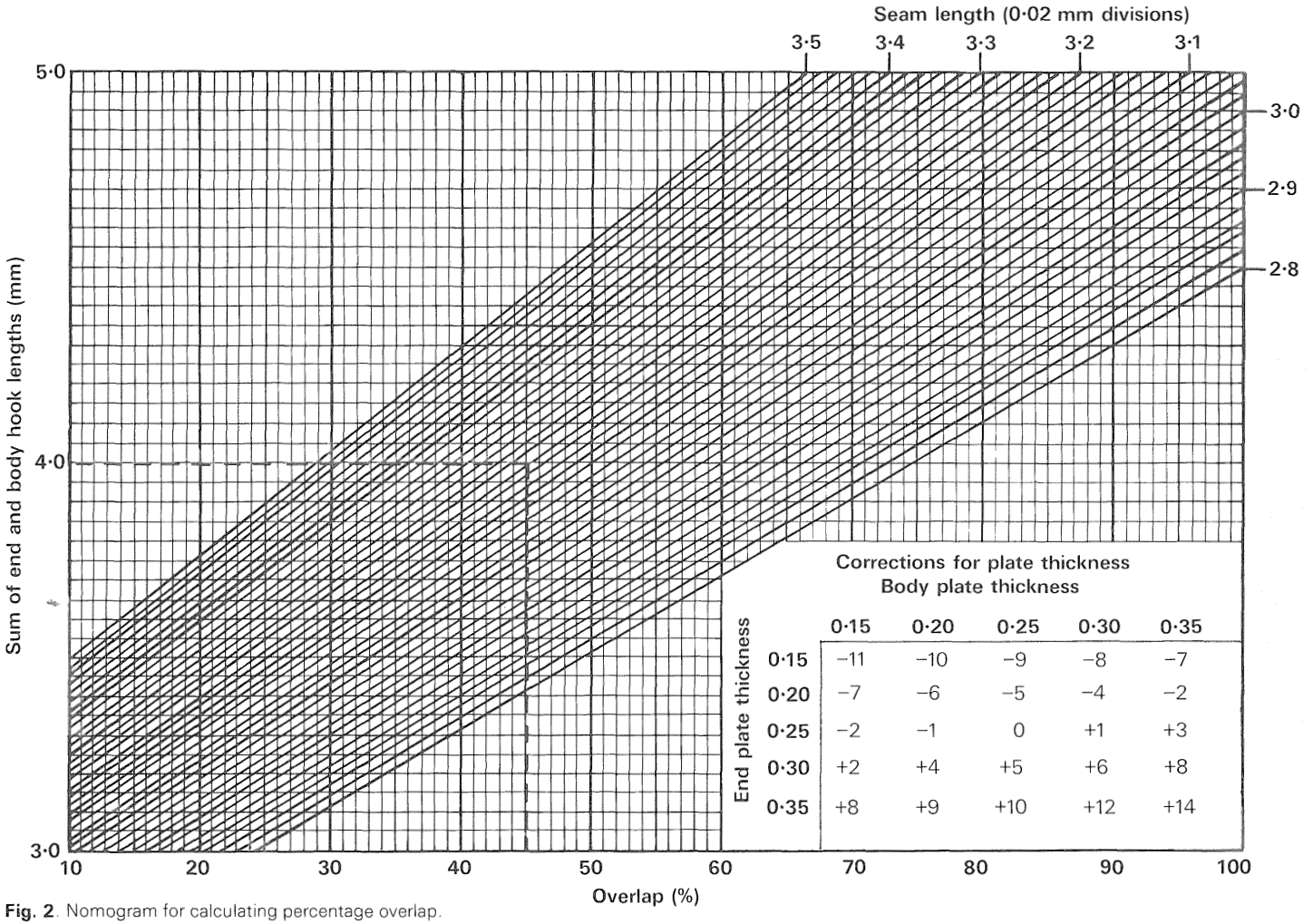


Fig. 2. Nomogram for calculating percentage overlap.

