

purification of semiconductor materials was also substantially reduced and effort transferred to applications for the substantial quantities of rare-earth elements that are becoming available.

A small research unit was set up to continue the Director's fundamental research on the chemistry of solids, and in this unit the study of physical processes and chemical reactions on absolutely clean metallic surfaces, using the field-emission microscope, has commenced. A research fellowship has been established and work started on the related and very powerful technique of ion microscopy, which is capable of imaging individual atoms on the metal surface. The Chemical Thermodynamics Group made a critical examination of existing data, and, with the assistance of the Association of British Chemical Manufacturers, this has led to a recommendation that, on the organic side, the Laboratory should commence work on the aliphatic compounds containing oxygen and continue its work on phenols. The study of the purification and physical properties of phenol, cresols and xylinols has been completed for publication; work continued on the precise determination of the critical temperatures of certain pure hydrocarbons and the ebulliometric apparatus for measuring vapour pressure has been re-designed and re-built. In the Non-metals Group, particular emphasis was placed on boron-nitrogen compounds, and the systematic study of the chemistry of borazole and its derivatives promises to provide polymers with greater thermal stability than is usually associated with a molecular skeleton of carbon-carbon bonds. Compounds of promise as pre-ignition suppressors for motor 'petrol' have been obtained. Work on ion exchange materials, particularly ion-exchanging membranes, has been narrowed to a thorough study of selectivity and its exploitation, and increased attention given to polymers with potentially applicable electrochemical and electrical properties in the form of reversible redox polymers and high molecular weight materials likely to exhibit semiconduction.

The Extraction of Metals Group has developed a modified rotary-film disk contactor for the solvent extraction of metals direct from solutions containing appreciable quantities of solids in which solvent and pulp flow parallel to the planes of the disks, and each

stage contains several disks. This has given excellent recoveries of uranium, with acceptable solvent losses, from sulphuric acid-leached ore pulps and sulphuric or nitric acid-leached uranium concentrates. Promising results were also obtained in extraction of uranium by heap leaching with acid, and in co-operation with the Warren Spring Laboratory, the extraction and concentration of beryllium from concentrates containing 2-4 per cent beryllium oxide, derived by flotation from low-grade ores, has also been studied. Examination of the solution chemistry of beryllium, mainly concerned with developing methods for the selective recovery of beryllium from sulphate leach liquors, showed the pronounced tendency of beryllium to form polynuclear species in both weakly acidic and alkaline solutions.

The Inorganic Group has given considerable attention to the extraction of the reducible elements, samarium, europium and ytterbium, by sodium amalgam, and has developed a continuous process for recovering these elements from concentrates. The possibilities of a new and rapid method of extracting aqueous solutions of lanthanons with tributyl phosphate are being examined and the purification of gallium and arsenic is being studied with the view of the preparation of gallium arsenide as a semiconductor. The Corrosion of Metals Group is seeking a better understanding of the basic physico-chemical factors which control corrosion and oxidation processes, and of which account must be taken in devising solutions to specific problems. Special attention has been given to the relative importance of the surface preparation of mild steel and the anions present in the solution in which the steel is immersed. In the study of corrosion in moving water, attention has been given to the chemical nature of the corrosive products. The very high initial corrosion-rate of mild steel in oxygenated dilute chloride solutions at 200° C. has been determined, and relations have been established between the rate of corrosion of mild steel in batch cultures and the hydrogenase activity of sulphate-reducing bacteria. Work is also in progress on the distribution in soils of different species of sulphate-reducing bacteria, as well as a pilot investigation of the corrosion of mild steel exposed at two sites on the River Thames.

THE NATIONAL RESEARCH DEVELOPMENT CORPORATION

IN its eleventh year of life, the National Research Development Corporation* negotiated more licence and option agreements with United Kingdom and overseas firms than in any previous year. Eighty-one such agreements were completed (as against sixty-one in the previous year) and, by June 30, 1960, some 456 such agreements were in force. Royalties and other payments received under licence and option agreements amounted to £259,000 as against £182,000 in the previous year. About half these receipts derived from overseas business, that is, from direct payments made by manufacturers abroad, and from royalties on goods exported abroad by United Kingdom manufacturers.

The outright sale of patent rights is another, but exceptional, form of exploitation activity, and is a fluctuating source of income.

* *National Research Development Corporation Bulletin*, April 1961.

By the end of 1960 the Corporation had a portfolio of 1,066 United Kingdom and 2,042 overseas patents and patent applications for inventions, derived chiefly from publicly supported research in the Government research establishments, research councils and the universities. The portfolio is under constant change. Unprofitable patents are allowed to expire, others lapse at the end of their periods of grant, and new accessions are continually being included.

At the end of 1960, the Corporation was providing financial assistance for thirty-five development projects. During the year, the Corporation's expenditure on development amounted to £427,000, and with its subsidiaries it has entered into commitments for £739,000 for development purposes. Recoveries of development expenditure amounted to £52,000.

