

COPY

HER MAJESTY'S HIGH COURT OF TANGANYIKA
AT ARUSHA.

14th July, 1955.

REF. No.: AR/L/20.

THE COMMISSIONER OF TRANSPORT,
EAST AFRICA HIGH COMMISSION,
RAILWAY HEADQUARTERS, NAIROBI.

SIR,

I have the honour to refer to your letter No. TA. 13 of the 7th June, 1955, and to inform you that the hearing of the public inquiry into the causes and circumstances of the accident to East African Airways Corporation Dakota, Registration No. VP-KKH, which occurred on the 18th May, 1955, was concluded on the 8th July, 1955.

The hearing occupied five days and the Court of Inquiry sat in the Court House, Arusha, on each of these days.

I now send you herewith my report which has just been completed to-day. It has been signed by both Assessors to signify their agreement with it. Two copies of the report are also enclosed.

All the exhibits are being returned to the Legal Secretary to the High Commission, who has a copy of the transcript of the oral evidence and the addresses of counsel.

I could not have asked for two better Assessors than Captain R. S. Colvin and Mr. A. A. Black; it was a pleasure to work with them and their advice and expert knowledge were invaluable.

The case was most competently and clearly presented by the Legal Secretary to the High Commission and the Court is indebted to both the Directorate of Civil Aviation and East African Airways Corporation for much assistance.

I have the honour to be, Sir,

Your obedient servant,

(Sgd.) J. S. ABERNETHY,

Judge.

APPENDIX II

List of Representations

Mr. H. G. DODD appeared for East African Airways Corporation.

Mr. M. B. SUMMERSKILL appeared for the British Airline Pilots' Association and the personal representatives of the First Officer, the late Mr. M. Cairncross.

APPENDIX I

List of Witnesses

THOMAS RUSSELL THOMSON, Chief Operations Officer of the East African Directorate of Civil Aviation and also Chief Inspector of Accidents.

JAMES ANDERSON JOHNSTONE, Surveyor, Air Registration Board.

SYDNEY EDWARD COX, Flight Engineer, East African Airways Corporation, Dar es Salaam.

ROBERT JOHN BEACH, Station Assistant, East African Airways Corporation, Dar es Salaam.

DAVID MCCALLUM, Meteorologist in charge of Meteorology Department, Tanganyika and Zanzibar, Dar es Salaam.

HENRY REYNOLDS DAVIES, Air Traffic Control Officer, Dar es Salaam.

RONALD HARRY ANDERSON, Air Traffic Control Officer, Dar es Salaam.

BERNARD FITZ-JOHN, Air Traffic Control Officer, Eastleigh, Nairobi.

NICHOLAS MARCO LYAMUYA, a resident of Marangu, Moshi, Tanganyika.

RAYMOND CYRIL GRIFFIN, Airline Pilot employed by East African Airways Corporation.

JOHN WOOD, Air Pilot-instructor employed by Noon and Pearce Aircraft, Ltd.

THOMAS MAXTED, Senior Inspector employed by East African Airways Corporation.

PHILIP ELVIN HENN, Deputy Operations Manager and Deputy Chief Pilot, East African Airways Corporation.

LEO PATRICK HORGAN, Radio Officer, East African Directorate of Civil Aviation.

WILLIAM ALFRED WOODWARD, Radio Officer, East African Directorate of Civil Aviation.

IVOR JOHN HILLIKER, Forest Surveyor, Forest Department, Arusha.

GERALD MALCOLM DICKSON, Air Traffic Control Officer and Inspector of Accidents, East African Directorate of Civil Aviation.

JOHN ARTHUR CHANNON, Meteorological Officer in charge of Central Forecasting Office, East African Meteorological Department, Nairobi.

JOHN FRANCIS HALSALL, Radio Officer, Moshi.

JOHN GILBERT OAKLEY, Air Traffic Control Officer, East African Directorate of Civil Aviation.

JOSEPH JAMES FURNISS, Chief Telecommunications Officer, East African Directorate of Civil Aviation and Acting Director.

MALIN SORSBIE, General Manager, East African Airways Corporation.

JOHN DOW DUFF, Airline Pilot, employed by East African Airways Corporation.

The evidence of the following was given by affidavit:—

W. R. WILMORE, Aircraft Mechanic, South African Airways, Durban.

CHARLES ELTHAM KIDNER, Communications Officer, East African Posts and Telecommunications, Nairobi.

IVAN LLEWELLYN NICHOLAS, Airline Pilot, Central African Airways Corporation.

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appears that he did not show the regard for the safety of his aircraft and his passengers that could be expected from a man of his training and experience.

Question 4.—At the time of the accident:—

Question 4 (a).—Was there a valid Certificate of Airworthiness in respect of the aircraft? (*Answer.*)—Yes.

Question 4 (b) (i).—Was there a valid Certificate of Safety in respect of the aircraft? (*Answer.*)—Yes.

Question 4 (b) (ii).—Had the aircraft been properly maintained in accordance with the current approved maintenance schedules? If not, did any failure to maintain the aircraft in accordance with such schedules affect the safety of the aircraft or contribute to the accident? (*Answer.*)—Yes, except for two technical breaches of the regulations affecting the turn and bank indicator and the magnetic compass. Neither of these breaches of the regulations contributed to the accident.

Question 4 (c) (i).—Was there a valid Certificate of Serviceability in respect of the radio station of the aircraft? (*Answer.*)—Yes, in a form approved of by the Directorate of Civil Aviation.

Question 4 (c) (ii).—Was the radio station of the aircraft serviceable? If not, did any defect in the serviceability of the radio station affect the safety of the aircraft or contribute to the accident? (*Answer.*)—Yes. The second part of the question does not arise.

Question 4 (d).—Was the aircraft properly loaded and trimmed within the limits specified in the Certificate of Airworthiness? (*Answer.*)—Yes.

Question 4 (e).—Were all members of the crew properly licensed and adequately experienced to make the flight? If not, did any defect in the licence or in the experience of any member of the crew affect the safety of the aircraft or contribute to the accident? (*Answer.*)—Yes. The second part of the question does not arise.

Question 5.—Prior to departure from Dar es Salaam did the person in command of the aircraft file an I.F.R. Flight Plan? (*Answer.*)—Yes, through the First Officer.

Question 5 (a).—If so, did he depart from such plan? (*Answer.*)—Yes.

Question 5 (b).—Did he fail to notify such departure. (*Answer.*)—Yes.

Question 5 (c).—Did any such departure or failure to notify any such departure affect the safety of the aircraft or contribute to the accident? (*Answer.*)—In view of the close proximity of his track to Mount Kilimanjaro and the prevailing weather conditions it was essential for him to depart from his flight plan. No failure to notify his departure from his flight plan affected the safety of the aircraft.

Question 6.—Upon consideration of all facts disclosed by this inquiry, what steps, if any, should be taken with a view to avoidance of similar accidents in future? (*Answer.*)—The answer to this question will be found in the recommendations contained in Part XII of this report.

14th July, 1955.

(Sgd.) J. S. ABERNETHY,
A. A. BLACK,
R. S. COLVIN.

D/F bearings when flying near Kilimanjaro and compare them with their known position. The collection and analysis of this information would be a simple matter and the information thus obtained would be of inestimable value. Furthermore, if results showed no significant deflection of bearings the confidence of pilots would be restored.

(7) In consultation with the operating companies the Meteorological Department should consider the establishment of additional meteorological stations between Dar es Salaam and Moshi, which will provide regular reports on meteorological conditions, with particular reference to cloud development, over the Usambara and Pare mountains.

(8) Consideration should be given to the provision of regular twice-daily radio sonde/radar wind ascents at Nairobi and Dar es Salaam.

(9) The establishment of a pilot balloon station at Moshi for obtaining data on the effect of Kilimanjaro on the direction and velocity of the general air stream should be considered.

(10) In consultation with the operating companies and the Directorate, the Meteorological Department should make further efforts to obtain regular weather reports from aircraft in flight operating scheduled services.

