ICAO CIRCULAR

CIRCULAR 18-AN/15

JUNE 1951

AIRCRAFT ACCIDENT DIGEST NO. 1

Prepared in the Air Navigation Bureau
and published by authority of the Secretary General

INTERNATIONAL
CIVIL AVIATION
ORGANIZATION
MONTREAL • CANADA

This Publication is issued in English, French and Spanish.

Published in Montreal, Canada, by the International Civil Aviation Organization. Correspondence concerning publications should be addressed to the Secretary General of ICAO, International Aviation Building, 1080 University Street, Montreal, Canada.

Orders for ICAO publications should be sent, on payment:

In Canadian currency ($), to

Secretary General, ICAO,
International Aviation Building,
1080 University Street,
Montreal, Canada.
(Cable address: ICAO MONTREAL);

In Sterling or Irish currency (s/d), to

The United Kingdom Stationery Office,
P.O. Box 569,
London, S.E. 1,
England.
(Cable address: HEMSTONERY LONDON);

In French currency (fr), to

ICAO Representative,
European and African Office,
60bis, avenue d'Iéna,
Paris (16e), France.
(Cable address: ICAOREP PARIS);

In Egyptian currency (m/ms), to

ICAO Representative,
Middle East Office,
Wadie Saad Building,
Sharia Salah el Dine,
Zamalek, Cairo, Egypt.
(Cable address: ICAOREP CAIRO);

In Peruvian currency (soles), to

ICAO Representative,
South American Office,
Apartado 680,
Lima, Perú.
(Cable address: ICAOREP LIMA);

In Australian currency (s/d), to

ICAO Representative,
Far East and Pacific Office,
17 Robe Street,
St. Kilda,
Melbourne, Australia.
(Cable address: ICAOREP MELBOURNE).

TABLE OF CONTENTS

FOREWORD

The Accident Investigation Division of the Air Navigation Commission of ICAO at its first session in 1946 recommended that States forward copies of reports of aircraft accident investigations and inquiries and aeronautical publications and documents relating to research and development work in the field of aircraft accident investigation to ICAO in order that the Secretariat might appraise the information gained and disseminate the knowledge to Contracting States.

The first summary was issued in October 1946 (List No. 1, Doc 2177, AIG/56) entitled "Consolidated List of publications and documents relating to Aircraft Accident Investigation Reports and Procedures, Practices, Research and Development work in the field of Aircraft Accident Investigation received by the ICAO Secretariat from Contracting States". This was followed by further summaries at regular intervals, the last report being issued on 31 July 1950 (List No. 12, Doc 7026, AIG/513). These summary reports were found to be of considerable technical interest and extremely useful to States, and in view of the large number of requests for copies, it was decided, early in 1951, to revise the method of publication and in future to produce the material in the form of an information bulletin entitled "Aircraft Accident Digest".

This is, therefore, the first issue under the new title, though the form and content are similar to that of previous reports. It is hoped that States will cooperate to the fullest extent their national laws permit in the submission of material for inclusion in future issues of this Digest. It is recognized that investigations take a diversity of forms under the variety of constitutional and juridicial systems that exist throughout the membership of ICAO, accident investigation presenting one of the knottiest problems of standardization in international civil aviation for this very reason. At the same time it is a most fruitful source of material for the attainment of the objectives of the Chicago Convention.

The usefulness of such a publication as this is directly proportional to the thoroughness with which accidents are investigated, the frankness and impartiality of the findings, and the readiness with which they are disclosed and authorized to be published. It is only in this way that this most fertile field for international cooperation can be effectively exploited. The measure of interest which this publication has aroused, and the salutory effects which the vital intelligence it imparts has had in informing everyone concerned before they have all individually experienced the disastrous possibilities inherent in the various situations explored within its covers, amply demonstrates the possibilities of ultimate achievement when every accident is investigated with the greatest thoroughness and the findings disclosed with complete frankness.

The ICAO Manual of Aircraft Investigation is a valuable guide to securing the information required for accident prevention measures and, whether available facilities and resources permit of the fullest investigation or not, if it is followed to the greatest practicable extent, uniformity of findings and usefulness of the Digest will be enhanced. Briefly, the intelligence required in order to be useful must include:

1) Aircraft Type;

2) State of Registry;

3) Date and Place of Accident;

4) Resumé of the Accident;

5) Result of the Technical Investigation;

6) Conclusions and Recommendations (if any).

Any restriction upon reproduction in the Digest seriously impairs of course the usefulness of any report, as it is only by comparison between the circumstances that occasioned the accident and the circumstances of other operations that potentially hazardous circumstances can be foreseen and avoided.

