speakers to aluminium-sheathed power cables, in view of their growing use in Britain; but R. C. Mildner referred to aluminium sheathing in telecommunications cables, and it was evident from comments by a number of speakers from overseas that aluminium sheathing (in place of lead) would be used in future for a wide range of cables as manufacturing techniques improve. Bus-bars and bus-bar jointing were discussed by A. R. Parish: many satisfactory installations go back thirty years or more, and jointing need not be a serious problem. The most desirable development here is the production of high-strength aluminium (magnesium-silicon) alloys showing a minimum loss of conductivity due to alloying constituents, for use in a.c. circuits.

The closing session of the symposium was concerned with aluminium in electrical equipment, and provided much of the most interesting new material. Aluminium windings for transformers and the like were described by F. W. Gee and R. J. Gresley (Ferranti, Ltd.), who stressed the need, referred to above, for manufacturers to gain experience with such constructions now, against the time when the economic advantage of aluminium, which already exists in some cases, becomes more general. In this application, as in all others involving aluminium windings, the need to use an aluminium conductor having a cross-section some 60 per cent greater than that of the equivalent copper conductor involves an increase in size of the apparatus if conventional insulated conductors are employed. Cases occur where such an increase would not be acceptable; but even when this does not apply, increased size would involve the use of more iron in the magnetic circuit and hence greater iron losses. Gee and Gresley referred to the interesting possibility of avoiding such increase by using aluminium conductors protected by anodic oxide layers which require no further insulation. The same possibility was discussed in greater detail by J. Staley, who presented a paper, not previously available as a preprint, on anodized aluminium strip conductors. Other uses of aluminium which were discussed included structural applications, for example, transformer tanks, where the low susceptibility of the metal could lead to economies due to elimination of losses arising from stray flux, and the use of die-cast aluminium in the equipment of telephone exchanges.

The symposium was accompanied by a comprehensive exhibition illustrating the matters discussed and by demonstrations of arc-welding and cold-pressure welding techniques. Its organization reflects the highest credit on all concerned, and the published proceedings, when available, will be a valuable contribution to the literature of the subject.

L. V. CHILTON

CLEAN FOOD

THE 108th meeting of the Nutrition Society (49th meeting of the Scottish Group) held in the Physiology Department, University of Aberdeen, on April 20, took the form of a symposium on "Clean Food". This was divided into three main papers, and five shorter papers dealing with particular aspects. In his introduction, the chairman, Sir Stanley Davidson, indicated the importance of clean food in preventing food-poisoning and the important parts played by the sanitary inspector, medical

officer of health and bacteriologist in looking after the health of the community from this point of view.

In his paper on public health aspects of food-poisoning, Dr. Kenneth Cowan, chief medical officer of health, Department of Agriculture for Scotland, stated that the public health issues involved in food-poisoning are related to the immediate action required to investigate and control outbreaks of food-poisoning, and to the education in hygiene of those engaged in the handling, storage and preparation of food.

An adequate alarm system in the form of prompt notification by medical practitioners and a thorough investigation by the medical officer of health leads to a knowledge of the types of bacteria and foodstuffs most likely to be associated with poisoning, thus making easier the task of establishing the cause of an outbreak.

When outbreaks occur in more than one family the prime duty of investigators is to trace the contaminated food back to a common source where, in their efforts to find the causal agent, attention will be given to the general hygienic conditions, and personal hygiene and history of recent illnesses among the staff. Early action is the most important factor in finding the causal agent.

The principles of prevention are relatively simple, being a high standard of personal hygiene among those handling food and adequate precautions against contamination in storage. This involves education of food workers in the principles of hygiene and the provision of premises which will enable the principles to be put into practice.

In describing the bacteriology of food poisoning Prof. J. W. Howie (Department of Bacteriology, University of Glasgow) pointed out that a recent report by the Public Health Laboratory Service showed that the majority of food-poisoning incidents successfully investigated in 1955 were caused, in order of importance, by salmonellas, staphylococci and *Clostridium welchii*. Of the other organisms known to cause food poisoning the most dangerous is *Clostridium botulinum*.

