REPORT OF THE COMET INQUIRY.

But, says the report, the number of pressurizations sustained was so large that, in conjunction with the numerous other tests, it was regarded as establishing the safety of the Comet's cabin with an even greater margin of safety.

Meanwhile (on May 2nd, 1953) Comet G-ALYV had crashed in a tropical storm of exceptional severity near Calcutta. Fatigue failure of the cabin was then suspected as a cause and, in the Comité de Récupération, subsequently a series of tests were made for doubting the conclusion of the Indian Court of Inquiry — i.e., that the accident was caused by structural failure resulting from severe gusts, or over-controlling or loss of control by the pilot.

The report next considers the circumstances of the accident to G-ALYV off Elba. Immediately on receiving news of the accident the R.A.C. suspended Comets from passenger service for the purpose of making a detailed examination of the aircraft in collaboration with the A.R.B. and de Havilland. To this end a committee was set up under the chairmanship of Mr. C. Abell, deputy operations director (engineering) of B.O.A.C. and composed of representatives of the A.R.B., B.O.A.C. and de Havilland. This committee decided that possible main causes of the accident were as follows: —

1. Flutter of control surfaces.
2. Primary structural failure with particular emphasis on the possibility of abnormally high loads caused by gusts; malfunctioning of the power controls; fatigue; explosive decompression; and engine trouble, with particular emphasis on possible fire.

As a result of the first two inspections and tests which followed the meetings of the committee a large number of modifications were made. The possibility of in-flight failures was, accordingly, considered as much the likeliest type of failure of the cabin fatigue, and the only recommendations specifically directed to fatigue related to the wing. One modification and two special inspections were called for. At about the time of the Elba accident, additional cracks had appeared near the edge of the wheel wells on the under-surface of the first prototype Comet wing, which was then under test at Farnborough, after the equivalent of about 6,000 flying hours. In February, 1954, the chairman of B.O.A.C. forwarded to the Minister of Transport and Civil Aviation a report on the inspections, investigations, modifications and other work carried out in the preceding four months; in the covering letter that, on the assumption that no further indication of the cause of the accident emerged before completion of the inspection and modification work, B.O.A.C. considered that all such steps as were possible before putting the aircraft back into passenger service would have been taken. Lord Brabazon, chairman of the A.R.B., wrote to the Minister on April 4th that "when these modifications are completed and have been satisfactorily tested the Board sees no reason why passenger services should not be resumed."

Meanwhile, the Minister, who had not revoked the Comet's C. of A. on March 15th, 1953, instructed Mr. A. R. Arnold, the Director of the R.A.E., to use all the resources at his disposal to perform a complete investigation of the whole problem presented by the accidents. On April 18th Sir Arnold decided that one of the lines of inquiry to be followed was a repeated-loading test of the whole cabin in a specially built water tank. At the same time, the Minister gave permission for flights to be resumed and the first Comet to return to passenger service took the air on March 23rd.

Decision to Tank-test

Comet G-ALYY, operating a S.A.A. service from Rome to Cairo, was lost near Naples on April 8th, 1954, whereupon the Minister of Transport and Civil Aviation, having announced the withdrawal of the Comet's C. of A. on April 12th, instructed Sir Arnold Hall, the Director of the R.A.E., to use all the resources at his disposal to perform a complete investigation of the whole problem presented by the accidents. On April 18th Sir Arnold decided that one of the main lines of inquiry to be followed was a repeated-loading test of the whole cabin in a specially built water tank at Farnborough. The R.A.E.'s interest in the possibility of primary failure of the cabin was inflamed so particularly by the similarity of the circumstances of the two accidents (each of which had occurred as the aircraft neared the top of its climb) and by the fact that the post-Elba modifications seemed to rule out many of the possible causes.

Repeated-loading tests on Comet G-ALYU began early in June. Fluctuating loads were applied to the wings and one application of cabin pressure was applied for a total equivalent of approximately 1,000 "flights"? there was a proving test in which the pressure was raised to 11 P (11 lb/sq in). Before the test Comet YU had made 1,250 pressurized flights, and after the experiment the equivalent of 1,830 such flights had been done. The test was designed to show the starting point of the failure being the corner of one of the cabin windows. The fact that it failed during one of the proving tests at 11 lb/sq in was not thought to be significant, since the crack would have spread in much the same way after a few more applications of working pressure.

Certain sources of fatigue — e.g., vibration due to irregular airflow, vibration due to engines and jet efflux and fluctuating loads due to landing take-off cycles — during take-off and landing. The report notes that the test fuselage would have a longer fatigue life than one in actual service, and estimated that YU's life of 3,060 flights might be equivalent to about 2,500 in practice.

The first inference suggested by the tank test was that the primary failure of G-ALYU was the bursting of the pressure skin near the port window.

Experiments were conducted to discover the probable path of fragments after disintegration caused by pressure-cabin failure, and as a result of these experiments the salvage operations off Elba were re-orientated.

The second inference of the tank test was that the pressure cabin had a much shorter fatigue life than previously estimated. Accordingly G-ALYU was repaired and again subjected to proving tests at 11 lb/sq in was not thought to be significant, since the care had been taken off before failure therefore low. At the time of the Elba accident YP had made 1,290 pressurized flights and at the time of the Naples accidents YY had made 900 pressurized flights.

The report accepts the R.A.E.'s conclusion that the first fracture occurred near the rear A.D.F. window and spread forward and aft from there. There were two potential starting points for the crack: a countersunk hole, near the starboard aft corner of the window; and a "manufacturing crack" (i.e., a crack drilled at its ends to prevent spreading) near the port forward corner of the same window. "I do not consider it possible," Lord Cohen states, "to establish with certainty the point at which the disruption of the skin first began"; but since the existence of fatigue cracks was undeniable the point at which the skin first began was established this was the more probable point.

The report outlines the history of the recovery and investigation of G-ALYU's four Ghost engines. It accepts the conclusion of the Abell Committee that B.O.A.C. had been right in doubting the conclusion of the Indian Court of Inquiry — i.e., that there was no failure of any part of any engine which could have been the cause of the accident.

Turning to the question of the cause of the Elba accident, Lord Cohen states that he is not prepared to accept the conclusion of the R.A.E., namely that the cause of the accident to G-ALYU was the structural failure of the pressure cabin brought about by fatigue. He then deals with suggestions that other causes might have brought about the accident.

Mr. D. Jablonsky contended at the inquiry that failure of the Redox bonding used in the construction of the Comet might have caused disruption of the cabin. The Commissioner states that he was not satisfied in rejecting Mr. Jablonsky's theories.

The chief technical officer of the A.R.B., Mr. Walter Tye, said at the inquiry that he was not satisfied that fatigue was the cause of the cabin failure. He appears, the report says, to have been impressed by the improbability of both the R.A.E. and of any other possible cause of the accident. Lord Cohen writes that Mr. Tye's caution is understandable, as he will be responsible for advising the Government on questions affecting the safety of aviation generally.

The report also rejects the possibility that the accident was caused of the failure of the Redox bonding or of any of the defects uncovered in the R.A.E. investigation — i.e., fatigue weakness in the wing skin; weaknesses in the fuel system causing possible escape of fuel during take-off or climb or during refueling; or possible cracks in the cabin skin caused by effects from the jet efflux. 

"I have unhesitatingly come to the conclusion that the R.A.E. were right."