WATER POLLUTION RESEARCH IN GREAT BRITAIN

A FURTHER stage in the development of the Water Pollution Research Laboratory of the Department of Scientific and Industrial Research was marked by two open days at Stevenage on October 11–12, when interested members of the public could see a wide range of work in progress and also inspect the new wing which came into use during the summer.

The new west wing, designed by the Ministry of Works, provides an additional floor space of nearly 20,000 sq. ft. and comprises four pilot-scale laboratories, with several smaller laboratories and offices (Fig. 1). One of the pilot-scale laboratories rises through three storeys and the others are two storeys in height, giving adequate headroom for treatment equipment of all kinds. The construction is in load-bearing brickwork, which facilitates the fixing and support of apparatus. A full range of services is provided, and the keynote is flexibility.

The fact that this new wing has become necessary —it is already almost fully occupied—only seven years after the Laboratory moved to Stevenage from its temporary headquarters at Watford is a sign of the increasing need for research into all aspects of the pollution of water. Three recent Acts, the Clean Rivers (Estuaries and Tidal Waters) Act, 1960, the Rivers (Prevention of Pollution) Act, 1961, and the Public Health Act, 1961, have extended control over the discharge of wastes into rivers and estuaries, and the field of pollution prevention and control is now a very active one, in which local authorities, river boards and industry are all closely concerned.

In order that the work of the Laboratory can be more closely applied in Scotland, an out-station has recently been established at East Kilbride, near Glasgow. This station carries out its own local research and can also call on the resources of the main laboratory at Stevenage when necessary.

The functions of the Water Pollution Research Laboratory are, broadly, to study and improve methods of treating polluting liquids, including both domestic sewage and trade effluents, and to study the effects of pollution on surface waters. The scope and variety of the work involved are so great that only a few examples can be described. Two subjects of wide general interest may be mentioned first.

The survey of the Thames Estuary, which was started in 1948, is now nearing completion. Its primary object was to provide information for the guidance of the Pippard Committee, the report of which is now with the Minister of Housing and Local Government and is expected to be published shortly. Analytical records collected by the London County Council during some sixty years, supplemented by detailed surveys made by the Laboratory staff, have been used to study the complex relationships between dissolved oxygen, temperature, pollutional load, freshwater flow and other factors. A theory of mixing developed at the Laboratory has enabled predictions to be made of the effect of changes in the pollutional load on the condition of the estuary water. It has given good results when applied to changes known to have taken place in the past. Fresh problems have presented themselves as the survey has proceeded. For example, the role of nitrates as a reserve of oxygen, the rate of nitrification of polluting matter, and the effect of synthetic detergents on the rate of settling of suspended solids have all required special study before the complete picture of conditions in the estuary can be built up.

The second subject of general interest is the search for synthetic detergents which can be broken down biologically in sewage treatment works and will not produce the familiar and objectionable foam on rivers. During recent years the Laboratory has tested 74 new materials for manufacturers on a repayment basis. It has also collaborated in the 'Luton experiment', in which a 'soft', straight-chain detergent, sodium 'Dobane *JN*' sulphonate, has, since 1958, been distributed by the manufacturers in Luton and the surrounding district instead of the normal 'hard' detergent. An extensive programme of sampling at Luton sewage treatment works and in the River Lea has shown a reduction of about 40 per cent in the surface-active material entering the river. This is rather less than expected on the basis of laboratory experiments, a result which may be due to the unusual method of treatment used at Luton, consisting of high-rate activated sludge treatment followed by high-rate biological filtration. A greater reduction of the new material has been observed at some other sewage works in the area, and this disparity between different methods of treatment is being further examined in the Laboratory.

Fig. 1. The Water Pollution Research Laboratory. Pilot-scale laboratories in the new west wing

Treatment of Sewage and Industrial Wastes

Little information has hitherto been available on the relative merits of the various filter media used in the biological filtration of sewage. Since April 1959 a portion of the Stevenage domestic sewage has been treated on a battery of eight small filters filled with two different sizes (nominally about 1 in. and 2½ in.) of four different media (clinker, blast-furnace slag, broken rock and rounded gravel). With the exception of the gravel which, in the smaller size, gave some ponding trouble during last winter, the smaller media have consistently produced better effluents than the larger media. The media with the larger surface area per unit bulk volume, namely, the clinker and slag, gave better results than those of more regular shape, namely, the broken rock and rounded gravel. These relative efficiencies of treatment applied not only to the removal of biochemical oxygen demand but also to the reduction in bacterial counts.