More than three hundred different types of salmonellas have now been identified. In Britain *Salmonella typhi-murium* is by far the commonest isolated from cases of food-poisoning. Rodents, certain farm animals and certain domestic animals may become salmonella-carriers and therefore a source of infection for man. The part played by human carriers in spreading infection is slight compared with that attributable to animal carriers. The commonest vehicles of salmonellas are meat, milk, artificial creams and eggs. The prevention of this type of infection, which would reduce food-poisoning to manageable proportions, involves control over distribution of particularly susceptible foodstuffs, higher cooking and lower storage temperatures for susceptible foods and more combined operations by public health officers and bacteriologists to discover more precisely which food ingredients carry the greatest risks.

In staphylococcal food poisoning the human carrier is most important. Staphylococci capable of producing the enterotoxin responsible for poisoning symptoms are to be found in the human nose and on the skin.

Clostridium welchii, which forms spores, is more resistant to heat than salmonellas or staphylococci. These spores resist temperatures of 100° C. for an

hour or more. The organism is widely distributed in soil and hence in human and animal intestines. Thence it becomes widely distributed in meat, water, milk, dust and sewage. Cooked meats which are kept overnight can become infected by the growth of heat-resistant spores while the cooling food passes through the 40–20° C. temperature-range. The larger the portion of meat cooked the greater the danger from infection because of the rate of cooling and favourable anaerobic conditions at the centre. Gravy and moisture enhance growth. Short periods of pressure-cooking at 105–120° C. destroys spores more readily.

Clostridium botulinum, a much stricter anaerobe than *Clostridium welchii*, has also a much more heat-resistant spore. A powerful toxin estimated to be lethal at 0.01 mgm. or less is produced in the food and causes true food-poisoning when consumed. No infection is set up in the human body. Invariably botulism is caused by avoidable faults in the preparation and preservation of food.

The chief sanitary inspector of Aberdeen, Mr. H. B. Parry, described some of the work carried out by officers of local authorities during inspection of food. Their first concern is the sampling and examination of foods which have proved to be the most likely vehicles for transmission of infection. The regulations governing the quality of retail milk and ice cream were described as well as methods of inspection of meat in the slaughter-house and the conditions leading to rejection of the whole or part of a carcass.

In large ports such as Aberdeen the inspection of fish is routine and is primarily directed towards detecting early decomposition caused by organisms penetrating the skin, gills or cavities. Sea fish are remarkably free from disease but certain species of fish caught in particular waters appear to be liable to parasitic infestations, and this is under investigation by research workers and sanitary inspectors at the moment. Imported food is sampled and examined at ports after Customs clearance and all stained containers are opened. Food may also be analysed to check manufacturers' claims on the label, or as otherwise advertised.

The first of the five subsidiary papers by Mr. E. W. G. Guest, joint managing director of Macvitties Guest and Co., Ltd., Edinburgh, gave the point of view of catering management. Mr. Guest stressed the importance of the training in hygiene received by students at technical colleges and baking and catering schools. He pointed out that the new hygiene regulations should establish conditions necessary for cleanliness in establishments concerned with food processing. Modern kitchen equipment undoubtedly improves hygiene but is expensive, more especially during present-day credit restrictions. Adequate attention must be paid to storage of prepared food. The display of such food in self-service establishments presents special problems because of the proximity of the customers, but new methods of protecting food on display should overcome many difficulties.

