

# Cranfield's Flight-Test Symposium

ON Thursday and Friday, April 7-8, over 200 people attended a symposium on flight-test instrumentation at the College of Aeronautics, Cranfield. They included representatives from aircraft firms and instrument manufacturers having connections with this specialized branch of aeronautical engineering, and overseas delegates from Australia, USA, Holland and France.

Many delegates commented on the timely nature of the symposium; with new-generation aircraft such as the TSR.2, D.H.121 and Bristol 188, a radical change is taking place in the techniques associated with prototype flight-testing. A great deal of interest was shown in radio telemetry and magnetic-tape recording as being the only airborne data-acquisition systems which would provide the answer to the problem of the large number of quantities to be measured in these aircraft.

The meeting was sponsored by the Department of Flight at the college, and the papers were arranged to cover a wide range of subjects including transducers, recording techniques, data handling and analysis, and future flight-test requirements based on research being carried out in Ministry establishments. The full list of papers was printed in the April 8 issue of *Flight*.

The present trend in the number of measurements to be made was illustrated (see diagram) by T. Kerr of Aero Flight, RAE Bedford. Tracing events back to the early 1900s when flight testing was carried out by a sensing element known as "seat of the pilot's pants," he was able to show the tremendous increase since then in the number of measurements required.

There is certainly a limit to the amount a pilot can be asked to do in a modern aircraft. One way of helping him, and an argument that was put forward as a case for telemetry, was described in a paper by T. Heffernan of A & AEE, Boscombe Down. During the spinning trials of the Scimitar, he related, certain information was telemetered to the ground and another pilot familiar with the aircraft was able to re-orientate the pilot in the aircraft during the spin, if necessary, by using this information. The telemetered quantities were airspeed, altitude, rate of roll, rate of yaw, and aileron and rudder angles.

Although this seemed a convincing argument for the use of radio telemetry, some delegates were doubtful as to whether it would form the sole method of obtaining accurate flight data. It certainly performs a useful monitoring function, however, and W. L. Horwood and J. Walsh (Radio Department, RAE) indicated how this monitoring function could be improved to provide a complete data-acquisition system.

On the question of accuracy, however, D. M. Ridland (RAE, Bedford) surprised many delegates by showing the order of accuracy required to evaluate aircraft transfer functions. Typical values for the longitudinal case were:—

	Range	Resolution required
Elevator	4°	0.0067°
Incidence	2°	0.0033°
C.G. acceleration	1g	0.0017g
Rate of pitch	14°/sec	0.0233°/sec

Instrument designers and manufacturers must obviously strive for an order of accuracy higher than that currently accepted for flight testing. Mr Ridland thought that this could not be achieved with electronic aids and black boxes, which he seemed to distrust. This opinion caused a certain amount of argument, especially in view of remarks by D. A. Drew of Rolls-Royce that the flight-test engineer of the future must be a qualified electronics engineer.

Two instruments which are capable of the above order of resolution were described by W. R. Macdonald (RAE Farnborough) and W. Horath (SFIM, France). The force balance principle or, as it is sometimes called, the servo transducer, can give as an accelerometer a range coverage of  $\pm 0.01g$  to  $\pm 10g$

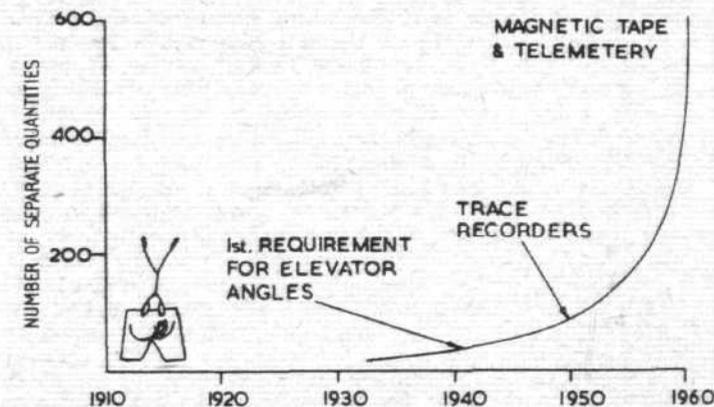
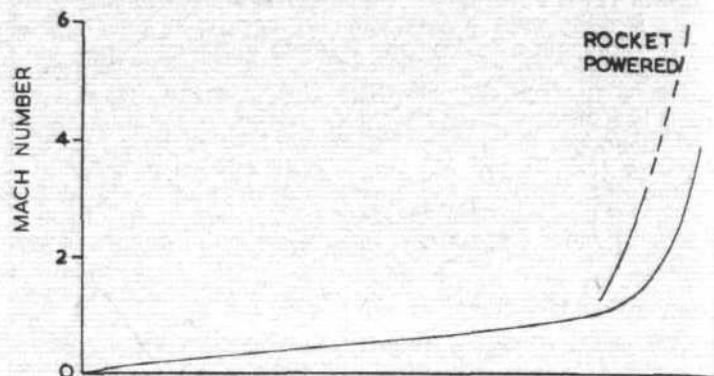
*Airborne units of the Ampex AR200 all-solid-state magnetic tape-recording system, displayed at the Cranfield symposium*



full-scale in one instrument with, according to Mr Macdonald, extremely high stability in its dynamic behaviour. These transducers have been used in the USA and also in Holland, according to T. Van Oosterom of NARI, Amsterdam, for in-flight thrust measurement.

M Horath gave details of the design and performance of a semi-floated rate gyroscope with an extremely good threshold performance and which incorporated a novel multipole inductive pick-off. One instrument nominally rated at  $\pm 20^\circ/\text{sec}$  full-scale with a resolution of 0.001 per cent and a natural frequency of 30c/s had a linear range extending to  $120^\circ/\text{sec}$ .

The Instrumentation Department of RAE Farnborough was well represented at the symposium. Dr G. E. Bennett gave a review of the techniques of magnetic tape recording and the scope



Variation of number of measured quantities with time (from paper by T. Kerr), from seat-of-pants days to the present

of its application to aircraft flight-testing, considered in terms of data capacity, data bandwidth and accuracy. He also showed a new tape deck designed by RAE to an SBAC specification, and demonstrated the miniaturization possible in the associated electronics. These modules were completely transistorized and formed part of a miniature tape-recording system for ballistic missiles.

The capacity of a magnetic tape system was shown by P. Bellerby of Blackburn Aircraft; in the case of the NA.39, he said, 107 quantities ranging from wing strains to airspeed and altitude were recorded on one machine.

Twenty exhibitors at the symposium, including Ministry establishments, showed items ranging from complete radio telemetry systems for aircraft to miniature differential pressure transducers just over one half-inch long. The highlight of the show was the first appearance in this country of the new all-solid-state airborne tape-recording system by Ampex (see photograph). At the informal dinner which concluded the meeting, guest speaker F. W. Page (English Electric), chairman of the SBAC aircraft data-reduction committee, stressed the need for a closer liaison between design and flight-test departments.

The general feeling among delegates and organizers was that the symposium had proved a great success in bringing together flight-test engineers and the designers and manufacturers of instruments. In addition, Cranfield was able to show its own current work in the field of flight-test instrumentation. It seems probable that this symposium could become an annual or bi-annual event in the aeronautical calendar. Proceedings of the meeting may be published if there is sufficient demand, and enquiries should be addressed to M. A. Perry, Department of Flight, The College of Aeronautics, Cranfield, Bletchley, Bucks.