

chemical research, £1 million for biological research of agricultural interest, £1.2 million for regional agricultural research, £971,000 for industries based on agricultural products, and £800,000 for work on plant and animal diseases and pests. The 210-ft. radio telescope at the National Radio Astronomy Observatory, Parkes, completed its first full year of routine operation; a new field station was established for pastoral research in Western Australia; a Computing Research Section was established to operate the network of computers and carry out basic research in computing and automatic data processing; and the Controlled Environment Research Laboratory, opened in August 1962, was able to provide unique features for growing plants under a wide range of precisely controlled climatic conditions.

Among the features of the year's work noted in the report are the investigations of organic phosphate preparations from soils, which have shown that inositol phosphates are a major component, while phosphorus determined after extraction of soil with ammonium fluoride in hydrochloric acid has been found to give a reliable idea of the need for additional fertilizer. Plant selection work has resulted in a new variety of rice, known as Sirena, which has been released for commercial production to meet the needs of the northern Australian environment; a survey of the effects of nutrient deficiencies has shown that manganese deficiency causes profound changes in chloroplast structure. A wet- and dry-bulb hygrometer has been designed to furnish a tool for transpiration measurements in research on cattle breeding and plant physiology, and 50 per cent reduction of bitter pit in apples has been achieved by spraying with calcium chloride or nitrate.

Blood tests have been devised for field-tests of the spread of infection in tick-infested cattle in selected environments, and work on drenching sheep with carbon tetrachloride against liver fluke has emphasized the critical importance of correct drenching procedure. Recent work at Armidale on posthitis in wethers has opened up new possibilities for the prevention and even eradication of the disease from a flock, while a clearer insight into the nature and workings of genetic correlations has been achieved through experimental breeding of *Drosophila melanogaster*. An association between the proportion of follicles with grossly enlarged outer root sheaves and the severity of crimp deterioration in wool has been confirmed, and the possibility of varying the sulphur concentration in wool at will by dietary procedures has been established. It has also been demonstrated that elimination of copper contamination offers savings in fat losses in churning which could represent some £200,000 to the butter industry. Losses of casein have been greatly reduced and the uniformity of the

product improved by a new method of precipitation from skimmed milk; a study of phosphoric acids in organo-metallic research led to a new method of preparing organic phosphates.

A description of the structure of a liquid or highly compressed gas in terms of a disordered 'tunnel' structure has been developed giving a picture in quantitative agreement with data from X-ray and neutron diffraction and permitting detailed calculations of the ways in which macroscopic properties are determined by the forces between the molecules. From work on the chemical properties of atoms, new methods for studying reaction mechanisms and new processes for making conventional materials have been developed. An investigation of the shapes and time distribution of the light pulses emitted in the early stages of crystallization has provided a new and powerful tool for examining crystallization; in an investigation of fuel-cell reactions a novel process has been developed by which the catalyst is deposited directly on to the membrane surface by reduction.

Strong evidence has now been obtained that at least some of the amino-end groups of wool and of the high-sulphur and low-sulphur proteins of wool are masked by acetyl groups. A number of steroids and fluorene derivatives have been found to possess ice-nucleating properties comparable with those of silver iodide, and  $\alpha$ -phenazine surpasses silver iodide in this respect. A simple radiometer for measuring both net radiation and its components has been developed and is now being manufactured commercially. To assist the design of large fluidized bed units, an experimental programme is being conducted with fluidized beds of large cross-sectional area; it has been found that in the desalination of sea-water by evaporation addition of very small amounts of polymers of low molecular weight, such as polyacrylic acid, to the sea-water prevents the formation of scale and the tube surface remains remarkably clean for long periods. A laboratory prototype monochromator suitable for production in Australia has been built and tested and a manufacturing prototype is being developed. Basic investigations of the mechanism by which moisture content changes produce deformation in timber under load indicate very close correspondence between the rate and extent of deformation and the rate and extent of change in moisture content. Road tar with flow properties as good as those of bitumen has been made by adding 10 per cent of coal to the tar before distillation provided moisture is present at the beginning of the distillation; an investigation of the denaturation of egg albumen under acid conditions indicates the presence of a small proportion of a component, S-albumin, which is indistinguishable from the remainder except for much greater stability to heat.

