

No. 43

British Overseas Airways Corporation, Boeing Stratocruiser Aircraft, crashed at Prestwick Airport, Scotland, on 25 December 1954. Aircraft Accident Report No. C.A.P. 129 Ministry of Transport and Civil Aviation, United Kingdom

Circumstances

At about 2158 hours on 24 December 1954, a Boeing Stratocruiser aircraft, took off from London Airport on a flight to Prestwick. It was manned by a crew of eleven, and carried 25 passengers and a quantity of cargo. The flight had been scheduled to leave London at 1745 hours, but a delay was occasioned through a passenger being flown from Manchester to London to join the aircraft there. Owing to the failure of the port wheel to retract on take-off it became necessary for the aircraft to return to London and in order to make a safe landing some petrol had to be jettisoned. Ultimately a landing was made at London Airport about 2245 hours.

Arrangements were made to transfer crew, passengers and cargo en bloc to another Boeing Stratocruiser. The crew comprised a captain, first officer, navigating officer, radio officer, 3 engineer officers, 3 stewards and 1 stewardess. One of the engineer officers was supernumerary. The ultimate destination of the aircraft was New York, but the crew were only to travel as far as Prestwick where a fresh crew were to take the aircraft over the Atlantic. The aircraft took off from London Airport at 0120 hours on 25 December for Prestwick.

The flight from London to Prestwick was uneventful. Throughout the flight the captain kept in touch with the weather conditions and Prestwick Approach Control received the aircraft about 0248 hours. Preceding the aircraft by approximately four minutes in arrival at Prestwick was a Constellation, and these two aircraft were fed into the stack at Prestwick; the Constellation at 4 000 feet and the Stratocruiser at 5 000 feet. The runway to be used was Runway 31 which required the approach to be made from the southeast. The Instrument Landing System (hereinafter called "I.L.S.") without the Glide Path and the Ground Control Approach system (hereinafter called "G.C.A.") were available on Runway 31. G.C.A. took over the Stratocruiser about 0314 hours and at 0323 hours the talk-down controller took over the aircraft. Meantime Meteorological Reports had been passing from ground to air. The talk-down was completed at 0325 hours when the aircraft was 400 yards from the threshold of Runway 31. The approach up to this point had been high but uneventful. A few seconds later the aircraft struck the ground 127 feet short of the threshold of Runway 31, sustaining some damage. It then ran on to the runway and proceeded for some 90 feet where it was again airborne for another 400 feet. It then contacted the runway and sustained considerable damage, and came to rest with the passenger compartment in an inverted position on the south side of the runway about 550 yards from the threshold. Except for the front portion of the fuselage which lay on its port side, severe damage resulted from fire which broke out and spread rapidly, due probably to the partial detachment of the port wing and rupture of the fuel tanks.

From the accident there survived seven of the crew and one passenger.

Investigation and Evidence

Runway 31 is 6,997 feet long which is amply sufficient for a Stratocruiser to land in safety. The runway lights consist of two rows of white lights spaced at 200 feet apart and of variable intensity; each row of white lights is inset 75 feet from the edge of the runway and laterally there is a distance of 150 feet between the rows. At 120 feet from the east end of the runway there are green threshold lights inset 75 feet from each edge of the runway.

The approach lights consist of a single line of sodium and red low intensity lights spaced back from the threshold at regular intervals of 300 feet for a distance of 3 000 feet. There was no Crossbar System of lighting installed.

There was a G.C.A. system in operation the purpose of which is to give the pilot guidance in Azimuth and along the glide path. The glide path is  $3\frac{1}{2}^{\circ}$  to the horizontal. The G.C.A. touchdown point is 1 235 feet from the end of the runway. The runway falls 16 feet in the 1 235 feet between the threshold and the G.C.A. touchdown point, and thereafter a further 15 feet.

Before the captain left London he received a Flight Forecast for the route from London to Gander via Prestwick and a weather briefing at about 0005 hours on 25 December from the senior forecaster on duty. The Prestwick weather conditions were forecast as follows:- The surface wind direction, 230 degrees true, speed 12 knots; the surface visibility, 3 miles, occasionally 1 700 yards; the weather, occasional drizzle; the cloud structure,  $\frac{4}{8}$ th stratus, cloud base 800 feet, with  $\frac{8}{8}$ th stratocumulus, cloud base at 1 200 feet with occasionally  $\frac{5}{8}$ th stratus, cloud base 400 feet and  $\frac{8}{8}$ th stratus 800 feet. In view of the weather actually encountered at Prestwick the above forecast proved remarkably accurate reflecting the greatest credit on the system and those engaged in the preparation of the forecasts.

