

survey was being undertaken jointly by British and American consultants working together. The Merseyside Survey should be ready this year and others would follow, while the City of Glasgow had requested a comprehensive survey to cover the Clyde Valley. Parallel with these special studies was a continuing programme of research to find out more about long-term trends in transport, examples of which were the large-scale sample survey of road-goods transport and continuing series of surveys of the ownership and use of private cars recently undertaken.

Mr. Galbraith pointed out that many of the skills required were those of economists, and for this interpretation it was necessary to rely largely on outside sources such as the universities, where transport research was developing in two ways: the first was in the growth of traffic engineering from engineering proper into the wider

questions of the economics of transport, pricing, and so on. Secondly, there was increasing interest in transport as a subject of its own with the overall field of economics. The Government was endeavouring to increase the demand for traffic engineers by emphasizing to local authorities the value of such engineers, and the Ministry had been strengthening its links with the universities, and a useful two-way traffic in ideas was developing. It was proposed to use the token sum specially voted for research to stimulate more research and where appropriate to commission specific studies which would help in making policy decisions. An example was the cost-benefit study of investment in a railway electrification scheme just commissioned with British Railways, and the Road Research Laboratory had done a good deal of work on this technique in relation to roads.

ROTHAMSTED EXPERIMENTAL STATION

REPORT FOR 1962

THE size of a modern research station and the range of its activities is such that to keep in touch with its activities by reading the annual report is a major undertaking. Yet to have compressed a report on the work of Rothamsted into little more than 300 pages is in itself a substantial achievement*.

The place of Rothamsted in agricultural science is evident in the notes on personalities and events. Three members of the staff were elected to fellowships of the Royal Society, and invitations to staff members to visit other countries were more than could be accepted without detriment to their work.

The name of Rothamsted is particularly associated with work on soils, and on the conditions that determine their fertility. As Mr. F. C. Bawden, the director, remarks, "There are many reasons for needing to increase crop yields, but no minor one is that when agriculture is inefficient, it is profligate in its use of land". A great part of the work reported is directed towards the more economical use of this basic agricultural resource. The Soil Survey of England and Wales is based at Rothamsted, and Rothamsted provides a base for the Commonwealth Bureau of Soils. Through these two organizations its influence extends both over Britain and to the world at large.

The high level of fertility characteristic of the agricultural soils of England has been brought about very largely as a result of the work on manures and fertilizers at Rothamsted. Progress has been such that in recent

years water has increasingly become the limiting factor in yields. Rainfall is barely adequate for unrestricted crop growth in eastern England, and even where the annual total is sufficient, irregularities in distribution give rise to shortages over periods long enough to depress yields. Under Penman's leadership, the Physics Department has opened up a most productive field of work on water supply in the soil and the consumptive use of water by crops. A few years ago it might have been argued that water, though the most important, was the least understood of the major plant nutrients. To-day, water ranks with the classic mineral elements in the fertility investigations at Rothamsted.

It was at Rothamsted that R. A. Fisher, whose sad death is recorded in this report, carried out the studies that established new standards of precision in biological experimentation. The enterprise that started with one man on a temporary basis is now a large and world-famous department, making extensive use of computers, and providing advice and guidance as well as computation service both in Britain and to Commonwealth countries overseas.

A report is primarily a record of work done, and this report is worth all its three hundred pages. In his wise and critical discussion of "The Use and Abuse of Toxic Chemicals" the director contributes to the assessment of the impact of research on agriculture and society. If it is permissible, after so comprehensive a report, to ask for a little more, one might hope that the director will in future use the general report more extensively for this kind of evaluation.

J. B. HUTCHINSON

* Lawes Agricultural Trust. Rothamsted Experimental Station—Report for 1962. Pp. 316. (Harpenden: Rothamsted Experimental Station, 1963.)

RADIO RESEARCH 1962

THE report of the Radio Research Board*, under its new chairman, Dr. E. Eastwood, has recently been published. It states that 1962 was an eventful year in the life of the Radio Research Station in so far as its work is now making use of rockets and satellites for exploring the Earth's atmosphere out to more than 1,000 km, and obtaining a better understanding of the dependence of its physical characteristics on the Sun's radiation.

Two successful *Skylark* rocket firings have been made at Woomera, carrying experiments devised at the Station in collaboration with the University of Sheffield, and these are being continued during the present year. By co-operation with the Canadian and American authorities,

* Department of Scientific and Industrial Research. Radio Research 1962: The Report of the Radio Research Board and the Report of the Director of Radio Research. Pp. iv+26+4 figs.+2 plates. (London: H.M.S.O., 1963.) 3s. net.

the ionosphere is now being explored from above as well as from the older established ground observatories. In assisting other universities and organizations in the conduct of experiments in satellites which are relevant to the Station's research programme, the network of tracking stations under its control has accumulated extensive telemetry records on magnetic tapes. So far these records have been sent to the U.S. National Aeronautics and Space Administration for processing, but arrangements are now in hand for the first stage of the processing to be carried out at the Radio Research Station. Liaison with other workers in the United Kingdom is maintained through the British National Committee for Space Research under the auspices of the Royal Society.

