diseases of oil palms, lack of staff made its Plant Physiology Division inactive. Thirty-one new appointments were made to the Colonial Research Service and seven research studentships were awarded to train candidates for research appointments.

Recruitment of field staff for geodetic and topographic surveys kept just ahead of transfers and resignations; but thirty-two new appointments to the cartographic staff were offset by thirty-seven resignations dismissals or call-up to national service. Nevertheless, very satisfactory progress was made with geodetic surveys. The overseas scientific staff of the Colonial Geological Surveys increased from 190 to 197 during 1953, and although there were still some twenty vacant posts, satisfactory progress continued in all branches, including geological mapping, the investigation of mineral resources, and in the geological aspects of engineering and water-supply projects.

Besides the expenditure from Colonial Development and Welfare Funds, the United Kingdom contributed approximately £20,200,000 from the Vote for Colonial Services during 1953–54, and the present report sounds a warning note in respect of finance. While public expenditure has continued to rise, as well as the total of Colonial government general and development reserves in London, financial prospects in many territories are not encouraging. Revenues in Nigeria and the Gold Coast continued to rise sharply as a result of the steady increase in cocoa prices, but in Malaya revenue was 20 per cent lower than in 1952. Tanganyika's revenue fell by more than 10 per cent, mainly as a result of the fall in sisal prices, while those of North Borneo and Sarawak also fell. Generally, the picture has been one of a flattening-out of the curve of revenue increases.

While capital goods have been easier to obtain, though not cheaper, and capital expenditure and development are at present limited rather by shortages of administrative and technical staff, it is clear from this report that developments in future may no longer be able to count on an almost automatic increase in revenue. More governments are likely to be faced with deficiencies in the near future if the present trends of revenue and expenditure continue, and the report emphasizes that the increase in government commitments and costs since 1939, particularly in the maintenance of the expanded social services, makes any decline in revenue a cause of alarm.

HYDRAULICS RESEARCH STATION

REPORT FOR 1953

THE report for 1953 of the Hydraulics Research Board* describes work done during the year at the Hydraulics Research Station, Wallingford, and also in the field. It covers a range of activities, including investigations, mainly by models, into the design of harbours, jetties and other coastal works, beach surveys, special investigations arising from the east coast floods of January 31–February 1, 1953, and a preliminary study, based on charts and maps, of drainage and reclamation works in the Wash.

Two parties from the Research Station visited a number of places on the east coast of England from Margate to Scarborough during the four days February 3–6, their main objects being to examine the damage to sea defences and beaches and to take photographs, before repair works were started or the return to normal conditions had obliterated the effects of the storm on the beaches. Experiments carried out on a pilot model of the Thames Estuary, at the request of the Waverley Committee, showed that if the freshwater flow had been at its maximum value of 20,000 cusec. at Teddington Weir, instead of the low value of 2,600 cusec. actually existing at the time, the high-water level in London would have been increased by 9 in., a result in good agreement with previous estimates.

An example of work carried out for other countries of the British Commonwealth is that done on two models of Lyttleton Harbour, New Zealand. The object of the investigation is to assess the merits of various proposed designs of harbour extensions from the point of view of protection from waves, susceptibility to ranging and the amount of dredging required. The tests carried out so far have been designed to reproduce the existing conditions. On the larger model, that of the inner harbour, the distribution of wave heights throughout the harbour has been plotted for several wave periods, and the response at a given point as the period of the waves is varied has also been examined experimentally. Another overseas project was the design of a weir block to prevent waves passing up the discharge channel for cooling water at the thermal power station recently constructed at Dekhelia in Cyprus.

The facilities for research on models will be increased when the first stage of the main hall of the Station, which will have a floor area of 300 ft. by 200 ft., has been completed; work on this was proceeding during 1953, and it is hoped that it will be ready for use early in 1955. One of the models to be housed in it will be a large model of the Severn Estuary, on which the effects of the proposed Severn Barrage can be examined. In the meantime, preliminary experiments are being made on a pilot model, which is largely a replica of that built by Prof. A. H. Gibson.

An investigation of a somewhat different kind has been started on land reclamation and drainage in the Wash, at the request of the Ministry of Agriculture and Fisheries. While training works, constructed at various times during the past hundred and fifty years to improve the outfalls of the four principal rivers, have had the desired subsidiary effect of increasing the area available for reclamation, they have been less successful in achieving their primary object, because of deterioration of the estuaries to seaward of them. By treating the Wash as a whole, it is hoped to be able to design extensions to the training works which will improve the outfalls and also result in an additional fifty thousand acres of saltings becoming available for reclamation.

While most of the work described was undertaken in connexion with specific engineering projects, an item of more fundamental research was that carried out in the wave tank on the effect of a vertical wall on a beach in front of it. After the beach had become stable under the action of waves and tides, the wall was inserted in a position between the high-water mark and the highest point reached by the swash.

* Department of Scientific and Industrial Research. Report of the Hydraulics Research Board with the Report of the Director of Hydraulics Research for the Year 1953. Pp. vi + 58 + 8 plates + 4 maps. (London: H.M.S.O., 1954.) 7*s*. 6*d*. net.

