SHERIFFDOM OF NORTH STRATHCLYDE

INQUIRY HELD UNDER FATAL ACCIDENTS AND SUDDEN DEATHS INQUIRY (SCOTLAND) ACT 1976

DETERMINATION by BRUCE ALEXANDER KERR, Queen's Counsel, Sheriff Principal of the Sheriffdom of North Strathclyde following an Inquiry held into the circumstances of the deaths on 15 March 2005 near Machrihanish of GUY HENDERSON, aged 40 years, and JOHN McCREANOR, aged 34 years.

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PAISLEY, 22 August 2008

The Sheriff Principal under and in terms of Section 6(1) of the Fatal Accidents and Sudden Deaths Inquiry (Scotland) Act 1976 makes the following determination:-

(a) The accident resulting in the deaths took place in the sea at a point some 7.7 nautical miles west north west of the Machrihanish airfield near Campbeltown at or about 0020hrs on Tuesday 15 March 2005. The accident involved a Pilatus Britten Norman Islander aircraft, registration G-BOMG. The deaths took place shortly after the accident in its approximate vicinity.

(b) The cause of the deaths was in each case drowning following upon the accident. The cause of the accident was the continued controlled descent of the aircraft below the level appropriate for a landing approach to the runway at the airfield until it hit the surface of the sea at a point some 7.7 nautical miles west north west of the Machrihanish airfield.

(e) ©There were two reasonable precautions whereby the accident and the resultant deaths might have been avoided. These were:-

(ii) The presence of a second pilot in the cockpit of the air ambulance might well have enabled the impaired ability of the first (sole) pilot to grasp the urgency of the dangerous situation facing his aircraft to be remedied when it continued to descend toward the surface of the sea below the level appropriate for a landing approach at Machrihanish and might well have allowed the situation to be recovered to a position of normality.

(iii) The carriage of a radio altimeter or similar low height warning device would probably have given the pilot audible and adequate warning of his aircraft's proximity to the surface of the sea and might well have enabled him to recover sufficient altitude in time to avoid the accident which occurred.

(d) There were no defect(s) in any system of working which contributed to the accident or the resultant deaths.

(e) Other facts established to the satisfaction of the Sheriff Principal which are relevant to the circumstances of the deaths include:-

(i) In the case of John McCreanor his drowning was preceded by his being rendered unconscious by a blow to the head when his forehead came into contact with the rear of the seat in front of the seat into which he was strapped within the aircraft brought about by the impact of the aircraft with the surface of the sea. There was no upper torso restraint fitted to the seat within the aircraft in which John McCreanor sat: he was strapped into the seat by means only of a lapbelt.

(ii) There was at Campbeltown no secondary surveillance radar in operation nor even installed at the time of the accident. Such a radar, had it been in use, might have enabled the pilot to be warned from the ground of the low altitude of his aircraft in sufficient time and may possibly have averted the accident.

BA Kerr

NOTE:

Evidence led

Apart from the evidence of the first witness, Karen Pickett, the evidence of all witnesses at the inquiry was led by the procurator fiscal depute (PFD) on behalf of the Crown. The evidence of Ms Pickett (who had lived with John McCreanor as his partner for some four years immediately prior to his death) was led at the start of the inquiry by the solicitor representing Mr McCreanor's family. Between them they had one child born in January 2005. They lived together in Paisley. He was employed by the Scottish Ambulance Service as a paramedical and had been part of their air ambulance service for two years.

In addition a number of joint minutes were lodged and read out at the inquiry covering the testimony of several witnesses who accordingly were not required to attend and so were not cross-examined. These included the fiancée of Guy Henderson, Agnes Lorne Blyth, who had lived with him for several years immediately prior to his death. They had one son between them. The joint minute in respect of her evidence consisted of a precognition taken earlier from her by the PFD who presented the Crown case in which she gave information concerning *inter alia* the mental state of Guy Henderson during the period leading up to his death, which she described in effect as normal. She also said that he was well-rested after a recent holiday. She indicated that on 14 March 2005 he had risen at about 6.45 am and spent the day on domestic activities which were not taxing. On these matters she was, consequently, not cross-examined. Those witnesses who saw Guy Henderson on the night of his death as he prepared to fly to Campbeltown (who gave evidence from the witness box) noticed no abnormality in his demeanour.

The evidence contained in the other joint minutes came from witnesses by the names of Andrew Mackie Scott (Scottish Ambulance Service Operations Room Assistant at Dundee), Dr John Clark (Forensic Pathologist), Stewart James Hawkins (Senior Inspector of Air Accidents (Engineering) with the Air Accident Investigation Branch (AAIB) of the Department for Transport) and Adrian Philip Burrows (Senior Inspector of Air Accidents (Engineering) with the AAIB of the Department for Transport). From these joint minutes there were established *inter alia* the following agreed facts:-

(i) At 2113hrs on 14 March 2005 there was received at Dundee in the Operations Room of the Scottish Ambulance Service a request from Campbeltown Hospital for an air ambulance to transfer to Glasgow a ten-year-old boy requiring surgical treatment for abdominal pain/appendicitis. For this the necessary arrangements were then made by Mr Scott.

(ii) On 21 March 2005 the body of John McCreanor was found on the seabed eight miles northwest of Machrihanish restrained by a lapbelt in an aircraft seat among wreckage of the aircraft G-BOMG. At a subsequent *post mortem* examination the cause of John McCreanor's death was found to be "drowning and head injury due to aircraft accident".

(iii) On 18 December 2005 the bodily remains of Guy Henderson were found by a fishing boat trawling four miles west of Machrihanish. At a subsequent *post mortem* examination the cause of Guy Henderson's death was found to be "unascertained". A toxological analysis of his liver blood gave a negative result.

(iv) A detailed examination of the recovered wreckage of the aircraft G-BOMG and in particular the engines and propeller blades thereof conducted by Stewart James Hawkins of the AAIB led him to believe that the aircraft hit the sea in a controlled flight attitude with symmetric power. No evidence was found to suggest any technical defect in the aircraft which might have contributed to the accident and there were no specific indications that the pilot was preoccupied with any emergency late in the flight.