Icing conditions were experienced by the aircraft at 8 500 feet, but the anti-icing and de-icing systems of the aircraft were operating and no difficulty was encountered due to icing conditions. As has already been stated, preceding the Stratocruiser was the Constellation aircraft, also owned by B.O.A.C. She was received into the stack at Prestwick at 4 000 feet and the Stratocruiser 5 000 feet. At 0248 hours the Constellation received a weather report from Prestwick Approach that the surface wind was 270, six knots, surface visibility was  $2\frac{1}{2}$  miles with slight continuous rain, cloud  $\frac{8}{8}$ th at 1 200 feet,  $\frac{5}{8}$ th at 500 feet and  $\frac{1}{8}$ th at 300 feet; the runway in use was Runway 31. This message was also received by the Stratocruiser which was at that time on the same frequency and at 0249 hours it received the same weather report direct from Prestwick Approach and was given Q.N.H. as 1012 millibars. At 0250 hours both aircraft received an amended report on the cloud,  $\frac{8}{8}$ th at 1 200 feet,  $\frac{6}{8}$ th at 700 feet and  $\frac{3}{8}$ th at 400 feet and that "there appears to be cloud on the approach Runway 31". The Constellation was then informed of a delay due to a technical fault in G.C.A. which kept the aircraft in the stack for some seven minutes while the fault was rectified. At 0301 both aircraft received a further weather report which indicated surface wind 270, seven knots, visibility  $2\frac{1}{2}$  miles, with continuous slight rain, cloud  $\frac{8}{8}$ th at 1 200,  $\frac{6}{8}$ th at 700,  $\frac{4}{8}$ th at 400,  $\frac{1}{8}$ th at 100 feet and again referred to patches of cloud on surface on approach to Runway 31. At 0312 hours the Constellation received another weather report and landed at 0318. At 0318 the Stratocruiser asked G.C.A. to give a report from the Constellation on the cloud state which he had experienced during landing. In answer to this request the Stratocruiser was informed at 0320 by G.C.A. that the Constellation reckoned he broke cloud at 700 feet and that the visibility was  $2\frac{1}{2}$  miles. A further amended report was passed by G.C.A. to the Stratocruiser at 0322 hours to the effect that the Constellation had reported that although he broke cloud at 700 feet there was a layer of cloud below that again. This report was later confirmed by the captain of the Constellation who said in evidence that he became visual at 700 feet, when he was about two miles from touchdown and that he remained visual for the rest of his approach until his touchdown. The captain of the Stratocruiser on his final approach broke cloud at 700 feet when he could see the extreme end of the runway lights and he remained visual until the last few seconds before the aircraft hit the ground. During these last few seconds the visibility had become somewhat reduced due to the presence of low scud clouds on the approach to Runway 31.

The weather minima laid down for pilots of B.O.A.C. are contained in the Operations Manual for Boeing 377. The critical height for Runway 31 at Prestwick during this approach was 600 feet and the visibility 1 mile. It is provided by Paragraph 4.3(i)(a) of the Manual;- "When using a recognized runway approach system a captain must not descend except in emergency below his critical height unless he is completely satisfied that he can thereafter continue his approach and landings by continuous visual reference to the ground or to the visual aids provided. This clearly indicates that no cloud is acceptable upon the approach

path below the critical heights". While the meaning of the first sentence of this paragraph is clear, the interpretation to be placed on the second sentence is not so clear. On one reading of this latter sentence it would prevent a pilot landing if there was cloud between him and the ground on his approach path notwithstanding that the intended glide path was clear. But this was not the interpretation placed on this sentence either by B.O.A.C. or by any of the pilots who gave evidence. It is in practice interpreted in the sense that a pilot may land although there is cloud below his critical height on the approach path, provided the glide path is clear. On this interpretation, if the captain's evidence that he became visual at 700 feet, when he could see the end of the runway, is true, his decision to land at this stage was a correct one. In any event weather conditions played no part in this accident until the talk-down had been completed.

