AIRCRAFT ACCIDENT REPORT

ACCIDENTS INVESTIGATION BRANCH

DHC-2 Beaver Floatplane VP-FAK

Report on the accident at Mare Harbour,

Falkland Islands, on I4 October I976

FALKLAND ISLANDS

Aircraft:	De Havilland Aircraft of Canada DHC-2 Beaver Floatplane VP-FAK
Engine:	One Pratt and Whitney "Wasp Junior" Piston Engine
Registered Owner and Operator:	Falkland Islands Government Air Service
Crew:	Pilot - Drowned
Passenger:	Injured
Place of Accident:	Mare Harbour, Falkland Islands. 51° 54' 42" South 58° 29' 48" West
Date and Time:	14 October 1976 at approximately 18.15 All times in this report are GMT

Synopsis

The accident was notified to the Falkland Islands Government by Falkland Islands Government Air Service (FIGAS) at about 1900 hrs on 14 October 1976. Following a request from the United Kingdom Foreign and Commonwealth Office, the Accidents Investigation Branch of the United Kingdom Department of Trade sent a team to the Falkland Islands to carry out an investigation; operations, engineering and human factors groups were established under the investigator in charge.

The accident occurred when the aircraft was returning to Stanley from Brenton Loch with the pilot and one passenger on board in poor weather with strong winds and rain. The aircraft capsized during a water landing at Mare Harbour, the passenger survived but the pilot was drowned. It is concluded that the passenger was flying the aircraft and that he lost control during the landing manoeuvre allowing the aircraft to stall, capsize and sink.

1. FACTUAL INFORMATION

1.1 History of the flight

The aircraft took off from Stanley on a normal Falkland Islands Government Air Service flight at 1255 hrs on what was planned to be an eight sector trip around the settlements. Landings were made at Port San Carlos, Hill Cove, Carcass Island, West Point, Roy Cove and Fox Bay. Take off from Fox Bay on the penultimate leg to Brenton Loch was at approximately 1715 hrs with two passengers on board. After a smooth and uneventful flight the aircraft landed at Brenton Loch and taxied right up to a beach on the north shore. Two people met the flight and held the floats whilst one passenger disembarked. There were no passengers waiting to be picked up but some mail and packages were loaded for Stanley. When the pilot was ready to depart the two helpers released their hold on the floats and allowed the wind to blow the aircraft downwind away from the beach. The last occasion on which the pilot was seen alive by observers on the ground was when he entered the cabin through the small pilot's door on the left hand side of the fuselage.

After drifting some distance, perhaps half a mile, the engine was started and the aircraft seen to taxi, apparently normally. The take-off run was made right up the loch into a brisk north easterly wind, however the surface of the loch was reasonably smooth.

The two helpers and the passenger who had disembarked watched the aircraft depart from a position near a 40 foot high bank at the north end of the loch. They observed that during the take-off run the aircraft travelled a considerable distance on the left float with the right, upwind, float about two feet clear of the water and that the take-off track followed was not straight. After starting the run into wind on a north easterly heading it gradually turned left ending up on a northerly heading. When the aircraft finally left the water it made a steep, slow speed, climb passing directly over their heads and clearing the bank by a small margin. At one stage the eyewitnesses were concerned that the aircraft might not attain sufficient height to enable it to avoid colliding with the bank. The estimated time of take-off was 1755 hrs.

The last recorded observation of the aircraft in flight was when it was seen passing just to the north of Darwin at about 1804 hrs. Its height was estimated to be about 300 feet and it was flying clear of cloud.

The evidence indicates that during the course of a water landing at Mare Harbour approximately midway between Brenton Loch and Stanley with full flap extended the left wing tip came in contact with the water. This caused the aircraft to yaw to the left, pitch nose up, and roll to the right, bringing the retracted right hand water rudder and right tailplane into contact with the water. The bow of the right hand float then "dug in" causing the aircraft to capsize.

When the aircraft failed to appear at Stanley at the estimated time of arrival (ETA) of 1830 hrs, FIGAS operations started making telephone enquiries to try and establish that it had left Brenton Loch. At about 1900 hrs after it had been established that it had departed from Brenton Loch at 1800 hrs it became apparent that the flight was genuinely overdue. Government was informed and an air and sea search was launched. M.V. Forrest and M.V. Monsunen, two Falkland based vessels conducted the sea search and the sole serviceable aircraft in the Islands, a Cessna 172, was used to make an aerial search along the presumed track followed by the Beaver.

In the event M.V. Forrest sighted the surviving passenger on a small reef in Mare Harbour at about 1800 hrs on 15 October, almost 24 hours after the accident. He was taken aboard M.V. Forrest and found to be suffering from the effects of exposure. He had no clear recollection of the flight from Brenton Loch to Mare Harbour and could offer no explanation for the unplanned landing at Mare Harbour.

The aircraft was located inverted and aground substantially intact with only superficial damage, a short distance to the north east of the reef in an area covered by heavy kelp.

An intensive search was made of the sea and land areas in the vicinity of the reef in an attempt to locate the pilot, without success. His body was eventually recovered on 3 November and he was found to have drowned. The estimated time of the accident was 1815 hrs.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	1	-	-
Non-fatal	-	1	-
None	-	-	

1.3 Damage to aircraft

The aircraft was substantially damaged. Although relatively little damage was caused when the aircraft capsized, more extensive damage resulted from the salvage operation to retrieve the aircraft from the sea and from the effects of prolonged immersion in sea water.

