

No. 14

Trans Australia Airlines, DC-4, VH-TAA, accident on Bulwer Island, 2.5 miles NE of Brisbane Airport, Australia on 24 May 1961. Report released in Aviation Safety Digest No. 29 (March 1962) of Department of Civil Aviation, Australia.

Circumstances

Flight 1902 departed Sydney for Brisbane at 0229 hours eastern standard time on the final stage of a regular freight service from Melbourne to Brisbane. At 0425 hours when it reported 30 miles south of Brisbane Airport, it was given landing information by Brisbane Tower. Nine minutes later the captain reported that the field was in sight, and the aircraft was observed by the airport controller. At 0441 hours when the aircraft had not landed, it was found that communication with it had been lost.

The aircraft's wreckage was found 2 hours 15 minutes later on Bulwer Island. It had crashed in a tidal mangrove-covered mud flat, killing the two crew members. The aircraft was destroyed.

Investigation and EvidenceThe Aircraft

It had flown a total of 46 006 hours and during the last two and a half years had been used almost exclusively for the carriage of freight between major airports in Australia. Since the last complete overhaul, the aircraft had flown 4 576 hours.

No unserviceabilities of the aircraft were reported by the crew at Sydney nor were any known to have developed during the flight. Maintenance inspections had been carried out as required.

Its Loading

The aircraft's cargo consisted of 11 151 lb of mixed freight and 1 158 lb of mail. According to a load distribution

sheet compiled at Sydney, the aircraft's centre of gravity was within limits.

At the time of the accident it was estimated that the all-up-weight of the aircraft was 58 771 lb, i. e. 4 729 lb less than the maximum permissible landing weight for Brisbane.

The Crew MembersThe Captain

The captain had flown a total of 13 019 hours including 11 367 hours in command. Of the latter, 378 hours were flown when in command of DC-4 aircraft. His last proficiency check on DC-4 aircraft was satisfactorily completed in March 1961. He held a current first class airline transport pilot's licence and a first class instrument rating.

Medical Aspects

With one exception it may be said that the medical history of the captain contained no evidence which might be significant in the consideration of this accident. It was found, however, in the post-mortem examination that his death was due to a cardiac failure arising from a condition of myocarditis or inflammation of the heart muscle. The injuries sustained by the captain in the impact were not such that immediate death would be expected from these injuries alone.

No obvious cause for the myocarditis was found in this instance, but it was of relatively recent onset and would have been virtually impossible to detect during life.

The cardiac failure arising from this condition may have occurred before or after

impact, and the premonitory symptoms of the attack may range from none at all to a vague feeling of discomfort for any period up to 30 minutes before the attack followed by breathlessness or coughing for a short period of minutes prior to the cardiac failure. In the circumstances of this accident it is perhaps most significant that the attack can occur at any time without warning and can involve an almost immediate loss of consciousness. It is also significant that, if there was any period of time between the onset of the attack and the loss of consciousness, one of the measures adopted for relief might be the undoing of the safety belt or the pushing back of the seat or both these actions as well as an attempt to stand up.

There was some evidence that only two months prior to this accident the captain was observed to become distressed by minor exertion. The medical evidence is insufficient to establish whether this was symptomatic of the condition which ultimately caused his death. The last electrocardiogram examination undertaken by the captain was in September 1960, and it was quite normal, but the condition of myocarditis cannot be detected in this form of examination. The captain is not known to have suffered any ailment likely to have generated or accelerated the condition. There is no evidence that the captain's performance was affected by fatigue, and the medical opinion is that fatigue cannot be associated with the captain's heart condition or with the time at which the heart failure occurred.

Although the medical evidence was insufficient to establish conclusively whether the captain died before or after the impact it was the opinion of medical specialists that the relatively minor degree of haemorrhage was very slightly suggestive of cardiac failure before the impact. The medical evidence left no doubt, however, that the captain suffered a cardiac failure, and it pointed strongly to the conclusion that this was the cause of his death.

The First Officer

The first officer had 3 132 hours of flying experience including 821 hours of command experience on DC-3 and Convair 440 aircraft as well as 406 hours as first officer on DC-4 type aircraft. In August 1960 he was issued a second class airline transport pilot's licence endorsed for DC-4's. This licence was current at the time of the accident as was his second class instrument rating. His last flight proficiency check on DC-4 aircraft was satisfactorily completed in January 1961.

