man with the intention of altering mental status has displayed the relatively small central effects produced in this way, in distinction to the marked effects of other thiols on the nervous system. Blood constituents are, however, altered by the administration of such quantities.

Analogues of glutathione have been found to occur naturally in the lens of the eye. Their isolation was described by Dr. S. G. Waley (Nuffield Laboratory of Ophthalmology, Oxford); they differ from glutathione at its cysteinyl residue, ophthalmic acid being γ-glutamyl-α-amino-*n*-butyrylglycine, and norophthalmic acid the alanyl derivative. They appear to be produced in the lens by the system which synthesizes glutathione, for competition can occur when substrates for more than one product are provided. Glutathione synthesis is affected also by the X-irradiation which induces cataract; after exposure, the glutathione concentration in the lens falls, but causal relationship between this change and the cataract is still under investigation. A further intriguing product isolated from the lens is S-sulphoglutathione, which can be formed from sulphite and oxidized glutathione.

Radiation Damage; Glyoxalase

In reviewing relationships between thiols and radiation damage generally, Dr. D. B. Hope (M.R.C. Radiobiological Research Unit, Harwell) described the inactivation of thiol enzymes brought about *in vitro* by irradiation. This has not been observed *in vivo*, so the enzymes involved are in some way protected, and attempts have been made to enhance the normal protection by administered substances. Glutathione to a small extent protects mice from the lethal effects of X-irradiation, but cysteamine, dithiocarbamates, and other compounds are more effective; they have in common the property of lowering the body temperature of animals.

Interesting points regarding glyoxalase came from several contributors. This is the system converting methylglyoxal to lactic acid, in which coenzyme status for glutathione was first established, and which once appeared to constitute the main route of glycolysis in many organisms. Its displacement from this role was exemplified in cerebral tissues: lactic acid formation from methylglyoxal, though rapid, is inadequate to account for the high rates at which lactic acid was afterwards found to be produced from glucose. That the glyoxalase system comprises two enzymes, adumbrated by F. G. Hopkins in his posthumous paper with E. J. Morgan, is generally agreed. Perhaps surprisingly, the immediate substrate for glyoxalase I is still debated, Dr. Waley's evidence favouring the hemimercaptal between glutathione and methylglyoxal. In this system in the lens, ophthalmic acid acts as a competitive inhibitor. Glyoxalase I yields S-lactoylglutathione, the substrate of glyoxalase II. However, a preparation from cerebral tissues is reported to hydrolyse at least one other substrate more rapidly than glyoxalase intermediate: this is S-acetylglycylglutathione. Hydrolytic enzymes have also been found in mouse liver which are specific to S-acyl derivatives of glutathione.

Concluding remarks by Dr. C. P. Stewart (University of Edinburgh) emphasized these and other aspects of the biochemistry of glutathione in which further investigation is still required. He indicated how studies of radiation damage, and the *S*-sulphoglutathione from the lens, offer hints on compounds intermediate in the conversion of —SH to —S.S— glutathione, a process likely to involve two stages.

NATIONAL OCEANOGRAPHIC COUNCIL

ANNUAL REPORT 1956–57

THE report of the National Oceanographic Council for 1956–57 (pp. v+34. Cambridge: At the University Press, 1957. 5*s*. net) describes the work carried out by the National Institute of Oceanography during the year ending March 31, 1957. The activities cover the two main fields of marine physics and marine biology, and follow the broad objectives set in previous years.

In marine physics, the technique of determining deep currents by tracking a neutrally buoyant float, drifting freely at a predetermined depth, has been exploited further. The most significant piece of work was the discovery of a southerly-flowing deep current, at depths greater than 2,500 m., beneath the Gulf Stream. This was achieved in the course of a joint expedition by R.R.S. *Discovery II*, and the U.S. research vessel *Atlantis* to an area about 150 miles off the coast of South Carolina. Other measurements of deep currents were made during the year in the Faeroe-Shetland Channel, off the Sogne Fjord, and in a region north of Madeira.

Waves and swell have been one of the Institute's main interests since its inception, and during the past year or two increasing attention has been given to their effects on the rolling, pitching and heaving of ships. The work on this subject has attracted much interest among scientists and engineers concerned with ship motion, in Great Britain and in the United States. A series of theoretical papers has also been published, treating the statistical properties of waves as those of a random, moving surface. Other studies of waves include their relation to microseisms and the relation of both to the movements of storms generating them. Turning to waves on a longer time-scale, basic research with a bearing on storm surges has been continued, both by mathematical models and by electrical analogue techniques.

The productivity of oceanic waters is one of the Institute's major objectives in marine biology, and advances have been made in instrumental and operational techniques for this purpose. An example of this is provided by work on the quantitative sampling of zooplankton from water layers at various depths. Research at sea on organic productivity included three weeks observations in one position, 600 miles west of Portugal, during the autumn of 1956. Repeated measurements were made from *Discovery II* of the light energy, rate of photosynthesis and the standing crop of phytoplankton and zooplankton.

