near the surface of the earth, since his appointment to the Meteorological Office in 1937. His association with the Chemical Defence Experimental Establishment, Porton, during his early years of service, was marked by a valuable experimental study of evaporation from a plane-free liquid surface into a turbulent air stream. Later, in charge of a small Meteorological Office group attached to the School of Agriculture, Cambridge, to study micro-meteorological problems with application to agriculture, he devised a method and equipment for the investigation (by the use of accurate vertical profile measurements of humidity and temperature) of the exchange of heat and water vapour between a grass-covered surface and the air immediately above. This led to a successful evaluation of evaporation from the surface. The aerodynamic drag of grassland was also investigated. Dr. Pasquill is now engaged in research on atmospheric diffusion processes on a more extended scale.

DR. J. M. SHEWAN studied chemistry in the University of Aberdeen, being awarded a medal in physical chemistry in 1932, and gained his Ph.D. for work at the Macaulay Soil Research Institute. He then entered on a career in marine bacteriology and biochemistry at the Torry Research Station, where his work has included the only really detailed study of the strict anaerobes of fish, a survey of the aerobic microflora of gadoids, and the discovery that the microflora of fish varies considerably with species, locality, time of year and method of catching. In the preservation of fish he has shown how the microflora changes in composition, as spoilage proceeds, and he has made pioneering studies of the effect of phenolic substances in wood smoke in the curing of smoked fish. He is at present engaged in unravelling the taxonomic confusion which exists in the field of marine bacteriology, and on an extensive study of the extractives of fish which are the substances first attacked by bacteria. In connexion with the preservation of fish on ice, he has developed a sensory scoring system which, as a research tool, has become of great use in defining and controlling standards of freshness.

MR. G. W. C. TAYLOR joined the Research Department, Woolwich Arsenal, in 1929, transferring to the staff of the Explosives Research and Development Establishment, Waltham Abbey, on its formation in 1945. His early experience was in the chemical analysis and testing of explosives, which was followed by photographic and radiological investigations. Since 1939 he has been concerned with a special class of explosives, carrying his researches from the laboratory stage to full-scale manufacture, and this has led to investigations on the control of crystallization which have given rise to practical results of the greatest value. Much of his work has been of a pioneering nature in a region hitherto unexplored because of the formidable hazards and difficulties involved.

MR. J. H. WILKINSON graduated in mathematics from the University of Cambridge and then worked on ballistics in the Ministry of Supply for some six years before joining, in 1946, the Mathematics Division of the National Physical Laboratory, Teddington. He has worked on the design and exploitation of high-speed automatic electronic digital computers, and has been very closely associated with the theoretical design, electronics and practical use of the Laboratory's machine, the Pilot ACE. In particular, he has made a very thorough study of practical methods of calculating latent roots and vectors of matrices, which are of wide application, especially in problems of aircraft design.

DR. H. G. WOLFHARD studied physics at the University of Göttingen, gaining his doctorate in 1938, and later joined L.F.A. Volkenrode, where he worked until 1946, taking charge of a group on combustion towards the end of this period. He joined the Royal Aircraft Establishment in the same year, where he has worked in the Chemistry Department and, more recently, in the Rocket Propulsion Department in charge of the combustion section. During 1946–52 he worked part-time with Dr. A. G. Gaydon at the Imperial College of Science and Technology, London. He has been outstandingly successful in the application of spectroscopy to the study of flames and combustion processes.

WORLD POWER RESOURCES

IN his presidential address given before the Institution of Electrical Engineers on October 7, Mr. J. Eccles was concerned mainly with the power resources of the world. He sketched in outline the origins of the earth's main resources of fuel, first tracing the exceedingly gradual evolution of man's use of mechanical power up to the opening of the industrial era. He then showed that, with the enormously accelerated rate of consumption of fuel which has developed during the past two hundred and fifty years, a further period of several hundred years will see the substantial exhaustion of the world's resources of coal and oil; indeed, the supply of oil fuel may well become critical during the lifetime of the present rising generation.

Dealing with other available forms of energy, apart from nuclear energy, Mr. Eccles first considered water power and tidal power. Some forty per cent of the world total of inland water power is located in Africa, and this total without, of course, regard to location, could supply at least three-quarters of the world's present energy requirements. He remarked that one of the largest and most spectacular sources of water power lies at the western end of the Mediterranean, for this inland sea loses water through evaporation at a rate exceeding its river inflow, so that water is constantly flowing through the Straits of Gibraltar and, to a lesser extent, through the Dardanelles. If both straits were dammed, the level of the Mediterranean would gradually fall, and rough calculation shows that, having established a differential of 70 ft., 12 million kW. (which is 75 per cent of the present demand for electricity in Great Britain) could be developed from suitable turbines operated by inflow from the Atlantic.

Summing up the position in regard to what may be termed the conventional sources of energy, Mr. Eccles said that, when coal and oil are exhausted, and in the absence of a successful outcome of the attempts to harness the nuclear fission or fusion process for industrial purposes, it should be possible to muster man's present-day energy requirements from all the known sources, but that energy transmission or population transportation would present enormous technical and social problems.

