

the 'pure' silver available might contain just over 99 per cent of silver and gold together (the presence of traces of gold in the silver was not recognized by early metallurgists) and perhaps 0.4 per cent of lead. Accepting this composition for the basis metal, the other impurities—tin, part or all of the lead, iron, nickel and, in one case, zinc—will, in the main, have come in with the copper when this and the silver were melted together. It is possible, therefore, to calculate the composition of the copper alloy used.

From such calculations it is clear that two different materials have been employed at different times, for the drachm and for the tetradrachm, and presumably at different mints. In one case the alloy appears to have been prepared from the 'pure' silver and very impure, but virgin, copper, the average analysis of that used in the manufacture of the drachms being: copper, 95; tin, 1.7; lead, 2.8; iron, 0.1; and nickel, 0.1. The copper used for the tetradrachms was of much better quality, being approximately: copper, 99; tin, 0.3; lead, 0.5; iron, 0.1; and nickel, 0.1; which in all probability was of the highest purity then available to the mint. The marked difference in these two analyses would suggest that the drachms and the tetradrachms were struck at different mints, which were possibly a considerable distance apart.

In the other case, there is consistent evidence that a bronze was employed the composition of which was very approximately: copper, 91; tin, 5.5; lead, 3; iron, 0.1; and nickel, 0.1. Comparison of this result with analyses of the earlier Parthian bronze coins shows that the two compositions are in many cases not greatly different either in the major elements present or in the content of impurities. It is suggested, therefore, that the bronze used for preparing the debased alloys was obtained by melting down bronze coins of the earlier Parthian kings. In some cases the amount of lead present is in excess of that likely to be present in the silver and that introduced by the bronze, and it may be, therefore, that in such coins a relatively small amount of lead was deliberately added as such.

F. C. THOMPSON

NATIONAL RESEARCH COUNCIL OF CANADA

REPORT FOR 1954-55

THE thirty-eighth annual report* of the National Research Council of Canada covers the year ended March 1955, and comprises, besides the president's report, the financial statement and the balance sheet and annual statement of Canadian Patents and Developments, Ltd. The president's report notes that in 1954 the National Research Council provided 2.5 million dollars in 410 awards and 263 scholarships for fundamental research at the universities, and that since the end of the Second World War the Council's support to the universities has increased five-fold. The Council's own scientific staff numbered 548, with 711 technicians and 775 engaged in general service and administrative, as well as about a hundred postdoctorate Fellows. Technical inquiries from Canadian industries num-

* Thirty-eighth Annual Report of the National Research Council of Canada, 1954-55, including the Annual Report of the Canadian Patents and Development, Ltd. Pp. 44. (N.R.C. No. 3607.) (Ottawa: National Research Council, 1955.)

bered about seven thousand five hundred, and the president stresses the value of the work of the twenty-eight associate committees in dealing with scientific and technical problems of national scope.

In an effort to reduce the surface drying of food-stuffs, the Division of Applied Biology has obtained relative humidities approaching saturation by cooling an experimental room indirectly through a jacket of cold air, and recent studies by the Division have shown that the grey discoloration of processed pork occurs much more rapidly in the muscle pigment, myoglobin, than in the blood pigment, haemoglobin. Investigations of the frozen storage of living cells and small organisms have shown that glycerol reduces freezing damage by changing the pattern of ice-formation. Studies of the carbohydrate composition of various grains, woods and marine algae have shown that in most plant tissues large quantities of hemicellulose and other complex sugars are associated with cellulose.

The scientific interests of the Maritime Regional Laboratory have been broadened considerably, and a dryer capable of operating on half-ton batches has been designed and constructed for studies of the drying of seaweeds and similar material. Nutritional tests on dried dulse and rockweed meals indicated that the meals compared favourably with casein and were superior to gelatin or soybean in regeneration of liver protein. A method has been developed for determining the presence of carrageenin in seaweeds, and a study of the cause of the flakiness of cod fillets was commenced. At the Prairie Regional Laboratory, Saskatoon, work was continued on the utilization of agricultural materials, including the utilization of straw for pulp, and an investigation on the production of lysine by fermentation. A new fermentation has been developed for *D*-arabitol, glycerol and erythritol. A study of contributory factors in elevator dust explosions points to particle size as the most important factor, only those fractions which pass through a 150-mesh screen being potentially dangerous in initiating explosions.

In the Division of Applied Chemistry, special attention was given to the corrosion in automotive cooling systems by ethylene glycol and the corrosion of iron in aqueous solutions, while studies of the adsorption and desorption of detergents by textiles, using radioactive tracer techniques, have led to a better understanding of detergent action and indicated possibilities for obtaining higher efficiencies in laundering. Work on the direct oxidation of ethylene to ethylene oxide has led to basic studies on the phase behaviour and magnetic susceptibilities of oxidation catalysts, the kinetics of the photochemical oxidation of hydrocarbons, the catalytic polymerization of ethylene and physical adsorption at gas-solid interfaces. Promising results were obtained in a new drying technique for contacting solids and fluids.