## SCIENTIFIC RESEARCH IN CANADA

THE forty-sixth annual report of the National Research Council of Canada\* covers the year 1962-63, in which the Council provided financial support for 62 projects involving 44 companies, as well as 10.4 million dollars for research in the universities by way of 1,200 grants and 575 scholarships and 160 fellowships; a further 4.3 million dollars was provided through the Medical Research Council. Some 19,000 technical enquiries from Canadian industries were handled during the year, and the Council now has a scientific research staff of 719 (including 144 post-doctorate Fellows), 952 technical personnel and 845 general service and administrative staff. Of the 10.4 million dollars for university research, 6.6 million dollars was in grants to individual staff and 1.2 million dollars

for major equipment: the total represents a 20 per cent increase on 1961-62.

The Division of Applied Biology is studying the lipoproteins of egg-yolk as experimental macromolecular models and also the effects of different immersion cooling methods on the rate and amount of water absorbed by poultry during processing, and the structure and composition of the ribosomes which form the raw material in living cells for muscle, hair, wool, bone and connective tissue. Long-range fundamental projects form the bulk of the programme of the Atlantic Regional Laboratory, Halifax, and have included investigations on unusual chemical compounds in fungi, mosses, lichens and marine algae, and on the biosynthesis of lignin and ergot alkaloids. Fundamental investigations at the Prairie Regional Laboratory, Saskatoon, have shown that the ergot fungus can be

\* The National Research Council of Canada. Forty-sixth Annual Report, 1962-63. Pp. 47. (Ottawa: The National Research Council of Canada, 1963.)

induced to produce lysergic acid in culture medium, and that rapeseed contains sulphur compounds which affect the ease of hardening of the oil and have growth-depressant effects when rapeseed meal is fed to livestock.

The Division of Applied Chemistry has a marked interest in metallic corrosion, which has now broadened to include the examination of the formation of metal oxide films at high temperatures. Work in the Division of Pure Chemistry is illustrated by that on the constituents of plants with reputed medicinal action, in which a new photochemical reaction with acid azides was used in the synthesis of the heterocyclic system of diterpenoid alkaloids, and also by that on the thermodynamic properties of some simple molecular crystals at very low temperatures.

In the Division of Applied Physics the development of the temperature scale at very high and very low temperatures continued and excellent progress is reported in thermal conductivity investigations. Better standard light sources are being developed for industrial colorimetry and colour tolerances in the production of coloured materials are also being examined. The outstanding event in the Division of Pure Physics was the establishment of the plasma physics group, but the cosmic-ray group designed a successful instrument package to detect energetic particles in the orbit of the Canadian Earth satellite *Alouette*, while considerable effort was concen-

trated on the de-Haas-von Alphen effect, which consists in magnetic oscillations of magnetic susceptibility as a function of the magnetic field.

Among field research from the Division of Building Research the exploration of the performance of piled foundations in permafrost was a major project, but housing research continues to be pre-eminent. The Division of Mechanical Engineering was concerned with the construction at Baie Comeau of a reinforced concrete break-water, allowing the minimum reflexion of waves. Construction of the National Aeronautical Establishment's 5-ft. supersonic wind-tunnel was completed and considerable effort went to developing a flying simulator for investigating the complex stability and control problems of short- or vertical-take-off and landing aircraft. The Radio and Electrical Engineering Division is investigating corona loss and radio interference, and has designed and built a compact medium-speed transistorized digital computer, using modular transistor-resistor logic throughout.

Besides brief reports from the Medical Research Council and Canadian Patents and Development, Ltd., the report includes the accounts for the year and lists membership of Council, etc. Further details of the work of the Council and of the membership of Committees, etc., together with lists of staff and of publications, are given in the *Review of the National Research Council, 1963* (NRC, No. 7426. Ottawa: National Research Council of Canada, 1963).