(11) Immediate steps should be taken by the Meteorological Department to ascertain the present standard of accuracy of surface and upper-air observations. Ways and means of obtaining and maintaining higher standards should be considered. It is suggested that this may be achieved by a system of frequent inspections of out-stations by competent officers, a review of the initial training course for meteorological observers and the institution of regular refresher courses.

(12) Consideration should be given to the installation in East African Airways' Dakotas of a further magnetic compass of the magnesyn or gyrosyn type.

PART XIII—QUESTIONS AND ANSWERS

My answers to the questions submitted by the Legal Secretary to the High Commission are as follows:—

Question 1.—What was the cause of the accident? (*Answer.*)—The cause of the accident was that the aircraft collided with a mountain ridge running to the south-south-east of Mawenzi Peak, Mount Kilimanjaro, at an approximate position 37° 28' E., 03° 06' S.

Question 2.—If several factors caused the accident, what were such factors and to what extent was each contributory? (*Answer.*)—Several factors may have contributed to the accident, but the evidence provides only two certain factors—the amount of cloud around the mountain at the time of the accident and the fact that the aircraft was attempting, in so far as weather conditions permitted, to follow the direct route from Dar es Salaam to Nairobi laid down by East African Airways Corporation and approved by the Directorate of Civil Aviation, which brings aircraft dangerously near to the mountain. Both these factors were equally contributory to the accident.

Question 3.—Was the accident due to the wrongful act or default or negligence of any party or of any person in the employment of that party? (*Answer.*)—The Captain of the aircraft cannot be exonerated. He knew, or had the opportunity of ascertaining, the probable cloud and weather conditions between Dar es Salaam and Nairobi and, taking all the evidence into consideration, it

THE COLONIAL CIVIL AVIATION (APPLICATION OF ACT) ORDER, 1952

THE CIVIL AVIATION (INVESTIGATION OF ACCIDENTS) REGULATIONS, 1954 (High Commission for East Africa)

Report of the Public Inquiry held at Arusha into the causes and circumstances of the accident which occurred on the 18th May, 1955, to Dakota Aircraft VP-KKH

AIRCRAFT—

Dakota VP-KKH.

ENGINES—

Two Pratt and Whitney Twin Wasp R1830-90D

REGISTERED OWNERS AND OPERATORS—

East African Airways Corporation.

CREW—

Captain J. N. Quirk (killed).

First Officer M. Cairncross (killed).

Radio Officer A. P. Gregory (killed).

Steward H. W. Monaghan (killed).

PASSENGERS—

Sixteen (all killed).

PLACE OF ACCIDENT—

Mount Kilimanjaro, Tanganyika.

DATE AND TIME—

18th May, 1955, at about 12.25 G.M.T.

In this report "Directorate" means the Directorate of Civil Aviation for East Africa.

All times mentioned in this report are G.M.T. unless otherwise stated.

should be given within half an hour of take-off. The minimum information, and the form the message should take, is listed below:—

- (a) Method of determining position.
- (b) Position.
- (c) Time of observation.
- (d) Track.
- (e) Flight level.
- (f) Flight conditions.
- (g) E.T.A. at destination.

(4) Careful thought should be given to the question of whether or not pilots rely too much on visual fixes and dead reckoning. East African Airways Corporation operate a number of short-haul routes where, due to the surrounding terrain and lack of navigational aids, contact flying coupled with good map-reading is the safest and surest method. Their pilots have developed great experience in this type of operation and it is understandable and natural that they should, by the very nature of the routes they mainly operate, increasingly depend on this rather elementary form of navigation. Similar methods, however, should not necessarily be adopted on longer routes where stage lengths often exceed 300 nautical miles and sufficient radio aids are available to practise the art of navigation on a higher plane. Throughout the inquiry the Court gained the impression that the pilots do not make intelligent use of the radio aids available to them.

Navigational plotting, the fixing of position, wind-finding and the keeping of a reasonably comprehensive navigational log are problems in the limited confines of a Dakota's cockpit, where no chart-table is available on which to work; but it is possible, and every encouragement should be given pilots to do so, even when such work seems tedious and unnecessary.

It should not be overlooked that the Corporation's pilots are not assisted by specialist navigators and communications officers and regular check flights should equally test navigational competence as assess flying ability. It is suggested that the longer routes, especially those to Durban, should be used for navigational exercises and training and logs and charts handed in on return to Nairobi and a percentage check carried out.

(5) The present system whereby standard flight plans are accepted by air traffic control for internal flights should be discontinued. It takes but a short time for the captain or his first officer to report to the control tower and prepare a flight plan with due regard to the weather forecast.

(6) During the course of this inquiry much has been said about doubtful beacons and D/F bearings in the vicinity of Mount Kilimanjaro, but no factual evidence was forthcoming to substantiate these doubts. Many differing estimates were also given as to range under normal conditions. It is apparent that, because of these doubts, pilots do not make the fullest use of these aids. It must be most disappointing to the Directorate to hear that since the installation of their new V.H.F. D/F station at Moshi not once has a bearing been asked for. It may well be that local operators consider the siting and installation of this equipment is ill advised and that the money so expended could have been better used on the provision of an alternative aid elsewhere. If so, point is lent to the recommendation with reference to the formation of a permanent committee to discuss these matters.

Here is an opportunity for co-operation between local operators (especially East African Airways Corporation) and the Directorate to establish whether or not large land masses have an effect on radio emissions. Pilots should be instructed by their employers to obtain the maximum number of beacon and

the observations made at one station for several consecutive hours and the cloud types in relation to the present weather reported all suggest that the standard of observation by some observers is below that which is essential if forecasters are to make reasonably accurate forecasts and aircraft pilots are to be given a true picture of the prevailing weather conditions.

(b) *Upper Wind Observations*.—It has been brought out in evidence that the upper wind observations on which forecasts are based are made and computed by meteorological observers who are, in some cases at least, not properly qualified to carry out this work accurately. Furthermore, upper wind observations are not always being checked in any way prior to being issued to forecasting offices or at any time afterwards.

(7) Standard of Forecasting

In spite of the low standard of observation by the observers at some stations it is considered that there was no negligence or incompetence on the part of the duty forecaster at Dar es Salaam and that the meteorological briefing for VP-KKH was adequate and was efficiently carried out.

(8) Operations Manuals

Regulations were introduced in June, 1954, regarding the provision of operations manuals for the guidance and information of crews. East African Airways Corporation have not fully complied, giving as their reason that they are still in negotiation with the Directorate over some of the requirements with which they claim they are unable to comply. It is of overriding importance that the fullest route information should be readily available to pilots in an easily accessible form and there is no consideration that should prevent the introduction of these manuals at the earliest possible moment.

PART XII—RECOMMENDATIONS

(1) An advisory route Nairobi—Manyani—Tanga—Dar es Salaam should be introduced as soon as the proposed 1 kW. M/F radio beacon at Manyani has been installed and calibrated. In the meantime, and without delay, a temporary advisory route from Nairobi via Mombasa and Tanga to Dar es Salaam should be adhered to. When the beacon at Manyani is operative it is considered that this route will then be adequately guarded by radio aids.

(2) Consideration should be given to the formation of a permanent committee to discuss means whereby the safety of air traffic in the East African territories can be increasingly assured. Representatives of the Directorate, local operators and such Government departments deemed necessary should comprise this committee and their deliberations should centre on the possible introduction of further advisory routes where necessary, and the provision and siting of additional and more efficient M/F beacons, D/F services, etc. By regular meetings these matters could be kept under constant review.

(3) With the steady increase of air movements in East Africa the principle of "disciplined air traffic" is an essential requirement to safety, and it is considered that the Directorate should insist on greater compliance with the regulations governing flight in a Flight Information Region.