The wording of Paragraph 4.3(i)(a) of the BOAC Boeing Operations Manual leaves a great deal to be desired for clarity and if the interpretation placed on the second sentence is to be the meaning of the clause, this should be made clear by an amendment.

As has already been stated, the flight was uneventful until the aircraft arrived in the stack over Prestwick about 0257 hours. While the aircraft was in the stack, the landing lights were extended and checked and left in the extended position. When the captain received the weather report above referred to at 0301 hours, he in common with the captain of the Constellation decided that there was nothing to prevent his landing. There was a 700 feet ceiling, being the lowest altitude at which more than 4/8th of the sky is covered with cloud. The captain however, in view of the other weather reports given to him was not unprepared to find patches of cloud beneath him on the final approach. He decided to proceed to his critical height. At 0319 the aircraft was given Q.N.H. 1012 millibars which was duly acknowledged. At 0321 the aircraft was just coming up on the final approach, and given a heading of 305 degrees and told to descend to 2 000 feet. Thereafter the aircraft was given headings from time to time by G.C.A. which were in turn acknowledged. At 0323 the final talk-down commenced and finished at 0325+44 seconds. The recorded talk-down is as follows with the calculated times:-

Time

0323	Ah, that is correct three one five, do not acknowledge further instructions, check your minima, turn left left five degrees heading three one zero, I say again heading three one zero,
0323+14	five and a half miles from touchdown, check wheels down and locked, you are right of the centre line slowly closing on heading three one zero,
0323+22	five miles from touchdown, shortly approaching the glide path, heading three one zero,
0323+30	begin your descent now at six hundred feet per minute,
0323+34	four and a half miles from touchdown, turn left left five degrees heading three zero five, I say again heading three zero five, and you are
0323+43	settled on the glide path now, on the glide path, three zero five is your heading,
0323+49	four miles from touchdown, heading three zero five, and you are just
0323+55	fifty feet above the glide path now, heading three zero five, turn right three degrees heading three zero eight, I say again heading three zero eight,
0324+4	eighty feet above the glide path now, eighty feet too high,
0324+9	three and a half miles from touchdown turn right a further three degrees heading three one one, I say again heading three one one and you are still
0324+17	eighty feet above the glide path, three one one is your heading,

<u>Time</u>	
0324+22	three miles from touchdown, fifty feet high now, forty, thirty,
0324+27	twenty, on the glide path now, heading three one one,
0324+32	on the glide path now, your heading is three one one,
0324+35	two and a half miles from touchdown, turn left left three degrees heading three zero eight, I say again heading three zero eight, and you are
0324+41	going above the glide path now,
0324+44	one hundred feet too high, one hundred and thirty feet above the glide path now,
0324+48	one hundred and forty, heading three zero eight,
0324+51	two miles from touchdown, obstacle clearance limit is two six three feet, turn left left three degrees heading three zero five,
0324+58	eighty feet above the glide path now, fifty feet high, coming back to the glide path, and
0325+4	on the glide path now, heading is three zero five,
0325+7	one and a half miles from touchdown,
0325+8	on the glide path, heading three zero five is good, and you are just
0325+13	twenty feet high now, turn right three degrees heading three zero eight,
0325+18	one and a quarter miles from touchdown,
0325+19	sixty feet high now, turn right a further three degrees heading three one one,
0325+25	one mile from touchdown, you are one
0325+26	hundred and fifty feet above the glide path, two hundred feet above the glide path now, if you are overshooting, climb to one five zero zero feet on heading three one one,
0325+36	three quarters of a mile from touchdown, I will continue with talk-down,
0325+40	one hundred feet high now, and
0325+42	four hundred yards from the runway, talk-down completed,
0325+44	out.