1.4 Other damage

Nil.

1.5 Personnel information

1.5.1 The pilot — Male aged 42 years.

Licence:	Falkland Islands Commercial Pilots' Licence valid until 30 March 1977.
Aircraft ratings:	Classes - Landplanes and Seaplanes
	Types - Auster Variants
	Beaver DHC-2
Instrument rating:	None.
Instructor rating:	None.
RTF licence:	Restricted flight radio-telephony operator only.
Total flying experience:	9,818 hours.
Flying experience on type:	9,550 approximately, mostly in command.
Flying hours in last 28 days:	19 hours 30 minutes.
Medical Certificate:	Last medical examination on 28 September 1976 valid until 30 March 1977.

The pilot was exceptionally experienced on the Beaver aircraft and had many years of safe operation in the Falkland Islands behind him.

1.5.2	The passenger	Male aged 34 years.
	Licence:	United Kingdom Private Pilot's Licence valid until 25 June 1980.
	Aircraft rating:	Group 'A' - landplanes.
	Certificate A test:	Cessna 150 - 22 June 1975.
	RTF licence:	None.
	Total flying experience:	79 hours 40 minutes.
	Total in command:	28 hours.
	Total on type:	3 hours 5 minutes.
	Total in last 28 days:	35 minutes.
	Medical certificate:	Last medical examination on 25 April 1975 valid until 30 April 1977.

The passenger was a friend of the pilot and there is strong evidence that he had been allowed to fly the Beaver prior to the day of the accident. He had recorded four flights in his pilot's flying log book all as "T1/S", ie commander under supervision. The first two flights were annotated "conv", ie conversion training. The third flight contained in the "remarks" column the entry "i/c Water land/t/o", ie he was acting as pilot in command for a take-off and landing on water. The fourth entry, on the day before the accident, was annotated with the name of the pilot. During these flights the passenger had occupied the left hand pilots seat for both take off and landing with the pilot seated in the right hand pilots seat.

1.6 Aircraft information

1.6.1 Aircraft history

VP-FAK was a De Havilland Aircraft Company of Canada DHC-2 Beaver floatplane manufactured in 1966 and purchased by FIGAS as a new machine in 1967. It was duly registered in the Falkland Islands on 3 April 1967 and a Certificate of Airworthiness (C of A) was issued by the Falkland Islands Civil Aviation Department on 15 April 1967 in the "normal category for the purpose of commercial, state, and private use". The C of A contained no date of expiry, its validity being contingent upon "the aircraft being maintained under continuous inspection".

1.6.2 Aircraft description

The DHC-2 Beaver is an all-metal, high wing monoplane powered by a Pratt and Whitney "Wasp Junior" piston engine which drives a Hamilton constant speed propeller. The cabin is designed to carry a pilot and seven passengers, one of whom occupies the co-pilot's seat. VP-FAK was fitted with a twin-float installation for operations on water only.

The aerodynamic control surfaces are conventionally operated by a single control column and one set of rudder pedals.

The upper portion of the control column, carrying the hand-wheel, may be "thrown over" to the right hand side for use by a co-pilot. VP-FAK was not equipped with rudder pedals on the co-pilot's side instead of which the right hand foot-well contained the folding anchor and its warp. The ailerons are differentially rigged so as to give a larger upward than downwind displacement and are drooped when the wing flaps are lowered.

The aircraft is fitted with wing flaps which are operated hydraulically by means of a handpump located on the right side of the pilot's seat. The selector lever for the flaps is located adjacent to the hand pump lever and has two marked positions "Up" and "Down". Intermediate positions of the flaps are selected by moving the selector lever to "Up" or "Down" and by then pumping the flaps to the desired position indicator. Normally, "take-off" or "land" flap positions are used for landing. "Full flap" is only required for landing in very restricted areas and was never used by FIGAS pilots.

Two retractable water rudders were attached to the rear of each float connected to the rudder pedals by a simple mechanical linkage. These water rudders are retracted and extended by means of a spring loaded trigger type control adjacent to the pilot's left knee.

1.6.3 Maintenance

Examination of the two "Aircraft Journey Log Books" (equivalent to the more normal Airframe Log Books) showed that VP-FAK had been maintained in accordance with the general requirements of the DHC-2 Inspection Schedule. In addition to preflight and daily inspections this Schedule requires a series of periodic and progressive inspections at intervals of 100 flying hours culminating in an 800 hour inspection. The engine and propeller are required to be removed for overhaul at this point in the inspection cycle, which then starts afresh for a further 800 flying hours. There are, in addition, further requirements concerning the overhaul and replacement of various cockpit instruments which have a specified "life" between overhauls either on elapsed calendar time or flying hours achieved. These additional maintenance requirements have not been wholly complied with.

No spares were held to allow routine replacement of aircraft instruments, the majority of which had exceeded the permitted period between overhauls in one case by $4\frac{1}{2}$ times. There was no record of either VP-FAK or its sister ship VP-FAL, which was damaged beyond economic repair in an accident in August 1976, having had a compass "swing" carried out since manufacture.

At the time of the accident VP-FAK had accumulated a total of some 5,498 flying hours. The last 500 hour inspection was completed on 13 August 1976 at which time an overhauled engine had been installed.

A Certificate of Maintenance (C of M) was issued after this inspection valid for a period of 100 flying hours and some 35 flying hours had been accrued since its issue.

1.6.4 Aircraft loading

The maximum authorised all up weight (AUW) of the DHC-2 Beaver floatplane is 5,090 lbs.