The Crown led evidence by oral testimony from seven witnesses, namely (i) Alexander James Holmes (a training pilot with Loganair), (ii) Paul Deakin (a pilot with Loganair), (iii) Harry Nodoro (an aircraft engineer with Loganair), (iv) Michael Thomas Davis (a movement controller with Loganair), (v) Angus Carmichael Robinson (an air traffic controller at Prestwick), (vi) Alan Francis O'Brien (a flight information service officer at Machrihanish) and (vii) Kenneth W Fairbank (a Senior Inspector of Air Accidents (Operations) with the AAIB of the Department for Transport). With the exception of Paul Deakin and Harry

Nodoro these witnesses were all cross-examined to a greater or lesser extent and the facts found established by me in those areas of doubt or controversy which arose at the inquiry are derived largely from their evidence.

Factors having no bearing on the occurrence of the accident.

At the inquiry it emerged clearly that certain elements which in some situations might contribute to the occurrence of an aircraft accident were on this occasion fully in order or at least sufficiently so to be discounted as possible contributory causes. These are briefly considered below but I do not consider it necessary to go into the minute detail of each.

1. The general qualifications and training of the pilot, including his "currency", were entirely in accordance with all rules and regulations bearing thereon. He was regarded by his colleagues as an excellent pilot in all normal circumstances. He had by 14 March 2005 not flown an aircraft for some thirty-two days and was accordingly required in accordance with normal Loganair procedures to perform a solo currency circuit flight (visual) at Glasgow Airport before proceeding with any passengers on the task allotted to him: this he did entirely satisfactorily before taking off again for Campbeltown.

2. The condition of the aircraft in all respects bearing on its airworthiness was good and in proper order. The aircraft had been properly maintained and all required inspections had been carried out at appropriate intervals and were up-to-date at the time of its final flight. The aircraft had been fully fuelled before the flight. There were no known defects which might affect its airworthiness or in any of its instrumentation.

3. The company procedures of the operator Loganair, and especially those pertaining to the approach to the airfield at Campbeltown for an instrument landing, were all properly in place and conformed to Civil Aviation Authority (CAA) and all other regulatory requirements. The approach procedure followed by the pilot until very shortly before the accident was an established and approved procedure.

4. The navigational aids and other support systems on the ground, including in particular the VOR/DME beacon at Machrihanish, were in proper working order and functioning correctly. The communication systems between the aircraft and the ground were operating normally, save only in respect that the recording of transmissions on the local frequency at Campbeltown was for some unknown reason defective in that only transmissions from the aircraft to the ground were being recorded and not those sent from the ground to the aircraft.

5. Save in respect of visibility (on which see further below), the weather was relatively normal and not such as to inhibit flying in respect of wind, squalls or storms. The wind was moderate from the west south west with rain and low cloud which restricted visibility and the whole flight required to be carried out in the hours of darkness. In consequence the flight had to be conducted by instruments throughout and there was some doubt attendant on whether the visibility conditions would be sufficient to enable a landing at Campbeltown to be effected at all. These conditions (of visibility) may have imposed some stress on the pilot (see further below).

<u>Factors which may have some bearing on the occurrence of the accident</u>

Certain features of the flight and the background conditions pertaining to it which were the subject of evidence at the inquiry require to be considered with a view to assessing whether or not they may have affected the pilot's performance or may give some indication of his condition during the flight or may have contributed to the occurrence of the accident or its causes. These are discussed below in chronologically sequential order so far as possible.

1. The pilot lacked recent flying practice in that he had last flown an aircraft some thirty-two days previously. For this reason he was required to fly a single currency circuit at Glasgow Airport before undertaking the flight with a passenger to Campbeltown and did so in an entirely satisfactory manner. Given that he thus complied with the requirement set in place to meet any supposed difficulty flowing from a lack of recent practice I do not think that any deduction can properly be made reflecting adversely on his capabilities for this reason. The most that can be taken from this is the observation that his first flight after that period of absence happened, as fate would have it, to be somewhat more difficult and less

straightforward than it might have been by virtue of being a night flight by instruments in poor conditions of visibility: this combination of circumstances may well have imposed some stress on the pilot.

2. By the time of take-off from Glasgow for Campbeltown at 2333hrs the pilot had been awake for nearly seventeen hours (since approximately 6.45 am). The flight itself lasted for forty-five minutes or so and by the time of the accident the pilot had been awake for some seventeen and a half hours. He had had eight hours of sleep the previous night and had only recently returned from a holiday. Nevertheless I take it from these facts that the whole of the flight required to be undertaken at a time when his body was ready again for sleep and it has to be deduced as a matter of commonsense that he must have been feeling tired by midnight, some seventeen hours after he rose in the morning and despite his being a man aged only forty years. I think it only reasonable to assume that tiredness may well have contributed to a lack of complete attentiveness on his part.

3. The weather conditions throughout the flight were not good at least in respect of visibility. Even at six thousand feet above sea level it is not clear that the aircraft was flying above the level of the clouds. In the Campbeltown area when the pilot arrived there, although no problem was posed by the moderate south-westerly wind, there was cloud and rain down to a low level and persistent. It appears that at the site of the accident the cloud level may have been as low as two hundred feet above the sea. These conditions meant that there were no visual aids available during the descending approach to the airfield so that reliance on instruments was total. The pilot had previously flown Islanders by instruments and had flown instrument approaches previously to Campbeltown Airport but the weather conditions must nevertheless have imposed a degree of stress upon him. In addition, equally or perhaps more importantly, these extreme conditions of visibility at or close to the applicable minima carried with them a question whether an actual landing at Campbeltown was going to prove possible at all — a question which in all probability remained yet unresolved at the time of the accident. That unresolved question must have been a source of anxiety and some stress to the pilot (and perhaps to his passenger too) given the nature and intended purpose of

the ambulance flight. I take this to have been a "stress factor", in modern parlance, of some significance on the pilot which may well have adversely affected his capabilities to some extent.

4. The weather report from Campbeltown was not available in the operations room at Glasgow Airport when the pilot was there and was eventually given in an envelope to the paramedic to take out to the pilot in the aircraft. This constituted a minor irregularity but there is no reason to think the pilot did not receive or see it and I do not regard this departure from strictly correct procedure as having diminished the pilot's capability or awareness of conditions he was likely to face nor as having had any contributory effect on the occurrence of the accident.

