Mr. Stagg:
Herewith dope on Testing Comet Wing etc., as supplied to the Press yesterday (WED. 20th).

Structures H/H.173/3

PRESS VISIT TO R.A.E.

on 20th January 1954

Programme

1. Conference Room

   (a) Reception and introduction by Director Mr. A. A. Hall

   (b) Introductory talk by Dr. P. B. Walker

2. Fatigue Laboratory

   (a) Component testing. Machines in operation.
   Display of broken components.

   (b) Wing testing by vibration methods
   Meteor tailplane representing small wing.
   Remains of York testing rig. Cold box simulating high altitude.

3. Tonks Terrace Fatigue-Testing Site

   Complete aircraft (Comet prototype) being tested by "slow-loading method.

4. Accident reconstruction hangar

   Comet wreckage from Calcutta accident assembled for accident investigation.

Structures H/H.173/3/PBW 20th January, 1954.

PRESS VISIT TO R.A.E.

(20th January 1954)

Two examples of work at R.A.E. on aircraft structures are being shown. Both are directed towards achieving a high standard of safety for British Civil Aviation. In other respects they are widely different. One is concerned with structural fatigue and the prevention of accidents from this cause. The other is concerned with the investigation of an accident that has already occurred and which has probably nothing to do with fatigue.

I. Fatigue

(a) Gusts

Fatigue is produced mainly by gusts or bumps as the aircraft proceeds through the air. Sometimes the wings are forced upwards and sometimes downwards. Usually these bumps are not severe and are well within the limits of structural strength, though passengers may notice them and air-sickness may result. The structure, however, while never resenting these bumps individually, has a long memory; and after too much of such treatment may show its resentment by what is known as fatigue failure.

In the prevention of fatigue failure the first objective is to measure the gusts or bumps that are the cause of the trouble. In recent years a new instrument called the counting accelerometer has been invented and developed at R.A.E. This not only counts the gusts but also grades them according to severity. With this instrument all British Air Routes have been surveyed for practically every British Civil type of aircraft in regular use. There is also another instrument that has only just been perfected. This is known as the "fatigue meter", and could be permanently fitted as supplies become available to every individual aircraft. It will record each aircraft's life history in terms of bumps.

(b) Fatigue tests on components

The main safeguard against fatigue failure is a limitation on flying life that is rigidly imposed by the Air Registration Board, the aircraft being withdrawn from service after its "safe" life is deemed to have expired. Calculations of life are based upon the gust measurements just mentioned and upon tests of specimens of the actual structures. All the main components, especially joints, of all Civil aircraft are fatigue tested to destruction, and the tests are repeated on at least six specimens of each component.

The R.A.E. have two component testing machines in continuous use. In each of these machines a heavy reciprocating load is applied by heavy weights vibrating on powerful springs. This reciprocating load is superimposed on a steady load corresponding to steady level flight. For all practical purposes the component is loaded as if in flight.

There is just one difference. The test takes place much faster, and one second in the test is equivalent to about one hour of flight. This speeding up is a great advantage since the fatigue life can be determined early in the operating life of a type.

The R.A.E. has not a monopoly of this kind of work. Civil aircraft firms are also testing, and R.A.E. is the focal centre of what has become a major contribution towards guarding against fatigue failure.

(c) Fatigue testing of wings and complete aircraft

In addition to testing components such as joints the R.A.E. tests complete wing systems and even complete aircraft. These tests have an entirely different function. They may be of direct value to the particular type experimented upon, but the information needs to be interpreted by scientists and the testing is never a pure routine.

Two quite different techniques have now been evolved. In the first the wings are made to vibrate naturally. No springs or weights are required, these being provided by the structure itself. The R.A.E. have tested sixty identical Meteor tailplanes to destruction by this method. These tests have nothing to do with the Meteor, since the tailplane was treated as a small-scale wing and loaded accordingly. Exhaustive research was carried out on these lines, including tests at low temperatures such as occur at 40,000 feet. The technique culminated in a test by the vibration method of wings of the York aircraft, with a span of

110 feet.

The difficulties in testing wings of large span - the first fatigue failure in the York test was in the testing rig and not in the aircraft - led to another method which is often preferred. In this the loads are applied by hydraulic rams which automatically go up and down. This method is known as the "slow-loading" method, but the term is relative, since one minute of testing time is equal to about one hour of flight.

The Comet aircraft is being tested at R.A.E. at the present time by this method. The aircraft is a worn out prototype and is not representative of the Comet in operational use. Nevertheless very useful scientific information is being obtained, and the test will continue indefinitely until it is quite beyond repair.

II. Accident Investigation

At about 11.05 hours GMT (16.35 hours IST) on 2nd May 1953 Comet Aircraft G-ALYV crashed near Calcutta with fatal results to all on board. After the formal inquiry by the authorities in India, a large proportion of the parts, collected over an area of many square miles, were sent to R.A.E. by Air. Other parts were sent later on request.

The R.A.E. then began their task of re-construction which continued for several months. The parts are laid out on the floor of a special hangar, as far as possible in their correct relative positions corresponding to an unbroken aircraft.

The accident investigation in this case followed well-defined lines. The position of every part as it fell on the ground was plotted on a map. From this it was possible to deduce the order in which the parts broke away. Scratches, and dents, and paint marks on the broken parts were then examined for further clues to the sequence of failure. The presence of fire which gutted the main wreckage rendered the task more difficult, but even this was turned to advantage in one respect. To the deductions drawn from dents and scratches was added those derived from blistered paint, burned surfaces and smoke marks.

As a result of this reconstruction and analysis, lightning strike and explosion were dismissed as causes of the accident. Fire was shown to be secondary, having occurred following the structural failure and as a result of it. The sequence of failure was also established: first one tail plane then the other, followed shortly by one wing and then the other. The investigation proceeds to try to find what led to these events; no structural weakness in the aircraft has been found, and it therefore seems that either some event occurred which led the aircraft into a very abnormal condition of flight, or that it encountered weather which would have broken any aeroplane.