Unfortunately the evidence of the captain and the first officer as to what happened during the final talk-down does not agree. The captain's account in evidence was that he became visual when he was approximately a quarter of a mile short of the most easterly approach lights, which would place the aircraft approximately three quarters of a mile from the threshold or half a mile from the point where the talk-down was completed. The captain stated that he could then see all the approach lights and all the runway lights. He was able to estimate his height from the ground visually and by reference to his altimeter which he reckoned to be 700 feet. During the final stage of the approach he was flying port wing low to counteract the cross wind. All the appropriate checks were carried out including the extension of the flaps to 25 and then 30 degrees. The landing lights were checked during the approach prior to the outer marker beacon. There was a slight drizzle which caused him to put on the wind-shield



wipers. Just as the aircraft was coming over the most easterly approach light, the captain gave an order to the first officer- "Landing Flaps, Full Flap; Landing Lights On". He says that from the feel of the aircraft in his hands he is certain that the flaps had been extended to the 45 degrees position, but that no acknowledgment of this order was given by the first officer. The landing lights were not illuminated and he again asked the first officer for the landing lights to be put on. According to the captain the first officer replied "They are on". The captain says he was misled into thinking that the landing lights were in fact on by the glare of the approach lights. All the eye-witnesses, except one who was undoubtedly mistaken, agree that the landing lights were never illuminated during the final approach. According to the captain the final manifold power setting was 20 inches or 25 inches. Up to the time of the completion of the talk-down he experienced nothing unusual. The aircraft had behaved normally and he made no complaint of the talk-down. He then describes what happened next in these graphic words- "I was slightly high on the glide path, I steepened my approach and when I reached the altitude that I wanted to soften my rate of descent I eased the control column back. The aircraft responded inasmuch as it changed attitude. Then it seemed to fall out of my hands. Visibility deteriorated to the extent that the lights were then visual as if seen through haze. We came out of that condition and hit the ground, I think port wheel first and it probably took much less time to happen than it has taken me to tell you". His steep descent was necessitated because he was high relative to his aiming point which was 200 to 300 yards up the runway. His speed was 130-135 knots until full flap was selected, then a decrease from 130 knots to cross over the threshold at 115 knots. His stated intention was to cross the threshold at a height of about 3 to 5 feet from the ground.

The first officer's evidence tallies with the captain's evidence up to the beginning of the final approach. Thereafter it differs to some extent. He agrees that they became visual at about 700 feet and that the captain ordered full flap before the approach lights. This order he acknowledged. The first officer executed this order by operating the flap selector switch until the instrument on the panel showed 45 degrees. When the indicator had gone to 45 degrees he said to the captain "You have Full Flap". He stated that he received no order from the captain for landing lights on during the final approach and accordingly did not apply the landing light switches and the landing lights were never illuminated. He had the impression that the aircraft was high for an approach and that the descent was fairly steep. His recollection is that the aircraft was in cloud for a few seconds. He obtained no impression of the aircraft sinking except in the last split second before the aircraft hit the ground.

The remainder of the crew gave no assistance on the conflict between the captain and the first officer. No one overheard the orders given by the captain on the final approach. The flight engineer, who was at the panel as engineer for the approach and landing, says that the power settings ordered were 37-1/2 inches, 28 inches and 25 inches all at an engine speed of 2120 rpm. These were, according to the witness, perfectly normal settings for an approach to Prestwick.

A number of eye-witnesses on the ground gave evidence as to the behaviour of the aircraft before and at the time of the crash. The most valuable evidence came from the Approach Controller who witnessed the approach of the aircraft and the accident through binoculars from the control tower. He observed the navigation lights when the aircraft passed the range of one mile from touchdown. The landing lights were never on. According to him, the aircraft appeared rather high and when it was about three quarters of a mile from touchdown it descended more rapidly than is normal. During the approach of the aircraft he was able to see all the runway lights, the threshold lights and all the approach lights except one, which was obscured by the configuration of the ground.

The aircraft struck the ground nose wheel first. Almost immediately thereafter the port landing wheels contacted the ground at a distance of 127 feet from the threshold; the starboard wheels first contacted the ground 70 feet from the threshold. The marks indicated that the aircraft had made a fairly straight approach to the runway being only 12 feet to the right of the centre line. The port main landing wheels continued their marks for a distance along the runway when the aircraft again became airborne for a distance of 373 feet. The second impact probably caused the collapse of the main landing gear and thereafter the aircraft

skidded along the runway for about 1 200 feet to its final position. Following the collapse of the port undercarriage the port wing folded back and trailed beside the fuselage. Various portions of the aircraft were shed during its course along the runway and No. 4 engine was completely detached during the final break-up on the south side of the runway. A severe structural failure occurred in the area of the wing root and the aircraft lay with the crew compartment on its port side and the main fuselage in an inverted position and resting on its tail fin. The port wing was partially covered by the fuselage.