## COCOA MIRID CONTROL

A CONFERENCE at which entomologists and other cocoa research specialists from Cameroun, Ghana, Ivory Coast and Nigeria were present was held at the Cocoa Research Institute at Tafo, Ghana, during August 6-7, 1963, to discuss the recent discovery that some cocoa mirids in Ghana had developed resistance to certain insecticides. Methods being used in Ghana to determine the distribution of resistant mirids and tests to select alternative insecticides to replace lindane were described. Owing to the short notice of the conference, delegates from some West African countries were unable to attend.

*Distantiella theobroma* (Distant) and *Sahlbergella singularis* Haglund (Hemiptera: Miridae) caused heavy damage to cocoa trees in Ghana prior to the large-scale use of lindane ( $\gamma$ -benzene hexachloride) in 1956. Since spraying began, annual exports of cocoa from Ghana have risen from a former average of about 240,000 tons to an average of 420,000 tons in the past three years. At £150 per ton (the lowest price reached on the market during 1960-63), this increase in yield would be more than £26 million each year. This increase has been due in part to the heavier crops produced by mature trees once they are protected from mirid attack, and in part to new plantings, which would have been more difficult to establish had mirids not been controlled.

Since the delegates from Cameroun and the Ivory Coast reported no evidence of insecticide resistance in cocoa mirids in their respective countries, and those from Nigeria had indications of probable resistance in only one small area, all papers were read by workers from Ghana.

Mr. J. N. Telford outlined the history of resistance in Ghana. Failure to control mirids with lindane was noticed first at Pankese Cocoa Station in August 1961, and was shown to be due to the presence of *D. theobroma* resistant to lindane and the cyclodiene insecticides<sup>1</sup>. By January 1963, resistant *D. theobroma* had been found at three of the other twenty cocoa stations and at one group of private farms. The cocoa stations, which are distributed throughout the cocoa-growing area, have been sprayed four times each year since 1956. The Cocoa Disease and Pest Control Unit of the Ghana Ministry of Agriculture

independently surveyed private farms for resistant mirids. One thousand two hundred and seventy-one mirid concentrations, termed 'pockets', were sprayed with increasing strengths of lindane within a few days until control was achieved. Mirids in only 37 pockets survived 0.5 per cent lindane applied at the rate of 5 gal. per acre. Confirmation that the survivors in some of these pockets were resistant to lindane was obtained by exposing them to dieldrin-impregnated papers; dieldrin is preferred to lindane because it gives a more sensitive test for resistance. All resistant mirids have come from the main cocoa area, and all pockets in the isolated cocoa area in the Volta Region were controlled by 0.125 per cent lindane. More extensive surveys, using dieldrin papers, are in progress, and results obtained so far from continuous exposure of *D. theobroma* to these papers suggest that a single pair of genes is involved in resistance, but this can only be confirmed by testing laboratory-reared mirids. Resistance has not been detected in the few *S. singularis* tested in Ghana. In the discussion that followed, it was learned that resistant *S. singularis* had been found in 4 of 118 pockets tested in Nigeria.

Mr. G. Prins described methods recently developed for rearing *D. theobroma* on cocoa seedlings in the laboratory. Females laid more eggs when given only 6 h of light each day and nymphal mortality was lowest in complete darkness; temperature and humidity were also important factors. *D. theobroma* had been reared through three generations, and about forty progeny per female parent were obtained consistently. An artificial diet had been tried without success. Laboratory investigations on the inheritance of resistance are planned.

Mr. D. G. Peterson described the present field trials of alternative insecticides for the control of cocoa mirids. Mirids resistant to lindane exhibited cross-resistance to the cyclodiene chlorinated hydrocarbon compounds but not to DDT, the organophosphorus insecticides or carbamates. An organophosphorus compound, 'Sumithion' (Imperial Chemical Industries, Ltd.), and a carbamate, 'Sevin' (Union Carbide Chemicals Co.), had given promising results during laboratory tests and preliminary field