In his talk on the clinical aspects of food-poisoning, Dr. A. W. Wright, Bangour Hospital, West Lothian, observed that, of the many papers published annually in the medical Press, only a few dealt with the clinical aspects. Food-poisoning may be a severe disease in the young and the aged as well as in hospitals or institutions where the impact on a sick or infirm population may be disastrous. Clinical features vary with the infecting organism. In staphylococcal

infections the patient is struck down two or three hours after eating contaminated material, the symptoms being severe vomiting and diarrhoea, with a rise in temperature. Recovery is usually rapid within twenty-four or forty-eight hours. With *Clostridium welchii*, symptoms are relatively mild—abdominal colic and diarrhoea from ten to eighteen hours after eating, with no rise in temperature and only occasional vomiting. In the commonest form of poisoning by *Salmonella typhi-murium* the incubation period is usually 12–24 hr. and in Dr. Wright's experience recently considerably longer. Systemic disturbance is common, with headache, rise in temperature and occasionally rigors occurring some hours before vomiting and diarrhoea. Many interesting features of salmonella infections were then discussed, a short account being given of a recent outbreak in a general hospital. In this case the organism proved resistant to sulphasuccidine but sensitive to streptomycin, chloramphenicol and tetracyclines. The latter two were advocated as a routine measure in all such cases.

An investigation during 1954–56, into hygiene in restaurants and public houses, was then described by Dr. T. S. Wilson, Health and Welfare Department, Corporation of Glasgow. In the first survey covering fifty representative kitchens only twenty-seven out of 260 washed utensils examined attained the United States Public Health Standard. Only two from forty-two drying cloths showed less than 500 organisms per square inch. Only seven from forty-two wash and rinse waters yielded less than 500 organisms per ml. 74 per cent of kitchens yielded faecal *Bacterium coli* from one or more items but no recognized types of food-poisoning pathogens were isolated apart from *Staphylococcus aureus*. *Clostridium welchii* was obtained from several articles. Arrangements in many kitchens were poor, the paramount need being for improved ventilation and more hot water at 180° F.

In the fifty public houses visited the sanitary arrangements, especially for women, could be much improved. Only fourteen from twenty-seven drying cloths gave counts less than 500 per square inch. *Staphylococcus aureus* was isolated from five cloths, *Streptococcus viridans* from three and faecal *Bacterium coli* from only one. Only fourteen from forty-five samples of wash water and eighteen from 142 'clean' beer glasses conformed to the United States Public Health Standard. No group A haemolytic streptococci were demonstrated on 'clean' glasses. On the whole, too little hot water was available, and when available it was at too low a temperature. Dr. Wilson recommended the use of a quaternary ammonium germicide in the washing water with a second rinsing sink properly maintained.

Miss L. C. Currie (Glasgow and West of Scotland College of Domestic Science), in her paper on protecting food at home and in the canteen, said that the education of housewives and canteen workers in food hygiene continues to be done by well-tryed propaganda methods and to be demonstrated in a practical way in the home by health visitors and in the canteen by managerial staff. Publicity should be given to the most susceptible foods, the conditions giving rise to contamination and practical ways of avoiding it. Conditions of work in canteens and at home should be such that the principles of good hygiene can be carried into practice. This includes the design of kitchens and provision of suitable space for food-storage when necessary.

The effect of spoilage and handling on the bacterial flora of fish was discussed by Dr. J. M. Shewan (Torry Research Station, Aberdeen). Although the flesh of newly caught fish is sterile, bacteria are always present on the skin and gills and in the gut. The flora consist of approximately 50 per cent *Pseudomonas*, 40 per cent *Achromobacter* spp., 5 per cent *Flavobacterium*, 2 per cent *Corynebacterium* and 2 per cent *Micrococcus* with 1 per cent miscellaneous groups. Despite repeated attempts, no enterobacteria have been found. The latter would be expected from polluted waters. This division of flora holds for haddock, cod, lemon sole and skate, the four North Sea species studied. It appears to hold also for herring from surrounding sea areas, but differs markedly from the findings for cod from Canada and for several species from Australia. The differences are attributed to environment. The bulk of fish landed in Britain comes from distant waters and has been five to eighteen days in ice. During storage the flora changes. By the third to fourth day in ice the lag phase of bacterial growth has passed and by the tenth to twelfth day, the end of the log phase has been reached with counts in the region of 10^7 to 10^9 per cm.² of skin or per gram of gill tissue. During this time pseudomonads increase steadily until they constitute 90 per cent of the flora and *Achromobacter* spp. about 5 per cent.