Medical Aspects

There was no evidence in the medical history or in the post-mortem examination of the first officer to suggest that he was, or was likely to have been, incapacitated by any pathological condition or that his physical and mental responses were affected by any circumstance occurring during this flight. His death was due to an injury sustained in the impact.

Weather Conditions

The flight segment Melbourne-Sydney was flown in fine, clear conditions. Before leaving Sydney for Brisbane the captain obtained a meteorological briefing at the Avmet Office.

The forecast indicated that en route conditions would be fine with no cloud or turbulence at the planned cruising flight level 90. In the Brisbane terminal area smoke haze was expected with a visibility of 8 miles and a ground wind of 6 kt from the southwest. Only a slight trace of cloud at 5 000 ft was forecast. The actual conditions encountered at Brisbane were not significantly different.

Brisbane Airport

It is situated 4 miles northeast of the city of Brisbane on a flat plain 2 miles from the coast, and its southern boundary is skirted by the Brisbane River, within which Bulwer Island is located.

The airport is 7 ft amsl, and its density altitude at the time of the accident was minus 360 ft.

Both runways at Brisbane are equipped with low intensity, omni-directional lighting. The radio navigation aids available consist of a visual-aural range transmitting on a frequency of 110.9 Mc/s, distance measuring equipment on a frequency of 206/224 Mc/s, an approach localizer serving runway 22 transmitting on a frequency of 109.9 Mc/s and a non-directional beacon transmitting on 216 kc/s. All of these radio navigation aids are located on the airport and were functioning correctly at the time of the accident.

Reconstruction of the flight

The flight plan for the Sydney-Brisbane portion of the trip indicated the aircraft would take 129 minutes to reach its destination via West Maitland, Point Lookout and Casino. The aircraft carried enough fuel to reach Brisbane plus sufficient for a further 3-1/2 hours cruising flight or 4-1/2 hours of holding.

Following take-off from Sydney at 0227 hours, the flight proceeded along the prescribed track reaching Casino at 0406 hours at which time it estimated its arrival at Brisbane at 0435 hours. A clearance was then issued by Brisbane area control for the descent from cruising level. Landing was to be on runway 22. The wind was 5 kt from the south, and the altimeter setting (QNH) was 1023 mb. At 0434 when the aircraft was sighted, apparently in the normal position, it was cleared for a visual approach and was to report again when on base leg. The clearance was acknowledged. When nothing more was heard from the aircraft, and the airport controller could not see its navigation lights in the circuit area or on the ground, it was called at 0441 on 118.1 Mc/s. There was no response, so the distress phase of search and rescue procedures was instituted at 0443 hours.

The accident occurred 1.65 miles, on a bearing of 081° magnetic, from the threshold of runway 22 at Brisbane Airport.

Evidence of witnesses - Discussion

Evidence was obtained from seventeen witnesses who saw the aircraft during the last six miles of its flight. Twenty-eight other persons heard the aircraft in the Brisbane area shortly before the accident. They also gave evidence. A series of simulation flights were conducted in Brisbane in order to test the reliability of the observations made by significant witnesses and to crystallize the conclusions which might be drawn from this evidence.

The track followed by the aircraft in the vicinity of Brisbane Airport involved no significant departure from the track normally followed by aircraft arriving from the south and carrying out a visual left-hand circuit for a landing on runway 22. Although it entered the circuit area and turned on to the downwind leg at the normal height of 1 000 - 1 200 ft, the impact occurred only three miles beyond this point. During the last 1-1/2 miles of its flight eyewitnesses noticed it because it was abnormally low and continued a high-rate descent with little or no engine noise apparent. Although the precise point at which the descent below normal circuit height commenced was not established from the witness evidence, the range was narrowed to a small segment of flight path 1-1/4 miles in length. Special test descents at idling engine power were conducted in a DC-4 aircraft similarly loaded, and the results of these tests pointed to the probability that the descent of VH-TAA commenced 1.8 miles short of the impact point assuming this was the power condition which pertained. All possible commencing points within the established range succeed the point at which the last transmission was made from the aircraft.

