New Methods of Research in Aeronautics

THE twentieth Wilbur Wright memorial lecture, delivered before the Royal Aeronautical Society by Mr. H. E. Wimperis, on May 26, under the above title, is of twofold interest to scientific readers. It gives an account of the work now in progress in aeronautical research. It also includes a more abstract discussion upon the aims of aeronautical research in Great Britain, the difficulties that confront it—not the least of which are those of finance—and the methods by which it is hoped they will be overcome.

Mr. Wimperis began by commending the methods of the Wright brothers as being the soundest in scientific research. They " made thousands of tests . . . and tabulated thousands of readings ". Few persons actually engaged in research will quarrel with that commendation. The paper then describes the organisation of aeronautical research in Britain, and pays tribute equally to the progress made by the scientific workers and to the aircraft industry's ability in utilising information so obtained. Mr. Wimperis scarcely gives full credit to Britain for its relative contribution to the world's aeronautical knowledge ; in fact, he more than once apologises for the inadequacy of the equipment, both in use and proposed. It is hoped to be able to use this limited amount of apparatus for the unhindered solution of various problems, by skilful adaptation, and extending results so obtained upon a basis of mathematical and physical reasoning.

The new British compressed air tunnel will be able to obtain a Reynolds number 1·93 times that of the only other one in existence in the U.S.A., by working at an air pressure of 25 atmospheres. The solution of many of the problems met in the course of the development of this apparatus has been very materially helped by the full and free communication of all available information from the National Advisory Committee for Aeronautics in America. Incidentally, the policy of delaying the building of this tunnel until the U.S.A. Committee had fully explored theirs has been fully justified, and the truly international aspect of scientific research, when unhampered by political affairs, is emphasised.

The large wind channel to be erected at the Royal Aircraft Establishment at Farnborough is to be only 24 ft. diameter, against the 60 ft. × 30 ft. cross seetion of a similar one in America, and will use 2000 h.p. for air propulsion, as compared with 6500 h.p. in the large American tunnel. It will thus be cheaper both in first cost and running expenses. A 24-ft. tunnel can be used to investigate all problems that must inevitably be so done, that is, those incapable of being attacked by direct full scale experiments during flight. These are all connected with the central part of an aeroplane, principally the cooling of engines, resistance of the body and its parasitic parts, and the investigation of airscrews. Problems upon the behaviour of the actual wing structure can be, and have been, successfully measured in full scale flight on a special Parnall research monoplane, and such results can be added to those found in the tunnel for the more complex parts around the body.

A vertical wind tunnel for the investigation of spinning is also described. The air in this moves upwards, so that the spinning model, while falling relative to the air, is actually kept in the plane of observation and measurement by the operator. These experiments raise extremely complex problems upon the validity of transferring results from models of one size to another, or comparing results at different speeds, because of differences in mass, moments of inertia about various axes, etc. The effect of the sudden movement of control surfaces is reproduced by a delay action mechanism incorporated in the model.

The visual examination of air flow has obvious uses in aeronautical research. This is accomplished by the introduction of smoke from titanium tetrachloride for slower speeds. For higher speeds, shadowgraphs are taken from air heated by passing it across an electrically heated wire and viewing the model in its wake, either stroboscopically or photographically. When conditions are analogous, water can be used, and the motion examined either by watching illuminated oil bubbles or by focusing a microscope upon ' objects ' in the water.

Experiments upon the suppression of noise are of interest not only for themselves, but also for the necessary development of the technique of the measurement of noise in 'decibels'. Considerable progress has been made in the insulating of the interior of an aircraft cabin from noise, but not so much upon the suppression of the noises at the source.

An ambitious programme of work on flying boat hulls and floats is outlined for the new tank at the R.A.E., Farnborough. Although the size of the tank is being limited, it is hoped to investigate all that is necessary by examining the behaviour of the model during the inevitable acceleration and deceleration in each run. It so happens that these are the two periods of greatest interest to designers, as the only parts of a seaplane's normal travelling life on the water are spent in either of these operations. Here again there will be considerable mathematical difficulties concerned with problems of mass, acceleration, and dynamical similarity.

The address concludes with a tribute to all those who have been concerned with the work of producing and handling machines for the Schneider contest. Mr. Wimperis expresses his satisfaction that these competitions have now automatically ceased, as the risk to the flying personnel was out of all proportion to the value of any results likely to be obtained from the mere further increase of flying speed alone. Nevertheless, the value of the technical progress that has been made in this respect is not to be underestimated.

Early Maya Culture in Northern Yucatan *

COBÁ, if only on account of its size, is one of the most important centres of culture in the Maya area of Central America. If, and when, its ruins are excavated, it is not improbable that it may prove crucial in the solution of a number of obscure problems connected with early Maya colonisation in northern Yucatan. Since its ruins were discovered in 1926 by Dr. T. W. Gann—it was not then known that it had been visited by Teobert Maler in 1891 five further expeditions of the Carnegie Institu ion have been engaged in exploration and survey work on the site.

Cobá, which is situated in the Mexican province of Quintana Roo in the north of the Yucatan Peninsula,

* A Preliminary Study of the Ruins of Cobá, Quintana Roo, Mexico. By J. Eric Thompson, Harry E. D. Pollock, and Jean Charlot. (Publication 424.) Pp. vii+213+18 plates. (Washington, D.C.: Carnegie Institution, 1932.)

about 100 miles east of the ancient Maya city of Chichen Itzá, and has the largest assemblage of buildings, with the exception of Tikal, in the Maya area, is one of the few sites of which the ancient name is still known to present-day Indians. Vestiges of ancient cult and ritual still linger on before its stelæ; while the deities of Cobá are venerated in bee-keeping and first-fruit ceremonies in distant villages, where the inhabitants assuredly have no knowledge of the present-day ruins of Cobá.