The present reporting procedure is inadequate and the use of fixed reporting points disregards the possible need for diversions due to factors outside the pilot's control. It encourages, in fact, pilots to give positions whether or not they are over those positions. A better method would be for position reports to be passed at fixed intervals of time determined by the initial report, which

INTRODUCTION

On 18th May, 1955, East African Airways Corporation aircraft VP-KKH left Dar es Salaam on the last stage of a scheduled flight from Durban to Nairobi and was airborne at 10.39 hours. Radio contact was maintained with the aircraft by approach control Dar es Salaam until it had reached a flight level of 5,000 ft. when communication and control were transferred to the Flight Information Centre at Eastleigh Airport, Nairobi. At 11.25 hours a message was received from the aircraft giving its position as Korogwe and its flight level as 10,500 ft. At 11.56 hours a message was received from the aircraft reporting its position as Lake Jipe, flying in visual flight conditions on top of cloud at the same height.

No further communications were received from the aircraft and at 13.00 hours inquiries as to the safety of the aircraft were commenced and "radio failure procedure" adopted.

Search and rescue action followed at 13.35, but it was not until 04.15 hours on Sunday, 22nd May, 1955, that wreckage lying high up on the south-east slope of Mawenzi, the eastern of the two peaks of Mount Kilimanjaro, was identified as the wreckage of aircraft VP-KKH.

An accident investigation team reached the scene, which was at a height of approximately 15,000 ft. above sea level, on the morning of 25th May, 1955. There were no survivors.

kilogrammes. On a statement made by the East African Airways Corporation station assistant at Dar es Salaam later, to the effect that the aircraft carried 600 gallons of fuel (instead of 500 gallons as shown on the load sheet), it was found that the centre of gravity of the aircraft was 256.44 in. aft of the datum point and the all-up weight 12,519 kilogrammes. On the Certificate of Airworthiness the limits for the centre of gravity are given as 239.6 in. to 263.1 in. aft of the datum point and the maximum weight 12,700 kilogrammes. The corrected figures are still within the limits set out in this Certificate and it is not considered that this error in any way affected the safety of the aircraft.

It would appear from the evidence that the Captain of VP-KKH signed the load sheet although he knew that he was taking 600 gallons of fuel.

(3) Fuel

The aircraft had ample fuel and oil for the flight and as samples taken from the bulk petrol tank and oil dispensary equipment were tested and found satisfactory it is considered that the supply of fuel and oil was quite adequate and up to specification.

(4) The Crew

The crew were sufficient in number. They were properly qualified in accordance with the regulations and sufficiently experienced to hold the posts they did. From the evidence as to hours flown prior to the last flight it is apparent that the crew should not have been suffering from fatigue.

(5) The Adequacy of the Meteorological Observation Network

(a) *Surface Stations.*—The direct route between Dar es Salaam and Nairobi lies very close to the Usambara and Pare mountains and Kilimanjaro, where orographic uplift may sometimes produce extensive cloud of considerably greater vertical development than over the plains. In order that a pilot may decide whether the weather is good enough to warrant a flight on the direct route he must be shown recent accurate weather reports from stations along or near the route, or be given a forecast which is based on recent weather reports from such stations. The meteorological station at Amani reports at 06.00 and 12.00 hours only. Apart from Moshi, which reports regularly several times per day, there are no meteorological stations on or near the direct route from which such information may be obtained.

(b) *Upper Air Stations.*—Nairobi is the only station in East Africa which has facilities for carrying out radio sonde ascents and determining upper winds above cloud by means of radar-followed balloons. Owing to lack of funds this station is unable to carry out regular daily ascents.

The network of pilot balloon stations in East Africa is fairly good. In view of the relatively high average cloud cover over Kenya and the eastern part of Tanganyika during the greater part of the year there would be little purpose in increasing the number of stations carrying out visually observed pilot balloon observations. An increase in the general accuracy of upper wind observations and forecasting could be obtained by providing several additional radar wind stations, but the cost of establishing and maintaining these would be prohibitive.

(6) Standard of Meteorological Observation

(a) *Surface Observations.*—For the purpose of this inquiry the Meteorological Department supplied lists of surface observations made by meteorological observers at ten stations at intervals of one hour from 10.00 to 15.00 hours inclusive. A comparison of the individual observations made at any one hour

miles (when, if the pilot's assumption that the Lake Jipe fix was correct, the aircraft would have been clear of Kilimanjaro). Although he must have felt fairly certain about his Lake Jipe position there was possibly some doubt in his mind and he would want to make certain by making a fairly wide detour. It has to be remembered that he still had not altered his E.T.A. As a further insurance against error at some time after 11.56 he must have climbed to 14,500 ft., probably in an effort to keep above cloud.

If, after covering the 40 miles or so on a course of 025° (M.), course was then altered back to 340° the aircraft would have reached position 37° 28' E., 03° 06' S. (the scene of the crash) at 12.25.

A reconstruction of the possible flight leading up to the accident was given by the Chief Inspector of Accidents of the Directorate, but as this does not take into account the fact that the pilot gave his estimated time of arrival at Nairobi at 13.20 and assumes that the pilot, in spite of cloudy conditions, held to his course it is considered that the reconstruction given above is a more likely one. There are, of course, many other possible reconstructions that would fit the known facts.

PART XI—COMMENTS

(1) The Aircraft

(1) The evidence shows that, with two minor exceptions listed below, the aircraft had been maintained in accordance with regulations and good engineering practice and was fully serviceable and airworthy prior to the crash:—

(a) *Turn and Bank Indicator.*—The "life" of this component was 600 hours, but since 17th December, 1954, when it was fitted, the aircraft had flown 759 hours. The overhaul life of this instrument, however, has since been extended to 1,200 hours in the latest issue of the maintenance schedules which were, at the time of the crash, being amended. This is regarded as a minor breach of regulations and in no way contributory to the accident.

(b) *P.12 Magnetic Compass.*—The maintenance schedules require that compasses be compensated after an engine change. Two engine changes had taken place since the compass was swung on 6th January, 1955, but there had been verbal agreement between the Air Registration Board and the East African Airways Corporation whereby the swinging of compasses after engine changes could be dispensed with. This was confirmed in evidence by the A.R.B. surveyor in Nairobi. It is considered that if there was a breach of the regulations the offence was minor.

(2) *Oxygen.*—A supply of oxygen was not available to the crew. For some period during the flight the aircraft flew at about 14,500 ft. To what extent judgment was impaired by oxygen lack is not known and the Court do not feel qualified to comment. It is understood that East African Airways Corporation have taken steps to comply with the regulations regarding the carriage of oxygen.

(2) The Load Sheet

The load sheet for the aircraft prepared at Dar es Salaam prior to the departure of VP-KKH on 18th May, 1955, when checked showed that the centre of gravity based on the information contained therein was 255.96 in. aft of the datum point, and the all-up weight of the aircraft was stated to be 12,190

PART I—THE AIRCRAFT

(a) The Airframe

The aircraft was constructed by the Douglas Aircraft Company, Inc., Santa Monica, California, U.S.A., in 1944, and was operated by the Royal Air Force under No. KP-266 until the beginning of 1952, by which time it had completed 954 hours 15 minutes flying.

The aircraft was then purchased by Eagle Aviation, Ltd., in the United Kingdom and sold to East African Airways Corporation without further flying. After comprehensive overhaul had been carried out United Kingdom Certificate of Airworthiness No. A. 3656 was issued on 10th December, 1952, valid until 9th December, 1953. This Certificate of Airworthiness was validated by the United Kingdom Ministry of Transport and Civil Aviation, on behalf of the Directorate to cover the delivery flight and upon arrival in Nairobi the aircraft was registered in the name of the East African Airways Corporation with effect from 15th November, 1952, and a Kenya validation certificate No. 115 was issued dated 17th December, 1952, and valid to 9th December, 1953. This validation was subsequently renewed and was valid until 9th December, 1955. The time flown by the airframe prior to the last complete overhaul was 5,259 hours 20 minutes and the number of hours flown since the last complete overhaul was 1,940 hours 40 minutes.