The permitted centre of gravity (C G) range at maximum AUW is from 25.65% Mean Aerodynamic Chord (MAC) to 37.8% MAC.

Below 3,800 lb the C G envelope extends from 17.5% MAC to 37.8% MAC.

Calculations based up examination of an aircraft load sheet recovered from the wreckage showed that the aircraft AUW on the first take-off from Stanley was 5,127 lbs and the C G was 40% MAC. That is to say 37 lbs overweight and 2% MAC outside the authorised C G envelope.

Further calculations indicated that at the time of the accident the aircraft weight was approximately 3,993 lbs and the C G was 28% MAC, well below the maximum permitted landing weight of 5,090 lbs with a mid range C G.

1.7 Meteorological information

The pilot received two weather briefings from the Stanley Meteorological Office before his departure on the morning of 14 October 1976. In the first, at 1145 hrs, he was warned that rain was expected to continue all day associated with low cloud and poor visibility, with a risk of fog especially on the northern coasts. The visibility was expected to remain at 1 to 2 miles provided that the rain continued. The visibility in fog would probably be about 400 yards. The wind was forecast to remain northeast 25 to 30 knots all day.

At 1220 hrs after the receipt of further information from Argentina and Chile he was told that there was a possibility that the wind might drop in West Falkland later in the afternoon with a high probability of fog and low cloud in that area.

East Falkland was still expected to have strong northeast winds and rain with the visibility remaining between 1 and 2 miles. At first the pilot expressed some reservations about the weather but finally said that he would "take a look" and if necessary use his "bad weather route" along the south coast if it should not prove possible to use the northern route.

The following weather observations were recorded at Stanley Meteorological Office, the only professionally manned forecasting station in the Falklands, throughout 14 October:

1200 hrs

Wind:	Northeast 27 knots
Visibility:	10 miles
Weather:	Rain in past hour
Cloud:	8/8 stratus - 500 feet
QNH:	1009 mb falling 1.5 mb in 3 hours

1500 hours

Wind:	Northeast 25 knots
Visibility:	6 miles
Weather:	Slight rain
Cloud:	6/8 stratus - 500 feet 8/8 nimbostratus - 1000 feet
QNH:	1007.4 mb falling 1.6 mb in 3 hours

1800 hours

Wind:	Northeast 30 knots
Visibility:	4 miles
Weather:	Continuous moderate rain
Cloud:	7/8 stratus

It is estimated that the weather at the time of the accident approximated to that recorded at 1800 hours.

1.8 Aids to navigation

The only navigational aid available in the Falklands is a Very High Frequency Omni-directional Radio Range (VOR) beacon provided for use of the weekly airline flight from Argentina. The Beaver was not fitted with a VOR receiver and therefore could not make use of this facility.

1.9 Communications

VP-FAK was not fitted with radio equipment at the time of the accident as it had been removed for maintenance.

The frequency officially allocated for Air/Ground Radio Telephony (RTF) Communications is 5580 kHz in the High Frequency (HF) band. However FIGAS aircraft normally operate on 4500 kHz which is the common frequency used by the outlying farms and settlements. Continuous watch is maintained on this frequency by the Royal Marines, by the Posts and Telecommunications radio station during normal daylight working hours, apart from a 30 minute lunch break, and by FIGAS at Stanley during aircraft operations.

Position reports are normally made by pilots at intervals not exceeding 30 minutes flying time. Usually calls are made on take-off from each settlement and an estimated time of arrival (ETA) is given for the next port of call.

1.10 Aerodrome and ground facilities

FIGAS operations around the Falklands are operated entirely by float-plane. Certain areas of water have been designated for use as aero-dromes. Neither Brenton Loch nor Hare Harbour were so listed. However, an adequate stretch of clear water is available at both locations for the operation of a Beaver floatplane.

1.11 Flight recorders

Neither fitted nor required to be so.

1.12 Wreckage

1.12.1 External examination

When the aircraft was examined at Stanley after salvage it was found to be substantially intact with only the left hand pilot's door missing.

Marked flattening of the left wing tip lower and upper surfaces, characteristic of water impact, were observed. The right elevator aerodynamic horn balance also exhibited signs of water impact. The structure had been distorted with flattening of the lower skin associated with "pulled" rivets on the top skin at the spanwise rib attachment.

Examination of the floats showed that, apart from some holes deliberately made in inspection panels during salvage, they were in a reasonable condition. There was some localised damage to the forward ends of the chine outboard flanges of both floats, apparently as a result of contact with the reef. Both inboard vertical anti-spray flanges had been distorted. The forward main float cross braces had slackened.

The outboard operating cable attachment to the right hand water rudder bell-crank had suffered an overstressing failure. The inboard cable attachment was undamaged. The trailing edge of the right hand water rudder had been deflected inboard by about $\frac{1}{4}$ inch. The left hand water rudder was undamaged with both operating cables remaining attached and no rudder blade distortion. Both water rudders were retracted.

Damage associated with the salvage of the aircraft was readily apparent. Distortion of the fin forward fairing and the ventral fin was consistent with a hawser being attached around the rear fuselage associated with a rearward pull. There was evidence that the aircraft had been dragged backwards whilst resting inverted on the sea bed. The upper surfaces of both wings were heavily scored, the marks running from right to left at about 45° to the longitudinal axis. Damage was also apparent to the right hand wingtip fuel tank vent and filler cap, the outside air temperatures probe and the pitot probe mounted on the left wing leading edge.