When the wave and tidal action was continued, the level of the sand against the wall fell until, after thirty-three tides, it was approximately at low-water level.

During coastal surveys in the Southwold and Christchurch areas, observations were made with drift indicators which showed that swell, accompanied by gentle or offshore winds, set up a drift which was shoreward near the bed and seaward at the surface. With steep waves accompanied by onshore winds, however, it appears that these directions are reversed. Among the new instruments developed is a miniature current meter for measuring the flow in models at velocities down to 0·25 in./sec.; this consists of a small plastic propeller the revolutions of which are timed electronically, making use of the change in conductance produced by the passage of each blade of the propeller between two electrodes.

K. F. BOWDEN

DRYING OF BIOLOGICAL CULTURES

JUDGED by replies to a questionnaire sent out in 1948, only twenty-five of ninety-five laboratories in the United Kingdom then used some form of drying technique for the maintenance of their stock cultures. Since that time the method has been applied much more extensively, and last September the British Commonwealth Collections of Micro-organisms arranged a discussion of the principles and methods of applying freeze-drying to culture maintenance to which home and visiting scientists were asked to contribute. The proceedings of the meeting have now been published*. In the event the discussion centred more on methods than on principles, about which we seem to be woefully ignorant.

Many methods are available for drying cultures on a small scale; but the only one readily applicable to the production of a large number of ampoules are those developed by R. I. N. Greaves from his experience of drying blood products. The designer's view is that the biologist is unnecessarily exacting, and to meet his requirements apparatus has become unduly expensive. Plant has to be designed to satisfy the biologist on three major points: the temperature of drying, the speed of drying and the rate of freezing; each of these is profoundly affected by small changes in technique, such as by increasing slightly the volume of material in each ampoule. The biologists are not prepared to accept the engineer's view that further developments lie with the bacteriologist; the best possible machine for the job has not yet been produced.

Of biological factors affecting survival of micro-organisms after drying, P. J. Fisher's work shows that the culture age is important, old cultures surviving better than young: it was suggested that autolytic breakdown products, such as deoxyribonucleoprotein, might have a protective action. The suspending fluid affects survival in at least two ways: during freezing, crystallization of salts may be injurious; but the main killing effect of the freeze-drying process takes place when the water is first taken off under vacuum. The ultimate survival-rate is improved by the addition of 7·5 per cent glucose to the suspending fluid, and, as survival also seems to depend on the residual moisture content of the dried product, it has been argued that glucose automatically controls the residual moisture. Unfortunately, moisture determination is technically difficult, but apparatus recently developed may so simplify the procedure that it will become part of the drying routine. With apparatus of this type it has been shown that, when solutions containing glucose are dried, moisture removal continues for three months. After sealing, there is an increase in vapour pressure in the ampoule which can be shown by a high-frequency discharge tester producing a glow inside the ampoule and not in the glass wall, and it is possible that there is a redistribution of moisture from the slow-releasing glucose to the protein which had been rapidly desiccated. In vessels closed with rubber stoppers there may be a re-hydration from diffusion of moisture through the rubber.

Freeze-drying may have some effect on the metabolism of surviving cells, and strains used for the production of antibiotics have been found to lose the ability to produce the dehydrogenase enzyme notatin. However, the experience of most of those taking part in the discussion was that, for bacteria and fungi, freeze-drying is the best method of keeping in stable form the metabolic activities which determine the biochemical reactions, antigenic patterns and the virulence of pathogens.

* British Commonwealth of Nations Scientific Liaison Offices, B.C.S.O. (London). A Discussion on the Maintenance of Cultures by Freeze-drying. Pp. ii+48+1 plate. (London: H.M. Stationery Office, 1954.) 5*s*. net.

THE FUTURE FOR TECHNOLOGICAL STUDIES

IN his Messel Memorial Lecture to the Society of Chemical Industry at Liverpool on July 14 (*Chem. and Indust.*, 940; July 31, 1954), Lord Cherwell suggested that recognition by the large chemical firms in Great Britain of the fact that fundamental research is essential to progress is the main reason why the British chemical industry has been able to develop so rapidly and to overcome its handicaps. No other industry in the country has shown so much foresight and understanding of the vital importance of fundamental investigation which at first sight might seem to have no relation with practical applications. First among the industry's handicaps is the lack of facilities in Britain for higher technological education. In spite of their efficiency and merit, the existing university departments of chemical engineering cannot meet all our requirements. In industrial atomic power the efficiency of the chemical recovery determines whether or not the plant is an economic proposition, and many more like Sir Christopher Hinton and his team are needed to tackle such novel and difficult problems. It is not possible in Britain, said Lord Cherwell, for a young man to study at university institutions the first principles of technology and the disciplines on which it is based before deciding which particular technology to follow, and it is wrong to confine teaching of the highest branches of technology to ordinary universities. Lord Cherwell argued again for a technological university—with some three thousand students and fifty or more professors—such as no existing university could accommodate without distorting its balance of studies.

The main obstacle to such a proposal, he urged, is intellectual snobbery regarding technology which