

the fact that organisms so treated retain completely their serological characteristics, toxin production and other physiological properties for very long periods of time. Bacteria suspended in saline alone have a poor survival-rate; but the addition of broth, serum or gelatin exerts similar protective actions. Serum is suspect because of its hygroscopic nature and the consequent deleterious effect of moisture on the organisms.

Survival-rates after drying are dependent on a number of factors, including temperature; for example, reported comparative rates at 4° and at 37° C. are 83 per cent and 28 per cent respectively. The relationship between storage loss and time is allied to losses on heating at temperatures between 60° and 100° C., and short heatings at these temperatures can give a measure of storage survival. In spite of reports that there is an optimum small residual moisture content for maximum survival, it now appears quite certain that such an optimum is not obtained, and greatest survivals are found in the driest preparations. It is desirable also to include a suitable reducing substance to prevent oxidation, and the gaseous atmosphere under which the dried material is sealed is important. Dry nitrogen or sealing *in vacuo* gives the best survival conditions, the rates being nine or ten times better than those with oxygen or air.

Following the main papers there was active discussion and questioning, during which two comments were made on changes observed in properties of bacteria on freezing and thawing. One concerned the destruction of phage associated with lactobacilli, and the other, changes in antigenic reactions of some streptococci. Mr. Proom said this was the first evidence he had heard of any change produced by freezing, and the suggestion was made that it may be due to the high and selective death-rate leaving a residue of viable cells which might not be fully representative of the original.

In reply to other questions, Dr. Ingram said that moulds will grow readily in chill rooms, and that flowing air and reduction of relative humidity to less than 96 per cent will practically stop the growth of bacteria.

COMMONWEALTH OF AUSTRALIA SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION

REPORT FOR THE YEAR 1949-50

THE second annual report of the Commonwealth of Australia Scientific and Industrial Research Organization* has been published, for the year ended June 30, 1950. The Organization, which now comprises sixteen Divisions, as well as several independent Sections and five regional centres, continues to face great difficulties in developing its research programmes because of the lack of suitable buildings, and many Divisions are working under crowded and difficult conditions. Work is proceeding throughout the Commonwealth on the mapping of soils and the determination of their physical and chemical properties.

* Second Annual Report of the Commonwealth Scientific and Industrial Research Organization for the Year ending 30th June, 1950. Pp. 157. (Canberra: Commonwealth Government Printer, 1950.) 9s.

Further progress is reported in the development of spectrochemical techniques for analysing soil and plant material. Some fundamental work on the downward flow of water into soil was completed, and the magnitude of movements of water in soil due to temperature gradients investigated. Soil microbiological studies centred mainly round *Rhizobium*, the genus of bacteria responsible for the nodulation of leguminous plants, and the investigations commenced in 1947 into its establishment in field soils, have been concluded.

The general programme of work on pastures continued on the same basis as in the previous year; at Canberra three systems of grazing management were being compared on a *Phalaris*-subterranean clover pasture, and at the Dickson Experiment Station a series of long-term trials on the relation of pasture and cropping practice to soil fertility trends, and especially on the factors involved in such changes in fertility, was being initiated. An ecological survey of vegetation and pastures at Trangie, New South Wales, was nearing completion, while at Deniliquin, New South Wales, investigations have been completed on irrigated pastures; these were begun in 1949 to determine the factors involved in the emergence of pasture and forage species sown in various conditions and depths and with different treatments of organic litter and fungicides. Weed investigations have included studies on the use of plant growth-regulating substances for the control of perennial weeds, the mechanism of action of such substances, and the control of perennial grass weeds; and, besides the trials of new pasture and forage plants, investigations with linseed and other vegetable oil plants have continued. Search has been made for apple rootstocks which give better performance under Australian conditions and also for improved rootstocks for pears and plums. The general results of the opium poppy improvement programme were published during the year, and the survey of native plants for sources of substances of pharmacological value and chemical interest has been concerned mainly with the Queensland flora. The promising prospects for expanding tobacco production by irrigation during the 'dry' season in northern Australia have opened up a new field of research requiring immediate attention. Among plant disease investigations may be mentioned those on potato virus X, the use of plant tissue culture techniques for controlled studies of virus recovery phenomena, and the control of 'dollar spot' (*Sclerotinia homœocarpa*) on turf by fungicides; a study of the effect of nutrition on the development of *Fusarium* wilt of tomato was concluded.