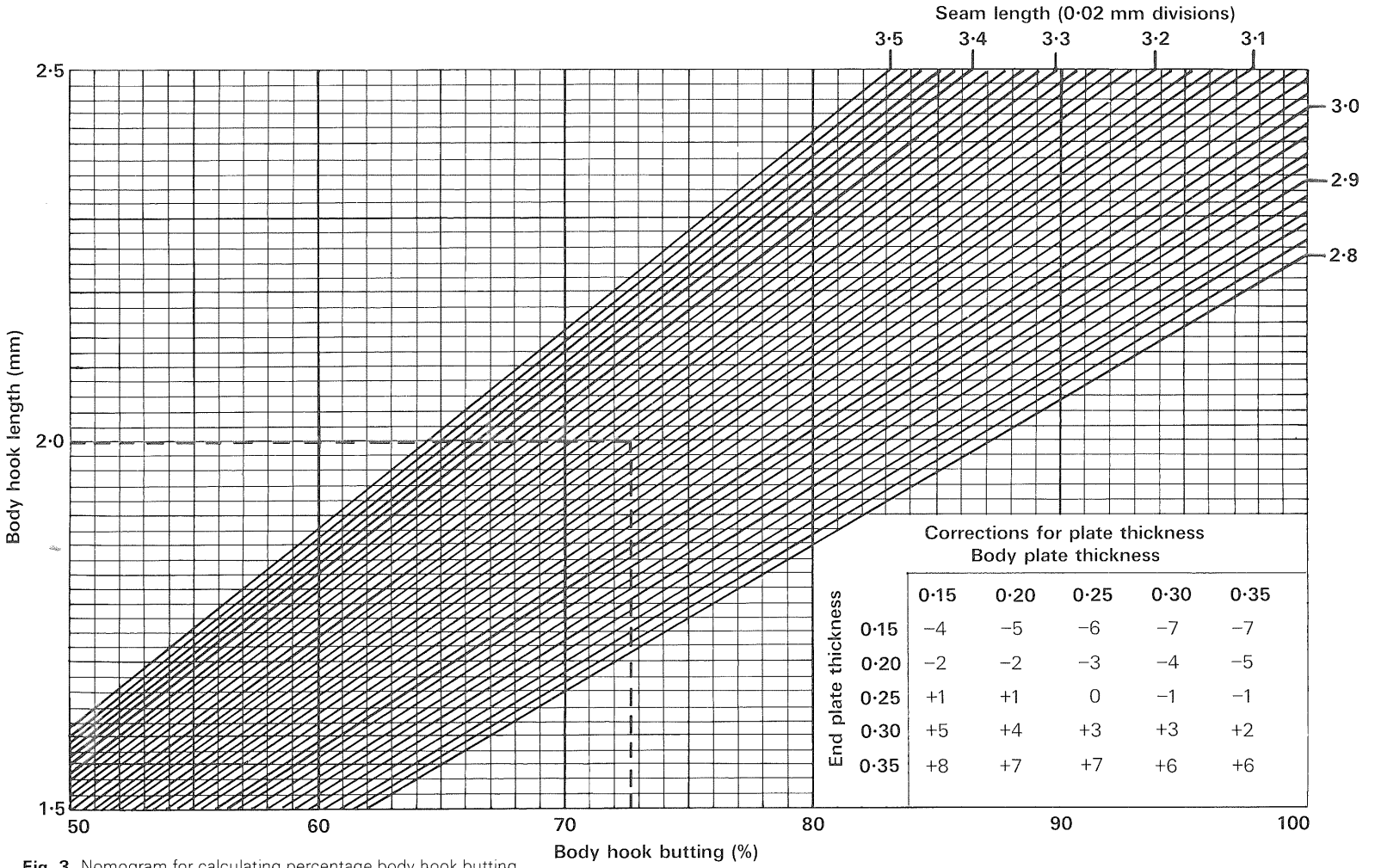


Fig. 3. Nomogram for calculating percentage body hook butting.

thicknesses of body plate and end plate of 0.25 mm.

Step 4. If the measured thicknesses of the body plate or end plate are not 0.25 mm the value for *percentage overlap* must be corrected using the table in the nomogram. In the example the *body plate* and *end plate thicknesses* are 0.20 mm and 0.30 mm respectively; the appropriate correction is therefore +4% so the true *percentage overlap* is 49.5%. (The value calculated from equation 1 was 48.7%.)