5. The route from Glasgow to Campbeltown chosen by the pilot was not the most direct route available and may have involved some change of mind on his part before taking off. The most direct route would have been directly over the top of the north Arran hills (approximately 2900 feet in height) and while taxiing at Glasgow Airport air traffic control clearance was given for this route. The pilot however then requested another route via the point known as ROBBO and thence westward before turning southwest for Campbeltown: for this route a revised air traffic control clearance was issued before the aircraft took off at 2333hrs. It is not clear what reason the pilot had for preferring a less direct route to the west but I accept without hesitation that the choice, within limits, of preferred route lies with the pilot and I draw no adverse inference from his choice of a less direct route. No doubt it was slightly longer in distance flown but I see no ground for thinking that the stress and strain of the flight on the pilot was thereby materially increased and I regard his choice as irrelevant to the occurrence of the accident.

6. In the event the pilot flew beyond the point at which he would normally have expected, on his chosen route, to turn southwest on to the 030^{o} radial inbound to the Machrihanish VOR/DME. His expected course would have involved a turn southwest onto that radial at or slightly northeast of a point known as TABIT (a point on the east coast of Kintyre not far from Skipness) but the pilot instead flew noticeably further west to the town of Tarbert until 2359hrs when the air traffic

controller (at Prestwick) noticed the absence as yet of a turn southwest and called up the pilot seeking confirmation of his routing. The pilot replied that he intended to pick up the radial referred to above but it was clear that by now the aircraft had passed it. The pilot then turned south but instead of continuing on to the missed radial took up a course heading directly for Machrihanish, more or less straight down the spine of Kintyre. There was I think nothing dangerous, in the result, of this unorthodox routing but it was a significant departure from the chosen advisory route of which the pilot seems to have been unaware until informed of it by the air traffic controller. I take this aberration, which I think was material even if not major, to be indicative of some inattention on the pilot's part to the flight's navigational requirements — as if he was preoccupied to some extent with something else and not concentrating absolutely fully on the job in hand.

7. The pilot's reference to the radial he intended to pick up at or near TABIT in order to fly down to Campbeltown was, during the exchange over the radio between him and the air traffic controller at Prestwick, technically incorrect in that he referred to "the 210 radial down to Campbeltown" instead of the 030^{o} radial from the Machrihanish beacon. A course of 210^{o} is the corollary of 030^{o} looked at from the other end and in that sense the pilot's reference to the radial was looking, so to speak, down the wrong end of the telescope. This is briefly commented upon by the AAIB in their report (see production number 13 at section 2.3.1 at page 47) but in my view is a matter of supreme technicality and of no significance to an understanding of the occurrence of the accident. The pilot was referring to the radial from the direction of his approach and I find nothing remarkable in that.

8. The pilot's descent toward Campbeltown as he flew southwestward down the spine of Kintyre also contained an unorthodox feature but on this occasion one to which I attach no great significance. The approach chart supplied by Loganair showed a "sector safe altitude" of 3900 feet to be maintained when approaching the Machrihanish beacon from the northeast quarter, the reason for this being the presence within ten miles on either side of the route to be flown of the hills of north Arran having a height above sea level of 2900 feet. The pilot however commenced to descend from 3900 feet to 3000 feet earlier than orthodox

procedure required that he should and so failed to maintain the SSA minimum for as long as orthodox procedure required. This descent from 3900 feet commenced at a point some six and a half nautical miles from the Machrihanish beacon and reached a level of 3000 feet some four nautical miles from the beacon. The chart contained an indication that aircraft should arrive over the beacon at a height not lower than the SSA (or 3000 feet if higher) and clearly the pilot was not complying with that indication. The AAIB and Mr Fairbank described this aberration as "contrary to safe practice as well as the operator's procedures". I do not however think it appropriate to level criticism at the pilot on this ground. The fact is that no hill on the Kintyre peninsula rises to a height greater than fifteen hundred feet and by the time the pilot commenced this early descent he was already farther south than the latitude of the high hills in north Arran situated well to the east. His early descent presented no danger nor any risk to the flight and I do not regard its occurrence as indicating anything seriously untoward about the pilot's condition or his attitude.

9. In the wreckage when recovered after the accident the autopilot was found to be switched off. The operator's procedures however required the autopilot to be switched on as part of the after-start checks. The most probable explanation of this situation is that the pilot never switched it on in the first place, preferring to conduct the flight manually throughout. From the evidence at the inquiry I accept without difficulty that it is a matter for the pilot to decide whether or not to make use of the autopilot for all or none or some parts of the flight, despite the operator's policy that it should be used during those parts of the flight above the level of one thousand feet. There is no reason to think that the autopilot in G-BOMG was unserviceable and its use would have reduced the workload imposed on the pilot. It could according to Mr Fairbank have been used on an instrument approach right up to the time of the final descent for landing. The fact that probably it was not employed by the pilot on this particular flight at all, while not in my view a point for criticism of him, leads me to think that by not availing himself of this helpful device the pilot imposed on himself a greater workload during most of the flight than he need have done. This may have contributed to his impaired ability to

control everything successfully in the final stages of the flight and so may have had a bearing on the occurrence of the accident.

10. Shortly before his arrival over the Machrihanish beacon (MAC VOR/DME) the pilot began to execute an early turn to the right, which amounted in effect to a short-cut in that a strict approach would have meant proceeding to a position directly over the beacon and then executing a turn directly on to the outbound 307^{o} radial to commence the approach procedure for a landing on runway 11. From the radar track we can see that it then took him some time, until the tenth last radar point, to establish the aircraft firmly on the outbound 307^{o} radial. It is not clear what reason(s) the pilot may have had for turning before the beacon was reached: there may have been a desire to save time by cutting the corner or the purpose may have been to avoid the "cone of silence" affecting radio transmissions in the airspace immediately above the beacon. In any event I do not regard this cutting of the corner as an aberration or a navigational error and it was in all probability done deliberately. It had the effect however, whatever may have been its advantages, of imposing on the pilot an extra workload in establishing the aircraft onto the desired outbound 307^{o} radial, a task made more difficult of achievement than it would have been had a course been flown directly onto the beacon before turning northwestwards. It may also have reduced the time available to the pilot, after establishing the aircraft onto the desired radial, to organise matters for the base turn.

