dilate or contract and the air entry to the nose will be adjusted by the force of inspiration and the control of the nostrils. All these adjustments will be regulated by the sensory discharges from the organs concerned as well as by the sensory feed-back from the muscles which carry them out.

In fact, the nervous system will be guided by a picture of the largest possible size, each item of which has been actively focused. The neurophysiologist has still a great many problems concerning the individual receptor cells; but the interest is shifting to their collective effect. The problem for the future will be to decide how the nervous system can react as it does to such a picture, how it is recognized and what determines the next step that the organism should take.

POST OFFICE ENGINEERING RESEARCH STATION

'OPEN DAYS'

THE Post Office Engineering Research Station at Dollis Hill was open for inspection during September 27–28, when a large number of representatives of science, industry, the technical press, etc., were invited to visit the Station and view its activities. The Station houses the Research and Radio Experimental Branches of the Engineer-in-Chief's Office of the Post Office Engineering Department, and the greater part of Post Office research work is done there, though other headquarters branches have small development laboratories in which many of their problems are studied. The staff, which at present totals nearly 1,100, is housed entirely in brick buildings erected since 1926, including two administrative blocks, which contain offices and laboratories, and a number of outbuildings in which are laboratories and workshops. The primary purpose of the work at Dollis Hill is to maintain and improve the efficiency of the telecommunication services which the Post Office provides for the public. The Station is consulted on telecommunications problems by other government departments, and some work is done for them. The work at the Research Station is split into seven main Divisions dealing with the following subjects: electronics, materials, mathematics and physics research, radio, switching, telephone and telegraph apparatus (including postal engineering), and transmission.

Two kinds of workshop facilities are provided. There are the central model shops equipped so that most types of apparatus can be made in small numbers; these shops serve all the Divisions and are capable of all kinds of constructional work from metal-welding to high-class instrument-making. Although there is a comprehensive array of machine tools, a certain amount of work is put out to specialist firms. Supplementing the main shops, most Divisions have small workshops in which the laboratory staffs themselves make experimental models and do jobs which are considered too small to be sent to the central shops. These divisional workshops are equipped with suitable hand-tools and a few simple power-tools. The divisional workshop was introduced during the Second World War and is now an important link in the organization. It performs the dual function of relieving the skilled instrument-makers of the need for carrying out many tasks which do not call for their skill, and it removes the laboratory workers' sense of frustration at the delay which sometimes occurs to small jobs in a big shop. Library, technical information and patent services are centralized, and these services are provided for the whole Engineering Department of the Post Office. A small mathematics group provides expert assistance on mathematical problems.

It is usually difficult to estimate the cash value of a research establishment in a commercial concern, and the Post Office Research Station is no exception to the general rule. It is true that some of its developments such as the speaking clock, have been put into service in such a way that a net revenue account can be readily compiled, but much of the result of successful research is tangible only as improvements in the services provided for the public. Typical of a development of this kind is the test set for detecting faulty connexions. It may not be generally realized that speech between people speaking over a single trunk circuit must pass through ten thousand or more connexions in the line equipment alone. Any one of these, if faulty, is liable to cause great annoyance to the speakers and may in the end lead to a loss of revenue. Test sets have now been developed for locating faulty connexions, in the first place, by tracing them to individual units (for example, amplifiers). These testers are sensitive enough to indicate a transmission variation of one millibel (0·01 db.) in magnitude and one millisecond in duration. When the fault has been traced to one unit, another instrument is used to test individual joints and contacts; this indicates short-duration resistance changes of 0·001 ohm.

The Transmission Division is keenly interested in problems relating to submerged repeaters. Shallow-water repeaters such as have been used with success on cables to the Continent since the Second World War are established engineering practice and have obviated the cost of many additional cables. Deep-water repeaters involve new mechanical and electrical problems. Glands to admit plastic cables must be watertight at 4 tons/sq. in., and casings, not too unwieldy to handle on a cable ship, must be designed for this pressure. On the electrical side there are difficulties due to the long lines and the need to run many repeaters in tandem; an amplifier, designed for this service, is unaffected by any single open-circuit or short-circuit in the majority of its components, including valves.

Progress to-day depends a lot on the development of new materials and the improvement in properties or consistency in known ones. To an engineer, consistency is often at least as important as improved properties; it enables him to design more economically without performance falling below prescribed limits. Present-day policy is to concentrate effort on a few selected fields; those of greatest interest are magnetic materials, dielectrics, semi-conductors, plastics and some metals. Grain-oriented materials, both metal and plastic, are of great interest and the importance of germanium in the telecommunications industry is fully realized. Contact problems in switching and connecting devices are also studied.

The work of the Switching Division is at present mainly concentrated on the immediate problem of operator-dialling over trunk circuits; less urgent, but even more important, are the problems of subscriber-dialling over trunk circuits and the long-term study of the application of electronic methods to automatic telephone switching.