The nomogram for *percentage body hook butting* is used similarly, except that the value for *body hook length* is the starting point on the left hand axis of the nomogram. Again using the same measurements as in the previous example we have:

Step 1. Find the point on the left hand axis of Fig. 3 corresponding to the value of the *body hook length*, in this example 2.00 mm.

Step 2. Look to the right from this point into the body of the nomogram to the point of intersection with the sloped line corresponding to the value of the *seam length*, in this example 3.20 mm.

Step 3. Look down from the point of intersection to the horizontal axis of the figure to find *percentage body hook butting*. In this example the value is 72.6% for assumed thicknesses of body plate and end plate of 0.25 mm.

Step 4. Correct the value for *percentage body hook butting* for *plate thicknesses* other than 0.25 mm using the table in the nomogram. In the example the correction is +4% which gives a value for *percentage body hook butting* of 76.6%. (The value calculated from equation 2 was 76.7%.)

The tables and nomograms give values for *percentage overlap* and *percentage body hook butting* which are usually within 2% of the values calculated from the standard equations. As the accuracy of measurement of the seam components is unlikely to be better than ±0.01 mm, the tables and nomograms give satisfactory estimates of the characteristics of the seam for quality control purposes. However, if the *overlap* or *body hook butting* of a seam is close to the minimum specifications the standard equations should be used to calculate the percentages to avoid the small errors inherent in the tables and nomograms.

References

Australian Bureau of Animal Health (1976). 'Manual of Instruction for Meat Inspection and Meat Handling Procedures.' 2nd Ed. Vol. 1. Inspection. (AGPS: Canberra.)

'Manual for Inspectors and Quality Controllers in Australian Meat Canneries' (1979). 4th Ed. ed. P. W. Board, and P. A. Baumgartner, (Hawkesbury Agricultural College: Richmond.)

The Metal Box Co. Ltd Research Division (1955). Evaluating a double seam of an open top can. Tech. Commun. No. 15.

The Metal Box Co. Ltd Research Department (1965). The formation and evaluation of double seams (of round processed food cans). Tech. Commun. No. 15, 3rd Ed.

Australian aid to Bhutan

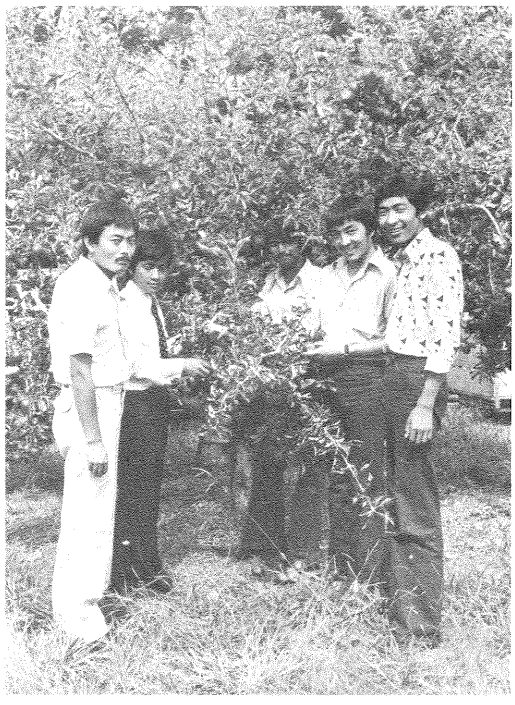
Bhutan is a landlocked country of 46 000 km^2 with a population of about 1.5 million. It has been described as the Switzerland of Asia because it is a very scenic country situated in the rugged Himalayas. The country is bounded by Tibet to the north, by Indian states to the east and south and to the west by Nepal. The people are mostly of Mongolian stock and are predominantly Buddhist. Until the beginning of this century Bhutan was governed by a theocratic system of fortified monasteries, but by agreement of the theocracy the country became a feudal monarchy. The current ruler is the fourth king, a young educated man who is doing much to encourage the orderly development of his country. Bhutan is currently listed by the UN as a 'least developed country'. The Australian government is supporting several projects in Bhutan and many of their young people have received tertiary training in Australia.