11. When announcing by radio message at 0007.40hrs to the AFISOfficer at Campbeltown his intention to perform the instrumental approach for runway 11 in the hope of thereafter making a visual landing on runway 29 the pilot referred mistakenly to the latter runway as "two five". I regard this misreference to the runway's designation as no more than a slip of the tongue and I attach no significance to it as an indicator of anything to do with the pilot's mental state or physical condition.

12. While descending on the outbound leg of the approach procedure to runway 11 at Campbeltown the aircraft at the third last radar point recorded reached the

minimum altitude of 1540 feet stipulated on the chart for the base turn and then passed below it (at around 0016.10hrs). The question why that was allowed to happen and why thereafter the descent was allowed to continue to 1340 feet and beyond without a re-ascent to 1540 feet being achieved and a levelling-out there to perform or complete the base turn is the chief issue arising in the inquiry and is further discussed below. The fact however that a descent below 1540 feet to at least 1340 feet was permitted without intervention is of itself indicative of inattention on the pilot's part at that part of the flight. The further fact there was no reappearance of the aircraft thereafter at a level of 1340 feet or higher indicates I think (see further below) that the pilot had an insufficient appreciation of his aircraft's altitude and the imminent danger in which it was placed to take the action necessary to recover the situation.

13. The line taken horizontally in execution of the base turn, if as seems probable it was commenced at the point 9 DME, appears from the distribution of the wreckage when recovered to have been tighter than would have been ideal and tighter than would be taken for a standard turn. I do not however consider this to be a significant aberration and, since other evidence indicates that the aircraft hit the surface of the sea in a controlled flight attitude which was not extreme and with symmetric power, I do not consider it to have contributed to the occurrence of the accident.

14. The setting of certain instruments in the cockpit, as found when the wreckage had been recovered, are of interest. These are three in number. The horizontal situation indicator (HSI) was set on a bearing of 103^{o} and its "bug" on a bearing of 157^{o}, while below it the omni bearing indicator (OBI) was set at 309^{o}. There exists a possibility that any one or more of these settings might be the consequence of the accident itself rather than a setting which had survived the impact, but since there exists a reasonable explanation for each of the settings being as it was I am inclined to accept them all as indicating the position in which each had been set by the pilot prior to the impact of the aircraft with the surface of the sea. It would, as I understood the evidence heard at the inquiry, be normal for the pilot to adjust the settings of all three of these indicators when preparing for or commencing the base

turn. In the event it appears to me probable that he adjusted one wrongly, one correctly and one not at all at that time.

The OBI was set on a course very close to that of the outbound 307º radial from the VOR/DME beacon and the only reasonable inference is that it had been set on that course earlier in the flight (probably sometime at or about the time of arrival in the vicinity of the beacon) but not altered, as it should have been, in preparation for or commencement of the base turn, thus depriving it of its function as a back-up or support indicator to the HSI.

The heading selection "bug" on the HSI was set on a course suitable for the execution of the base turn in order to close with the intended inbound 115º course toward the beacon and runway 11. It appears therefore that the pilot had set it for the purpose of the base turn and had done so correctly.

The course selection arrow on the HSI was mis-set on a course of 103º instead of 115º. I find it difficult to believe that this setting of 103º was a random or fortuitous selection when the same figure of 103º appears on the chart which the pilot had in front of him as the radial to be followed when proceeding eastward beyond the beacon on a missed approach or perhaps suitable as a bearing to execute a further turn for a subsequent landing on runway 29, a maneouvre which the pilot had in mind to perform if possible as his preferred mode of effecting a landing (as intimated by radio message earlier at 0007.40hrs). For the approach first of all to runway 11 the pilot should instead have selected a course of 115º and then have adopted a new course only if and when it became apparent that a visual landing on runway 29 would be feasible. Given the presence of the figure 103º on the chart and the pilot's earlier stated plan to "hopefully break visual for two five" I think it a reasonable inference that the pilot inadvertently chose the wrong figure of 103º instead of 115º when setting the HSI arrow for the base turn by mis-reading the chart in front of him.

The setting of the HSI "bug" was correct but that of the HSI arrow was incorrect and the re-setting of the OBI was never performed at all when it should have been.

I take the latter two aberrations (one error, one omission) to be indicative of some degree of inattention on the pilot's part at a critical stage in the flight. That inattention may have been due to some pre-occupation of his own, or to some condition affecting him (including tiredness) or even to some distraction of which we have no evidence and cannot therefore determine the nature.

15. The pilot's last radio transmission was sent out at 0018.02hrs and its content was "base turn complete" when in fact that turn was not yet complete. Indeed it appears probable that at the moment of that transmission the base turn had only been half performed and that the accident occurred very shortly thereafter. To that extent therefore the content of the message was premature. To this I do not attach very great significance but it perhaps indicates that the pilot thought he had now done all that he had to do in order to carry out the base turn (including all proper instrument re-settings) when in fact he had not.

<u>The cause of the accident</u>

The AAIB in their report 2/2006 (production number 13) at section 3.2 identified from their investigation certain causal factors. They found that the pilot had allowed the aircraft to descend below the minimum altitude for its position in the approach procedure and that the descent probably continued unchecked until the aircraft flew into the sea. This they thought to be due to a reduced performance on the part of the pilot which was probably contributed to by a combination of fatigue, workload and lack of recent flying practice. In addition they suggested that some undetermined influence (eg disorientation, distraction or a subtle incapacitation) may have affected the pilot's ability to control safely the flightpath of the aircraft.

Counsel who appeared on behalf of the family of the deceased pilot made a submission to the effect that, whatever else had happened (which he said had to remain unclear/unexplained), the accident could not have happened in the manner suggested or contended for by the AAIB — namely by a continuous unchecked descent from the last radar point at a uniform rate of descent, without intervention to reduce the rate of descent from the pilot, until the aircraft hit the surface of the sea at or just after 0018hrs. The rationale behind this submission depended on a minute examination of the timescales and decreasing altitudes involved. It was

maintained that from a height of 1340 feet at the last radar point a period would be required of 76.56 seconds to descend to sea level at a uniform rate of descent of 1050 feet per minute. Yet the period which had elapsed from the last radar point at 0016.22hrs until the transmission of the final message at 0018.02hrs was one of 100 seconds, ie 23.44 seconds longer than would be expected. Why then or how could the aircraft have remained in flight for an extra 23½ seconds? To this counsel said that there could be only one answer namely that the pilot had intervened in some way to reduce the rate of descent. There must however be more to it than that because Mr Fairbank had said, in answer to a question from the sheriff principal, that it would be "extremely unlikely" for the pilot to have intervened to reduce the rate of descent and then, if a levelling off was achieved which he did not discount, allowed the otherwise unchecked descent to be resumed — thus falling into a second error or, more precisely, perpetrating the same error for a second time. The implication manifest in counsel's submission was that something else therefore must have happened to cause a resumption of the descent but it was impossible to say what on the available evidence that was, with the consequence that we could never be certain what was the true cause of this accident and that would be the appropriate conclusion for the sheriff principal to reach in his determination.