Other plant investigations are carried out at the irrigation research stations at Merbein, Victoria, and at Griffith, New South Wales, the former being concerned with the problems of irrigated horticultural lands of the middle and lower Murray, particularly the cultivation and processing of grapes, and the latter, besides studies on irrigation and soil salting, being concerned especially with the development and nutrition requirements of such crops as oranges and vegetables. Successful control of hardhead (*Centaurea pteris*) with the weedkiller 'Hormex' and of hoary cress (*Lepidium draba*) with 'Methoxone' and 'Hormex' is reported.

The Division of Animal Health and Production, which has its headquarters in Melbourne, has been concerned mainly with problems in the sheep and cattle industries. Besides a further study of the nutritional factors which determine wool production,

this work on sheep has included studies of the processes of rumination, the toxicity of large rations of wheat, the effect of cobalt and copper deficiencies in nutrition, the physiology of reproduction, biological studies of the growth of skin and wool, the efficacy of phenothiazine against the large-mouth bowel worm (*Charbertia ovina*), resistance to nematode infestation, and the value of DDT and BHC preparations in preventing body strike as well as tests with insecticidal fogs for this purpose. Cattle investigations have included studies on pleuropneumonia, tuberculosis and brucellosis, the value of antibiotics in eliminating udder infections, the epidemiology of parasitic gastro-enteritis of cattle; the ecology of the non-parasitic stages of the cattle tick and bio-assay tests with a number of chlorinated hydrocarbons and organic phosphates which permit the division of potential ascaricides into three main classes. Other work on nutrition has embraced studies of the influence of copper or zinc deficiency on the phosphorus metabolism of Algerian oat plants in aqueous culture, on accessory food factors and on the reactions of amino-acids.

Some of the work which has been here noted was carried out in association with the Division of Entomology, which, besides work on various aspects of insect physiology, made an intensive field study of the control of St. John's wort, *Hypericum perforatum* L., with *Chrysomela hyperici* and *C. gemellata*. Encouraging results were also obtained in the biological control of the cabbage moth, *Plutella maculipennis*, with the ichneumonid parasites, *Angitia cerophaga* and *Diadromus collaris*. Preliminary work on population dynamics has been based on the sheep blowfly, and work has continued on the ecological control of the Australian plague locust, *Chortoicetes terminifera*, and on the distribution and ecology of the pasture cockchafer, *Aphodius howitti* Hope. The Wild Life Survey Section, established early in 1949, has been solely concerned with basic ecological studies on the rabbit, further trials of the virus disease, *Myxomatosis cuniculi*, and of poisons for the same pest (see *Nature*, Dec. 1, p. 932).

Fisheries investigations included work on the races of the Australian salmon (*Arripis trutta*), a survey of tuna resources in northern Australia, a study of barracuta in the Bass Strait area, further investigations of the properties of the deep waters off Rottnest Island, Western Australia, and continued surveys on crayfish and sand crabs. Work on pilchards is described in two papers to appear in the new periodical, the *Australian Journal of Marine and Freshwater Research*, publication of which commenced in April 1950 (see *Nature*, 166, 719; 1950). Food research included investigations on the anaerobic destruction of ascorbic acid, on the natural coating of apples and on protein denaturation. Investigation of the factors affecting the germination of heat-treated spores continued, as well as of the effects of oil and other coatings applied to the shells of eggs before storage, the variability in the storage behaviour of apples, the canning of peas, the dehydration of fruit and meat, and the drying of sultanas. Studies on the incorporation of skim milk powder in bread have been resumed and those on the chemistry of the taint in butter caused by *Coronopus didymus* continued.