SUMMARY

ACCIDENT TREND BY TYPE

TYPE	List Nos. 11 and 12 (Period-June 1949 to June 1950)			Digest No. 1 (Period-June 1950 to June 1951)			Percentage increase or decrease on previous year	Comments
	No. of Accidents	Percentage	No. due to Pilot Error	No. of Accidents	Percentage	No. due to Pilot Error		
Missing or undetermined	8	13.1%	1	5	13.1%	1	No change	High percentage results from number of non-scheduled accidents where no evidence is available as to cause.
Collision (air or ground)	5	8.2%	4	4	10.5	4	2.3%	Increase and continued high percentage principally due to recent air collisions in the U.S.A.
Take-off	6	9.8%	6	7	18.4%	7	8.6%	Percentage has nearly doubled during the last year, although the number remains approximately the same. All were due to pilot error with contributory cause mainly material failure.
Landing (Normal or emergency)	18	29.5%	16	12	31.6%	11	2.1%	Decrease in number but slight increase in percentage. Still most prevalent type of accident with pilot error the main cause.
Structural Failure	4	6.6%	-	1	2.6%	-	- 4 %	An appreciable decrease presumably due to better design and maintenance.
Fire - Explosion	4	6.6%	-	1 *	2.6%	-	- 4 %	* This case due to sabotage by infernal machine.
Flying into terrain	11	18 %	10 #	5	13.2%	5	- 4.8%	Decrease of 50% in this major type of accident, where the consequences are so often fatal.
Loss of control	5	8.2%	1	3	8 %	2	- .2%	Included in this category are accidents caused by stalling due to pilot error, loss of control due to icing, buffeting, gusts, etc.
TOTAL	61	-	38	38	-	30	-	The number of reportable accidents (commercial) has dropped considerably during the last year.
	Accidents due to Pilot Error = 62.3%			Accidents due to Pilot Error = 79%			See page 11 for discussion on these figures.	

Partial blame in two cases to other personnel.

Note.- The total number of accidents quoted above has no signification, nor should the above figures be used for statistical purposes as they do not provide a complete picture due to lack of information from a number of States.

THIS PAGE INTENTIONALLY LEFT BLANK

PILOT ERROR

Although the percentage of accidents due to pilot error shows an appreciable increase over the previous year, this is mainly due to the reduction of accidents from other causes and the difficulty of evaluating statistically only a limited number of reported accidents. The figures convey, however, the unpalatable implication that, although considerable progress has been made in increasing the reliability of the airplane, very little has been accomplished in reducing the element of human error in aircraft accidents.

It has been claimed that the possibility of accidents in flying is inevitable by reason of the inherent conditions of flying which necessitate, besides reliance on the technical factor, considerable reliance upon the skill, judgment, memory, and physical and psychological conditions of the human being. These latter qualifications can vary between different human beings and from day to day in the same human being, so that, unlike the technical factor, which can be predicted fairly accurately, the probability and frequency of accidents occurring due to the human factor, are extremely difficult to predict and therefore to prevent.

Since human error in aircraft operation is less likely to be reduced by improving the human being than by simplifying the task that is given to him, efforts to reduce accidents by more careful selection of personnel and their training do not appear to have kept pace with the increasing demand upon human capabilities and though these efforts should be ceaseless they do not necessarily represent the most profitable avenue to explore. A large proportion of the accidents in recent years could have been prevented by better flying qualities, a more reliable engine, better weather forecasting, better lighted runways or some other improvement in whatever it was that made flight conditions so difficult that the pilot made a mistake. If a task is extremely easy, errors in its performance will be correspondingly rare. As a task increases in difficulty, errors grow more frequent. It would seem, therefore, that errors may be reduced in number and gravity by reducing the difficulty encountered by the human in the performance of any task.

If accidents in this category are to be reduced it is suggested that designers, operators, operating personnel and those responsible for preparing air regulations, in addition to aiming at methods for the prevention of mistakes and emergencies, must always have the following in mind:

> "Can we, by the simplification of controls, equipment, procedures and rules, reduce the burden imposed on ground and air personnel so that any initial mistake or emergency will not be too great a load for the human link, thereby precipitating further mistakes and an accident?"

PART I.- Summaries of Aircraft Accident Reports

ICAO REF: AR/119

BURMA

Union of Burma Airways Dove Aircraft XY-ABR crashed on take-off at Mingaladon Airport on 22 November, 1950

Circumstances

The aircraft commenced a normal take-off and when airborne, "wheels up" was selected. Since sticking of the undercarriage selector knob was experienced the radio operator was requested to operate the undercarriage safety switch. The undercarriage retracted normally and the aircraft immediately sank and struck the runway. The pilot shut off power and the aircraft slid at high speed for a considerable distance down the runway. The aircraft caught fire but all passengers and crew were evacuated safely before the aircraft was almost completely destroyed.