There are a number of comments or observations which could be made on this submission. One of them is that it tends to divert attention from the equally or perhaps more important question how did the pilot allow the aircraft to descend below the stipulated minimum altitude of 1540 feet for the base turn in the first place, some forty seconds before that turn had been commenced? According to Mr Fairbank the rate of descent was increasing at the point where the minimum 1540 foot level was passed through (increasing, he said, for the last thirty to thirty-six seconds of the radar track). Another observation is that there may be a difference between (a) the probability of the pilot checking the descent to the point of levelling off and then allowing a new descent to the sea to commence before completing the base turn and (b) the probability of the pilot reducing the rate of descent to some extent but not to the point of levelling off and not ultimately to a sufficient extent to prevent a collision with the surface of the sea. It appears to me that Mr Fairbank's opinion that such an event would be "extremely unlikely" because it would have involved a further error on the pilot's part is more applicable to the first possibility than the second. In terms of the answer he gave it seems that he was thinking more of a levelling off followed by a further descent and logically one can see how a further descent would have constituted a further error of the same type as had already

occurred, ie a repeat error. The second possibility would not have involved the repetition of an earlier error but rather an error of a different type in simply not sufficiently reducing the rate of descent but allowing it to continue at a slower rate. While I can understand Mr Fairbank's view as applied to the first possibility I find it much more believable that the second possibility could have occurred, ie that the pilot realised at some point that he was or might be descending too far too fast and intervened to correct the situation to some extent but not as it turned out sufficiently. A further observation is that counsel's examination of the timescales and decreasing altitudes, put to me with precision in closing submission, were not put to Mr Fairbank in cross-examination for his comment with the same precision as they were presented to me. He was asked to account for the difference between the period of 100 seconds which had elapsed from the last radar point until the transmission of the final message and a period of 80 seconds "more or less" which would have elapsed between the last radar point and the accident at a rate of descent of 1050 feet per minute. To this he replied, not very convincingly to my mind, that some of his flight trials had been within that timescale; that the "more or less" variant was important; and that the practicalities of flying were such than an extra 20 seconds could be taken up in the descent or by a slightly different line being taken along the route of the base turn.

Counsel representing the family of the deceased pilot also submitted that the AAIB's version of the accident's occurrence contained a feature of great unlikelihood in that it involved by implication the proposition that the pilot failed to look at his instrumentation (so far as relevant to the altitude of the aircraft) for a period of 118 seconds from "the point of normality" (the fourth last radar point) until the point at which the aircraft struck the sea which counsel described as "an extremely long time in the circumstances". I accept as a layman in these matters without difficulty that almost two minutes seems a long time indeed during which not to look at instruments when flying an aircraft in the dark by reference to instruments but I do not recall this suggestion being put specifically to Mr Fairbank in cross-examination for his comment and his observations on it might have been valuable: he said that a glance to check one's instruments would be accomplished in a matter of seconds but how often would he have expected a pilot in Mr Henderson's situation to be doing it? The 118 seconds is calculated from the fourth last radar point but a period of approximately eighteen seconds only elapses from there until the last radar point and if the pilot looked at his instruments immediately thereafter and took some action to reduce his rate of descent (albeit

inadequately in the end) then the period during which he failed to check his instruments after "the point of normality" may shrink to eighteen seconds or thereby, which I find a much more credible proposition.

What then do I consider to have been the most likely mechanism of the accident's occurrence if, contrary to counsel's submission that this matter has to be left as one of uncertainty, I consider it possible to identify such a mechanism? Three possible causes were discussed in closing submissions. These were (i) that the pilot had allowed the aircraft to descend below the minimum permissible altitude (1540 feet) and this descent continued unchecked until the surface of the sea was reached, these events being due to conditions such as fatigue, workload and lack of recent flying practice affecting the pilot; (ii) that the pilot had been adversely affected by some undetermined influence such as disorientation, distraction or a subtle incapacitation whereby his ability to control the aircraft's flightpath had been undermined; and (iii) that there had occurred some undiscovered technical malfunction. So far as causes (ii) and (iii) are concerned, not only is there no direct evidence (as counsel said) to support them: there is, as I see it, no evidence at all. On the evidential material available from this inquiry I regard these two possibilities as lying essentially in the realm of speculation. Returning then to the first possibility, can it be said to be unlike the others more than a speculation on the evidence available? It was suggested that to support this cause there was likewise no direct evidence, but with this I disagree. There is clear evidence from the radar plot of the most important single fact, namely that at the third last radar point the aircraft passed below the height of 1540 feet and continued to descend, a thing which the pilot should not have permitted to happen. There is also the agreed evidence of Stuart Hawkins (less direct, more inferential) to the effect that the engineering evidence from examination of the wreckage led him to believe that the aircraft hit the sea in a controlled flight attitude with symmetric power. These adminicles of evidence are supportive of the first possible cause favoured by the AAIB but their inference that the aircraft continued in an unchecked descent until it collided with the surface of the sea runs up against the difficulty that the aircraft appears to have remained in flight before hitting the sea for 23½ seconds longer than it should have on their figures for rate of descent and altitude lost. That however does not mean that no plausible explanation of the mechanism of the accident can be found so as to leave the matter in a state of almost complete or general uncertainty as counsel suggested to me I should find. We know that at the fourth last radar point the aircraft was descending normally but that at the third last radar point the