The Division of Pure Chemistry continued its investigations of alkaloids and also work on the quantitative description of solvolytic reactions of aromatic and aliphatic sulphonic acids in water and alcohols. Studies of infra-red spectra have been applied to the identification of small amounts of steroid hormones and metabolites isolated from natural sources, and work on free radicals has been extended to the liquid and solid states. A method has been developed in the Molecular Spectroscopy Section for obtaining standard Raman intensities, the sum of which is useful in determining the structure

of petroleum hydrocarbons; and in a study of the extent to which the properties of very small solid particles differ from those of bulk solids, besides effects due to the small dimensions, effects attributable to the structure of solid surfaces have been found.

In the Division of Physics, the Applied Physics Branch has provided a common dosage standard for X-radiation at cancer clinics throughout Canada, has made a significant contribution to Canadian mapping methods, and has completed a mutual inductance on which the Canadian ohm will be based, a highly precise temperature scale extending over most of the international scale, and the reproduction of the standard of brightness through the brightness of melting platinum. A major effort in the Interferometry Section was the study of new wave-length standards with the view of basing the international metre, and hence the Canadian yard, on a wave-length. Good progress was made on an analytical method of bridging, and the usefulness of a radar altimeter and of combined vertical and oblique aerial photographs was also demonstrated. The Pure Physics Branch reports a considerable advance in the knowledge of the relative ionizing effects of particles of different energies, in the energy-range of billions of electron volts, and the same photographic plate technique has been used to study and identify rare types of mesons produced by cosmic rays. The outstanding developments in the Solid State Physics Group have been in studying 'anomalous' electron behaviour in metals at low temperatures, and the resistance minimum in copper was studied in greater detail in an attempt to understand its origin. Well-resolved absorption and emission spectra of the molecules O_2 , NO, NO^+ , HCN, CO and CN in the vacuum ultra-violet have been obtained with the 3-m. vacuum spectrograph, and using the same instrument the absolute wave-length of the Lyman alpha-line of deuterium has been determined with considerable precision. The structures of pyrobelonite and brackebuschite (vanadium minerals), codeine hydrobromide dihydrate, lindgrenite (a copper molybdate mineral) and potassium dithionate have been determined in the X-Ray Diffraction Laboratory.

The Division of Building Research continued to develop steadily, and, in co-operation with the Central Mortgage and Housing Corporation, steady progress was made in the improvement of technical housing standards and designs, consistent with every practicable reduction in true costs. A completely revised National Building Code of Canada was issued

in June 1954, and the research into fire fatalities is already yielding significant results. Jointly with the Meteorological Division of the Department of Transport, the Division also published the first Climatological Atlas of Canada, the result of two years work by its own climatologist.

Much of the work of the Division of Mechanical Engineering continued to be devoted to defence, but in the Hydraulics Laboratory activity was concentrated on projects related to the St. Lawrence Seaway development. Extended work was carried out on the suitability of Western Canadian fuel oils for industrial gas turbines, and the facilities of the Fuels and Lubricants Laboratory were being extended to permit qualification tests of heavy-duty automotive and marine oils, hypoid gear lubricants, lubricating greases, and hydraulic and brake fluids. The investigation of aircraft icing in flight was terminated, but the icing project is continuing with an investigation of the icing of helicopters, while icing protection studies have also been made on radar components, gas turbine components, radomes and icing instruments.

About half the work of the Radio and Electrical Engineering Division has continued to be concerned with defence; but besides the microwave position-fixing system for inshore survey operations, the Division has designed a microwave system to operate combined automatic-light and fog-alarm stations which cannot be easily or economically controlled by submarine cable, and two installations have been completed. Considerable progress has been made in developing an instrument making an electronic inspection for flaws of high-quality paper while it is being manufactured. The use of silica in place of germanium as the active element in transistors was being investigated, and theoretical studies of electron-tube physics have led to the development of a new detector for microwave energy and to a new laboratory method of measuring the maximum electron emission from cathodes. An experimental microwave radio link has been established between Ottawa and Toronto to study the scattering of microwave signals beyond the horizon, caused by turbulence in the atmosphere, and, besides daily observations of radio emission from the Sun on a wave-length of 10.7 cm., three electronic musical instruments were being developed.

The Division of Medical Research made 151 grants during the year and granted eight senior and sixteen ordinary research fellowships. About two-thirds of the grants were for a continuation of researches.

SELECTIVITY OF ENZYME-ACTIVATED NITROGEN MUSTARDS

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IN chemotherapy, in general one of the outstanding problems is to obtain drugs which will have a much greater effect upon the cells which are intended to be the target for the drug than upon other cells. In the chemotherapy of tumours, this problem is particularly difficult to solve because tumour cells closely resemble many normal cells, to which extensive damage cannot be tolerated. In theory, the

selectivity of a drug can be increased by administering it as a derivative, the action of which is contingent upon one or more cellular variables¹. The more variables involved in eliciting the action of a drug, the greater will be its selectivity.

We have made a preliminary investigation of this theory, starting from the aromatic nitrogen mustards, such as (I), which have been developed at the Chester