The pilot-in-command stated in his evidence that he had no idea of the airspeed at the time he retracted the undercarriage but he was satisfied that he had the safety speed. Although 'Pilots Notes' give 20 degrees of flap for take-off no flap was used in this case as the pilot felt that, in the event of engine failure after take-off, 20 degrees flap would make it more difficult to handle the aircraft on one engine. It was brought out in the evidence that in handling the undercarriage lever, which is at times awkward to operate in Dove aircraft, the attention of the pilot can be distracted from actual flight.

Findings

The Board found as follows:

1. The aircraft was airworthy at the commencement of the flight.

2. The aircraft was not overloaded and the load was correctly distributed about the centre of gravity of the aircraft, despite the incorrect documentation.

3. The aircraft was pulled off after too short a take-off run at a low airspeed.

4. The undercarriage was retracted too early and before safety speed was reached, whilst still at a very low altitude.

5. The aircraft sank back on to the runway before the safety speed was reached. This may be due to either a thermal disturbance or to the fact that the pilot's attention was distracted by difficulty in retracting the undercarriage.

6. The aircraft caught fire to the rear of the starboard engine nacelle while still sliding down the P.S.P. runway, due possibly to the fracture of petrol pipes and electrical circuits.

7. The pilot failed to operate the fire extinguishers in the engine nacelles which might have prevented the outbreak of fire. (The inertia switch of the static fire extinguishers in the engine bays were not operating due to the relatively slow acceleration).

8. The airport fire tender delivered its full complement of 2,500 gallons of foam, but was late in arrival as a result of taking the unserviceable taxi track, and the equipment on it was not applied to the best advantage due to the inexperience of the crew. The fire burnt itself out and the aircraft was almost totally destroyed.

9. No loss of life or injury occurred.

(Remarks.- The difficulty experienced by the pilot in undercarriage retraction was not considered to be a technical defect but merely that the pilot attempted to retract before the safety switch operated by the wheels dropping to their full travel after the aircraft was airborne, had had time to function.)

ICAO REF: AR/121

CANADA

Norseman Aircraft CF-GPG crashed on take-off at Gander Lake, Newfoundland, on 18 August 1950

Circumstances

A float-equipped Norseman VI Aircraft taxied out to take-off position on Gander Lake, Newfoundland, with a pilot and one passenger on board. Several people watched the take-off and, according to one witness, the aircraft never did get on the step but was pulled off the water in a nose high attitude and semi-stalled condition. At a height of roughly 10 to 15 feet above the surface, the left wing went down and the aircraft began to sideslip, continuing to lose height until the wing tip struck the water causing the aircraft to cartwheel and partially submerge.

Investigation and Evidence

The pilot and passenger died as a result of drowning.

Inspection of the aircraft, and evidence of witnesses, failed to disclose any indication of malfunctioning of the aircraft, engine or controls prior to the crash.

Weather was suitable for the flight. Although the aircraft did not take off directly into wind according to the Gander Airways Weather report, the wind velocity was only 7 M.P.H.

The pilot held a valid Senior Commercial Pilot Licence and had logged well over 3,000 hours' flying time.

Conclusions

The immediate cause of the accident would appear to be that the left wing tip of the aircraft came into contact with the water following which the aircraft crashed and partially submerged.

The major contributing factors would appear to be:

1) poor judgment on the part of the pilot in attempting a turn at approximately 15 feet above the water; and

2) poor technique on the part of the pilot in permitting the aircraft to stall.

ICAO REF: AR/122

CANADA

Norseman Aircraft CF-OBH, crashed near Timagami, Ontario, on 30 August 1950

Circumstances

The aircraft took off from Trout Lake, (North Bay), with pilot, engineer, four passengers, and roughly 1,200 pounds of equipment for Timagami, Ontario. A fisherman on Ingall Lake stated that he saw an aircraft fly over at roughly 1,200 feet and heard the engine cut out for a period of approximately ten seconds then pick up again. It was this man's opinion that, although the engine caught again, it did not appear to have the same power and sounded as though it was missing. A short time later, two men, located at separate points on the shore of Wilson Lake, heard an aircraft approaching and stated that the engine was sputtering and missing and that the aircraft was losing height. One of these witnesses stated that just before the aircraft went out of sight it banked steeply to the right and then went into a spin. A fourth man in his cabin at Milne Lake, heard an engine roar very loudly and then fade out three times. The sound seemed to be quite close and he stepped out the door just in time to see the aircraft hit the ground thirty feet away. Fire broke out immediately and in a matter of seconds the aircraft was a mass of flame.

Investigation and Evidence

The pilot, air engineer, and three passengers were fatally injured. The aircraft was written off.

The condition of the propeller indicated that very little power was being developed at the time of impact. The carburettor had been damaged by fire, and the fuel filters could not be found. There was still fuel in the tanks even after the fire. The aircraft landed in a small clearing surrounded by trees and cottages, and did not move more than three feet from the point of initial contact. Weather was not considered to have been a contributing factor.

