AERO RESEARCH. LTD.: TWENTY-FIRST ANNIVERSARY

THE firm of Aero Research, Ltd., at Duxford, Cambridge, owes its inception in 1934 to the urge of a university man—Dr. N. A. de Bruyne, at that time a Fellow of Trinity College, Cambridge—to carry out his own applied research work. This type of firm is probably commoner abroad than in Britain, although the Cambridge Instrument Co., Ltd., may be cited as another example.

During the first few years of its life as a small research unit, it pioneered a number of developments that have since proved their worth. These include structural materials for aircraft, honeycomb structures (British Patent 577,790 of 1938), the analysis of sandwich stabilization (*J. Roy. Aero. Soc.*, **44**, 1; 1940) and the conception and realization in 1941 of the technique of metal-to-metal glueing for aircraft structures. This work on metal-to-metal adhesives called for both an investigation of the problems of adhesion (see, for example, *Aircraft Engineering*, **16**, 115, 140; 1944. *J. Sci. Instr.*, **24**, 29; 1947. *Research*, **6**, 362; 1953) as well as the production problems presented by its almost immediate application in the de Havilland Hornet fighter. The techniques developed at that time remain the basis of the widespread use of 'Redux' glue in modern civil aircraft. The report on the Comet aircraft accidents unequivocally exonerated this method of construction and, in view of the conclusions reached by the inquiry, its use is to be welcomed as a method of reducing stress concentrations (Duncan, W. J., *Engineering*, **179**, 196; 1950).

In all its projects the company has consistently emphasized the need for the research man to follow through to the final application of his work, as evidenced even in 1934 by the building of a complete aeroplane to demonstrate the value of concepts, such as Wagner's tension field analysis, that were new at that time (*R. and M.* 1694).

On the outbreak of the Second World War the company made for the Ministry of Aircraft Production thirty Miles Magister tail-planes, and a Spitfire fuselage of plastic material; their performance on test (including flight trials of a tail-plane) was entirely satisfactory, but as the shortage of light alloys was overcome, the need for substitutes disappeared. With the rise in aircraft speeds that has since taken place, however, interest in plastics for aircraft has considerably revived. A war-time development that considerably accelerated the production of wooden aircraft and gliders was the 'strip heating' process for which the Royal Commission on Awards to Inventors made an *ex gratia* award.

Until 1946 the company had been wholly owned by Dr. N. A. de Bruyne, but in that year a majority shareholding was taken up by Ciba, Ltd., the world-wide organization known for its research in dyestuffs, pharmaceuticals and plastics. Under an arrangement with Ciba, Ltd., Aero Research, Ltd., continued under its own board as an active research centre, as well as becoming a large production unit for 'Araldite' epoxy resins and the 'Aerolite' urea formaldehyde adhesives which the company had been making since 1937.

The recent visit of H.R.H. the Duke of Edinburgh on April 20 provided a fitting occasion to celebrate the twenty-first birthday of the company by a display of research and production, including some of the new high-temperature adhesives which are now under development.

FATIGUE IN METALS

AT a joint meeting in the Clarendon Laboratory, Oxford, on April 15, of the Oxford Local Section and the Metal Physics Committee of the Institute of Metals, the morning session was devoted to a discussion on "Fatigue". Prof. G. V. Raynor (Birmingham) presided, and invited papers were given by Dr. N. Thompson (Bristol) and Dr. J. Holden (National Physical Laboratory, Teddington). Dr. Thompson first mentioned the usual analysis of a fatigue experiment into three stages, consisting respectively of a period of rapid work-hardening, a long secondary stage in which local deformation may increase slowly but nothing much seems to happen, and a short third stage in which a crack is rapidly propagated, leading to failure. In contrast to this, recent work suggests that the formation and growth of the crack occupy a considerable part of the second stage, and Dr. Thompson devoted most of his introductory talk to a discussion of the evidence for what he described as this still slightly heterodox view.

In specimens containing notches, it is generally accepted that a crack may be present from an early stage in the fatigue life. The difficulty here is to explain why this crack does not spread rapidly, and no very convincing reason has yet been given. In plane specimens, without deliberately introduced stress raisers, cracks are not normally visible until just before failure. A theoretical model, due to Head, suggests that the length l of a crack is given by a formula of the type

$$l^{1/2} = 1/A(N_{\infty} - N)$$

where N is the number of cycles, and N_{∞} the number of cycles to failure. The rate of growth of the crack is thus proportional to $l^{3/2}$, and since this varies so rapidly, it is possible that for a large part of its life the crack may be too small to be visible. The few experimental measurements which have been made are in agreement with Head's equation.

Dr. Thompson next mentioned some experiments by Sinclair and Dolan, in which fatigue tests on α-brass were interrupted every 20 per cent of the estimated life in order to give the specimen a half-hour annealing treatment at 400° C. These anneals had no effect on the fatigue life, although the specimen was completely resoftened at every stage. Sinclair and Dolan suggested that the only type of defect which would survive the annealing treatment was a small crack, which must thus have been formed in the first 20 per cent of the life. Similar experiments at Bristol in which copper specimens were annealed