It was deduced from witness evidence that the impact probably occurred between 0436 and 0437 hours. This implies that the aircraft was four miles south of the airport and five miles from the impact point when the "field-in-sight" report was given to the airport controller. It was determined beyond reasonable doubt that this transmission, which seems to have been quite normal in every respect, was made by the

captain as were all the previous transmissions from the aircraft during the flight from Sydney. Having regard to the normal division of cockpit duties on this flight, it is most probable, therefore, that the aircraft was being flown by the first officer during the approach to Brisbane Airport.

The descent path was quite similar to the expected power-off glide path for this type of aircraft, but it apparently remained under adequate aerodynamic control right up to the point of impact. In the final stages of flight there was some evidence that the aircraft was banked to port and turned left some 40° from the downwind heading. There are several possible explanations of this circumstance, but it occurred at such a low height that it can only be regarded as incidental to the accident.

Wreckage Examination

Attempts to operate vehicles to the accident for the removal of components were unsuccessful because of the nature of the surface. The early activity was, therefore, concentrated on accurately establishing the configuration of the wreckage and raising the movable components above the level of the peak tides which were expected to cover the area three days after the accident. All of the components required for testing or for workshop examination were ultimately extricated by manhandling or, in the case of heavier items, by winching the components on specially constructed sleds across mud areas cleared of mangrove vegetation. Although the extremely difficult condition of soft mud and dense mangroves at the accident site was accentuated by tidal action and by heavy rain, the early precautionary action taken was successful in that the engineering conclusions were unhampered by salt water corrosion, by weathering or by an unpremeditated disturbance of the wreckage.

The functional state of the aircraft immediately prior to the impact was established with a reasonable degree of certainty. The undercarriage and wing flaps

were in their fully retracted positions whilst the landing lights were extended but not switched on. All four propellers were rotating, but none of the engines were delivering power. The heading of the aircraft at the time of impact was 358° magnetic, and the forward speed was probably between 115 and 125 kt. The aircraft was banked some 10° to port, and the flight path angle was approximately 7° below the horizontal. This evidence carries no suggestion that there was a complete loss of control in the aerodynamic sense prior to this accident.

All major components were located in the area of the principal impact, and there was no evidence of any structural failure, fire, explosion or of any other event which would have affected the integrity of the aircraft in flight. There was no evidence to suggest that any of the flight control systems were not functioning correctly or that any of the hydraulic, electric, radio or other systems required for safe flight were not capable of normal operation. The most significant feature in this area, perhaps, was the evidence that all electrical and radio systems had been disconnected from the aircraft's electrical power sources prior to the impact by movement of the emergency disconnect switch, which is located in the cockpit overhead panel.

A careful examination of the engines and propellers together with their associated control systems and the ignition, fuel and lubrication services failed to reveal any circumstances which might have prevented the crew from utilizing up to full power on all four engines. Uncontaminated fuel of the correct grade was found in the fuel lines leading to the fuel feed valve where fuel enters the induction section of the engine, and it is apparent that, with the propellers windmilling, some fuel must have been circulating through all four engines. It was concluded, however, that all four of the engine ignition switches were probably in the "off" position at the time of impact.

As the aircraft's flight deck was severely damaged in the impact, practically no significant information was obtained from

the cockpit dial indicators and only corroborated evidence can be accepted in respect of the positions of most cockpit controls. Both crew seats were severely damaged and had separated from the floor. The first officer was found strapped into the right-hand seat, which had been adjusted prior to the accident to the lowest available position and fully forward. The captain was found about 5 ft from his seat, the belt of which was unfastened. The chair had been adjusted prior to impact to the second lowest position and although the fore-and-aft adjustment could not be reliably determined, it is probable that it was positioned against the aft stop at impact.

Analysis

In considering the cause of the accident three conclusions arose from the evidence on which to focus:

- a) Although the aircraft was fully airworthy and, in the engineering sense, capable of being operated normally, it struck the ground with no engine power being delivered and with some crash/fire precautions having been taken.
- b) The aircraft was operating normally until it reached the mid-position of the downwind leg where a rapid power-off descent was commenced and continued without loss of aerodynamic control until the accident occurred.
- c) The captain's safety belt was not fastened at the time of the impact, and he had suffered a cardiac failure.