In its programme of research on the ionosphere, considerable attention has been directed to exploring the

D-region (below 90 km), and the lower portion of the E-region up to about 100 km, since it is at these heights that the absorption of radio waves of all frequencies mainly occurs, and that the phase and polarization of the lower frequencies is determined. For this exploration of the lower atmosphere, a quasi-stationary pattern is set up by a vertical beam of waves at 200 kc/s, which are reflected back from the ionosphere. A rocket fired up through this pattern measures the characteristics—strength and polarization—of the field, and these depend on the height distribution of the electrons and on the frequency with which they collide with neutral molecules. The field pattern, as recorded on three mutually perpendicular aeriels carried in the rocket, is complicated, and attempts are being made to explain the results on the basis of a 'model ionosphere' suggested by theoretical workers in the subject.

The staff of the Radio Research Station have taken full advantage of the opportunity provided by the Canadian 'Top-side Sounder' project to explore the characteristics of the ionosphere from above the height of maximum ionization. The satellite travelling at a height of about 1,000 km carries a complete ionosphere sounding station, and telemetry records have been obtained when the satellite passes over the Station at Slough and the out-stations at the Falkland Islands and Singapore. Some typical results are illustrated in the report, and these, together with others obtained by their Canadian and United States colleagues, have been discussed previously in *Nature* (197, 636; 1963).

For the past two years, oblique incidence sounding of the ionosphere has been carried out over a long-distance path between New Delhi and Slough. As the frequency is raised, the value at which the signal becomes weak or fades out is termed the maximum usable frequency. In this way, the highest useful frequency for a practical communication circuit over this path can be found at any time, and used to adjust the long-term average values which are provided from the prediction charts issued by the

Station. Trials have been conducted over a number of paths in co-operation with the various civil and military authorities operating the related circuits. The technique should be found of advantage during the coming period of minimum sunspot activity when the usable frequencies will be severely compressed into a narrow part of the spectrum, and when any information which enables the operator to work outside it will be of great value.

To provide the facilities for the expansion of the research programme on the lines described here, some curtailment has been necessary on a few of the items which have received much attention in the past. The short-term ionospheric forecasting has been reduced to the provision of an ionospheric index for use with the long-term world charts which are now available for each of the 24 h. The information in these charts is based on the knowledge and experience obtained at the Radio Research Station in studying the characteristics of the ionosphere over more than two sunspot periods. The main programme of radio noise measurements, which was in progress for some ten years before the International Geophysical Year of 1957–58 and has continued since, has now been terminated. Finally, the preparation for publication of the *Abstracts and References* to radio literature, which has been the responsibility of the radio staff of the Department of Scientific and Industrial Research since 1926, was discontinued at the end of 1962, in the knowledge that the field surveyed was becoming increasingly covered by other abstracting services. Acknowledgment from users of the *Abstracts and References* is paid to the small section of the staff who, over the period of thirty-six years, devoted themselves to this work with unusual enthusiasm and energy.

Other features of the director's report show that he and his staff are maintaining and improving the high traditions of the Radio Research Station in advancing knowledge in the field of radio science in step with the contemporary progress being accomplished by the launching of satellites for space research. R. L. SMITH-ROSE

TELEMETRY APPLIED TO ENGINEERING AND MEDICINE

A MEETING was held at the Institution of Electrical Engineers on August 8 in connexion with the first International Telemetering Conference, which will be held at the Institution during September 23–27.

The chairman of the U.K. Organizing Committee, Dr. J. S. McPetrie, outlined the rapid growth of telemetry, the science/technology of measurement at a distance. He explained that the term telemetry applied to all cases in which the information from any form of measurement was transferred to some point other than that at which the measurement itself was made. This means that the measurement has to be made by a special type of equipment, known as a transducer, which transforms the result of the measurement into a form, usually electrical, suitable for transmission to the remote receiving point where the reading is required. Telemetry assumed great importance towards the end of the Second World War with the emergence of guided weapons and later satellites and space vehicles. In the development of such complex equipment, in which reliability of performance is of paramount importance, it is essential to know at all times how the various component parts are operating, and for this purpose some form of telemetry is essential. Telemetry, of course, is not limited to the fields of weapons and satellites but has many civil applications in which British scientists have played a leading part. All these fields will be covered by papers to be presented at the Conference.

The chairman then introduced Mr. Pruss, a member of the North American Organizing Committee. Mr. Pruss gave a brief account of the various conferences on telemetry which have been held annually in the United States since 1951. The committee responsible for these conferences, realizing that much work on the subject had been carried out in countries other than the United States, considered that the time had arrived when a conference of a more international character would be extremely useful. It was suggested, therefore, that such a conference should be held in Europe, preferably London. The Institution of Electrical Engineers and the British Institution of Radio Engineers agreed jointly to sponsor this conference. The international character of the forthcoming conference is indicated by the fact that the 500–600 delegates expected will come from some seventeen different countries, including the U.S.S.R., Poland, Australia, Japan and South Africa, while 59 papers will be presented by authors from the United States, the United Kingdom, Canada, Belgium, France, Australia and Japan.

Dr. R. H. Barker, who is chairman of the Programme Committee, next gave a brief summary of the scope of the papers to be presented at the Conference. It opens with an introductory session, at which three papers will be discussed. Two of these deal in a general way with the present state of the art of telemetry, while the third paper outlines the history of the extensive use of telemetry