Inspection of the hinge mounting areas for the missing left hand pilot's door showed that the upper hinge bracket had been torn from the fuselage skin due to forward displacement. The hinge pin on the still intact lower hinge assembly had been deflected forward and outboard. The three remaining doors were attached to the fuselage and undamaged. All cabin windows and the windscreen were unbroken. All doors were of the permanently attached, non-jettison type. There was no evidence of bird strikes. Both wing flaps were fully extended (60°) with the associated aileron droop.

1.12.2 Cockpit and cabin

Inspection of the cockpit revealed the control and indicator settings listed below:

Control wheel	Locked on left side
Flap selector lever	"Down"
Flap indicator	Between "land" and "full flap"
Water rudder selector	Up (ie rudders retracted)
Fuel selector	Centre tank
Magneto switch	Off (at "Both" when salvaged)
Battery master switch	On
Throttle	Fully forward (open)
Propeller control	Fully forward (full fine)
Mixture control	Fully forward (Auto lean) (lever induced witness mark in slot adjacent to "Rich" position)
Carburettor heat control	Mid position
Fire extinguisher switch	Wire locked
Emergency fuel/oil shut off	Open (normal)
Flight instrument switch	On
Engine instrument switch	On
Generator switch	On and gated
Artificial horizon switch	On
Clock	3:17

Examination of the lap-straps on the two pilot's seats showed that with the straps adjusted so that the buckle was centred the occupant of the left hand seat would have to have a girth of 40" whereas in the right hand seat a girth of 48" would be necessary.

The left hand pilot's seat was adjustable, fore and aft, over a range of 3 inches. It was found to be located $1\frac{5}{8}$ inches aft of the forward step. There was no significant distortion of the seat pan but there was a marked forward displacement of the top right hand side of the backrest. This had caused distortion of the seat pan web plate together with a significant "kink" half way up the left edge of the backrest consistent with a heavy load having been applied to the top left hand corner of the backrest. No distortion was observed on the co-pilot's seat, which was of a different type.

The three-place bench passenger seat located behind the pilot's seats appeared to be free of distortion. Two small holes on either side of the seat cushions that had been punched through the fabric co-incided with two belt heads on the seat back rest when it was folded down and the seat cushion placed on top. It was also noted that the seat fabric was extensively split over one of the backrest frame supports on the left hand side consistent with a heavy downward pressure on the seat back when folded forward.

The collapsible anchor was secured in its stowage and was causing no obstruction or interference with any controls.

1.12.3 Fuel and oil system

All three fuel tanks were drained and found to contain small quantities of sea water contaminated petrol. The main fuel filter was found to be clean and some 200 cc of fuel was drained from the carburettor. Fresh fuel was placed in each tank and the system pressurised to a pressure of 10 psi using the priming pump without producing any visible leaks. Fuel flow to the engine was checked on each tank selector position and found to be satisfactory.

The throttle and mixture controls and linkages to the carburettor were inspected and found to be intact and easily moved. The carburettor was strip-examined and found to be in good condition with no sign of jet blockage or dirt in the inlet filter or reservoir. The acceleration pump operated satisfactorily and the air intake together with the associated duct and mesh filter were free of obstruction. The engine driven fuel pump was strip-examined and found to be satisfactory.

The engine oil filter was clean and some $2\frac{1}{4}$ gallons of oil still remained in the 5 gallon capacity tank in spite of spillage and sea water contamination.

1.12.4 Electrics

The magneto switch and associated wiring to each magneto was checked electrically and found to be without defects. Apart from sea-water corrosion, the condition of the contact breakers was found to be satisfactory. Both magnetos rotated freely and their drives were found to be intact. Both ignition harnesses and all spark plugs were found to be in a satisfactory condition.

1.12.5 Flying controls

Examination of the flying control system showed that the elevator, ailerons and rudder could be moved over their full range without restrictions. The elevator trim indicated slightly nose down with a small amount of right rudder trim applied.

The hydraulic flag actuating system was function tested and found to function normally. The flaps extended symmetrically through their full range and applied the appropriate droop angle to the ailerons. Differential aileron operation was completely normal with the droop applied.

1.12.6 The Engine and Propeller

The engine turned over quite easily shortly after recovery of the aircraft. However when a strip-examination was started it was found to be immovable. Further examination showed that severe sea water induced corrosion of the supercharger impeller was preventing the engine from rotating. All the accessary drives were found to be intact. The nine cylinder barrels were removed and the valve gear, cylinders, pistons, gudgeon pins, connecting rods, crank shaft and associated counterweights were found to be undamaged.

The propeller and propeller governor were found to be undamaged and in a satisfactory condition.

1.12.7 Safety equipment

One RFD type 50c Mark 2A life jacket was found attached to the co-pilot's seat. The date of manufacture was November 1961. The life jacket inflated satisfactorily when the CO_2 bottle was discharged.

An RFD type 6U Mark 1A six person inflatable life raft was found jammed in the baggage stowage at the rear of the cabin. The date of manufacture was January 1962. The life raft inflated satisfactorily when the activating line was pulled. The aircraft contained no survival pack.