Although the engineering conclusion does not completely explain the accident, it does contain two significant points. It is clear that no power was being delivered by any engine at the time of impact although there was no reason why full power on all four engines could not have been utilized by the crew right up to this point. This fact supports the witness evidence of a

descent without any audible engine noise. It was also clear that the aircraft was prepared for the impact at least to the extent that all electrical power and ignition were switched off. This dispels any view that neither crew member was aware of the seriousness of the situation. It also shows that although there was no means, in the time available, to overcome the emergency, at least one member of the crew was still capable of rational action. The proposition that the aircraft remained under control in the aerodynamic sense during this descent is also consistent with this view.

Various hypotheses were examined to try and provide an operational reason why an aircraft would suddenly enter a rapid but apparently controlled descent on the downwind leg of a visual circuit and strike the ground without there being any evidence of recovery action. There was no support for the proposition that this was a landing approach on to an illusory runway since there were no lights in the immediate area of the impact, and the undercarriage and flaps were not extended. It is also highly improbable that any reference to inadequate visual cues or any misreading or malfunction of the altimeter deceived the crew as to the real height of the aircraft since it passed over a large and brightly illuminated oil storage depot at a height of some 300 ft only 3/4 mile before impact. A simulation of the flight path in similar circumstances showed clearly that this was a dominant and unambiguous point of reference. The evidence of preparations in the cockpit for the impact supports the view that the crew were well aware of the dangerously low height which had been reached.

A wide range of emergency situations which might have induced loss of control, errors of judgement or serious distractions sufficient to cause this accident was examined and, in each hypothetical situation, it was found that the proposition either ran contrary to the evidence or was unsupported in any way. It is difficult to envisage any emergency situation arising at this point in the preparation for landing which would induce the crew to avoid using engine power,

either in the recovery action itself, or, in the last resort, to avoid an accident, unless that emergency itself involved the complete loss of power on all four engines.

The medical conclusion alone also afforded no ready explanation of this accident. Accepting the probability that the captain's death occurred suddenly in flight, the presence of a competent and experienced first officer should have been an adequate safeguard against an accident of this nature. There is no suggestion that the first officer was also incapacitated, but there is little doubt that a sudden collapse by the captain would have induced a major distraction of his attention for some period. The evidence that aerodynamic control of the aircraft was retained and that it was prepared for the impact indicates that this distraction did not persist for sufficiently long to cause the accident.

In the light of all the evidence it is entirely reasonable to believe that this accident was associated with events arising from the heart attack suffered by the captain. His seat belt was unfastened and a premonitory symptom of the attack might be a desire to stand up for some relief. This led to a consideration of the ways in which collapse of the captain could deprive the first officer of the ability to utilize engine power. After discussion and experiment, a quite feasible mode of collapse which would have just this effect became clear. It envisages the captain moving his seat to the rear, unfastening his seat belt, standing and turning half-right in the normal actions to leave the seat and then collapsing across the engine control console with his body falling so as to bring all throttles to the fully closed position and moving all pitch control levers towards the full fine position. The experiments also confirmed that, with a body in this position, it would be impossible for the first officer to remove the obstruction so as to regain engine power control without leaving his seat and abandoning control of the aircraft for an intolerable period of time. There would also be some forward pressure on the control column from the cap-

tain's legs which could be overridden without difficulty by the first officer but, nevertheless, would be sufficient to cause nose down pitching if counteracting pressure was not continuously applied.

The period within which the collapse of the captain must have occurred can be narrowed to the half minute of 1-1/4 miles of flight path between the turn on to the downwind leg and the mid-position of this leg where the abnormal descent commenced. The fact that the captain himself gave the field-in-sight report only 4 miles south of the airport indicates that there was little or no warning of his collapse. This is completely consistent with the range of possibilities described in the medical evidence. The proposition of a collapse in this segment of the flight path also introduces a logical explanation of the undercarriage and flaps being in their retracted positions at impact. The evidence indicates that the emergency situation arose at or prior to the aircraft reaching the mid-downwind position. In the known circumstances of this aircraft's approach to the airport it could not be expected that the undercarriage would be extended until after this position had been passed.