A project on post-harvest horticulture began in 1976 with a visit to Bhutan by Eric Hall (CSIRO retired) and Greg Morgan of FRL. CSIRO has now contracted with the Australian Development Assistance Bureau to conduct this project. Equipment and facilities are being supplied by the Australian government and on-the-spot assistance with problems will be provided as required. A major part of the project is the provision of practical training in post-harvest horticulture.

Training programs

Five young men aged 23–25 have been selected to undertake practical training in Australia: Sherub Gyaltshen, Kezang Thinley, Roop Narayan Sharma and Kezang Namjey from the Bhutan Department of Agriculture, and Zeko Dorji from the Food Corporation of Bhutan.

Sherub Gyaltshen is trained in agricultural engineering and will be expected by the Department of Agriculture to supervise a wide range of projects on his return to Bhutan, including new cool storage facilities to be installed at Phuntsholing and elsewhere. He will spend about 6 months in Australia on a specific program concentrating mainly on refrigeration engineering and cool store design and operation. For most of this time he will work with Mr Morgan at FRL and also with commercial refrigeration engineers and operators.



Bhutanese trainees. From left, Sherub Gyaltshen, Kezang Thinley, Roop Narayan Sharma, Zeko Dorji, Kezang Namjey. (Photograph by courtesy of Dennis Rutzou Public Relations Pty Ltd.)

The other four trainees will spend about a year in Australia. All of them have received technical training in horticulture and have had various amounts of in-service experience. They will receive an initial period of instruction in the principles of post-harvest horticulture and then be given an opportunity to specialize as requested by their employers.

Kezang Namjey will have responsibility for the day-to-day management of cool storage operations at a new centre to be built at Phuntsholing. He will also be concerned with the two refrigerated road trucks to be supplied to FCB to cater for perishable foodstuffs to and from India. Zeko Dorji will be expected to concentrate on marketing.

Kezang Thinley and Roop Narayan Sharma will concentrate on extension on return to Bhutan. They will be expected to assist growers in the development of correct methods of harvesting, handling, packing,

transport and storage adapted to local requirements. Eventually the Department of Agriculture expects to employ two graduates trained in post-harvest horticulture. A set of experimental cool rooms is to be supplied at the Department of Agriculture's Yusipang Horticultural Research Station. Initially the two trainees will be expected to work without back-up from their own research workers.

Agencies participating in the training programs are expected to 'put trainees to work'. It was made clear to the trainees at the outset that they will gain most from their stay in Australia if they participate actively in all aspects of the projects in which they become involved. All of them were raised in rural villages and we anticipate from our knowledge of the Bhutanese that they will adapt easily and work well.

Australian Nutrition Foundation Open Day

The N.S.W. Branch of the Australian Nutrition Foundation held its first Open Day on Saturday, 29 March, at the Division's Food Research Laboratory at North Ryde. The organizers wished to invite a cross-section of interested people to hear about the aims of the Foundation and to participate in a program of talks and discussion concerning such topics as 'Food Facts and Fallacies', 'The Much Maligned Foods' (bread and potatoes), 'Food Processing and Your Health', as well as comments on the feeding of children — at home and at school — and family pets! Speakers included nutritionists, dietitians, teachers and university and CSIRO scientists.

During the lunch-break participants inspected a number of displays set up in the Food Processing Pilot Plant. Consumer information was distributed by the Bread Research Institute, Sydney Teachers College and CSIRO; demonstrations by staff of the Food Research Laboratory of food-processing equipment and post-harvest handling of produce were also mounted.

Approximately 100 persons attended the Open Day which was judged to have been a most successful first public venture by the Nutrition Foundation. It is planned to hold similar functions at other centres.

Strathleven Centenary Symposium

The centenary of the first successful commercial shipment of frozen meat from Australia to England was marked by a symposium on food refrigeration on 26 and 27 February 1980. Originally planned for FRL, the venue was changed to the lecture theatre of the CSIRO Division of Applied Physics at Bradfield Park because of the gratifying response from around 190 registrants. Most of the delegates came from the meat, frozen food, refrigeration engineering, road, air and shipping transport, industries, but research, educational and regulatory authorities were also well represented.