A careful and minute examination was made of all parts of the aircraft after the accident. The position of the flap mechanism indicated that the flaps at the final point of rest were at the 35 degrees setting. The left elevator compensator trim tab was at a setting which would be commensurate with the flap setting at 35 degrees. The torque bar which operates the flaps was fractured: the wing flap indicator was found, but it was so badly damaged that no setting could be determined. The wing flap and landing lamp control panel was also recovered, but this had been so destroyed by fire that it was impossible to make any safe deduction as to the position of the switches at impact or final rest. The left landing light was in the fully extended position. The rear spar of the port wing was fractured, but it was impossible to say whether this occurred at first or second impact. When the rear spar fractured it is possible that the torque tube which operates the flap mechanism became out of alignment and this, if it occurred, would have prevented the flaps from operating further in either direction.

Various possibilities were canvassed as to the likelihood of the flap mechanism operating after the first impact. There is a remote possibility that the flap mechanism operated after the first impact either by the relay making a connection or the switch being moved in the course of the crash, but the Court considered that the strong probability is that the flaps were in the 35 degrees setting at the moment of first impact and never moved from that position after.

The marks on the ground and the damage to the aircraft indicate that at the time of hitting the ground the port wing was low to the extent of about 5 degrees to the horizontal.

Having regard to the evidence of the talk-down, the ground damage, and the damage to the aircraft, it is possible to obtain a fairly accurate picture of what happened up to within a few seconds of the aircraft hitting the ground and after the aircraft hit the ground. The important gap lies in the few seconds which elapsed after the talk-down was completed. The captain's explanation of the accident is that the flaps must have retracted from 45 degrees to 35 degrees during the last five seconds or so prior to the crash and that this caused the aircraft to sink and so hit the ground. In considering this explanation it was necessary first of all, if possible, to resolve the conflict between the evidence of the captain and first officer as to the landing lights. The Court had no doubt that the captain gave the order to switch on the landing lights and that this order was not carried out by the first officer and that the landing lights were accordingly not illuminated during the final approach. The order for flaps and the order for landing lights should, wherever possible, be separately given and separately acknowledged. However this may be, it is not possible to explain the first officer's failure to put on the landing lights by the confusion of the double order because the captain, if he is to be believed and on this matter the Court was prepared to accept his evidence, reiterated the order for landing lights. The Court found it difficult to understand how the captain could have been misled into thinking that the landing lights were on from the glare of the approach lights, but it was possible that the low cloud on the approach path led him into this mistake. The Court felt that if the order for landing lights had been given earlier and had been carried out the flight of the aircraft into low cloud might have been avoided. The advantage of giving the order for landing lights at an earlier stage is that if the order is not carried out or if the lights do not go on, there is time for the pilot to reconsider his position. The next point considered was if the flaps retracted from 45 degrees to 35 degrees, how this took place. The Court dismissed the suggestion that the flaps were never extended to 45 degrees for the reason that there is no evidence to support it. It was clear that the flaps could only retract by the operation of the flap selector switch. This is on the instrument panel next to the landing light switches immediately adjacent to the first officer's seat. The flap selector switch

is guarded on either side by a projection of metal. To operate the flaps to the down position the switch is moved in a forward motion. The switch being spring loaded from this position returns automatically when released to the neutral position which is vertical. To retract the flaps the switch is moved aft and on this side the switch is not spring loaded and only returns to the neutral position on being moved to the vertical. Prior to the accident, on a training flight, a pilot had the experience of the flap selector switch on the final approach springing into the retract position after full flap had been selected and the switch released. This caused B.O.A.C. to issue a warning to captains and first officers, to ensure that the flap selector switch is returned to the "off" position at all times. Since the accident three other B.O.A.C. pilots have reported similar malfunctioning of the flap selector switches which occurred prior to the accident. The Court did not consider that this malfunctioning of the flap selector switch was due to any mechanical defect in the system. The flap selector switch operated correctly if it was handled with care. The first officer testified that he did not allow the switch to move to the retract position and in fact asserted that he kept his fingers on the switch until he returned it to the "off" position. There was a further possibility that the first officer in a last-second attempt to switch on the landing lights in response to the captain's reiterated order for them inadvertently operated the flap switch. The first officer denies this and it was considered improbable in view of the different position, structure and movement of the two switches. Assuming, however, that the flaps retracted from 45 degrees to 35 degrees the next question considered was what caused them to retract. The possibility of the flaps retracting between first and second impact was canvassed, but having regard to the damage and the rate of retraction of 2 degrees per second the Court rejected this possibility. It was considered that contrary to the first officer's evidence the most probable explanation was that when operating the flap selector switch he allowed the switch to spring back from the extend position past the "off" position and that the strength of the spring did, as it had done on the other occasions, move the switch into the retract position which caused the flaps to move from 45 degrees to 35 degrees. If this did take place, the mechanism must at some point prior to the aircraft coming to rest have stopped retracting. It was considered that the probability is that this occurred with first impact when the rear spar was fractured and the torque tube put out of alignment.