1.13 Medical and pathological information

1.13.1 Fitness of the pilot

The pilot was a small, wiry man of 42 and of a fit appearance. However his family had a history of heart disease. Some two years ago during a routine medical examination for the renewal of his Commercial Pilot's Licence a rise in his blood pressure had been noticed but remained within the normally accepted limits for his age group at that time. More recently, in September 1976, during another routine medical examination, a large and sudden rise in blood pressure (170/100) was observed associated with changes in his Electrocardiogram (ECG) which became more apparent after exercise. Examination of the pilot's ECG records covering a period of years was made by a consultant cardiologist in the UK. He expressed the opinion that the ECG's were suggestive of coronary artery disease. A blood sample taken at the time was later shown to have a raised cholesterol level. The pilot was then grounded and started on a regime of Benrofluizide (a diuretic) and Propanalol (a beta blocker drug), the latter treatment consisting of 40 mg twice daily.

Arrangements were made for the pilot to be examined at the Argentinian National Institute of Aviation Medicine in Buenos Aires. When he attended for his examination the pilot took with him a letter to the Argentine authorities detailing the medication he was receiving. On the day before being medically examined in Buenos Aires the pilot presented the letter to the Institute but, due to a slip in communications, the doctors who were involved in the medical examination were unaware that he was required to undergo anything more than a routine medical examination for the renewal of his pilots licence. If they had been aware that he was under treatment with hypotensive drugs the doctors categorically stated that they would not have declared the pilot fit to fly as, under Argentinian rules, he would automatically have been grounded if he had been taken Propanalol.

If the pilot had been a UK licence holder he would have been classified as a "high risk" and would have been grounded for further investigation by a specialist in cardiology; these investigations would probably have included exercise ECGs and possibly a coronary angiogram. In the interests of his future health most probably he would have been prescribed Propanalol and, if his blood pressure could be controlled by such a small dose, 80 mg per day would seem appropriate. If the

elevated blood pressure had been the sole sign of coronary artery disease, and if 80 mg per day of Propanalol had controlled his raised blood pressure he might have been allowed to fly as co-pilot or captain with a check captain in the other seat; he would not have been cleared for single pilot operations. However it is doubtful that, with his family history, ECG changes and high blood cholesterol levels in addition to raised bood pressure, he would have been allowed to fly in any capacity unless all signs had reverted to normal for 12 months after treatment.

When the Argentinian Institute of Aviation Medicine declared the pilot fit and when the supporting medical form reached Stanley, the lay reader was not to know that, since the examiners were unaware that the pilot had been taking Propanalol the assessment of fitness to fly was invalid. The medical report form from the Argentine Institute of Aviation Medicine was passed to the competent medical authority in the Falklands with a request for comments on it contents. There is no record that he has disagreed with the fitness verdict on the pilot.

1.13.2 Incapacitation

Although the pilot could be considered a "high risk" when considering coronary artery disease, this only means that he was more likely to suffer at some indeterminate future date from an acut cardiac condition than a person without the signs he exhibited. Because of the stringent requirements of flight safety it is normal to ground a pilot in this category, but this does not necessarily mean that this pilot was in imminent danger of a heart attack, particularly as he was on Propanalol.

People who knew the pilot and who saw him on the day of the accident did not consider him to be behaving in anything other than his normal manner. The surviving passenger, a qualified medical practitioner, was quite firm in his opinion, expressed after the accident, that the pilot at no time exhibited any symptoms of cardiac distress. There is no evidence to indicate that the pilot became incapacitated before the accident.

1.13.3 Injuries

The pilot was found to have sustained severe bruising and abrasions high up on the centre and left side of his chest and neck, a large bruise on the ulna side of right forearm and various injuries to his lower abdomen and lower limbs consistent with him not being strapped in a seat at the time of impact with the water. Death was caused by drowning.

The passenger was found to be practically uninjured, apart from a distinct and deep bruise approximately $3\frac{1}{2}$" x $2\frac{1}{2}$" centres over the mid-abdominal line between his umbilicus and pubis. This bruise was entirely consistent with having been caused by the seat buckle on the pilot's seat.

1.14 <u>Fire</u>

There was no fire.

1.15 Survival aspects

The accident was survivable and, if both occupants had been secured by their lap straps, the deceleration forces would not have been sufficiently high so as to cause significant injuries. However, the evidence indicates that the pilot was not secured to his seat.

FIGAS have no written instructions regarding the carriage of survival equipment, but the Beaver aircraft normally were equipped with a six man inflatable life raft, a survival pack and eight life jackets. At the time of the accident only one life jacket and the life raft were onboard the aircraft. The life raft was stowed in the baggage compartment with no method of access from outside the cabin; in addition there was no method of restraining the pack in the event of large longitudinal deceleration forces being experienced. Both in the subject accident and in a previous accident to the other Beaver VP-FAL some two months previously when the aircraft was inverted in the water it was not possible to extricate and inflate the life raft or life jackets.

The absence of jettisonable cabin doors made egress extremely difficult and it was fortuitious that in the first accident the sole occupant was the pilot and in the second accident only two people both of whom were pilots were on board.

No facilities exist in the Falkland Islands for the overhaul and repacking of safety equipment. In the past this task has been tackled in an informal way by using the services of a Royal Navy safety equipment rating from a visiting ship more or less on a casual basis.

The water temperature around the Falklands seldom rises much above about 4°C. At this temperature the chances of anyone surviving more than one hour's immersion are remote. The survivor was fortunate in that, as a doctor, he was aware of the dangers of hypothermia and that he recovered a large plastic bag from the aircraft, which he first used as a form of flotation gear and then, when lying on the reef, he places his feet in the bag to conserve body heat. He also built a small wall around himself as a shield against the wind and used quantities of kelp to cover the remainder of his body. Even with these precautions it is remarkable that he managed to survive for 24 hours before being rescued.