After handling on shore the relative proportions in the bacterial load can alter considerably. This has been found in recent work on the commercial filleting process, in which shigellas and salmonellas have never been encountered during tests. Small numbers of true faecal coli have been found at the filleting stage, and coagulase-positive staphylococci found in 30 per cent of fillets examined. However, the results are in accord with existing information on the incidence of food-poisoning caused by fish and show that fresh fish is one of the safest articles of diet in Britain.

J. DAVIDSON

CONTROL OF THE PLANT ENVIRONMENT

THE University of Nottingham held its fourth Easter school in agricultural science during April 15-17, on "Control of Environment in Crop Experimentation". Since the past century, physiologists have been studying various aspects of plant growth under conditions in which one or more factors of the environment were controlled, but the possibilities of that approach were restricted by the difficulty of growing healthy plants for any length of time in artificial light. Within the past thirty years the introduction of many new types of electric lamp, with characteristics more suitable for plant growth, has made it possible to grow normal plants in opaque rooms even to maturity, under conditions where several environmental factors can be controlled simultaneously.

A number of workers became interested in this approach, but the development of Dr. F. W. Went's 'phytotron' at the Earhart Plant Research Laboratory, Pasadena, California, suggested new possibilities of providing a wide range of different controlled environments within a single installation. Interest grew in the use of environmental control for experimental work, and although there is nothing in Britain as elaborate as the Californian installation, a recent survey showed that some seventy university depart-

ments and research stations in Britain now have facilities for work in controlled environments (Univ. Nottingham Dep. Hort. Misc. Pub. 8).

This approach offers attractive possibilities in several fields of research, ranging from fundamental aspects of plant physiology and genetics to applications of immediate importance in plant breeding and agronomy. The wide interest in the field was shown by the attendance of two hundred scientists at the Easter school, including physicists, chemists, biologists, agronomists, horticulturists and engineers, all with a common interest in environmental control but looking at its problems from different points of view. A vigorous exchange of views between such various disciplines proved to be both stimulating and profitable.

Three main themes dominated the proceedings, namely, the relation between the plant and its environment, methods of controlling the environment in experimental work, and the possible applications of environmental control in crop husbandry.

Prof. S. J. Wellensiek (Agricultural University, Wageningen) opened the school by discussing the plant and its environment in general terms, distinguishing between variations caused by genetical factors, soil conditions and the aerial environment. After discussing the effects of the main individual factors, with special reference to shifts in temperature optima according to the phase of growth, attention was directed to important interactions between several of the factors, notably photosynthetic light and temperature, photoperiod and temperature, and soil-moisture and relative humidity of the air. Experiments on peanut plants under controlled conditions have revealed relations between weather factors which were hitherto unsuspected. For example, growth of stems and increase in number of flowers are closely linked with soil-moisture, optimal development being associated with conditions where the soil remains relatively moist. When soil is allowed to develop even moderately high moisture tensions between irrigations, rate of flowering falls off, but there is a rapid increase in the number of flowers two days after each application of water. Interactions have also been demonstrated between soil-moisture conditions and the relative humidity of the air, a high relative humidity giving best growth, especially during the first month.

Attention then turned to detailed methods of using controlled environments in the study of plant behaviour. Dr. W. W. Schwabe (Research Institute of Plant Physiology, London) discussed the differential effects of some environmental factors on plant development, instancing rates of differentiation of primordia and of leaf expansion as examples of the morphogenetic changes which are affected by factors such as temperature, day-length and intensity of illumination. Prof. E. C. Wassink (Agricultural University, Wageningen) placed the emphasis on plant growth, giving examples of the effects of various environmental factors on such diverse aspects of growth as the production of flowers in bulbous irises and the hearting of lettuce plants. A two-stage growth cabinet has been used for subjecting roots and shoots of a plant to different temperatures to study this interaction, which has wide implications in agronomy, since disharmony between soil and air temperatures is frequently the cause of depressed growth in crop plants. Prof. P. T. Thomas (University College, Aberystwyth) showed how controlled environments could be used in plant genetics for the