(b) The Engines

The engines were manufactured by the Pratt and Whitney Aircraft Corporation, West Hartford, Connecticut, U.S.A., and were of the Pratt and Whitney Twin Wasp R. 1830-90D series. The port engine, No. 488834, had completed a total of 5,172 hours 25 minutes. It was installed in VP-KKH on 3rd February, 1955, since when it had been maintained in conjunction with the airframe. This engine had flown 505 hours 30 minutes since its last complete overhaul which was carried out in the workshops of the British Overseas Airways Corporation at Treforest, U.K.

The starboard engine, No. 56512, had completed a total of 595 hours 05 minutes. This engine was installed in VP-KKH on 20th March, 1955, since when it was maintained in conjunction with the airframe. It had completed a total of 267 hours 15 minutes since its last complete overhaul which was carried out by the Grand Central Aircraft Company, Glendale, California, U.S.A.

(c) The Propellers

The propellers were manufactured by the Hamilton Division of the United Aircraft Corporation, East Hartford, Connecticut, U.S.A., and were three-bladed fully feathering type 23-50-473, an approved propeller type for fitment to Dakota aircraft fitted with Pratt and Whitney R. 1830-90D engines. The port propeller had completed a total of 2,637 hours since the last complete overhaul. It was installed in VP-KKH on 3rd May, 1955, since when it had been maintained in conjunction with the airframe. The starboard propeller had completed a total

of 5,428 hours 15 minutes. This propeller was last overhauled by East African Airways Corporation on 26th November, 1954, and was installed in another aircraft. It operated in that aircraft for 441 hours 45 minutes before it was removed on 1st April, 1955, for desludging and repainting of the blades. It was then fitted to VP-KKH on 5th May, 1955, since when it had operated for 45 hours. It, too, had been maintained in conjunction with the airframe.

(d) Maintenance

The aircraft completed its first and only "life overhaul" in East Africa at a total of 2,362 hours 05 minutes since its previous overhaul, which was within the maintenance schedule requirements that aircraft should be completely overhauled after 2,400 hours' flying or 24 months, whichever occurred first. The overhaul was completed on 10th June, 1954. The aircraft log books show that the necessary inspections and overhauls had been carried out within the specified period.

A routine check III inspection was carried out and certified on 13th May, 1955, and as a result of this check a Certificate of Safety was issued valid under the terms of the maintenance schedule for 50 hours' flying, or a period of 14 days, whichever occurred first. This certificate was the one valid at the time of the accident. The time flown by the aircraft since its last check III was 37 hours 45 minutes.

Following this check and the issue of a Certificate of Safety the aircraft completed a service to Dar es Salaam via Arusha, Moshi, Mombasa, Tanga and Zanzibar. During the aircraft's stay at Dar es Salaam it carried out two hours of night-flying training and then returned to Nairobi via Tanga, Moshi and Arusha. The only comment in the technical log book during this trip was made on 13th May, 1955, when the pilot reported a tendency for the aircraft to turn to port on take-off and landing and suggesting that the alignment of the tail wheel should be checked with the tail wheel lock engaged. This snag was rectified at Nairobi on 14th May, 1955, by the fitment of a new tail wheel locking pin. These facts are entered in the aircraft log books and the technical log sheets.

A between-flight inspection was carried out at Dar es Salaam prior to night flying on 13th May, 1955, and a departure inspection was carried out on 14th May, 1955, prior to the aircraft's return to Nairobi. A further departure inspection was carried out 14th May, 1955, and the aircraft left Nairobi for Durban on 15th May, 1955, at 06.15 hours.

In view of the fact that the technical log book is not available there is no record that the departure inspection at Lumbo, where the aircraft night-stopped, was carried out on the morning of 16th May, 1955, but it may be assumed that the pilot did in fact carry out this inspection. From Lumbo the aircraft proceeded to Durban where it night-stopped and a check A inspection was carried out. From the check A sheet for Durban it can be seen that the only snag reported by the aircrew on arrival there was a 75 r.p.m. magneto drop on the right-hand magneto of the starboard engine. This snag was checked in the course of the check A when it was found that the engine was smooth and the magneto drop was within the limits laid down by the manufacturer. After completing the check A inspection the engineer actually completed a new Certificate of Safety which was unnecessary as the original issued at Nairobi on 13th May, 1955, was still valid.

(b) *Course Keeping*.—With the type of compass fitted to VP-KKH it is not possible to steer a course within an accuracy of 1°.

(c) *Auto-pilot Precession*.—The auto-pilot fitted to the Corporation's aircraft tends to wander off course due to gyro precession and requires frequent correction by the pilot.

(d) *Avoidance of Cloud*.—There is expert meteorological evidence available that along his track it would have been necessary to weave around cloud in order to maintain visual flying conditions.

(e) *Winds*.—These are never constant and forecasts and estimates are subject to a degree of inaccuracy.

These variables can be regarded as having a plus or minus value and, in practice, often cancel one another out. But this is not necessarily so and it is possible for a combination of these factors to have the same value causing a displacement of the aircraft from the plotted D.R. position. The amount of this displacement would depend on how long the aircraft had been in flight without taking accurate observations and determining drift, position, etc. Under certain conditions the aircraft might have been displaced sufficiently to the west to have been within sight of the dry salt lakes near the Pangani River. It is possible that the pilot catching a quick glimpse of these lakes through broken cloud mistook them for Lake Jipe.

To have been over Lake Jipe at 11.56 would have required a tail wind component of 45 knots from Korogwe and there is no evidence to suggest such a strong wind. What other evidence could have made the Captain believe he was over Lake Jipe? The wind required to put him there since leaving Dar es Salaam was approximately 160/28, and it is significant that this is the 5,000 ft. wind given in his forecast for the coastal strip. The direct track lay along or very close to the ridge formed by the Usambara and Pare mountains and there is evidence that cloud tops might have reached 14-15,000 ft. The orographic effect of this range on a south-easterly air stream would almost certainly have caused a build-up of cloud extending higher than the general level over the plains. From his message of 11.56, "10,500 ft. V.F.R. on top", it can be reasoned that he was over the lower ground on one side or other of the Pare Mountains. If he had been to the east there was no stretch of water or salt lake (excepting Lake Jipe) that he could have mistakenly identified and in any case if he was that side of the Pare Mountains he would have been virtually clear of the Kilimanjaro range. He could, however, equally well have been to the west and this reconstruction utilizes that assumption.

From 11.56 there are only four known facts: Firstly, the final position of the aircraft—and this is indisputable. Secondly, the wristlet watch, stopped at 2.25, which may or may not have given the actual time of the crash. Thirdly, the altitude at which the wreckage lay—approximately 15,000 ft. Lastly, that the aircraft was most probably on a course of 340° during the final stages of its flight. Supporting evidence for this comes from the African (already referred to) whose house lay on a bearing of 160° from the scene of the crash. Further, two experienced members of the accident investigation team have given it as their considered view that, due to the configuration of the immediate surroundings at the point of impact, the aircraft must have been on a course within a few degrees of 340°.

Any reconstruction of the aircraft's flight after 11.56 must be purely conjectural, but it is possible to show by plotting that had he been near the salt lakes, course could have been altered 45° to the east and maintained for some 40

Although Captain Quirk did not personally file the flight plan a pilot of his experience must have had a plan in his own mind as to how he intended to conduct the flight. He set course from Dar es Salaam at 10.40 hours and shortly afterwards sent an E.T.A. at Nairobi of 13.20. This gave an elapsed time for the flight of 2 hours 40 minutes—that is five minutes longer than the still air time as given in the standard flight plan. Even a cursory glance at the meteorological forecast would have shown him that he could anticipate a tail wind component throughout his flight. Why then give a flight time longer than would be required under still air conditions?

It is not unreasonable to assume that he anticipated the need to divert at some stage during the flight, and that his estimate made allowance for that fact. He would probably have steered a course of 340° magnetic—the course as shown on his map—disregarding the wind effect and feeling fairly confident that he would see Kilimanjaro, or the build up of cloud surrounding it, in ample time to take necessary diversion action. From evidence given by other pilots this is the normal procedure, and as at least two of his previous flights on this route had been under the supervision of other captains there is no reason to believe that he would have done otherwise. There was also evidence that verbal instructions to this effect are given by East African Airways Corporation to all their pilots.