The pilot emerged from the aircraft after the passenger and was last seen clinging to one of the floats. His injuries, although not incapacitating would undoubtedly have been extremely painful and, taken together with his waterlogged, clothing, would have made swimming extremely difficult. In the post accident search divers equipped with wet suits took 50 minutes to swim through the kelp from the aircraft to an adjacent island.

1.16 Tests and research

None.

1.17 The FIGAS operation

1.17.1 Introduction

Before the two recent accidents FIGAS operated two Beaver floatplanes based at Stanley, and it is the intention that two replacement aircraft will be introduced into service. A virtually on demand taxi type service is provided, serving more than forty isolated settlements and sheep farming stations throughout the group of islands. Roads are practically non-existent, there is no regular inter-island service by sea and the only practicable means of communication is by air. The furthest settlement from the base at Stanley is New Island in the west of the group, a distance of 131 nm. Direct flights over such a distance rarely occur as daily flight planning is normally arranged to cover as many en-route stops as possible.

For some twenty years the vast majority of the flying has been carried out by two pilots, one of whom has also had administrative responsibilities. With two aircraft this situation has, in the past, frequently led to a very heavy work load for individual pilots.

1.17.2 Operations manual

FIGAS does not have an Operations Manual, as required by Article 21 of the Colonial Air Navigation Order, Instead they have issued a list of Pilots Orders containing some of the material which would be included in an Operations Manual. In January 1975, as a result of recommendations made in a UK CAA report made on the operating procedures of FIGAS a start was made to amplify the information contained in the Pilots Orders with a view to the production of an Operations Manual. However, the scope and content of this document fell far short of that required in an Operations Manual. The Tenth Schedule to the Order, which stems from Article 21, specified in Part A the matters which should be included in the Manual. The CAA document CAP 360 "Air Operations Certificates" provides guidance material on the manner in which both specific and general requirements relating to the operation of aircraft should be met.

1.17.3 Load sheets and technical logs

Article 23 of the Order requires the operator to provide written instructions as to the manner in which the load on board an aircraft is distributed and secured.

The Article further requires that a load sheet is prepared in duplicate and is signed by both the person supervising the loading and the commander of the aircraft. In the case of FIGAS the commander himself supervises the loading, so that only one signature is required. One copy of the load sheet should be carried in the aircraft and the other left on the ground on the occasion of each flight.

The FIGAS aircraft load sheet is prepared in duplicate in so far as Flight number, Aircraft Registration and days routeing is concerned, together with, on the back, a list of passengers booked and their destinations. Only this skeleton copy is left on the ground. The columns for recording fuel and oil quantities and weights; passenger numbers and weights; luggage height and weights and AUW at take-off were left for the pilot to fill in and were not available on the ground until the end of the day's flying. Fortunately the pilot's copy of the load sheet was recovered for the accident flight. It was noted that the various figures had been faithfully recorded for each leg of the flight. No entries had been made for take-off weight, maximum AUW or Basic Weight. No space was provided for recording C G. In the event of the pilot's copy of the load sheet being lost in an accident, no record of the actual weights carried would be available on the ground.

Although a record of defects and the corresponding certificates of maintenance and compliance after rectification of defects are kept in the FIGAS hangar at Stanley, no technical log is carried in the aircraft or left on the ground at en-route stops.

1.17.4 Carriage of Documents

Article 51(2) of the Order provides that an aircraft registered in the Colony shall, when in flight, carry documents in accordance with the Eleventh Schedule to the Order as amended. This Schedule requires seven documents to be carried by aircraft for the purpose of public transport within the Colony. Of these documents only three, the load sheet, the technical log and the operations manual, are considered to be necessary for flight safety purposes in the particular conditions in which FIGAS operates.

1.17.4 Safety launch

No safety launch is provided to cover operations in Stanley Harbour. However, boats are usually available when aircraft use approved landing areas around the islands.

2. ANALYSIS

2.1 The Accident

The aircraft was making a flight from Brenton Loch (not an approved aerodrome) to Stanley. Whilst making an unscheduled landing at Mare Harbour (also not an approved aerodrome) the aircraft's left wing tip contacted the water and it capsized. There was no evidence of any pre-accident failure of the aircraft, its engine or equipment. The fact that neither Brenton Loch nor Mare Harbour were approved aerodromes is not considered to have been related to the accident as both areas of water were suitable for use by Beaver floatplanes. The weather, although not good, was not particularly severe by Falklands standards and Mare Harbour would have provided good shelter from the prevailing northeast wind with comparatively smooth water available in the lee of the land.

There is no evidence to suggest, despite his recent medical history, that the pilot suffered any incapacitation which caused him to make a precautionary landing en route to Stanley. The surviving passenger, a qualified medical practitioner, although unclear concerning certain portions of the flight, was adament that the pilot had exhibited no signs of cardiac distress either before or after the accident.

The standard of flying skill demonstrated during the take-off from Brenton Loch was below that to be expected from a pilot with over 9,000 hours experience of the Beaver floatplane. In addition, the use of full flap in high wind conditions was significant on two counts; firstly one of basic airmanship and secondly as this flap setting was never used by FIGAS pilots. The maximum setting used in their operations was "Land" and, under the prevailing weather conditions, it is considered that an experienced pilot would probably have used the "Take-off" setting.