One project which was commenced in the year under review was the automatic process plant control. This is concerned with the development of electronic automatic control equipment suitable for plant and process control automation and, for example, for the control of power stations and chemical plants. It contemplates the development of a range of standard equipment which will permit electronic analogue and mixed analogue/digital computing techniques to be used for this purpose, the individual elements being

capable of assembly in a variety of ways to enable control systems to be designed as required for any particular plant.

The work is being undertaken by an established firm in the electronic computing and control engineering fields, which is sharing the cost with the Corporation. The project is still in its early stages, but work has started on the design of circuit elements and components, and on the study of potential plant applications.

FETAL AND NEONATAL PHYSIOLOGY

ALTHOUGH there have been great reductions in infantile mortality within the present century, it is only now being realized how much can be done to reduce mortality before birth and in the first days after it. The application of fundamental physiological principles to the management of premature infants has become a study in its own right. These principles were recently examined in the *British Medical Bulletin**, the contributions varying from investigations of blood pressures in new-born babies, the requirement of immunity and immunological tolerance, protein and amino-acid movements in the foetus and new-born animal, transport mechanisms in the placenta and red cells, enzyme development, the newer aspects of placental histology, foetal endocrinology, and the chemoreceptors and their function in the aortic-pulmonary body.

Among the more outstanding experimental work is a review by Dr. R. Deanesley of the present position in foetal endocrinology. Experimental operations by Jost, Wells and their collaborators, on pregnant rabbits and rats, and on foetuses *in utero*, have shown that in these animals the pituitary and testes become active before birth and play a decisive part in differentiation. Thyroid and adrenal development is controlled by the foetal pituitary. The developing foetus at certain stages can react to exogenous hormones which reach it directly or through the placenta. The fact that the endocrine glands are active in the foetus carries no implication that their secretions can affect the maternal physiology.

In their review of the foetal kidney, Miss Pauline Alexander and Dr. D. A. Nixon show that development of function in the metanephros is spread over a period of time—some activities appearing earlier than others.

The onset of glomerular filtration precedes tubular activity so that large volumes of urine may be passed into the amniotic or allantoic sacs from an early age. Subsequent appearance of tubular activities results first in the production of a hypotonic and, later, a hypertonic urine. The maximal osmolarity of the urine is low by adult standards because of the low excretion of solute. The renal capacity to acidify the urine is limited in the early stages, in part by the very low excretion of phosphate. The glomerular filtration-rate appears to be somewhat labile at first, and the factors leading to its stability in later life are not known. Ratios for the clearance of *p*-amino-hippurate: inulin suggest that the supply of blood to

the kidney is low in foetal life in comparison with that in the adult, and this may limit its functional capacity considerably.

The stage of metanephric development at which a foetus of any particular species attains an independent existence will determine its initial renal problems.

Dr. Heather J. Shelley has investigated reserves of glycogen and their changes at birth and in anoxia. However, there is no reliable information on the glycogen reserves of the new-born human infants, but, by analogy with other species, they probably have a high concentration of liver glycogen and a fair amount of muscle glycogen. New-born babies have been known to withstand anoxia for up to 30 min. (Bullough, 1958), so it is likely that their cardiac glycogen concentration is also high. Since lactation is not established in man until 24–48 hr. after parturition, the new-born baby must be particularly dependent on its reserves; if its liver glycogen falls as rapidly as in other species it will be in a precarious metabolic state for several days. If kept warm, the new-born baby can survive for several days without food, but if exposed to cold it later dies of hypoglycaemia (Mann and Elliot, 1957), probably the result of an attempt to maintain its body temperature (Bruck, 1959). It is therefore possible that factors which reduce the glycogen content of the foetus *in utero* or at birth may jeopardize the infant's chances of survival after birth, and future work must determine to what extent the deleterious effects of maternal nutrition, placental insufficiency and birth asphyxia may be the consequence of inadequate glycogen reserves.

The ability of young mammals to withstand a total lack of oxygen was considered by Dr. Joan Mott. She believes that the practical conclusion to be drawn from the present state of knowledge of the conditions under which anoxic survival is possible is that the carbohydrate stores, particularly of the heart, should be protected from dissipation. Re-synthesis of carbohydrate does occur, but may be limited by the rate of entry of glucose into the cell. Thus the factor of vital importance is the store of carbohydrate already available within the cardiac cells. Repeated episodes of anoxia or hypoxia are cumulatively as well as individually dangerous, and it is probable that, if the *pH* is not restored to normal level, a stage is reached at which glycolysis may be completely inhibited. Repeated anoxic episodes may also exhaust the liver glycogen and lead to hypoglycaemia, so that maintenance of the circulation might be insufficient to protect the brain from injury.

* *British Medical Bulletin*, 17, No. 2 (May 1961): Foetal and Neonatal Physiology. Pp. 79–176 + 8 plates. (London: British Council, 1961.) 20s.