The next step considered, in what came to be known as the "flap theory," was whether this caused or contributed to the accident. On the captain's account nothing unusual occurred until the last few seconds before impact. The question was therefore whether the flap retraction from 45 degrees to 35 degrees could have caused the sink which the captain sensed and resulted in the aircraft "falling out of his hands" as he described it. Tests were made in the air on a Stratocruiser by a B.O.A.C. pilot after the accident as to the effect of a flap retraction from 45 degrees to 35 degrees at varying speeds. The results of these tests, which were not controlled, were indeterminate and the Court did not find itself assisted by them. More valuable assistance came from the Test Pilot of Boeing Airplane Company. He produced a report from his Company made in response to questions asked by B.O.A.C. in relation to this accident. Graphs were produced which showed that the stalling speeds of this aircraft with flaps at 45 degrees and 35 degrees were very close. The evidence shows that this aircraft at no time prior to the accident approached these speeds. Graphs also showed that the lift co-efficient was not materially affected by the retraction of the flaps from 45 degrees to 35 degrees and that a retraction of the flaps from 45 degrees to 35 degrees would only require an increase of 2 degrees in the angle of attack to compensate for this retraction. The retraction of the flaps which would be at a rate of approximately 2 degrees per second would be gradual and the change is partially compensated by the left compensator trim tab which works in conjunction with the flap retraction gear. The Test Pilot's view was that the difference in handling characteristics of the aircraft caused by the retraction of the flaps from 45 degrees to 35 degrees was one which a careful pilot should be able to cope with.

After a close and careful study of the evidence the Court reached the conclusion that the retraction of the flaps from 45 degrees to 35 degrees did not cause or contribute to the accident.

Assuming that the retraction of the flaps was not associated with the accident, it became necessary to consider what was the cause of the aircraft hitting the ground 127 feet short of the threshold. In approaching this branch of this case the Court had perforce to discard the

captain's evidence as to what happened during the last few seconds before impact. The captain's approach was, on his own admission, high, and from the talk-down record, considered unduly high. In order to touch down in the position and at the point which he was aiming at it was necessary for him to make a steep final descent. The rate of descent has been calculated accordingly to a profile prepared in relation to the talk-down at 1260 feet per minute in the last 10 seconds before completion of the talk-down. This compares with a steady descent by the captain of the Constellation of 636 feet per minute. At what stage the aircraft went into reduced visibility due to cloud it was impossible to state with precise accuracy. It was probably, according to the first officer's evidence, in these conditions for a longer period than the captain stated. It was considered that the captain, owing to the reduced visibility into which the aircraft passed and the lack of landing lights, flared out too late and too severely, thereby causing the aircraft to sink too rapidly during the last few seconds. Flap retraction may have played a minimal part in the final sink, but in the opinion of the Court, owing to the captain's errors of judgment, the aircraft would, in any event, have hit the ground at about that point apart from any question of retraction of flaps.