The wind forecast at the 5,000 ft. level for the initial part of his flight was 160°/28, which, in any case, would have given no drift.

His next message giving a position at Korogwe is of interest in that it demonstrated his decision to proceed on the direct track. Using the analysed wind his D.R. position at 11.24 was within a mile of Korogwe, but whether he saw that town or not the time of his message shows that he must have been aware that his ground speed exceeded his air speed—yet still no alteration of E.T.A.!

His track lay almost along the ridge formed by the Usambara and Pare mountains and from the meteorological evidence available there was probably almost complete cloud cover below, the tops extending possibly to 14–15,000 ft. This view is supported by his message of 11.25 giving his altitude as 10,500 ft. and flight conditions intermittent I.F.R.—in other words, in and out of cloud. During the next stage of his flight it is possible that he was unable to get an unrestricted view ahead due to the cloudy conditions surrounding him.

The next message from the aircraft was at 11.56 giving a position at Lake Jipe. Until this time he would not be unduly worried about maintaining the direct track as under practically no circumstances could he be in the vicinity of Kilimanjaro before 12.00 hours. To have done so would have required a tail wind component since leaving Dar es Salaam of 60 knots and over 100 knots since his position at Korogwe. If he could not see the peaks of Kilimanjaro or obtain an unobstructed view of the "cloud cap" over the mountain prudence would have dictated a change of course not later than 12.00 hours.

Using the analysed wind, it is possible to determine a D.R. position of approximately 37° 55' E., 03° 55' S. at 11.56 when the Captain gave position as Lake Jipe.

There are various factors which affect an aircraft in flight and a navigational plot does not necessarily reflect the actual track of an aircraft over the ground, such as:—

- (a) *Compass Deviation.*—This compass had not been swung since 6th January, 1955, and no astro-compass or sextant was carried to check deviation in flight.

The aircraft left Durban on 17th May, 1955, and proceeded on its scheduled route to Lumbo where it night-stopped. The pilot should have completed another departure inspection at Lumbo on the morning of 18th May, 1955, but again there is no documentary evidence on this point.

Prior to the aircraft leaving Dar es Salaam on 18th May a departure inspection was carried out by a licensed engineer. There were no snags reported on the departure check routine sheet completed at Dar es Salaam.

(e) Instruments and Ancillary Equipment, Radio Equipment and Compass

The hours run of all instruments and ancillary equipment which may be described as "lived" components had been checked, and with the exception of the turn and bank indicator all these components were found to have run less than the stipulated number of hours. The overhaul life of the turn and bank indicator, according to the maintenance schedule in force on 18th May, 1955, was 600 hours, and it does not appear from the aircraft records that this component had been changed since 17th December, 1954, since which date the aircraft had completed 758 hours 45 minutes.

The aircraft carried all the necessary radio communication and direction-finding equipment, including a radio compass, H.F. transmitter and receiver, etc., in accordance with the Certificate of Airworthiness. A Certificate of Serviceability in respect of the radio station of the aircraft was issued on 13th May, 1955, in a form approved by the Directorate.

The aircraft radio compass was last swung on 1st July, 1954, and a record of this swing and a copy of the correction card fitted to the aircraft is recorded in the official radio compass log book.

The magnetic compass, which was of type P.12, was last swung on 6th January, 1955, when the compass was first fitted to the aircraft. The requirements of the maintenance schedule in force at the time of the accident were that compasses must be compensated after an engine change or whenever the accuracy of their readings became suspect. As engines were changed on 3rd February and 20th March of 1955 these requirements had not been complied with.

PART II—THE CREW

(a) Captain Jack Neville Quirk

Captain J. N. Quirk was born on 6th December, 1923, in South Africa. After flying with the South African Air Force, which he left in January, 1946, with a total of 527 flying hours, he joined the Royal Air Force in May, 1948, and after training on Dakotas was posted to a transport supply squadron in Malaya in October, 1949. In July, 1951, he was posted to another squadron in Malaya, still flying Dakotas, and remained there until January, 1952, when he left the Royal Air Force. His total flying at this time was 1,898 hours. After refresher instrument-flying training at the Rand Flying Club he joined Africair, Ltd., of Francistown in November, 1952, and continued to fly with this company until November, 1954. He was mainly flying Dakotas and his total flying amounted to 4,249 hours. In December, 1954, he joined East African Airways Corporation and in January, 1955, he commenced flying under training on their routes. In February, 1955, he obtained his command and flew as captain on the services operated by the Corporation. Up to the date of the accident he had flown 1,031.55 hours as a second pilot on Dakotas and 2,439.15 hours as first pilot on Dakotas. His total flying time amounted to 4,539 hours.

Captain Quirk was the holder of Kenya Airline Transport Pilot's Licence No. 209, issued on 15th December, 1954. Following a medical examination on 23rd December, 1954, the licence was subsequently renewed from 25th December, 1954, until 24th June, 1955. This licence, which was rated in Group I for Rapide and Dakota aircraft, was issued in accordance with the qualifications contained in his Union of South Africa Airline Transport Pilot's Licence, dated 15th June, 1953, and valid to 24th December, 1954. Captain Quirk's instrument rating privileges were valid until 24th June, 1955, his last tests having been conducted on 25th June, 1954. He also held a valid Kenya General Flight Radio-telephony Operator's Licence, No. 91, issued on 15th December, 1954. Records show that since he joined the East African Airways Corporation in December, 1954, he had flown the direct route Dar es Salaam-Nairobi 11 times.

(b) First Officer Michael Cairncross

First Officer M. Cairncross was born in South Africa on 20th November, 1930. He commenced his flying career in January, 1952, when he joined the South African Air Force, and completed his initial flying training on Tiger Moths and Harvards. He subsequently attended an operational training unit for Spitfire aircraft and on completing this was posted to Korea for operations on Mustangs. On completion of his operational tour in Korea he returned to the Union of South Africa and underwent a conversion course on to Dakota aircraft, which he continued to fly until he left the South African Air Force in May, 1954. At this time he had completed a total of 940 flying hours, of which 328 had been on Dakotas. In May, 1954, he joined East African Airways Corporation as a first officer.

He was the holder of Kenya Senior Commercial Pilot's Licence No. 191, issued on 12th September, 1954. Following a medical examination on 10th March, 1955, this licence was renewed until 11th September, 1955. This licence, which was rated in Group 1 for Tiger Moth and in Group 2 for Dakota aircraft, was issued in accordance with the qualifications contained in his Union of South Africa Senior Commercial Pilot's Licence, dated 5th February, 1954, and valid to 11th September, 1954. His instrument rating privileges were valid until 30th April, 1956.

First Officer Cairncross also held a valid Kenya General Flight Radio-telephony Operator's Licence, No. 65, issued on 12th September, 1954. Up to the time of the accident he had flown 1,042.15 hours as second pilot and 119.20 hours as first pilot on Dakotas. His total flying time was 1,695 hours. Records show that since he joined East African Airways Corporation he had flown on the direct route Dar es Salaam-Nairobi 26 times.

(c) Radio Officer Arthur Percy Gregory

Radio Officer A. P. Gregory was born on 24th April, 1922, in the United Kingdom. He received his training as an aircraft wireless operator with the Royal Air Force from 1941 to 1946, and subsequently flew with British South American Airways as radio officer from 1946 to 1949 and for a period to the end of 1949 as a radio officer with a charter company.

For a time he was self-employed in the radio trade and in 1951 joined the Directorate as a radio officer employed on the aeronautical mobile and fixed telecommunications service. On completion of his contract with the Directorate he joined East African Airways Corporation as a radio officer in March, 1955.

There is no evidence to support any of the first four possibilities. Examination of the wreckage gave no indication of structural or engine failure and it is unlikely that the aircraft would have been flying at such a height if there had been any engine fault. Although fire had occurred, expert evidence shows that this occurred after the crash.