If the present pattern of civilization is to endure, the problems of nuclear energy must be mastered. It has been established, said Mr. Eccles, that, on the basis of present costs, an expenditure of about

£50 per pound of pure metal would be sufficient to mine and to refine sufficient uranium to provide the world's present energy requirements for some 1,500 years, or on a similar basis, an expenditure of £100 per pound could furnish these requirements for 8,500 years. The abundance of hydrogen in the earth's crust could provide almost unlimited power from the hydrogen–helium reaction, but the industrial application of this must await the discovery of means of enabling the reaction to proceed at a lower sustained temperature.

Because of the possibility of supplying the world demand for power by means of nuclear fission, it is now sometimes argued that all development effort should be applied in that direction and the development of other sources abandoned. Mr. Eccles, however, did not hold this view: when there is, for example, "a local surplus of water power, the energy could be used to purify fissile material so as to provide power in lands where the alternatives are insufficient. Since fissile material, even in its natural state, is easily transportable, such packaged fuel might solve the power transmission problem".

Finally, Mr. Eccles referred to the minute fraction of existence of the human race within which this tremendous demand for power has developed, and he emphasized the paramount necessity to match, by means of continued technological advancement, the world's progressive demands for the basic necessities of food and fuel. "In sum, therefore, man having evolved during a million years has, over the past 250 years, developed a mode of living which is unique in human history. This achievement has thus lasted for only 0·025 per cent of his sojourn here and already it has made great demand on the energy resources of our planet. Unless he is able and willing to match his technology to the unfolding needs of the situation, he has no prescriptive right to a continuance of this latest civilization, and the history of civilizations discloses that discontinuity—decay and rebirth—is the normal method by which successive stages have been reached. However, to-day man is equipped with a knowledge of natural laws (science) and an ability to harness these laws to his needs (engineering) that were absent in all previous civilizations, and there is good reason for thinking that the present mode of living can be greatly prolonged if he will but use this knowledge and ability aright."

AIRCRAFT ELECTRICAL SYSTEMS

A VACATION school on "Aircraft Electrical Systems" was held in the Electrical Engineering Department of the Imperial College of Science and Technology, London, during September 20–24 and was attended by nearly seventy engineers drawn from electrical and aircraft industries, research organizations and the College of Aeronautics, Cranfield. The purpose of the school was to bring out the scientific principles underlying the design and application of all forms of equipment used in aircraft electrical systems, in relation to both present and future requirements. The course was very successful, particularly since those who participated contributed a large part to the discussions. The conclusions drawn were that more co-operation is needed between design and installation engineers and that, notwithstanding the special conditions of aircraft work, much can be learned from ordinary industrial practice; educational work was also stressed, particularly the part being played by Imperial College.

In his opening address, Sir Frederick Handley Page emphasized the importance of fundamental research in that it often leads ultimately to useful practical results. After directing attention to electrical and aeronautical engineering as the two newest branches of the art, he referred to the interesting problems which have arisen as they have progressively come together, and to the need for closer liaison between members of these two branches. In an introductory survey, D. F. Welch (British Thomson-Houston Co., Coventry) outlined the problems facing the aircraft electrical engineer. Since 1940 power requirements have risen from 1 kW. to 200 kW. for large aircraft, and with these powers the potentially destructive power of a fault has focused fresh attention on circuit protection. The avoidance of any breakdown is doubly important in that the introduction of power-operated controls and the electrical operation of essential flying instruments mean that the safety of an aircraft is now dependent on the maintenance of the electrical power supply. M. Hancock (Royal Aircraft Establishment, Farnborough), speaking on environmental conditions and functional requirements, pointed out that these lead to acute differences between aircraft and ground-based electrical engineering practice: operation at high altitude increases arcing problems in switchgear and decreases machine cooling, while the wide temperature-range over which the equipment must function increases insulation and lubrication problems. Mechanical problems, vibration, weight and bulk considerations are all factors with special problems in relation to aircraft. In the third lecture, J. H. Rea (Rotax, Ltd.) dealt with power systems, and discussed the factors which determine the choice of system, methods of load analysis which distinguish between 'safety' and 'comfort' loads, and methods of weight analysis which lead to the lightest installation capable of supplying the load. The place of the battery, with particular reference to the problem of engine starting, was also considered.

The more specialized lectures given at the course commenced with that of R. F. Sims (Farnborough), who first discussed the physical causes of the abnormal brushwear experienced at high altitudes, outlining remedial measures such as the use of special materials or the control of the moisture content of the machine-cooling air, and then in the second part of his lecture considered vibration problems. After a general survey of cooling problems, Dr. C. S. Hudson (Farnborough) reviewed the effects of radiation, natural and forced convection, and conduction, and discussed methods of calculating the pressure head required in a cooling system. The topic of d.c. machines was covered in the next lecture by B. Adkins (Imperial College, London), who showed how machines must be compactly constructed in order to obtain the output required with minimum weight. He also pointed out how the insulation, the methods of connecting and securing the windings, and the grease used for lubrication, all set a limit to the permissible temperature rise.

On September 22 the members of the course visited the works of Vickers-Armstrong, Ltd., at Weybridge, including the company's Electrical Laboratory and the Research Department, and the seventh lecture, on electrical installation engineering, by H. Zeffert (Vickers-Armstrong), was partly a com-