pilot had allowed it to descend through the minimum stipulated altitude of 1540 feet and that at the last radar point it had descended to around 1340 feet and was continuing to descend at a rate of about 1050 feet per minute. Approximately twenty seconds later the pilot commenced a base turn probably at the point 9 DME, at which point he presumably would be concentrating his attention chiefly on the horizontal direction of the aircraft and the instruments relative thereto. We know also that he did not arrest and reverse the aircraft's descent so as to return it to an altitude of 1540 feet (or even 1340 feet) there to level out for the base turn or the remainder of it as the chart which he had before him suggested: had he done so the aircraft would have reappeared on the radar plot, which it did not. That would have indicated that he had become aware of the inappropriateness of his descent pattern with sufficient precision to take steps to rectify the departure from normality entirely and return to the course which he should have been following at the altitude which he should have been maintaining. It does not however follow from his failure to take these fully corrective steps that he was wholly unaware of his inappropriate pattern of descent and did nothing to attempt to rectify it or at least reduce the rate of that descent. It appears to me quite possible that the pilot could at any stage from the last radar point at a height of 1340 feet onward have realised that something was or might well be wrong with his pattern or rate of descent and may have intervened in order at least to reduce the rate of descent — albeit not in the end sufficiently to avoid colliding with the surface of the sea. His intervention may have been sufficient to account for an extra 23½ seconds of flying time and may have happened early enough to negate the inference that he neglected to check his instruments relative to altitude for almost two minutes. It seems to me much more probable that he realised something was wrong and sought to rectify it but without success due to his own failure to understand fully the situation of his aircraft than that the accident was brought about by either of the more extreme mechanisms suggested by the AAIB or by counsel. The AAIB have suggested, in effect, that the pilot failed entirely to grasp the imminence of disaster and simply continued in an unchecked descent until the aircraft struck the sea, but that suggestion does not fit the known data for the interaction between timescale and altitude. Counsel did not suggest a positive finding that the pilot became at some stage properly aware of the situation of danger facing him and took steps to avert it but was prevented from achieving that object by some supervening event or factor beyond his control, but I took there to be a suggestion underlying his submission that I should accept that to be at least a possibility sufficient to justify a conclusion that the mechanism of the accident must remain altogether uncertain. I am not

however willing to accept that as a realistic possibility because it requires acceptance of the idea that some supervening event or malfunction occurred of which we know nothing and for whose occurrence no evidence appears to exist; such an event or malfunction is moreover rendered improbable by the considerations that at the time of the pilot's last message he appeared to remain in control of the aircraft and that the impact with the surface of the sea took place in a controlled flight attitude.

I therefore take the view that on the evidence available to me the most probable mechanism of the accident's occurrence after the establishment of the aircraft on the outbound radial (MAC 307R) of the approach procedure for runway 11 was as follows. At the fourth last radar point the aircraft was descending normally towards the commencement at the 9 DME position of the required base turn. At the third last radar point at around 0016.10hrs however the pilot allowed the aircraft to descend below the 1540 foot minimum stipulated altitude for the level base turn and continued to allow it to descend for at least a further twelve seconds until it disappeared from the radar screen at a height of around 1340 feet at the last radar point at 0016.22hrs. At that point the aircraft's rate of descent was according to Mr Fairbank actually increasing somewhat. At some point subsequent to that last radar point, but it is not clear at precisely what point, the pilot became aware that his rate of descent was excessive and/or that he was getting too low and he intervened to slow the rate of descent but, not being precisely aware how low he was, he did not reverse the descent and climb back up to a higher level to complete the base turn. Instead he allowed the aircraft to continue to descend, albeit at a slower rate than before, until it unexpectedly struck the surface of the sea some one hundred seconds or so after it had disappeared from the radar screen and shortly after he transmitted his last message at 0018.02hrs saying (somewhat prematurely) that his base turn was complete. During this period (from 0016.22hrs onward) the pilot did not transmit any other radio messages and it is likely that his attention was focussed chiefly on the horizontal direction of his aircraft in preparation for and execution of the base turn required to bring it onto a new inbound bearing of 115º for the approach to runway 11. He may well at this time have been still considering also whether, having regard to the weather conditions, he should land on runway 11 or overfly it in a generally easterly direction to execute a further turn with a view to landing on runway 29 or even whether he would be compelled to abandon any landing at Campbeltown and return to Glasgow or Prestwick.

What then were the reasons or was the reason for the pilot allowing the aircraft to descend below 1540 feet at 0016hrs approximately and then permitting it to continue to descend even if he retarded to some extent the rate of that descent? In the first place his workload must have increased markedly during the period from 0016hrs on account of the need to execute the base turn and for the reasons indicated immediately above at the end of the preceding paragraph the aircraft's altitude may not have presented itself to his mind as the matter of paramount concern. In the second place his workload generally during the flight was not light, since the whole flight had to be performed in darkness and low cloud; there are some indications (see above) in the flight history generally that he may have increased his workload somewhat beyond the necessary minimum. For instance he appears to have declined to make use of the autopilot during the flight (discussed above); and he cut the corner shortly before arrival at the MAC beacon, thus requiring extra effort to meet the increased difficulty of establishing the aircraft on the 307^{o} outbound radial (also discussed above) with the possible consequence that less time was left to prepare for the base turn. In the third place there are elements in the history of the flight indicative of a degree of inattention on the pilot's part (see above), as if perhaps he were preoccupied in some way not known to us or overloaded latterly with other tasks or concerns. There may have been some element of distraction affecting him during the critical last two minutes of the flight but of this there is no evidence nor any means of gathering such evidence had it existed. For instance he overflew the MAC 030^{o} radial as far as Tarbert before being informed of his departure from the intended route by the air traffic controller (discussed above); and when re-setting his directional instruments for the base turn during the approach procedure to runway 11 at Campbeltown he set one instrument wrongly (HSI arrow) and omitted to re-set another (OBI) (also discussed above). In addition, as already discussed above, the poor weather conditions affecting visibility may well have been subjecting him to some stress and anxiety concerning the prospects for a successful outcome to the mission as a whole. In the fourth place there must have been some degree of tiredness affecting the pilot during at least the latter stages of the flight and perhaps during the whole of it. I hesitate to use the word "fatigue", which appeared during the inquiry to acquire something almost of a technical import, but I am not at all persuaded by counsel's suggestion (put forward in connection with evidence given by Mr Fairbank on the topic of "fatigue") that account can be taken on this subject only of evidence coming from an "aviation psychologist" (which Mr Fairbank was not). I appreciate of course that the alertness of the mind, even when tired, can be enhanced for a time when faced with a demanding task requiring attention, but