The site of Cobá was especially favourable for Maya colonisation, owing to the propinquity of an ample supply of surface water in a chain of lakes, and a plentiful rainfall, which fostered the growth of vegetation and the pursuit of agriculture.

The area which has been mapped up to the present covers 9 km. from north to south and 5 km. from east to west.

To the south the ground is still unexplored, and more ruins may yet be found there. Of the surveyed area, the northern part is literally covered by ruins. Between the main groups of Cobá and Nohoch Mul there is an almost unbroken succession of mounds, culminating in a group of considerable importance associated with Nohoch Mul. The shores of Lakes Cobá, Macanxoc, and Sacakal are surrounded by mounds which, excluding those of the last-named lake, form one great site, 3·5 km. by 2 km.—certainly one of the largest in the Maya area.

One of the most striking features of Cobá is the network of artificially constructed raised roads connecting the various groups about the lakes and running off in all directions to distant sites. One of these leads to Yaxuná, a distance of 100 km., terminating only 20 km. from Chichen Itzá. These roads are raised above ground-level and, for the most part, run perfectly straight. They are built of vertical slabs of roughly dressed stone, with an inside fill of large stone, covered with smaller stone. A fine plaster surface has now weathered away.

Broadly speaking, the ruins of the Cobá district fall into two classes of construction, a superior and an inferior, which, while not differing radically, exhibit certain variations in quality of workmanship and design. A preponderance of the buildings shows a closely connected court type of assemblage with a fixed scheme of orientated groups. The Macanxoc groups, however, abandon the orientation. Such compact assemblage finds its most common expression in the Peten region of Guatemala at Tikal, Nahum, and similar sites; while Uaxactun shows a tendency to separate groups, though still with an orderly scheme of arrangement of buildings, definitely related to one another. Notwithstanding the difficulty of drawing parallels between Cobá and other areas, there are certain distinctly marked affinities with the 'Old Empire' centres to the south, which is borne out by the analysis of the art of Macanxoc, for which Mr. Jean Charlot has been responsible. At the same time, there is sufficient evidence of independence in development, especially in the unique character of the complicated system of artificially made roads, to suggest a long period of growth locally, and even possibly several occupations.

At one time or another, no less than fifty monuments have been discovered at Cobá. Of these, twenty-four are carved, twenty-three being stelæ and one an altar. The stelæ at Cobá and Macanxoc are placed in 'shrines'—stone structures consisting of a platform with back walls and short projecting side walls. Structures of this type have not been reported from any other Mayan site. It is possible that they were roofed over with thatch.

Some of the stelæ are dated in the Maya notation. Of these, the earliest is of some importance in its bearing on the spread of Maya colonisation into northern Yucatan. Hitherto it has been held, on the authority of a statement in the Book of Chilam Balam, that Chichen Itzá marks the first Maya intrusion into the area. This is dated at an equivalent in the Christian system of A.D. 452; but a dated monument at Cobá gives a date equivalent to A.D. 353, making this site at least a hundred years earlier; while the evidence of the development of style in architecture and art suggests that the original settlement was considerably older. A series of dates is now known from the three cities of Tuluum, Ichpaatun, and Cobá, ranging from A.D. 314 to 353, which points to a movement along the east coast of Yucatan, of which the terminal was Cobá, and the place from which it originated in the 'Old Empire' area of Peten, possibly at Naranjo, though on the evidence of affinities in art, Mr. J. Charlot thinks it possible that the site of origin may still await discovery.

Sunspots, Planets, and Weather

ONE of the most interesting problems of meteorology is the relation between sunspots and terrestrial weather. In most parts of the world, including the British Isles, the relation is too complex to be readily demonstrable, and the number of unknown factors too great for it to be of use in forecasting, but in a few areas, for one reason or another, the control by sunspots becomes dominant. Mr. Inigo Jones, Director of the Bureau of Seasonal Forecasting in Queensland, believes that Australia is one of these areas under solar control, and in a recent presidential address to the Queensland Astronomical Society* he quotes a number of examples.

Mr. Inigo Jones carries the problem a stage further, however, seeking beyond sunspots for their causes. The sunspot cycle, striking as it is, is not perfectly regular, and the dates of maxima and minima cannot be forecast exactly. He believes that this cycle is caused by the movements of the planets; it is dominated by Jupiter, which has a periodicity of 11·86 years, but irregularities are caused by Saturn and to a less extent by Uranus and Neptune, and these introduce additional cycles which reduce the average length to 11·1 years. Hence he seeks for the explanation of abnormal weather not only in the sunspots themselves but also in the conjunctions of the planets. Especially important is the conjunction of all four, which occurs at intervals of 164 years and is often associated with world-wide climatic disturbance and severe famines.

The way in which sunspots operate is still a mystery, but there are many indications that the greatest effects take place high in the atmosphere, in the ozone layer, the conducting layers, and the auroral zone, and the surface effects may be of a secondary nature only. Mr. Inigo Jones describes a possible mechanism as follows: "Cyclones to which our heaviest rains are attributable are caused by discontinuities between air masses having different temperature and moisture contents, and it is clear that any upper air changes must accelerate such differences, and further, the fact that sunspots by their emanations disturb the upper air and so suddenly intensify these differences, shows easily how it is that the effect is produced, and at the initiatory or terminal stage of each sunspot's visibility". More prolonged effects may take place through the action of ozone, and investigations which

* "Seasonal Forecasting." Brisbane, 1931.