Investigations into the activated sludge process have been principally concerned with the efficiencies of various methods of aeration. The work has suggested ways in which the efficiencies (on a basis of oxygen put into solution per unit of power supplied) accepted in normal sewage treatment practice could be considerably improved by such means as altering the geometry of the aeration tanks. Whether the gain in efficiency would be outweighed by other disadvantages such as increased capital cost would depend on local conditions.

Interesting fundamental studies have been started on the kinetics of the activated sludge process, to determine the relative importance of the method and intensity of aeration, the level of dissolved oxygen and the concentration of sludge maintained in the tanks, the degree of turbulence and longitudinal mixing and other variables.

There is an increasing demand for investigations into methods of pre-treating specific industrial wastes, and this work is done by the Laboratory on repayment. Recent and current work of this nature includes the removal of ferrocyanide from engineering wastes, the electrolytic oxidation of cyanide, the bacterial oxidation of thiocyanates, the use of beds of calcined magnesite to neutralize acid wastes, and the treatment of washings from cattle sheds and other farm premises—this last being a growing problem which sometimes causes difficulty at small sewage works.

River Pollution

A large part of the work on rivers is devoted to assessing the relative effects of surface aeration, photosynthesis and plant respiration on the oxygen balance. As a positive step towards increasing the oxygen content of a polluted river, experiments are being performed on air entrainment in a Venturi tube, which could be inserted in an effluent pipe near the point of discharge to a river. The method is simple and, on the laboratory scale, has shown promising results.

Work on the toxicity to fish of ammonia and other chemicals has continued, and the effects of mixtures of toxic substances are now being examined.

Measurement Techniques

It is inevitable that a laboratory such as this should from time to time find that existing standard methods of analysis and measurement are unsuited to its needs in many specialized lines. A valuable part of its work is therefore the improvement of old methods and the development of new. Among its contributions in this way are the improvement of established methods for determining nitrites and nitrates, the introduction of new techniques for assessing organic carbon and for the separation of radioactive strontium and barium, and the design of automatic sampling equipment for sewage, and recorders for dissolved oxygen and suspended solids.

The work of the Water Pollution Research Laboratory is thus seen to be a judicious combination of fundamental investigation and practical application for the benefit of the man on the job. On the impressive evidence put forward during the open days, it seems to be doing this work very well indeed.

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COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, AUSTRALIA

THE thirteenth annual report of the Commonwealth of Australia Scientific and Industrial Research Organization for the year ended June 30, 1961, besides being a general review and a brief survey of some of the more important developments arising during the year out of the research being carried out by the Organization, includes a list of papers published during the year and details of the membership of the Advisory Council, the State Committees and staff*. Total expenditure amounted to £9,603,963 and the Treasury appropriation to £7,571,104, of which £1,058,246 was in the animal research laboratories, £886,518 on plant research, £334,613 on food preservation, £396,600 on forest products, £856,192 on the chemical research laboratories, £246,683 on fisheries and oceanography, £767,705 on the National Standards Laboratory, £451,278 on radio physics, £574,252 on wool research, £280,904 on fuel research, £333,237 on land research and regional survey, £51,700 on research association grants and £95,069 on overseas research studentships. While since 1950 the total budget increased from £2·7 million to £9·6 million, the research staff only increased from 750 to 880, and the Executive believes that this increase in staff is quite insufficient.

The giant radio telescope being erected at Parkes for the Division of Radiophysics is structurally completed and is in fact now available full time for research. The Controlled Environment Research Laboratory is scheduled for completion early in 1962.

Among the research developments noted in the review are a new method of stimulating the germination of legume seeds by exposing water-soaked seeds

* Commonwealth of Australia. Thirteenth Annual Report of the Commonwealth Scientific and Industrial Research Organization for the year ending June 30, 1961. Pp. iii+150. (Melbourne: Commonwealth Scientific and Industrial Research Organization, 1961.)