Although the first stage of flap extension is often taken prior to this point, it is by no means unusual for this action to be delayed until a later point in the flight path is reached when there is no excess height or speed to be lost. It is reasonable to assume, therefore, that the emergency arose before the extension of either flaps or undercarriage had been carried out and, in view of the nature of the emergency which is postulated, it could not be expected that the first officer would take these actions subsequently.

The mode of collapse envisaged offers a complete explanation of the otherwise inexplicable evidence, that this descent occurred without engine power being applied at any time. It is compatible with the evidence that, in the engineering sense, this power was available at all times. It explains why no feathering action was taken despite the

apparent lack of power, and it clarifies the apparent resignation of the first officer to the inevitability of an accident as is reflected in the actions to switch off the electrical power and engine ignition before the impact. It is compatible with the evidence that the aircraft remained under control throughout the descent and it gives a ready explanation of the fact that no emergency call was made on the radio. If both crew members had been competent to jointly deal with the emergency which arose, the first officer, during the 55 seconds which the descent would occupy, would have had time to give some indication to the airport controller that an emergency existed although it is by no means certain that he would do so. If the first officer was obliged to cope with this emergency alone, however, he could not be expected to make any transmission in the time available.

Another feature of the evidence which puzzled the investigators until this proposition had been developed was the fact that the landing lights were in the extended position at impact and yet even the closest eyewitnesses denied that they were illuminated at any time during the descent. It is most difficult to conceive of any pilot attempting a crashlanding at night on unknown terrain without, at some point in the descent, using the landing lights to gain some appreciation of the terrain or to select the most favourable terrain within the usable area. The landing light extension and illumination switches for this aircraft are situated in the ceiling panel immediately above the captain's position and they cannot be reached by the first officer whilst he is in his seat with the belt fastened. It is feasible that the captain had extended the lights earlier in the approach when he was capable of doing so in order that they would be ready for immediate use when required for the normal landing. The fact that they were not subsequently used despite a pressing need can only be attributed to the fact that the captain was then incapable of actuating the switches, and the first officer was unable to take the steps necessary to reach them.

Several other possible ways in which the operation of the aircraft might have been affected by the captain under the influence of a disordered cardiac function were also examined. It was concluded that the evidence did not admit any possibility that a physical collapse by the captain could have affected any other engine controls such as the mixture levers or the fuel tank selector levers so as to produce the known circumstances of the final flight path. It was shown by experiment to be extremely unlikely that any mode of collapse in or from a seated position, even with the safety belt unfastened, would affect control of the aircraft or of the engine power in a manner consistent with the evidence in this accident. The investigators also considered the possibility of irrational behaviour of the captain in the premonitory stages of his cardiac failure, being a causal factor in the accident. This hypothesis was not supported by any evidence, and it is difficult to believe that any irrational act affecting the operation of the engines could go unnoticed or could remain long undetected by the first officer. There was no evidence of any conflict between the captain and the first officer in the control of the aircraft, and it is considered that the possibility of irrational behaviour by the captain cannot be supported as a significant factor in this accident.

The opinion formed as to the cause of this accident was only reached after careful examination of a wide range of hypotheses. None of the alternative explanations were acceptable in the light of the firmly established evidence, and none of them were supported so strongly by circumstantial evidence as was the view that the captain's heart failure occurred on the downwind leg of the circuit and that his collapse deprived the first officer of all engine power. This in turn provided a reasonable explanation of some items of evidence which could not be explained in any other way. Some minor variations of the accepted mode of collapse are equally feasible, but they all involve closing of the engine power levers and the forming of a complete obstruction to their further movement. There was no suggestion in the evidence that the captain, whilst in normal health, undertook any

action likely to endanger his aircraft, and it is probable that the first officer, without warning, was presented with an emergency situation which was beyond the capacity of one person alone to rectify under the circumstances. The evidence points to the fact that he took action to minimize the dangers of the imminent impact.

Probable Cause

The accident occurred during the pre-landing circuit when the captain tried to leave his seat under the influence of a disordered cardiac function and, in the course of so doing, collapsed across the engine control console in such a way as to bring all four throttle levers to the closed position depriving the first officer of the throttle movement necessary to avoid a crashlanding off the airport.