From all the evidence it seems improbable that abnormal weather conditions or winds in the vicinity of the mountain forced the aircraft into the ridge. Evidence was given regarding possible mineral deposits in the mountain creating a magnetic field, particularly on the south-east slopes, and causing compass deviation. This possibility has not been disregarded, but it is felt that the effect of any extraneous magnetic field would be limited and could not under any circumstances have an effect on the compass of an aircraft maintaining a prudent distance from the mountain, and accordingly it seems very unlikely that the aircraft was forced or misdirected into the mountain by unforeseen conditions.

It is considered that the basic cause of the crash was the pilot's decision to proceed on the direct track to Nairobi, and this consideration is not affected even if he intended to divert in the vicinity of Kilimanjaro. The meteorological conditions were marginal and his first mistake occurred in not discussing the weather with the meteorological forecaster. Had he done so he might well have decided to proceed via Tanga, although in making this decision he might have been influenced by the fact that there were no specific instructions regarding an alternative route. It must be remembered, however, that he was fairly new in the Corporation and he might have thought it impolitic to depart from normal practice.

Having once decided to fly direct it was then his responsibility so to navigate his aircraft that there could be no possibility of colliding with the high ground that lay so near his route. It was his duty to use the utmost discretion—to take not the slightest risk in the navigation of his aircraft. He was not pressed for time and had ample fuel reserves. There was obviously a navigational error, but the degree of this error is immaterial—the final tragedy is mute evidence that adequate precautions were not taken.

PART X—RECONSTRUCTION OF POSSIBLE FLIGHT

Any reconstruction of the last flight of VP-KKH must include the known facts of which the Court has knowledge. The scanty factual evidence must form the framework on to which any assumptions should be fitted. VP-KKH struck a mountain ridge at position 37° 28' E. and 03° 06' S., a distance of approximately seven nautical miles from the direct track joining the new aerodrome at Dar es Salaam to Nairobi. The only factual evidence regarding the time of impact is a watch that was found on a passenger at the scene of the crash and which had stopped at 2.25. As the passenger had boarded the aircraft in Durban it is possible that the watch had not been advanced to East African standard time and would correspond to 12.25 G.M.T.

Except on an "airway" there is nothing wrong about an aircraft being a few miles one side or the other of a planned track—it is an inherent factor of aerial navigation. As this particular route lay so near to high ground it should never have been flown therefore other than under good visual conditions. It must be assumed that Captain Quirk was well aware of this elementary fact and that he intended, and would have taken, such diversion action as he considered necessary in the event of being unable to maintain visual flight when in the vicinity of Kilimanjaro.

Tail Plane Fin and Rudder

The tail plane was intact on the rear portion of the fuselage, the elevators were secure in position but all fabric had been burned off. The fin and rudder were some 100 ft. from the rear fuselage portion, having been torn from the main structure under impact. The fin and rudder were intact, the fabric being in place on the rudder.

Starboard Main Plane

This component was located in an inaccessible position, but it was possible to ascertain that the root end attachments were secure and that the aileron was in position.

Fuselage

This section of the aircraft was broken into several parts each of which was heavily damaged, the cockpit section having completely disintegrated. The control column and pedestal were located some distance from and above the main wreckage, but no information could be gained from these as they had suffered obvious impact damage. The engine ignition control panel was located and the position of both magneto switches was in the "on" position and the magneto master switch was also in the "on" position. No trace could be found of the instrument panel or the instruments relating thereto.

The Engines

The remains of both engines were located in inaccessible positions, but it was possible to see that the reduction gear casing had broken away, this component being located with the individual propellers, the propeller shafts still being in position.

The Propellers

The starboard propeller was located on a ledge near the main wreckage and was seen to be heavily damaged and in the fine-pitch position. The port propeller was located at the base of the escarpment and was also heavily damaged. The propeller fine-pitch stops had sheared by the force of impact and the blades had moved into the reverse-pitch position.

It appeared from the position of the wreckage that the aircraft had hit the ridge while travelling on a course of between 335° and 345°.

PART IX—POSSIBLE CAUSES OF THE ACCIDENT

The primary or immediate cause of the accident was quite clearly the collision of the aircraft with the ridge. Possible secondary or proximate causes are:—

- (1) Deliberate act of a member of the crew or a passenger.
- (2) Structural failure.
- (3) Engine failure.
- (4) Fire.
- (5) That the Captain when navigating a safe course was forced or mis-directed into the mountain by unforeseen conditions.
- (6) Error of judgment.
- (7) Error of navigation.

Radio Officer Gregory was the holder of a Kenya 1st Class Flight Radio-telegraph Operator's Licence, No. 18, issued on 28th February, 1955, and valid until 28th April, 1955. Following a medical examination on 28th April, 1955, the licence was renewed until 28th April, 1956. This licence was issued in accordance with the qualifications contained in his United Kingdom 1st Class Flight Radio-telegraphy Operator's Licence, No. 740, dated 2nd May, 1950, and subsequently renewed from time to time.

Up to the date of the accident he had flown 3,964.47 hours on various types of aircraft. Records show that since he joined the Corporation he had flown the direct route Dar es Salaam-Nairobi 23 times.

(d) Steward H. W. Monaghan

The Chief Inspector of Accidents of the Directorate made no investigation into the history of Mr. Monaghan since it was not considered that he could have played any part in the events leading up to the accident. No investigation was made by the Court of Inquiry for the same reason.

PART III—METEOROLOGICAL SITUATION

The main feature of the meteorological situation over the eastern half of East Africa on 18th May, 1955, was a south-easterly air stream which extended from the surface up to 12,000 ft. Above 12,000 ft., and up to 15,000 ft., winds backed with height to easterly along the coastal plain and north-easterly to the west of the Usambara-Pare-Kilimanjaro ridge in Tanganyika and over most of Kenya.

Pilot balloon observations made in the period 04.00 to 06.00 hours show that wind velocities of between 20 and 30 knots prevailed up to 12,000 ft. on all parts of the Dar es Salaam-Nairobi route. In the east to north-easterly air stream above 12,000 ft. the few available observations indicate that this air stream had a velocity varying between 5 and 12 knots.

Upper wind observations made between 09.00 and 13.00 hours show that after 09.00 hours the south-easterly air stream below 12,000 ft. had backed by some 10° to 20° towards easterly and the general wind velocity was in the neighbourhood of 10-15 knots. This backing in direction and decrease in velocity is a natural consequence of diurnal convectional mixing of the south-easterly air stream with the more slowly moving north-easterly air stream above 12,000 ft. and was correctly anticipated by the forecaster at Dar es Salaam who carried out the pre-flight meteorological briefing for VP-KKH.

Although no upper air temperature and humidity observations were available for any part of East Africa on 18th May the general distribution and development of cloud on that day indicate that the south-easterly air stream below 12,000 ft. was relatively moist and that there was no marked instability.

Cloud development in these territories is largely determined by the diurnal variation in temperature at and near the surface and the topography of the country; these factors have a considerably greater effect than is produced by the movement of pressure systems and fronts, the latter being conspicuous by their absence. On the 18th May, 1955, the weather and cloud distribution appeared to follow the normal diurnal pattern. Up to 10.00 hours there was extensive

cumulus and strato-cumulus (mainly 6/8ths to 8/8ths) of base mainly 2,000 ft. to 3,000 ft. above ground level over the coastal plain and to the east of the 4,000 ft. contour between the latitudes of Nairobi and Dar es Salaam. No observations of the general height of the tops of this cumulus and strato-cumulus layer could be observed from the ground but it is probable that this cloud was not more than 2,000 ft. to 3,000 ft. thick. There was also an extensive layer of altocumulus and altostratus at a height of about 10,000 ft. above sea level over the coastal plain. Owing to the large amounts of cumulus and strato-cumulus which were present over Makindu, Arusha, Moshi and Voi up to 10.00 hours the extent to which this middle cloud extended inland is unknown.