At the Symposium Dinner, Dr J. H. B. Christian, Chief of the CSIRO Division of Food Research, presided; Dr J. R. Vickery gave a short talk on the historical significance of the occasion, and greetings were expressed by Mr J. Medway, Chairman of the Meat and Allied Trades Federation which had supported the Symposium, and Mr R. G. Jordan, General Manager, Australian Meat and Livestock Corporation.

Proceedings of the Symposium will be published in *CSIRO Food Research Quarterly* in a combined issue: Vol. 40, Nos 3 and 4, 1980.

Fifty years of Food Research

The account, which appeared in Vol. 36 Nos 3 and 4, and Vol. 37 No 4, of the growth of the CSIRO Division of Food Research from its origin into one of CSIRO's largest Divisions and the main centre in Australia for research on problems of food science and technology, has been collected into a hard-covered book with the addition of a 13-page index (ISBN 0 643 02524 3).

Copies are now available at $12.50 each plus $1.50 for packing and postage from Mr. G. Fisher, Consumer Liaison Officer, CSIRO Division of Food Research, P.O. Box 52, North Ryde, N.S.W. 2113. (Cheques should be made out to Collector of Monies, CSIRO.)

Symposium

Energy and the Food Industry

An international symposium on Energy and the Food Industry, organized jointly by IUFoST (International Union of Food Science and Technology) and CIIA (Commission Internationale des Industries Agricoles et Alimentaires), will be held in Madrid, Spain, on 6–8 October 1980. The official languages are English, French and Spanish, and simultaneous translation will be provided. The program will be conducted under the following headings:

- Energy and process selection: energy in concentration and drying processes; energy and preservation processes.
- Towards a more rational use of energy in the food and agricultural industries: energy management in factories; choice of energy forms and modes of utilization.
- Agricultural and food industries as producers of energy: agro-energetics; bio-energetics.

Further information from J. F. Kefford, IUFoST Secretary-General, CSIRO Food Research Laboratory, tel. (02) 887 8333.

Book notices

Recommendations for chilled storage of perishable produce

International Institute of Refrigeration — Publishers
177, Bd Malesherbes, 75017 Paris, 148 pages
(16 x 24) hard cover, 35 FF.

The International Institute of Refrigeration has already published two editions (1959, 1967) of 'Recommended Conditions for the Cold Storage of Perishable Produce'. The new booklet takes into account recent technical advance and accumulated knowledge; in reality it is an original document compiled with the participation of experts of world renown from different countries.

This book includes 8 chapters. The first one, a broad introduction, gives general information on the behaviour of chilled produce under refrigeration: storage life and quality, cooling, storage temperature, relative humidity, air circulation and ventilation, packaging and stacking, volatile substances, hygiene, condensation. The other chapters deal with the specific requirements for the storage of various products: fruits and vegetables, meat, poultry and eggs, fishery

products, dairy produce, cut flowers, seeds and miscellaneous.

The new 'Recommendations' are published in the two official languages of the I.I.R. — French and English.

This booklet is a valuable reference for all those concerned with the chilled storage of perishable produce.

A history of refrigeration throughout the world

Roger Thévenot. Translated from the French by J. C. Fidler.
International Institute of Refrigeration, Paris, 1979.

There are few people better qualified than M. Thévenot to compile a history of refrigeration. For many years he was Director of the International Institute of Refrigeration. Dr J. C. Fidler, the translator, is a former president of the Institute and a distinguished British research worker on the storage of fruit.

The book surveys four periods — before 1875, 1875–1914, 1918–1939, and after 1945.

The first period covers the development of the science of thermodynamics and of mechanical refrigeration based on the compression and expansion of gases such as air, ammonia and carbon dioxide.

During the second period, preservation of food by cold became a major industry throughout the world and, through long-distance transport, meat, dairy produce and fruit mainly from the Southern Hemisphere, supplied the needs of many European food-deficient countries.

The third period was marked by the discovery of the basic principles of preservation of food by cold and their application to packaged, frozen and chilled foods so common in today's supermarkets.

Since World War II, major technological advances have occurred particularly in the design of the mechanized cold stores.

The author presents the history of each period in fascinating detail, with many little-known facts, such as Jacques Bérard (France) conducting experiments on controlled-atmosphere storage of fruits as early as 1821.