Another broad field of investigation concerns the oceanic distribution of marine organisms. Compre-

hensive studies have been made of the distribution of various species of the plankton fauna in the Southern Ocean and in the Benguela Current. An interesting feature is the tendency for populations of different species of zooplankton to be segregated in concentric circumpolar zones. A technique for obtaining underwater photographs of squid has been developed and used successfully at depths of 300–1,000 m.

Work has been continued on the distribution and life cycles of whales, a knowledge of which is required in formulating international regulations. An investigation is being made of two alternative methods of age determination in baleen whales: by the laminations in the ear plugs and from the accumulated corpora albicantia in the ovaries. A comprehensive paper has been published on the biology of sperm whales, and a study of ambergris is in progress. Work is also being done on the geographical distribution of the various species of whale and their movements between one ocean area and another.

R.R.S. *Discovery II* was kept in full commission throughout the year, although for three months she was on hire to the Admiralty and so not employed on the Institute's research programme. For six weeks in July–August 1956 the ship was lent to the Department of Geodesy and Geophysics of the University of Cambridge, for a cruise to the Mid-Atlantic Ridge, which included seismic studies and measurements of heat flow through the sea bed.

The Institute has continued to be directed by Dr. G. E. R. Deacon with Dr. N. A. Mackintosh as deputy director. Its total staff is about eighty (excluding the officers and crew of *Discovery II*), of whom thirty-six are in the scientific and experimental officer grades. In addition, seven visiting scientists from overseas were working in the Institute during the year. The expenditure on the year's work amounted to £193,000, of which £78,000 was for running *Discovery II*. The main source of income was £110,000 in grants from the United Kingdom Government. Commonwealth Governments contributed £9,000. The Treasury has decided to increase its grants to £175,000 per annum for the next five years and this should go a long way towards ensuring the further development of the Institute's research programme.

K. F. Bowden

OPENCAST MINING

THE Opencast Coal Bill, which had an unopposed second reading in the House of Commons on January 22, is a complicated Bill which replaces the powers at present exercised under Defence Regulations by a system of planning control, acquisition and compensation incorporating some of the main points made in the Franks report. It provides that no opencast operations can take place without the permission of the Minister, who will, in his consent, insert conditions ensuring that damage is reduced to the minimum, and, when agricultural land is affected, that the land be restored to a reasonably fit state for agriculture.

It is intended to proceed wherever possible by agreement, and the compulsory rights order when used will give the Coal Board the right for a maximum of ten years to use the land for opencast mining. In moving the second reading, the Paymaster-General, Mr. R. Maudling, said there would be a continuing need for opencast coal for a considerable period: about 160 million tons of coal had been produced by this method from 109,000 acres, 13·5 million tons of this in 1957, and the need was generally but reluctantly accepted by the House; though Mr. Maudling, and Mr. A. Robens for the Opposition, alike recognized the damage done to amenity and agriculture and our duty to hand on the land in a better and not a worse condition.

While Mr. G. Nabarro condemned opencast mining generally but supported the Bill, Mr. M. Philips Price and Mr. R. Speir pressed more specifically for safeguards and greater attention to amenity both in mining and in restoring the land. In replying on the debate, the Parliamentary Secretary to the Ministry of Power, Sir Ian Horobin, urged that, given the need for opencast mining, while the provisions of the Bill were not perfect, they were probably the best we could make. The vital question of amenity had not been overlooked and would be permanently in the minds of the Ministers who had to administer the Act. Improvements could possibly be made during the Committee stage and compensation would no longer be arbitrary.

ANIMAL HEALTH IN GREAT BRITAIN

ANYONE interested in the health of domesticated animals and in their transit to and from Great Britain should read the "Report on the Animal Health Services in Great Britain 1956" (H.M.S.O., London, 6*s*. net), which includes a report on proceedings under the Diseases of Animals Act, 1950. The outstanding features of the report are, on the debit side, the high incidence, during 1956, of foot and mouth disease and anthrax, and the increase of fowl pest; but these liabilities were offset by the steady progress of the Ministry of Agriculture's scheme for the eradication of tuberculosis from cattle in Great Britain, by the demonstration by the Ministry's veterinarians in the Isle of Wight that warble fly disease can be substantially reduced by co-operation between the veterinarian and the farmer, and by the evidence provided in the report of the very wide range of research that is being devoted to the diseases of domesticated animals.

The year 1956 was the worst year for foot and mouth disease since the widespread outbreaks of 1951 and 1952. In 1956 there were 162 outbreaks, but these were confined to England and Wales. Of the 162 outbreaks, thirty-two, which had no known connexion with other outbreaks, were attributed either to swill or to imported meat, bones or meat wrappers, and it was concluded that the disease came from the Continent. It was necessary to slaughter 10,547