With a wind speed of 25 to 30 knots at Mare Harbour the ground speed at initial wing tip water contact could have been as low as 25 knots or even lower if the aircraft had stalled after a touchdown on its floats and becoming airborne again. It is considered that mishandling of this magnitude would be most unlikely by a pilot with considerable experience on the Beaver, particularly as the slow speed handling characteristics of the aircraft are excellent.

The pilot and the passenger were friends and it was established that on at least four previous occasions the pilot had permitted the passenger to handle the controls, including during take-off and landing.

The Beaver aircraft in question, VP-FAK, was not equipped with dual controls and the only feasible way in which dual instruction could be given, with the instructing pilot retaining any significant ability to control the aircraft would be for the pupil to be seated in the pilot's (left hand front) seat and the instructor to position himself behind the pupil, sitting on the edge of the middle passenger seat with the seat back folded forward and with the seat cushion placed on top to increase the height and provide a firm base. The pupil could be secured in his seat by the lap strap, but the instructor could not use the lap straps provided as they would be underneath the folded seat back and in any case even if available would not have enabled him to have access to the control wheel.

Seated in such a fashion it is quite convenient for the instructor to brace himself with his left hand by holding onto the back of the pupil's seat with his left hand and by leaning forward provide aileron and elevator control inputs via the control wheel if necessary. However he would not be able to exercise any control over the rudder pedals. In the event of a sharp wing drop being experienced, at low speed, during a landing manoeuvre rapid and large rudder pedal deflections would be necessary in order to "pick up" the downgoing wing and restore the aircraft to a laterally level attitude if wingtip contact with the water was to be avoided.

If it is assumed that this was the state of affairs obtaining during the landing at Mare Harbour, it would have been natural for the instructor to lean forward in order to open the throttle so as to increase engine power. Taking into account the deduced aircraft motions during the capsize, the instructor, not being secured by a seat belt, would be thrown forward and to his right in which case his right fore-arm would come into sharp contact with the throttle and propeller controls, which would gave been fully forward by this time anyway, and the mixture control which should have been at the "Rich" setting moving the latter lever to the "Auto Lean" position where it was found after the accident. An indentation in the mixture control quadrant adjacent to the "Rich" reference point supports this hypothesis.

Examination of the survivor showed that his only significant traumatic injury had been caused by a seat belt buckle and, because of its design, only the pilot's lap strap buckle could have caused the particular bruise on his abdomen. The injuries sustained by the pilot were entirely commensurate with his having been seated on the passenger seat. His left forearm was bruised where it came in contact with the pupil's seat back, his chest was heavily bruised from contact with the right top corner of the seat back, which had also been distorted. His right forearm bore a large bruise where it would have contacted the throttle, propeller and mixture control levers. His lower limbs also exhibited injuries entirely commensurate with his not being restrained by a seat belt when the aircraft experienced a sudden deceleration. As the aircraft rolled he received head injuries consistent with contact with fittings in the cabin.

The pilot was known invariable to fly the Beaver with his seat adjusted fully forward. Examination of the wreckage revealed that the pilots seat was locked approximately half way back along its travel, a position more appropriate for a heavily built man of moderate height than the pilot who was a short wiry man.

Reviewing the evidence, the conclusion must be reached that the passenger was flying the aircraft during the attempted landing at Mare Harbour and that he lost control of the aircraft, at low speed, during the landing manoeuvre and that the pilot without access to the rudder pedals was unable to regain control before the left wing tip struck the water.

It is considered that the pilot was most imprudent in attempting to carry out dual instruction on an aircraft not equipped with dual controls particularly in view of the weather conditions obtaining at the time of the accident.

2.2 FIGAS Operations

2.2.1 General

The excellent safety record of FIGAS since its inception must be associated with the dedicated service of the two pilots who have operated the Air Service for the majority of the last 20 years. Air communications are vital to the Falklands. However in a small community, where pilots are an integrated part of that community, sociological pressures applied to them can be as, if not more, demanding than the normal pressures present in any air transport undertaking. In this context there is ample evidence that over the years the pilots have been asked, and finally expected, to fly in conditions which their better judgement might have suggested were unsuitable.

2.2.2 Operations Manual

Apart from the purely legal requirement for FIGAS to have an Operations Manual, it is a most necessary document from a flight safety point of view. It provides a set of standards against which the operation can be judged. Without it, standards can slip, effectively reducing the level of safety. This state of affairs had been reached in FIGAS at the time of the accident.

2.2.3 Load sheet and technical logs

The form of load sheet currently used by the Air Service does not result in a true take-off weight or C G being established, nor is a copy of the load sheet left on the ground before each take-off. The weight of the dinghy pack is not taken into account, nor is the effect of its carriage on the C G. A good example of the shortcomings of the load sheet was the situation which existed on the first take-off from Stanley on the morning of the accident. On this occasion both the weight and the C G were outside the permitted limits without this state of affairs being apparent to the pilot. Suggestions made in the 1974 CAA report on FIGAS, pages 10 and 11, are most pertinent and should be actively considered.

2.2.4 Communications

With the lack of search and rescue facilities available in the Colony radio communications are most necessary to ensure a rapid response to an emergency. Except for the "get you home" case with an en-route failure, all flights should be required to carry a serviceable HF radio and this should be used to indicate departures and arrivals away from base. In addition ETAs at the next point of call should be given to base and if any sector is longer than 15 minutes flying time a progress check should be made at intervals no greater than 15 minutes.