Work has continued in the Division of Forest Products on wood structure in relation to properties, the chemistry of wood, creep in wood, the physical properties of wood and related materials, timber

mechanics and seasoning, as well as on the toxicity and permanence of water-borne preservatives and on veneer and plywood manufacture. The status of the Building Research Section has been raised to that of a Division, and the experimental work on foamed concrete continued. Investigations on surfacing materials have included a study of the physiological effects of the thermal and mechanical properties of concrete floors, while the acoustic behaviour of rooms and halls, the suitability of bituminous membranes for flat roofs and the efficiency of the inter-layer bond of membranes of various kinds as well as the sulphide staining and growth of mould on water-paint films on fibrous plaster are all being studied. A new Wool Textile Research Laboratory was being organized in each of the three major textile centres—Melbourne, Sydney and Geelong—and studies were being made on detergency in connexion with wool scouring, the aliphatic alcohols of wool wax, the recovery of wool from skin pieces by complete digestion of the skin pieces, the application of resins to wool, the action of shrinkproofing agents on wool, the structure of the cuticle of wool fibre, and the molecular structure of amino-acids, lower peptides, synthetic polypeptides and natural fibrous proteins. In the Flax Research Laboratory efforts have been made to devise methods of carrying on the retting bacteria from ret to ret so as to avoid the necessity of inoculating each ret separately.

In the Division of Industrial Chemistry, promising results have been obtained in the refining of sugarcane wax recovered from waste materials from the sugar mills, while a project on the utilization of brown coal provides the basic data for a programme for producing liquid fuels and organic chemicals from the extensive low-grade coals of Australia. A report on the clay resources of South Australia was in preparation, and extensive research to improve the performance of refractories, particularly for the gas and cement industries, was in progress. Other investigations include the application of surface chemistry to the study of the flotation of minerals, the kinetics of the phenol-formaldehyde condensation and the physical properties of fluids at high pressures. In the Section of Physical Metallurgy work on the strength and structure of metals has been continued, particularly on the mechanism of failure by fatigue and the influence of rate of strain on the mechanism of deformation at high temperatures; but attention has been given chiefly to the constitution and properties of alloys of titanium, the allotropy of titanium and the creep of lead alloys.

The Division of Tribophysics reports further progress in the study of friction and lubrication, and plastic deformation and phase changes of metals. The work of the Division of Metrology has been largely directed towards meeting the requirements of the National Standards Commission and so enabling the Weights and Measures (National Standards) Act, 1948, to be proclaimed. Much of the work of the Division of Physics also consisted in research on the maintenance of standards and on methods of accurate measurement. The Division also investigated the composition and temperature distribution of the solar atmosphere, and a spectroheliograph which will take photographs of phenomena such as flares and prominences on the sun's surface is being constructed. Much work has also been done on the construction of equipment for researches on the properties of matter at very low temperatures and for the measurement of the elastic properties of wool

by supersonic techniques. In the Division of Electro-technology, besides work on electrical measurements and standards, the dielectric properties of materials have been investigated with particular reference to the mechanism of dielectric loss. In the Division of Radiophysics further advance has been made in the knowledge of the radiofrequency radiation which reaches the earth from the sun, from radio-stars and from the galaxy, as well as in our understanding of the processes by which natural rain occurs; and a new programme of radio and radar aids to navigation was introduced, including microwave direction-finding and relay radar. The Organization has also been co-operating with the University of Melbourne in research on nuclear physics and cosmic rays under the direction of Prof. L. H. Martin.

LABOUR TURNOVER AND ABSENCE IN GREAT BRITAIN UNDER FULL EMPLOYMENT

IT is generally believed that rates of labour turnover and absence in Great Britain have been higher under full employment than they were before the Second World War, and constitute a substantial obstacle to industrial efficiency; but hitherto there have not been records in sufficient detail to reveal the course and causes of turnover and absence in a particular setting. Accordingly two monographs* published by the University of Birmingham Faculty of Commerce and Social Science—"Labour Turnover under Full Employment", by Dr. Joyce R. Long, and "Absence under Full Employment", by Hilde Behrend—are important. They report and analyse the experience of factories in the Midlands, employing between them upwards of sixty thousand persons, mostly in engineering and metal working. The collection of this material was made possible through the Midland Advisory Council on Industrial Productivity.