one hardly requires the instruction of a trained psychologist to appreciate also that after a certain period that enhanced alertness usually falls away again, even if the demanding task has not yet been completed, if the time for performance of the task coincides with a period when the body wishes to sleep. The pilot had recently returned from a holiday which apparently had not been taxing or arduous and he had had eight hours of sleep during the previous night from about 10.45 pm until about 6.45 am. Nor had he spent his subsequent daytime hours on any demanding activity but he had remained awake throughout the day and by the time he took off from Glasgow Airport at 2333hrs for Campbeltown nearly seventeen hours had elapsed since he rose in the morning; by the time of the accident he had been awake for just over seventeen and a half hours. It seems to me entirely reasonable to assume that his body would have been thinking of going to bed again some sixteen hours or so after he had got up in the morning and it would follow that the whole of the flight fell within a period when he would again be looking for some sleep. From this the conclusion seems to me inescapable that the pilot was somewhat tired during the currency of the flight which may well have affected to some extent his attentiveness. The flight itself moreover, as has been already observed, was not straightforward but a demanding exercise conducted in accordance with instrument flight rules.

I deduce that it was some combination of the factors mentioned immediately above which affected adversely the pilot's ability to attend fully to all the matters requiring his attention during the last part, and in particular the last two minutes, of the flight. It was that impaired ability which led to his permitting the aircraft to descend below 1540 feet and to his failure, when he noticed or thought that he was descending too far too fast, to grasp the urgency of the situation sufficiently to remedy it by arresting the descent completely and climbing back to an appropriate altitude. In summary my opinion is that the pilot was more attentive to the risk posed by his descent below 1540 feet than the AAIB seem to have thought but nevertheless insufficiently aware of the degree of that risk to avert the accident. I do not think his descent was wholly unchecked but I do think it was never sufficiently arrested to avoid a collision with the surface of the sea. His descent below 1540 feet and then below 1340 feet and his failure to grasp the urgency of the situation sufficiently to rectify it fully were due most probably to a combination of tiredness, stress and an excessive workload. Some elements in these features were of his own making and others were not; the majority however arose from the situation in which he found himself in my opinion. That situation included several factors

which, while each were within normally accepted limits, were at or close to their extremity and in combination may explain the failure of the pilot to manage the situation successfully at the time of the base turn.

Death of John McCreanor: upper torso restraint

John McCreanor's body was recovered within a few days of the accident and it was apparent that he had sustained a head injury when the aircraft hit the sea which had rendered him unconscious and was most probably due to his head hitting the seat in front of his own because he was not restrained in his own seat by an effective upper torso restraint. He was accordingly unable to take steps to escape from the sinking aircraft. Had he been able to do so he would not in my opinion have survived the accident because the effects of hypothermia would have overcome him before any rescue could be effected and before he could himself have reached a place of safety (eg by swimming ashore). The pilot Guy Henderson appears to have survived the impact with the sea and escaped from the aircraft but to have succumbed within an hour or so to hypothermia and so died from drowning. The only reasonable assumption is that the same fate would have overtaken John McCreanor had he remained sufficiently conscious to escape from the aircraft after it hit the sea.

Nevertheless the AAIB in their report number 2 of 2002 (number 13 of process) made a recommendation (Safety Recommendation 2006 – 101: see page 67) which I think it appropriate to adopt here to the effect that there should be a review of the proposal earlier made by the UK Civil Aviation Authority to require the retro-fitting of upper torso restraints in all Transport Category (Passenger) aircraft below 5700kg with a view to having it implemented by regulation. Had an effective upper torso restraint been fitted to John McCreanor's seat which he could have used he would have had an increased chance of survival, albeit that would not in my opinion have availed him in the circumstances of this accident. That being so it must follow that there will be circumstances on some occasions in which the presence of an effective upper torso restraint will prevent a fatality which would otherwise occur or mitigate the severity of injuries sustained in an air accident and that sufficiently in my view justifies the recommendation. It was suggested to me that had he not been rendered unconscious John McCreanor might have survived this accident had it occurred in midsummer with a warmer sea temperature in better weather during the hours of daylight but there is no evidential basis here for me to indulge in such speculation.

I note with interest that Appendix A attached by the AAIB to their report of the present accident consists of the proposal mentioned above made by the UK Civil Aviation Authority in consequence of their study of the matter carried out in implement of a similar recommendation made by the AAIB in their report number 2 of 2001 (Safety Recommendation 2001 – 40) that such a study be undertaken in order to identify what retro-fitting should be applied to aircraft in the Transport Category (Passenger). That report related to the fatal crash of a Cessna Titan (G-ILGW) near Glasgow Airport on 3 September 1999 in respect of which the subsequent fatal accident inquiry (FAI) was conducted by myself. In my determination following upon that FAI I adopted the AAIB's recommendation, as I have done here, and now wonder what if anything has been done since toward implementation of the CAA's proposal for the retro-fitting of upper torso restraints. Clearly nothing had happened by the time of the present air accident on 15 March 2005 and nothing was said at the present FAI to indicate that anything has happened or is likely to happen by the time of this determination. The relevant authorities (European Aviation Safety Agency & Joint Aviation Authorities) should now act.

Recommendations

In light of the all the foregoing it will not be surprising that I find it appropriate to adopt all three of the safety recommendations made by the AAIB and set out in their report (at page 67) number 2/2006 which formed production number 13 at the present inquiry. For ease of reference these are set out again below with such additional commentary as I think it proper to make.

Safety Recommendation 2006-101: The European Aviation Safety Agency and Joint Aviation Authorities should review the UK Civil Aviation Authority's proposal to mandate the fitment of upper torso restraints on all seats of existing Transport Category (Passenger) aeroplanes below 5700kg being operated for public transport and consider creating regulation to implement the intent of the proposal.

This recommendation is discussed immediately above in the section headed "Death of John McCreanor: upper torso restraint".

Safety Recommendation 2006-102: Considering the unique circumstances of air ambulance flights the Civil Aviation Authority in conjunction with the Joint Aviation Authorities should review the circumstances in which a second pilot is required for public transport flights operating air ambulance services.