2.2.5 Maintenance

The present system of maintenance documentation is unsatisfactory. When the long serving contract aircraft maintenance engineers were replaced by RAF personnel on short term secondment, a system should have been devised so that the in service life of the various components was easily obtainable. With a one or two year tour it is quite unrealistic to expect RAF personnel to simultaneously introduce a new system and at the same time try and work a defective existing system. The history of the aircraft flying instruments was quite unacceptable for a public transport undertaking. For example, one instrument was 4,500 flying hours overdue for overhaul. An adequate stock of serviceable spare components should be maintained and their shelf life remaining should be readily apparent.

The maintenance of radio equipment is unsatisfactory. If an appropriately qualified radio engineer and suitable test equipment and maintenance equipment cannot be made available, then an adequate supply of spare radio equipment should be available so that unserviceable radio sets can be replaced immediately and the defective equipment sent away for rectification.

The absence of any record of a compass swing having been carried out since manufacture on a nine year old aircraft used for public transport must be unique in the history of British air transport and is quite unacceptable. Swings should be carried out at least annually and after any major maintenance inspection.

2.2.6 Safety equipment

With the type of flying carried out in the Falklands each crew member and passenger should obviously be provided with a life jacket. As the accident demonstrated, a stowed jacket is of little use if there is no warning of an impending emergency and the aircraft occupants do not have time to don the jackets. Certainly at the comparatively low heights at which aircraft in the Colony are forced to fly, the pilot in particular, would be unable to put on a life jacket in flight. When the risks inherent in transferring infirm and possibly old - or very young - passengers between tender and aircraft are also considered, the adoption of some form of constant wear life jacket should be seriously considered.

The carriage of a life raft was presumably originally decreed because of the low sea temperature obtaining around the Falklands throughout the year. However, both the accident to VP-FAL and to VP-FAK have shown that the use of the existing stowage for the life raft is quite unrealistic. In neither accident was it possible to deploy the life raft with the aircraft inverted, if on the other hand the aircraft is not inverted then the life raft is not required immediately. In the case where a fully loaded aircraft capsizes, the existing combination of an unsatisfactory dinghy stowage and non-jettisonable cabin doors would, it is considered, prove to be lethal. Ideally, some form of dinghy stowage is required where the dinghy can be deployed from outside the aircraft whilst it is inverted. A further potential hazard inherent in the existing installation is the lack of an effective restraint to prevent the dinghy being ejected into the cabin in the event of a high longitudinal deceleration being encountered.

2.2.7 Safety launch

By far the most used alighting area in the Colony is Stanley harbour and at present it is one of the few aerodromes without some form of tender which can act as a safety launch. This is an anomalous situation and should be reviewed critically.

2.2.8 Pilots

FIGAS, in the near future, will need to acquire more pilots. In view of the workload imposed by a two aircraft, two pilot situation in the past, particularly when one of the two pilots bears an administrative load in addition to his flying tasks, it is considered that at least three experienced pilots are needed to operate two Beaver aircraft efficiently.

With the operating environment found in the Falklands the training of even experienced new pilots should not be thought to be a simple task. Experienced floatplane pilots are generally in short supply and it is considered that a dual control facility is necessary for the safe training of new pilots. If newly trained pilots are acquired a considerable period of time would need to elapse before they could be considered adequately experienced to fly passengers unsupervised.

3. CONCLUSIONS

(a) Findings

(i) The aircraft had a valid Certificate of Registration and Airworthiness.

(ii) The aircraft had not been maintained in accordance with Part 5 of the DHC-2 Inspection Schedule insofar as aircraft instruments were concerned.

(iii) The pilot was properly licenced and sufficiently experienced to carry out the flight.

(iv) The Falklands Islands Government allowed the pilot to fly on the authority of a medical certificate issued by the Argentine authorities.

(v) However the medical condition of the pilot was such that he should not have been piloting an aircraft. There is no evidence that he suffered any incapacitation.

(vi) There was no pre-crash failure or malfunction of the aircraft, its engine or flying controls.

(vii) The passenger was flying the aircraft at the time of the accident seated in the pilot's seat with only one set of flying controls available.

(viii) The left wing tip struck the water during a landing manoeuvre causing the aircraft to capsize and sink.

(b) Cause

The accident was caused when the passenger, who was flying the aircraft, lost control during a landing manoeuvre which caused the aircraft to stall, capsize and sink.

4. SAFETY RECOMMENDATIONS

It is recommended that:

4.1 A complement of at least three experienced pilots is provided for a two Beaver operation.

4.2 The recommendations of the 1974 CAA Report on FIGAS be implemented, particularly in respect of the provision of an Operations Manual, Load Sheets, Technical Logs and the carriage of documents in aircraft.

4.3 Active consideration should be given to the provision of cabin door jettison facilities for use in emergency.

4.4 Constant wear life jackets should be provided for the use of passengers and crew.

4.5 The present life raft, stowage, restraint and deployment facilities should be urgently reviewed.

4.6 The servicing of safety equipment be put on a more regular footing.

4.7 Conversion training on the Beaver should only be carried out in an aircraft fitted with full dual control.

4.8 A regular inspection of FIGAS should be carried out by an outside agency, such as the UK CAA, covering both operational and airworthiness aspects at intervals not exceeding three years.

4.9 The administration of the FIGAS maintenance organisation should be reviewed, in particular the control of spares.

4.10 Serviceable HF radio equipment should be required to be carried on all FIGAS flights originating from Stanley.

4.11 An adequate reserve of spare radio equipment should be available for rapid replacement of defective installations.

4.12 Aircraft compasses should be swung at least annually.

G C Wilkinson

Inspector of Accidents