Despite a few minor errors, Thévenot's history will be an essential reference book for many years to come.

J. R. Vickery

News from the Division

Honours and awards

Dr W. J. Scott, formerly Officer-in-Charge of MRL, was elected to the Fellowship of the Australian Academy of Technological Sciences, for his outstanding work as a food microbiologist, with an international reputation in several fields. He was responsible for the microbiological aspects of the pioneering work that resulted in the successful export of chilled beef to the U.K. More recently he introduced into microbiology the concept of water activity as an indicator of the availability of water for microbial growth. Dr Scott's election makes him the sixth member, or former member, of DFR to be so honoured: he joins former Chiefs Dr J. R. Vickery and Mr M. V. Tracey, the present Chief, Dr J. H. B. Christian, Dr June Olley (TFRU), and Dr K. E. Murray (FRL).

Mr J. E. Algie, FRL, has been granted a doctorate by the University of Toulouse, France for his published work. Mr D. Barnett, FRL, obtained a B.A. (Hons) degree from Macquarie University. Mr H. A. Bremner (TFRU) received an M.Sc. from the Royal Melbourne Institute of Technology. Mr G. Fisher, FRL, was awarded an M.Sc.Soc. degree by the University of New South Wales. Mr Hing Chua of MRL's Industry Section completed his studies for the M.B.A. degree; in addition, he received a Merit Award Certificate from the Productivity Promotion Council of Australia for designing the 'Sirolift' pallet resulting from work on materials handling of cartoned meat.

Work overseas

Mr H. N. Panhuber (FRL) is working in the electrophysiology laboratory of the Claude Bernard University, Lyon, France for 6–8 months, under an Australian–French Government Scholarship. He is using electro-physiological techniques to study the effects of long-term adaptation to odours on the sense of smell. This is in conjunction with anatomical and behavioural studies of odour-exposure in progress in the Division.

Appointments

Mrs Dianne Glenn was appointed an Experimental Officer for 2 years from December 1979 to work with Dr J. I. Pitt in

FRL's Food Safety and Nutritional Quality Group. Mrs Glenn, who holds a B.Sc. (Hons) degree from the University of New South Wales, is collaborating in studies of *(i)* the occurrence of aflatoxin and other mycotoxins in Australian peanuts, *(ii)* factors influencing the growth of toxigenic moulds in peanuts and on artificial substrates, *(iii)* storage facilities and other aspects of quality control in Australian factories utilizing peanuts. Mrs Glenn was appointed on a Commonwealth Special Research grant which is funded jointly by the Commonwealth Department of Primary Industry and the National Peanut Council of Australia.

Mr D. G. Browne joined MRL's Industry Section as an engineer (Experimental Officer). In addition to engineering design and equipment evaluation, he will participate in educational activities to improve technical understanding in the meat industry. Mr Browne has a B.Eng. (Mechanical) degree from the Darling Downs Institute of Advanced Education.

Miss Pattylou Walcott has commenced a 2-year appointment as an Experimental Officer, to work with Dr D. G. Bishop in the Plant Physiology Group at Macquarie University. Miss Walcott graduated B.Sc. (Hons) in Biochemistry from the University of Sydney in 1979. She is studying the effect of storage conditions on potato tubers to relate these to the storage and marketing qualities of new varieties of potato developed in Australia. The appointment is funded by the Rural Credits Development Fund.

Mr R. Koca, B.App.Sci. (Swinburne) has commenced a 3-year appointment as an Experimental Officer at DRL to study the means of control and prevention of age gelation in UHT milk, a defect which often limits the effective life-time of this product. A group of six dairy companies is funding these studies.

Retirements

Mr Ross Kirkwood, FRL's Senior Clerk for many years, retired in October 1979 after 28 years service with CSIRO. Mr R. A. Wilkinson, one of DRL's Senior Experimental Officers, retired in 1979 owing to ill health. He had been with CSIR and CSIRO for 35 years, his most recent work involving the analysis of skim milk lipids.

Resignation

Mr D. G. James of FRL (TRFU), after serving on secondment for some years, resigned from the Division in February 1980 to accept a permanent appointment with FAO in Rome.