This recommendation accords with the first of the reasonable precautions established to my satisfaction under section 6(1)(c) of the 1976 Act. It stems not only from the evidence heard at the present inquiry concerning the circumstances of the accident involving G-BOMG but also from a Safety Recommendation 2000-50 contained in an AAIB report number 1/2001 on the circumstances of the loss of an aircraft G-BMBC which crashed into the estuary of the River Mersey on 14 June 2000. The circumstances of that earlier accident are referred to in the AAIB report number 2/2006 (at section 2.12) forming production number 13 in the present process and were spoken to also by Mr Fairbank in evidence at the present inquiry.

In the circumstances of the loss of G-BOMG I consider (as stated above) that the single pilot on 14/15 March 2005 had an impaired ability to attend fully to all the matters requiring his attention during the last part of the flight due to a combination of tiredness, stress and an excessive workload. A second pilot in the cockpit might well have been able to make up for the deficiencies of attentiveness stemming from that impaired ability by understanding the endangered situation of the aircraft and taking the steps necessary to correct the position thus averting the accident.

Safety Recommendation 2006-103: The Civil Aviation Authority in conjunction with the Joint Aviation Authorities should consider mandating the carriage of a radio altimeter or other independent low height warning device for public transport IFR flights operating with a single pilot.

This recommendation accords with the second of the reasonable precautions established to my satisfaction under section 6(1)(c) of the 1976 Act. The matter is referred to in the AAIB report number 2/2006 (at section 2.12) forming production number 13 in the present process and was spoken to also by Mr Fairbank in evidence at the present inquiry.

From the evidence at the present inquiry it was clear that the carriage of such a device (which could be retro-fitted to an Islander aircraft) would provide the pilot with an audible warning in the event of the aircraft descending below the height to which the indicator was set on the device. Had G-BOMG carried such a device correctly set it is likely that the pilot at 0016hrs or later on 15 March 2005 would have received a warning that he was dangerously close to the surface of the sea and probable that he would have been able to take rapid corrective action at least to avoid a collision with the surface of the sea. Even if the carrying of two pilots were to be mandated for air ambulance flights, the carriage of this extra safety device would be an additional benefit.

In addition to the foregoing recommendations adopted from the AAIB's report some consideration requires to be given to other measures or equipment mentioned in the course of the inquiry which might have been deployed but were not. These are four in number.

(i) Secondary surveillance radar at Campbeltown.

There was at Machrihanish no radar system in operation, the RAF having removed their radar on their departure some years ago. Had there been a secondary surveillance radar in operation it is possible that the accident may have been averted but I do not think that prospect could be placed higher than the level of possibility. It is probable that a secondary surveillance radar would have provided information enabling us to understand more fully the movements of G-BOMG during its final descent to the sea when executing the base turn and immediately prior to commencing that turn after an altitude of 1340 feet had been reached in the descent. Such information might have been useful but would not necessarily have provided a complete explanation of the cause of the accident. For this information there would have required to be present the necessary equipment and a trained operator and the whole apparatus would have had to be in operation at the time of the arrival of the flight. It is possible to conjecture that the operator would have noticed at some point that the aircraft was very low at the time of the base turn, indeed too low, and the AFISOfficer could then have told the pilot of this observation but whether these things would have happened in time and how the pilot would have reacted in the time available to him I do not find it possible to say. Nor am I in a position to understand or even hazard a guess at the likely cost of such equipment, operator and deployment in the middle of the night: on these matters no

evidence was forthcoming at the inquiry but I imagine that the costs involved would be very considerable. For these reasons I do not think it appropriate to include a secondary surveillance radar at Campbeltown Airport as a reasonable precaution established to my satisfaction under section 6(1)(c) whereby the deaths and accident might have been avoided.

Nevertheless it was suggested on behalf of Loganair to me at the close of the inquiry that consideration should be given to the possibility of installing secondary surveillance radars at small airfields in the United Kingdom (UK) such as Campbeltown, especially since Campbeltown in particular has a long runway inherited from the RAF and so might from time to time become a resort of emergency for larger aircraft. There is I think some merit in this suggestion made against the background of the accident considered at the present inquiry and especially the circumstance that the aircraft disappeared from the only radar screen tracking it at 0016.22hrs when it descended below 1340 feet in altitude. I accordingly recommend that consideration be given by the Civil Aviation Authority to the desirability of requiring installation of secondary surveillance radars at smaller airfields in the UK such as Campbeltown Airport.

(ii) Flight data recorder

There was no requirement under any applicable regulations for a flight data recorder to be fitted to G-BOMG and none was carried. Had one been carried it might have revealed the existence of a malfunction in the aircraft had there been one but there is no reason to think from any other evidence available to the inquiry that any such malfunction existed or occurred. I do not consider it appropriate on the available evidence to make any recommendation concerning the fitting of flight data recorders to aircraft of this category even although such equipment would be likely to have revealed more precisely the descending track of the aircraft to the sea after it left the radar screen at 0016.22hrs.

(iii) Cockpit voice recorder

There was no requirement under any applicable regulations for a cockpit voice recorder to be fitted to G-BOMG and none was carried. While it would have been

interesting to know what if anything was being said by the pilot or between him and his passenger inside the aircraft during the last stages of the flight there is no reason to think from any other evidence available to the inquiry that anything was going on within the passenger compartment and cockpit of the aircraft at that time which contributed to the occurrence of the accident or affected the ability of the pilot to concentrate on what he was doing. In these circumstances I do not consider it appropriate to make any recommendation concerning the fitting of cockpit voice recorders to aircraft of this category even although such equipment might possibly have yielded a greater insight into the pilot's state of mind.

(iv) Back-up recorder at Campbeltown Airport

For some unknown reason a fault in the recording of radio transmissions between the AFISOfficer on the ground at Machrihanish and the pilot in the aircraft during the period from 0006hrs to 0020hrs resulted in only those transmissions passing from the aircraft to the ground being recorded and available to the inquiry. The transmissions passing from the AFISOfficer to the pilot were thus lost. Fortunately the evidence of the AFISOfficer himself (Mr O'Brien) was available to the inquiry and he had made useful notes, being aware of the recording defect, in the Campbeltown air traffic control watch log (production number 12). Nevertheless it would have been useful to have had an exact transcript of what he was saying to the pilot and the provision of a back-up recorder to record such transmissions is accordingly recommended.

BAK