In accordance with the normal diurnal variations the cumulus and strato-cumulus layer along the route to the south and east of Kilimanjaro began to break up after 11.00 hours and it became evident that the coastal belt altocumulus extended as far west as Moshi and Arusha. The lower layer of cumulus and strato-cumulus, while decreasing in lateral extent, developed vertically giving scattered showers between 12.00 and 15.00 hours. There appeared to be no extensive development of cumulo-nimbus cloud and thunderstorms until after 15.00 hours.

While it appears that the general weather conditions were normal for this time of the year the hourly observations from Moshi and the reports of the captains of two aircraft flying in this area and pilots of the aircraft conducting search operations indicate that extensive cloud covered the greater part of Kilimanjaro and an area of up to 20 miles from the mountain throughout the day. This fact is of some importance in that visual identification of Kibo and Mawenzi peaks during the period when VP-KKH was in flight could probably not have been made by an observer situated to the south or south-east of Kilimanjaro unless he was flying well above 15,000 ft.

PART IV—THE WEATHER

It has been extremely difficult to obtain an accurate picture of the weather which prevailed on the route Dar es Salaam to Mawenzi between 10.39 and 12.30 hours, the approximate period in which VP-KKH was in flight. This difficulty arises mainly because of the paucity of ground stations on the route, the inadequacy of such stations for reporting weather conditions above the lowest layer of cloud and the relatively few aircraft which were in the vicinity during the period.

Firstly, the report from the aircraft indicated that VP-KKH was probably above the main layer of cloud but was flying through occasional cumulus tops which extended above the 10,500 ft. flight level at 11.25 hours. The report received at 11.56 showed that VP-KKH was above the layer of cloud at flight level 10,500 ft.

Secondly, the pilot of VP-KJR on a flight from Nairobi to Dar es Salaam observed the Kilimanjaro area from 9,500 ft. during the period 11.20 to 11.40 from a distance of about 50 miles and he judged the cloud over the area to the south and south-east of Kilimanjaro to be 6/8ths to 8/8ths. The cloud top had the appearance of a table top at about 9,000 ft. with occasional slightly higher tops. There were no significant cumulus towers apart from the build-up over the Kilimanjaro area. Kilimanjaro appeared to be completely covered in cloud but there was no indication of cumulo-nimbus heads. The build-up over

at that time and there is no reason to doubt his story, with the important exception that it is virtually certain that the aircraft he heard, if in fact it was VP-KKH, must have been at a height not less than 6,000 ft. above the observer. However, it is probable that the aircraft was climbing under full power at that time and that this fact, accentuated possibly by some form of echo or resonance due to the close proximity of the mountain, gave a false impression of lowness.

The accident investigation team, who searched the scene of the accident, found no navigational log or other evidence that might have thrown further light on the aircraft's flight, although a wristlet watch which had stopped at 2.25 was found on a passenger.

PART VIII—THE WRECKAGE

An official accident investigation team reached the scene of the accident on the morning of 25th May, 1955. The aircraft was found to be in a very broken up and scattered state, obviously having suffered very severe impact and fire. The centre of the fire was concentrated in the area of the fuel tanks which are contained in the centre section. Several components lodged in the fire area had suffered fire damage. The wreckage was widely scattered down the eastern face of a ridge running approximately south-south-east from the peak of Mawenzi and it appeared that the aircraft had hit the ridge at a height of approximately 15,200 ft. above sea level, and following an instantaneous explosion had disintegrated. The nose of the aircraft had borne the first impact and possibly in the explosion which followed the aircraft was turned over on its back with the starboard wing and engine falling vertically into a ravine. The port wing and tail plane fell some 75 ft. to the right of what appeared to be the line of flight. The major portion of the fuselage had obviously suffered the consequences of the explosion and fire and only small portions were identifiable.

To have reached and examined all the major identifiable parts would have entailed feats of rock climbing beyond the capabilities of the untrained persons undertaking the investigation, but with the exception of the starboard wing and engine all major parts were examined. Much of the wreckage was lying in chimneys, ravines and ledges which were inaccessible to all but the most experienced of climbers and this, together with the exacting conditions under which the investigating team worked, hampered a detailed and thorough investigation of all parts of the wreckage, but in the circumstances and because of the initial strike and explosion it was the unanimous opinion of the team that nothing of value to the investigation was lost through their inability to examine every part of the wreckage.

No trace of any instruments was found except the sub-scale of an altimeter which was recovered some 1,500 ft. below the rock face. The only papers recovered were part of an operations manual from which all instructions and directions concerning the last lap of the flight from Durban to Nairobi were missing.

The following is a list of components on which it was possible to carry out an investigation:—

The Port Wing and Port-side Centre Section complete with Undercarriage

Although heavily damaged, it was possible to ascertain that the main plane root and attachments were secure; that the undercarriage was in the fully retracted position and that the aileron was in position.

Furthermore, the forecaster informed First Officer Cairncross that the middle cloud over the coastal plain was spreading westwards and drew attention to the fact that the 7/8ths altocumulus at 10,000 ft. above ground level had been reported by Moshi at 08.00 hours. The forecaster noted in his diary that this advice was given at 10.30 hours which may be taken as the time at which meteorological briefing had been completed.

The flight forecast for the section of the route "on coast" contains an expectation of 5/8ths to 8/8ths Ac.As., base 10,000 ft. to 12,000 ft., tops 12,000 ft. to 14,000 ft. Although there was no mention of this layer of middle cloud in the section of the route headed "inland" it is considered that the First Officer received adequate warning to expect fairly extensive middle cloud inland, as far north as Kilimanjaro at least, in that the forecaster pointed out the presence of 7/8ths Ac. over Moshi and stated that the middle cloud was spreading westwards.

The analysis of the weather which was made after the accident confirmed that the flight forecast, coupled with the supplementary verbal briefing, gave a reasonably accurate description of the weather, cloud, visibility and upper wind conditions which the crew could expect to find.

PART VII—THE FLIGHT

After engines were started two-way communication between VP-KKH and the control tower was established on frequency V.H.F. 118.1 mc/s and at 10.39 hours the aircraft took off on Runway 23 and did a right-hand turn out on course for Nairobi. At 10.52 hours the aircraft reported passing through flight level 5,000 ft. and asked permission to change frequency to 6,552 kc/s. This was granted and control was thereupon transferred to Nairobi. All further known messages were transmitted by radio-telephony on 6,552 kc/s and were addressed to that station.

The aircraft established communication with Nairobi at 10.55 hours, reported departure from Dar es Salaam, estimated arrival Nairobi at 13.20 hours and indicated that it was still ascending to 10,500 ft. under I.F.R. weather conditions. The terminal airport weather was requested and this information was passed to VP-KKH at 11.08 hours. There were further communications with Nairobi which did not concern the flight and at 11.25 hours the aircraft reported at Korogwe at 10,500 ft. flying in intermittent I.F.R. conditions.

At 11.58 hours a further message was passed to Nairobi giving position as Lake Jipe, 10,500 ft. in visual flight conditions on top of cloud.

No further communication was received from the aircraft and at 13.00 hours radio failure procedure was adopted and search and rescue action followed at 13.35 hours. As a result of that search on the 22nd May the wreckage of an aircraft was located on a ridge running south-south-east from Mawenzi peak at a height of approximately 15,000 ft., and later positively identified as VP-KKH.

The only other factual evidence regarding the flight was given by an African living near Marangu, situate in the foothills of Kilimanjaro at a distance of approximately 14 miles from the scene of the crash on a true bearing of 160°. The African stated that between 3 p.m. and 4 p.m. on the 18th May he heard an aircraft flying low to the east of his house and on a course he estimated to be from south to north. The sky was covered by 8/8ths cloud and he could not see the aircraft. It was established that no known aircraft were in the area

the mountain extended beyond the mountain for a distance of about 20 miles from the north, east and south sides. The pilot thought that the cloud top could not have been more than 5,000 ft. above Kibo peak. Bearing in mind that the freezing level in this latitude is fairly constant between 15,000 ft. and 16,000 ft., that cumulo-nimbus tops normally extend to somewhere between 35,000 ft. and 50,000 ft. and that there was no observation of anvil tops or pileus formation on the cloud over Kilimanjaro, it is very improbable that cumulo-nimbus capable of sustaining severe vertical currents was present in the area before 15.00 hours.