Each monograph sets out what evidence there is for the difference between recent working and that of the interwar years. Such evidence is scanty; but, so far as it goes, it shows less difference than common report suggests. A survey by the National Institute of Industrial Psychology¹ in 1937 gave annual turnover-rates of 18 per cent for men and 51 per cent for women in a sample of London firms, and 11 per cent for men and 34 per cent for women in a Leeds sample. Records for 1949 collected by the British Institute of Management give rates of 21–24 per cent for men, and 38–41 per cent for women. Rates vary so much from firm to firm that generalizations from samples are hazardous; but these inquiries at least show considerable overlap between the pre-war and post-war ranges. As regards absence, the only continuous record is that for the coal miners, and, though the percentage of possible shifts missed has been around 12 of recent years as against 6 before the War, Miss Behrend in her monograph shows that this is due to a rise in the number of possible shifts rather than to a fall in attendances, which remain fairly steady, now as in the interwar years, around 4.7 shifts a week.

* University of Birmingham Studies in Economics and Society. Monograph A.2: Labour Turnover under Full Employment. By Dr. Joyce R. Long (pp. 134). Monograph A.3: Absence under Full Employment. By Hilde Behrend (pp. 137). (Birmingham Faculty of Commerce and Social Science, 1951.) 15s. each.

The main finding of Dr. Long's study of turnover is perhaps that the rate of turnover depends on the type of worker rather than on the type of firm, and that some types of worker have high rates of turnover whereas the majority are stable. She calculates a stability-rate, defined as the percentage of a firm's employees who have not left it during a certain period, and finds that the same firm may have both a high stability-rate and a high turnover-rate. Herein lies much of the explanation of the negative relation which she shows has generally held between unemployment and turnover: turnover is lower when unemployment is high not because all types of labour change jobs less often than, so much as because the unemployed contain a high proportion of types whose turnover-rates are habitually high. The characteristics associated with such rates are chiefly youth, lack of skill, and coming to work from a distance. Long service may be a source of stability; but it is hard to separate this influence, for those who have stayed on will be those who were more stable initially. Women usually show higher rates than men; but much of this seems to depend on lack of skill rather than on sex, for men doing unskilled work often have rates as high as the women, or higher. By contrast with these personal factors, the conditions of employment, such as the size of the firm, the level of pay and the working environment, show no clear association with the turnover-rate, though some differences between the rates of otherwise similar groups of workers are attributable to the state of personal relations in the plants, and especially the quality of supervision.

The special contribution of Miss Behrend's study of absence is the means it proposes for measuring controllable and uncontrollable absence separately. One element of the uncontrollable part is 'unavoidable' absence due to sickness, accidents and family affairs; but Miss Behrend holds that there is a further element which likewise is largely beyond the power of management to control because it is inherent in the nature of the work and of the labour force this work attracts. A sample of daily absence-rates shows marked differences between one day of the week and another, with Friday usually the lowest, and a given plant or department seems to have a characteristic and persistent weekly pattern: Miss Behrend suggests that it should take its Friday-rate as the measure of the uncontrollable absence specific to it, and the excess of absence on other days as the measure of controllable absence (see *Nature*, 165, 831; 1950). More particularly, she proposes a 'Blue Monday' index, giving the shortfall of Monday's attendance below Friday's as an indication of the workers' attitude to their work. In a study of two companies she finds that the 'Blue Monday' index is not correlated with the total absence-rate, for this depends mostly on sickness and workers' ages, whereas the 'Blue Monday' index singles out voluntary absenteeism. This is high among short-service workers and where work is unskilled or is reckoned to impose psychological strain, but it does not seem to be associated with other working conditions.

These studies collect evidence on an important problem on which exact information has hitherto been scanty in Great Britain. Their analysis of it is thorough, suggestive and directed towards practical application. It shows how collaboration between industry and the universities in this field can yield results useful to industry.

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¹ *Occupational Psychology*, 12, Nos. 3 and 4 (1938).