ment' of a magnetic disturbance on April 30, 1933, was judged to appear practically simultaneously at places so far apart as Copenhagen, Thule (in north-west Greenland) and Fort Rae.

Nearly all recording instruments were run in duplicate to make sure that the records would be as complete as possible, the secondary records in most cases providing the additional safeguards of furnishing data with other characteristics, as, for example, a more open time-scale or lower sensitivity.

As part of the programme of meteorological work, more than four hundred pilot balloon ascents were made during the term of occupation of the station and twenty-eight *ballons sondes* were sent up. The hydrogen for this work was manufactured on the spot in a new apparatus designed at the Airship Works, Cardington, and was produced by the interaction of granulated silicon with heated caustic soda. Two of the instruments from *ballons sondes* released in winter with surface temperatures about -30°C. attained heights of 16 km. In both cases, the base of the stratosphere was very well marked at 8·5 km. and with temperatures about -60°C.

With Fort Rae in an exceptionally good position relative to the zone of maximum auroral frequency, much importance was attached to the observations and photography of aurora for precise determinations of its height and orientation. To a substation (which was actually the site of the station in the First Polar Year fifty years ago) some 25 km. to the south-east, a telephone line was erected allowing photographs of the aurora to be taken simultaneously by cameras specially designed for auroral work in Norway. From these pairs of photographs, some 4,700 of which were taken by the party during the stay at Rae, it is hoped to obtain much definite information about aurora in that part of Canada. Although the period was so near the minimum of the present cycle of solar activity, aurora was observed at some time on every night when conditions were practicable. It was not infrequent during the winter months for aurora to continue almost uninterruptedly for fifteen hours.

In addition to the activities in these, the main lines of investigation, observations in atmospheric electricity claimed much attention. Continuous records of the potential gradient of the earth's electric field near the surface were maintained autographically, and frequent measurements of air-earth current and small ion content of the air were made. Experiments were also carried out to determine the nature of the diurnal variation of these quantities and also of the rate of production of ions near the ground.

The winter conditions at Rae during 1932–33 were characterised more by the steadiness of the cold than by extremes of temperature reached. Over the seven months ending April 30, 1933, the average temperature was -20°C., but the lowest average for any single month was only -31°C.—January and February were almost the same in this—and the lowest daily mean was only -40°C. During the short warm summer, daily temperatures frequently exceeded 20°C.

The party returned from Rae in September and early October 1933 with a very large amount of observational matter for further study. It is now the intention that each country participating in the international programme should make all its data available by reduction and publication as early as possible, so that the larger and more important task of co-ordination of the results from all the stations may not be delayed. In many ways it was unfortunate that the Second Polar Year should have coincided with times of such grave financial stringencies in so many countries. But the difficulties encountered in the preparations both by the International Commission responsible for the general organisation of the Polar Year activities and by the individual national committees in each country served to emphasise the value of the work. It is certainly illuminating that forty-six different countries have taken part in the programme in one way or another, and of these, twenty-three have set up extra stations—in many cases more than one—either within their own territory to extend the number of their regular observatories, or outside their own lands as temporary observation posts.

Progress of Industrial Research

IN a recent address Dr. F. A. Freeth made an eloquent protest against the habit in Great Britain of always classifying science as something apart from ordinary life. It would be difficult to imagine a document better fitted to demonstrate the essential place of science in our ordinary everyday life, or to inspire a general confidence in scientific workers and science by the public, than the eighteenth annual report of the Department of Scientific and Industrial Research.* Published within a couple of days of Dr. Freeth's address, the report describes contributions made by the work of the Department to every major need of our social and industrial life. The comparatively small sum of £654,736 (gross) or £451,987 (net), which represents the expenditure of this Department for the year ending March 31, 1933, represents also a contribution to the efficiency of every department of State and to the recovery or the prosperity of many industries, the true value of which it is impossible to assess in cash, but which repeatedly has earned dividends many hundredfold on the expenditure involved.