Thirdly, at approximately 12.30 the pilot of an Anson *en route* to Arusha from Nairobi was able to recognize Kilimanjaro from a height of 10,500 ft. as a large mass of cumulus cloud protruding above a flat sheet of extensive layer cloud at 10,000 ft. At the level of the top of the layer cloud the Kilimanjaro cloud mass appeared to be about 20 to 30 miles across. This pilot estimated the wind to be east to south-east, 10 to 15 knots, with a tendency to back towards easterly in the area of Mount Meru and Arusha.

Fourthly, about 15 miles north of Tanga a Viking, VP-YEW, emerged from cloud at 11,000 ft. and set course for Nairobi just above 8/8ths stratiform cloud at approximately 13.20 hours. The pilot observed that over the Usambaras the cloud tops rose to 12,500 ft. and the top of Kibo peak was visible some 100 miles away. He stated that the cloud appeared to be banked up on the side of the mountain to a height of about 16,000 ft. A visual fix coinciding with a D.R. position confirmed that the forecast upper winds issued by Dar es Salaam were accurate. Near Maktau there was 7/8ths layer cloud at 12,000 ft. and 5/8ths to 6/8ths cumulus cloud below with a few cumulus heads penetrating the layer cloud. Descending through the cloud at about 14.00 hours to search for VP-KKH and flying from Maktau to Ziواني and Lake Jipe the pilot estimated cloud to be 5/8ths to 6/8ths cumulus, base about 5,000 ft. above mean sea level. On the slopes of Mawenzi there was 8/8ths cloud, base 4,000 ft. to 5,000 ft. above sea level and 2/8ths to 3/8ths at a lower level to the north and east.

This pilot confirmed that the top cloud layer extended from the coast to Kilimanjaro and the height of the top of this layer was 10,500 ft. at the coast, rising gradually to 12,500 ft. over the Usambara mountains and 16,000 ft. against Kilimanjaro.

From the pilots' reports and the post-analysis which was carried out by the Meteorological Department it would appear that VP-KKH flew over a fairly continuous layer of cloud between Dar es Salaam and Mawenzi. The top of this cloud was about 10,000 ft., rising to 12,500 ft. over the Usambaras, but probably decreasing to mainly 10,000 ft. with scattered cloud tops in the neighbourhood of 12,000 ft. in the Lake Jipe area. To the north of Lake Jipe there was probably extensive thick cloud from about 20 miles south of Mawenzi with a top sloping from 12,000 ft. in the south to 16,000 ft. against the mountain.

PART V—THE FLIGHT PLAN

East African Airways Corporation have filed with the Directorate certain operational details for their internal routes, known as standard flight plans. The Directorate accepts these plans for internal flights only and does not require the pilot to report to the control tower before each flight. The aerodrome traffic control officer prepares the plan using the standard operational information—the intention being to facilitate quick turn-rounds.

In this case First Officer Cairncross, accompanied by Radio Officer Gregory, reported to the control tower and asked the A.T.C.O. to file a standard flight plan. He was told that this was not authorized and that he would have to complete a full flight plan. He then filled in the necessary form using the operational details laid down by the Corporation. He omitted to sign this and it was later initialed by another A.T.C.O.

This flight plan was addressed to the aerodrome control at Nairobi West airport and approach control and the Flight Information Centre at Eastleigh Airport, Nairobi. It intimated that East African Airways Corporation Dakota VP-KKH would operate the scheduled service EC. 104 from Dar es Salaam to Nairobi West Airport and that it would cruise at a flight level of 10,500 ft. By the insertion of a flight level the intention of the pilot to conduct his flight under I.F.R. was made known.

No estimated time of arrival was given, but the aircraft was airborne at 10.39 hours and cruising at a true air speed of 150 knots estimated an elapsed time of 2 hours 35 minutes to arrive at Nairobi West Airport, the first point of intended landing, at 13.14 hours. The alternate aerodromes were given as the coast stations, Moshi, Eastleigh and Kisumu, and normal radio frequencies were to be used. In addition the flight plan signified that a radio-compass was carried for navigational purposes. There were twenty persons on board, the pilot being stated as Captain Quirk. The endurance of the aircraft was given as 5 hours 14 minutes. There was no indication of the route to be followed, but it is reasonable to assume that the intention was to fly direct, diverting around Kilimanjaro only if weather conditions necessitated such action. There are two points of interest to note:—

- (a) The endurance of the aircraft was given as 5 hours 14 minutes, but the actual fuel on board totalled 600 gallons giving an absolute endurance, using normal cruising technique, of eight hours.
- (b) The term "flight plan" is a misnomer as it is apparent from the evidence that the meteorological forecast had yet to be collected from the duty forecaster and the information given therein was not used. Any flight plan that does not take into consideration the weather likely to be encountered *en route* is hardly an accurate plan of that particular flight.

PART VI—THE METEOROLOGICAL BRIEFING

The flight forecast for VP-KKH was prepared by the forecaster at Dar es Salaam between 10.00 and 10.30 hours on 18th May, 1955, and there is no reason to believe that it was not conscientiously prepared, using all information that was available.

At some time between 10.00 and 10.30 hours First Officer Cairncross visited the meteorological office at Dar es Salaam for meteorological briefing. He was handed a flight forecast covering his proposed flight from Dar es Salaam to Nairobi. The flight forecast was as follows:—

FLIGHT FORECAST

For the air route from Dar es Salaam to Nairobi via.....

Valid for departure between 10.30 hrs. G.M.T. and 11.00 hrs. G.M.T.

Valid for arrival between 13.30 hrs. G.M.T. and 16.00 hrs. G.M.T.

Special features of the meteorological situation:—

Zone	On Coast	Inland
*Winds and temperature at:—		
5,000 feet	160/28	—
7,000 feet	150/17	150/15
10,000 feet	160/17	120/12
13,000 feet	—	070/10
Weather	Mainly cloudy with occasional light rain or showers	Partly cloudy or cloudy with scattered showers
Surface Visibility ..	25 miles but 1–3 miles in ptn.	
Cloud:		
(Heights above M.S.L.)	On Coast	Inland
Amount, type ..	Variable	4/8–6/8 Cu.
	3/8–5/8 cu. 1/8 Cb.	1/8 Cb.
	5/8–8/8 Ac. As.	
Height of	2,000/5,000. 1,000	7/8,000
Base	10,000/12,000	7,000
Height of	7,000/10,000. 20,000	10,000/13,000
Tops	12,000/14,000	25,000

Landing at Nairobi:

Wind	Surface wind 140 degs.	10/15
Weather	Partly cloudy or cloudy with adjacent showers.	
Surface Visibility ..	25 miles but 1–3 miles in ptn.	
Cloud:		
Amount, Type ..	3/8–5/8 Cu.	1/8 Cb.
Height of Base ..	2,000–3,000 Agl.	1,000–1,500
Freezing level (above M.S.L.)	—	—
Ice Formation ..	—	—
M.S.L. Pressure (QNH) ..	—	—
Remarks	—	—

Certified true copy of Flight Forecast issued to the Second Pilot of Dakota VP/KKH.

Issued by the Meteorological Office at Dar es Salaam on 18/5 at.....
G.M.T.

D. McCALLUM,
Issuing Officer.

* Wind speed in knots.

In addition the forecaster described the weather conditions which had been observed at Moshi at 08.00 hours as indicated by the 08.00 Aeric report. The salient features of the weather at Moshi at 08.00 hours are that there was intermittent slight drizzle, horizontal visibility at ground level was good and there was a total cloud cover of 7/8ths, 4/8ths of which had a base of 2,500 ft. above ground level, but the main sheet of cloud consisted of 7/8ths alto-cumulus at 10,000 ft. above Moshi Aerodrome.