A growing feature of the work at Dollis Hill is that connected with the postal service. Statistical studies

of the work in sorting offices are leading to important results, and the more precise knowledge gained may make useful improvements in routing possible in the future. Experimental work on the mechanical sorting of mail was started before the Second World War, but was dropped for more urgent matters A new start has been made and an experimental letter-facing machine built, based on photoelectric selection. The general principle of photoelectric scanning is applicable to other purposes, such as the conversion of pencil-stroke codes on white tickets, to other forms, such as punched-hole codes which can be handled by conventional office machinery.

The Electronics Division has made considerable progress in its experimental studies of the factors affecting valve life. The manner in which valves fail is now largely understood, and effort is being concentrated on practical means for eliminating the principal causes of cathode failure, gas poisoning and interface growth. It is also concerned with the performance of crystal diodes and triodes, which are essential for some of the latest developments in communications techniques.

Much of the work in the radio laboratories is directed towards improved overseas radio-telephony services. The single-sideband technique is being more and more used in these services, and a new receiver for this type of signal has recently been developed. Efficient aerials are essential in long-distance services, and there is a group of workers concerned with aerial development. The steadily increasing number of aerials at large radio stations tends to cause congestion, and a model technique using centimetre wave-lengths has recently been brought into use in the investigation of the effects of obstructions upon the directional properties of aerials.

Turning to internal radio communications, the development of microwave systems for the transmission of multi-channel telephone or television signals between large cities continues. Precise information on propagation is necessary in the design of such systems, and several experimental links, over land and over water, are under observation. At the other extreme, radio links are useful for providing single-channel telephone communication with isolated communities, such as live on some of the small islands off the coasts of Britain: a primary-battery-operated, very-high-frequency system for this purpose is on trial. A radio service may be partly or completely upset by interference from electrical machinery or another radio service, and the Post Office tries to minimize such interference by regulation, licensing and technical assistance. In this connexion it is necessary to develop and test interference-measuring sets and to determine the degree of interference that can be tolerated in various radio systems. Recent work includes the determination of the amount of co-channel and adjacent-channel interference permissible in television reception.

Accurate frequency control is necessary in both line carrier and radio communication, and a frequency standard is maintained at Dollis Hill. It includes a number of quartz ring crystals, in improved mountings; these crystals have an outstandingly good performance, and some have been supplied to the National Physical Laboratory and to the Royal Observatory. Equipment similar to that at Dollis Hill has been installed at Rugby radio station to control the standard frequency transmission that the Post Office provides for the Department of Scientific and Industrial Research. The Post Office has recently taken part in international discussions to determine the best form of distress signal for use on 2,182 kc./s. in the marine radio-telephone band, for the operation of automatic distress-signal receivers. A simple device for use with a conventional receiver has been developed; although sensitive, it is remarkably immune to false operation by ordinary speech.

It should be remembered that the whole of the work in Great Britain on civil telecommunication research is not confined to Dollis Hill; all the large manufacturers of telecommunication equipment, radio and line plant have their own research departments where much original work is done. There is also the Radio Research Station at Slough, of the Department of Scientific and Industrial Research. Since the final development stages of equipment which is to be manufactured in quantity are best done in laboratories associated with factories, arrangements exist for the transition from laboratory model to large-scale production to be undertaken by contractors.

APPLICATIONS OF PHYSICS IN THE DIAGNOSIS AND TREATMENT OF CANCER

AMONG a number of scientific and medical gatherings to mark the centenary of the Royal Cancer Hospital, London, S.W.3, the Physical Society held a symposium on the "Applications of Physics in the Diagnosis and Treatment of Cancer" in the Physics Department of the Hospital during October 5–6; Prof. L. F. Bates, president of the Physical Society, took the chair for the first session.

Opening the meeting, Prof. W. V. Mayneord remarked that this was the first occasion on which the Society had met in a hospital and, in doing so, marked yet another stage in the recognition that the applications of physics in medicine now constitute an important branch of applied physics. He gave a brief historical sketch of the influence of the physical sciences on medical thought and practice from early times, and stressed the present need for physicists trained in biology and biophysics.

In his paper on "The Use of High-Energy Particle Accelerators", Dr. D. A. Layne discussed the difficulties of the treatment of deep-seated tumours by normal-voltage X-ray therapy and the ways in which the use of high-energy particle accelerators can help to overcome them. The application of high-energy beams of X-rays and particulate radiation were considered and also the most probable useful energy ranges for each type of radiation. It was emphasized that considerable preparation, both physical and biological, is necessary before any generator of this type can be applied clinically. Each machine has its own special problems, but, as an example, particular reference was made to those encountered in the clinical preparation of the 30-MeV. synchrotron at the Royal Cancer Hospital. Finally, attention was paid to experimental and theoretical work on the process of particle injection into betatron orbits, undertaken in the hope of increasing the X-ray output. It is normally supposed that, for most betatrons and electron-synchrotrons, only 1–2 per cent of the theoretical maximum charge is actually accelerated, but the work described suggests that this theoretical limit has been incorrectly assessed