The captain reported to the Meteorological Office at London Airport at 1520 hours on 24 December 1954, having telephoned for information about the weather at 1400 hours. The first officer had reported about noon on the same day. The flight had been scheduled to leave London at 1745 hours, but owing to a delay in waiting for a passenger to be flown from Manchester, the aircraft did not become airborne till 2158 hours. In the course of the flight the port undercarriage failed to retract and fuel had to be jettisoned prior to making a landing at 2245 hours. The take-off of the second aircraft from London Airport took place at 0120 hours and the accident happened at Prestwick about 0325 hours on 25 December. The captain had accordingly been on duty for about 12 hours and the first officer for a slightly longer period. These members of the crew had undoubtedly had a long and tiring day and the captain had throughout anxieties about the weather to be encountered at Prestwick and indeed had considered the possibility of several alternate airports for landing. His actual flying time was, however, approximately three hours. While the Court was prepared to believe that the captain would by 0320 hours on the morning of the 25 December be fatigued, it did not consider that he was so unduly fatigued as to endanger the safety of the aircraft. The captain himself disclaimed any feeling of tiredness at the time of the accident.

The Regulations of B.O.A.C. provide no maximum period of duty for members of the aircraft crew. It is left to the discretion of the captain to call for a stand-by crew. In the opinion of the Court consideration should be given by B.O.A.C. to Regulations providing for on-duty time limitations prior to departure from the airport and in the course of the flight. The Ministry of Transport and Civil Aviation had at present under consideration the question of the tours of duty by air crews.

#### Rescue Services

These functioned efficiently and promptly. The aerodrome services were in operation and assistance was obtained from local fire brigades. Doctors and ambulances were on the scene promptly and the services of ministers and priests were readily available. The Airport Police were supplemented by the Civil Police. So fierce was the fire that it was not finally extinguished till 0800 hours on 25 December. There was close and integrated co-operation between all the Services and full co-operation and assistance was obtained from the United States Air Force Services.

The aircraft was marked externally to show where access to the aircraft was easiest. While these marks would be of assistance to those engaged in Rescue Service, it would be of further assistance if some plainly marked instructions were given on the outside of the aircraft doors in order to show how these could easily be opened. The court approved a suggestion that a system of battery operated lighting should be installed on transport aircraft in order that in the event of failure of electrical power, passengers would be able in the event of an accident to see their way to safety.



### Conclusions and Recommendations

The aircraft had been maintained in good condition and was properly equipped, fuelled and loaded for its flight from London to Prestwick. The engines functioned normally and there was no reason to believe that there was any failure of the equipment. There was no mechanical defect in the aircraft.

The crew were experienced and competent. The captain was a pilot of great experience who had familiarity with Prestwick. The first officer also had considerable experience in the position of co-pilot. Although nothing was disclosed in the evidence, the conclusion from the temperament of these two individuals may be that there was some lack of co-operation between them. There was nothing in the tour of duty to cause undue fatigue. B.O.A.C. should consider some limitation of the hours of duty of an air crew at an airport.

The flight proceeded normally up to the point where the G.C.A. talk-down began. The G.C.A. system worked normally and correctly. Any error in the glide path was minimal and had nothing to do with the accident.

The captain's orders to put on the landing lights were not carried out by the first officer. The landing lights would have enabled the captain to observe earlier the presence of low cloud into which the aircraft passed immediately prior to striking the ground.

Weather conditions were such that the captain's decision to land was correct. The weather minima of B.O.A.C. on Runway 31 at Prestwick are adequate to ensure the safe operation of aircraft.

The captain kept the aircraft unduly high on the final approach. His descent to the runway was abnormally steep and in order to correct his steep descent his flare out was too late and too severe. The aircraft passed through low cloud over the approach lights and owing to the absence of landing lights the reduced visibility took the captain by surprise and in the last few seconds he failed to appreciate how near to the ground he was.

The lighting at Prestwick was considered adequate, although this will be considerably improved when the Calvert Crossbar System of lighting is installed.

The G.C.A. system functioned correctly and the facilities provided gave reasonable and safe assistance to the aircraft. An effort should be made to institute complete ILS with glide path on either Runway 31 or 13 without further delay, if this has not already been done. The inter-departmental working of the Telecommunications Section of the Ministry should be looked into.

Improved marking of points of access to an aircraft should be introduced and battery operated emergency lighting to supplement the normal system should be made obligatory.

### Probable Cause

Errors of judgment on the part of the captain in

- a) starting his final approach to land at too steep an angle and
- b) flaring out too late and too severely with the result that the aircraft sank and hit the ground short of the runway. During the flare out the aircraft passed through low cloud, thus reducing the captain's visibility. The accident was also contributed to by the failure of the first officer to carry out the order of the captain to put on the landing lights which prevented the captain from observing timeously the low cloud over the approach lights.