Even this expenditure, however, represents a further decrease on that recorded in the previous

* Department of Scientific and Industrial Research. Report for the Year 1932–33. (Cmd. 4483.) Pp. iv+189. (London: H.M. Stationery Office, 1934.) 3*s*. net.

report—£695,677, the actual expenditure in 1931–2 being £543,700. Receipts, however, increased from £160,977 to £202,749, thus exceeding those of 1930–31 (£184,829). Expenditure on the National Physical Laboratory was £195,316, against which receipts amounted to £90,854; on the Chemical Research Laboratory, £18,406 net; Forest Products Research, £32,286 net; Fuel Research, £84,226 net; Radio Research, £11,340 net; water pollution, £8,642 net and Headquarters Administration, £24,791 net. Against expenditure of £44,583 on Food Research, a grant in aid of £30,133 from the Empire Marketing Board assisted to bring the net expenditure to £10,774. Receipts of £7,380 bring the expenditure on Building Research to £34,663 net, while the £46,140 balance of the Million Fund brought the Grants for Research to a total of £51,700 net.

A large part of the report of the Advisory Council, over Lord Rutherford's signature, which precedes the summary of work, is devoted to a discussion of the 'million fund' to which reference has already been made in NATURE of January 20, p. 77. The same report, however, also refers to the transference to the Department from the Ministry of Transport of the responsibility for the direction and supervision of road research. This is a matter of direct concern to every citizen whether he uses the roads in his own car or in public vehicles. The traditional methods of road-making were designed to provide a surface sufficiently firm to prevent slow-moving horse-traffic from sinking appreciably in wet weather. Despite the revolutionary changes which have taken place with surprising success in the last thirty years, we have still very little scientific knowledge either of the foundations of the road or of the materials of its superstructure such as will ensure that a success in one place can be repeated in another. A systematic programme of research has been prepared, covering not only the testing of the materials but also the processes involved in road construction, maintenance and use. One of the most important requirements for success in laboratory investigations is correlation between behaviour in practice and the results of laboratory tests. Such correlation in road work is a protracted process, as the information from practice is obtained only after the road has been in existence many years. Results from road tests at the Harmsworth Experimental Station, for example, are incomplete after 3½ years of heavy traffic, and to accelerate progress attention is being given to the development of road-testing machines.

Other work bearing on transport is also being carried out by the Department. The Chemical Research Laboratory is investigating the properties of road tar, while investigations to discover the most suitable traffic signal beams have been carried out at the National Physical Laboratory, the results of which, after tests on signals in actual use at Reading and in Oxford Street, London, have been embodied in a British Standards specification. Other work at the National Physical Laboratory on motor-car headlights has led to a method of determining the light distribution which should be aimed at for a headlight beam.

The National Physical Laboratory has also been concerned with other methods of transport. Its Aerodynamics Department has been responsible for much important work bearing on the design of new types of aeroplane and particularly on stability and control of aeroplanes, including an investigation on the spinning properties of typical aeroplanes. The corrosion fatigue of certain aircraft materials has been studied by the Engineering Department, the Sound Division has rendered assistance in connexion with the acoustical features of aircraft design. The recent series of aviation disasters alone should indicate the great importance of work on systems of direction-finding which is proceeding under the Radio Research Board.

Research on the design of hulls and propellers for ships carried out on models at the William Froude Laboratory, dealing with the influence of waves on the resistance, propulsion and pitching of ships has reached a stage when the general effects of rough water upon the hull resistance are known. Such progress has been made with the study of the action of a screw-propeller when propelling a ship in a rough sea that performance can be predicted with confidence from model tests. In addition, investigations have been carried out to determine the effect of wind forces from any direction on the steering of ships.

Particular stress is laid on timber research in the Report of the Advisory Council. The work carried out in the Forest Products Research Laboratory covers the working and finishing properties of wood, as well as its natural durability and its resistance to insect or fungus attack, which is of widespread importance to the builder of houses or maker of furniture, etc. It is, however, only one link in a chain which connects the forest in the Empire Overseas with the timber user in Great Britain. The other two links, information on prices and supplies and marketing promotion, are seriously threatened by the disappearance of the Empire Marketing Board, and upon their continuance much of the utility of the research on timber depends.

Timber naturally suggests building, and the work of the Building Research Station provides many illustrations of the influence of scientific research on the comfort and efficiency of the home. These include investigations on factors influencing weathering, a study of the most economical means of heating a house, which indicated the superiority of the intermittent method, investigations on plasters, on the problem of damp walls, the exclusion of solar heat by thin roofs, on painting on cement and plaster. Other contributions in this field come from the work of the Research Associations. Such, for example, are those dealing with frost-bursting of water-pipes of various materials, with methods for preventing the corrosion of galvanised hot-water tanks or the dulling of bright metal surfaces used in architecture, both inside

and outside buildings. Investigations on earthing to eliminate risks of electrical shock have continued: a comprehensive survey of causes of radio interference due to the operation of electrical equipment is proceeding, while at the National Physical Laboratory the transmission of sound through partitions or double windows is receiving attention with a view to better design of rooms and houses, nor should we overlook the work which is being carried out on steel frame buildings.

A method of determining the efficiency of hot plates is being standardised, and the discovery of a means for reducing the temperatures reached by gas-filled lamps in show-case and shop-window fittings has definitely reduced the risk of fire in stores where inflammable goods are displayed.

So much of the work of the Department has a direct bearing on public safety and health that its activities can quite legitimately be summarised as that of a great national life assurance department. In addition to the industrial examples already given, space allows us to mention only two: the metallurgical research dealing with the factors causing the cracking of boiler plates and the work carried out on the production of a more efficient respirator for use in industrial processes as a protection against the inhalation of dust. From a more general point of view may be cited the search of the Chemical Research Laboratory for new drugs efficacious in the treatment of sleeping sickness in Africa, or the work on atmospheric pollution and water pollution.

Such a dry year as 1933 emphasises the importance of the latter field, and the report itself points out that two recent serious outbreaks of enteric fever in Yorkshire were both due to comtaminated water supplies. Frequently the condition of streams and rivers cannot be improved sufficiently until satisfactory methods of reducing the amount or polluting nature of various domestic or trade effluents have been devised. Since new types and sources of pollution are always arising, as, for example, the effluents from modern milk depots or factories, the department concerned is continually charged with fresh programmes for investigation.

The whole of the important food investigations carried out under the Department have a profound bearing on the national health. The quality of foodstuffs is continually being improved and waste eliminated by means of better methods of transport and storage. One effect of such work is to make possible a steadily rising standard of living. The Food Investigation Board has been responsible for work covering the storage of meat by freezing or chilling, the transport of bacon from Australia and New Zealand, the freezing and smoke-curing of fish, the gas-storage of apples, the storage of fruit for canning, and much effort is being given to the development of appropriate methods of studying the damage which fungi, etc., can produce in fruit and other foodstuffs. The Flour Millers' Research Association has undertaken investigations designed to place the conditioning of flour on a scientific basis and is studying the effect of added oils and fats on the baking quality of the flour. The Cocoa, Chocolate, Confectionery and Jam Trade Research Association has materially assisted in improving the making of marmalade, jams and jellies by its study of pectins, and has studied the development of means of combating insect pests of nuts and chocolates and other confectionery in retail shops and of remedying defects which develop in chocolate-covered wafers and candied peel. An outstanding investigation of the Food Manufacturers' Research Association has been the development of an instrument for determining the amount of salt in any part of a piece of meat during curing, and in consequence allowing of closer control of the process.

Some will be surprised to learn that important dental research is being carried out under the Department, including the determination of the best composition of amalgams for dental purposes and the properties of widely-used dental rubbers, or that as a result of studies on aluminium paint made by the Paint, Colour and Varnish Manufacturers' Research Association it is possible to indicate the conditions which must be observed to avoid the loss of brilliance or other special properties.

The relation of such research associations as those of the cotton, woollen and linen industries, or the Launderers' Research Association to our everyday needs is equally impressive. The first, for example, has provided the industry with a new method for the rapid separation of good cotton from dust and other foreign matter. The second has developed a method for treating the fibres in bulk before spinning, whether for woollen or worsted processes, which renders them unshrinkable, besides giving lustre and softer handling, thus eliminating the prickly feeling which sometimes causes discomfort in wearing woollen goods. The same Association is developing reliable scientific tests for judging the fastness of dyed woollen fabrics to light and other agencies.

The Linen Research Association has not only established the causes of the comparatively rapid wear of double damask on laundering along lines near the selvedges but has also found a method modifying the cloth structure so as to enable it to withstand the laundry wear. The Launderers' Research Association has been responsible for tracing the cause of the development of holes in collars for which ordinary wear could not account and, as a sequel, for co-operation with the manufacturers to eliminate the defect. Moreover, the arrangement by which certain manufacturers have agreed to submit new fabrics to the Association for examination of the laundering properties before putting them on the market is one the importance of which to the public is obvious.

Through the work of the Department, science is contributing not merely to industrial efficiency and safety, to public health and safety and social welfare, but also to a steady rise in the general standard of living and in the quality of the service rendered by our interdependent industries.