The aircraft was overloaded by an estimated 173 pounds at the time of the accident.

The pilot transmitted the distress signal "MAYDAY" but no details of the emergency were given.

Between the point where the engine was first reported to have been malfunctioning and the location of the accident, the aircraft passed over two lakes which could have provided adequate space for a successful forced landing.

Conclusions

The immediate cause of the accident would appear to be that the engine failed to supply sufficient power to maintain height.

The major contributing factor would appear to be poor judgment on the part of the pilot in continuing the flight beyond two lakes where a forced landing could have been made, after it became evident that the engine was not operating in a normal manner.

ICAO REF: AR/123

CANADA

Fairchild Aircraft M62A-3, CF-FXC, crashed North of Port Huron, Michigan, U.S.A. on 1 April 1950

Circumstances

At 2117 EST on 31 March, aircraft CF-FXC with pilot the sole occupant, and with sufficient fuel for four hours' flight, took off from Buffalo, N.Y. for Detroit, Michigan. A VFR flight plan filed by the pilot at Buffalo gave E.T.A. Detroit City Airport at 0002 EST on 1 April 1950. After leaving Buffalo the aircraft is not known to have been seen again in the air.

Between 0045 and 0100 EST on 1 April, an aircraft was heard running smoothly by local residents at Port Huron, Michigan. Moderate rain was falling at the time blown by a wind of considerable velocity.

At approximately 0700 hours EST a resident of a beach cottage north of Port Huron saw the tail section of the aircraft sticking out of the water about 1,000 feet from the shore. Subsequently the body of the pilot was found in shallow water off the adjacent beach. Death was due to drowning.

Investigation and Evidence

The accident occurred off Port Huron, about 55 miles NNE of the intended destination. Approximately seven gallons of fuel remained in the aircraft's tanks. The landing light was turned on and the throttle closed. The mixture control was set to "rich". The radio was turned on and tuned to approximately 290 Kc/s. The aircraft was certified for night flying. The pilot held a licence valid for day flying only.

Examination of the aircraft failed to reveal any evidence of mechanical failure of the aircraft or any of its components.

Conclusions

While it was not possible to determine the cause of the accident, it is considered likely that the pilot became lost and realized that he was in danger of running out of fuel and as a result attempted to carry out a precautionary landing which resulted in his death by drowning.

ICAO REF: AR/124

CANADA

Fleet 80 Aircraft CF-ENT, crashed on landing at Saint John Airport, Millidgeville, N.B. on 20 October 1950

Circumstances

At 1657 hours AST on 20 October, aircraft CF-ENT took off from Millinocket, Maine, U.S.A. for Millidgeville, N.B., with pilot and one passenger on board.

On 20 October 1950, night, as defined in the Air Regulations, began in the Milledgeville area at 1742 hours AST. In the pilot's flight plan, one hour and fifteen minutes was shown for the time en route, thus giving 1812 hours AST as the estimated time of arrival at Millidgeville. This time is thirty minutes after the beginning of night, as defined in the Air Regulations. The accident occurred at approximately 1830 hours AST, forty-eight minutes after the beginning of night. The Saint John airport at Millidgeville is not licensed for night flying and the aircraft itself carried no lighting equipment whatsoever.

During the final approach to land, the starboard wing of the aircraft collided with a one and one-half inch steel water pipe which extended fourteen feet above the ground on the airport and which had formerly been used by the Royal Canadian Air Force as a light standard. This light standard is located approximately two hundred and fifty-eight feet to the right of the nearest point of runway 23-06. The aircraft swerved to the right and remained airborne for approximately two hundred and fifty feet, when it crashed and burst into flames.

Investigation and Evidence

The terrain where the light standard was located is eight and one-half feet above the runway level. The top of the light standard thus protruded twenty-two and one-half feet into the air.

After striking the lamp standard, swerving to the right, and continuing for approximately two hundred and fifty feet in the air, the aircraft struck the ground in a nose down attitude with power on and burst into flames. Thus resulted in the death of the pilot and serious third degree burns to the passenger.

At the time of the accident, there was at least two hours' fuel remaining in the tanks.

Conclusions

After striking an unlighted lamp standard, the aircraft struck the ground in a nose down attitude and burst into flames during an attempted night landing at an unlighted airport. This situation was caused by the pilot departing from Millinocket with insufficient daylight remaining to complete the flight to Saint John before night, as defined in the Air Regulations.

ICAO REF: AR/125

CANADA

Swissair, Douglas DC-4 Aircraft, HB-ILE, crashed on Landing at Sydney, N.S. on 13 December 1950

Circumstances

At 1410 hours on 12 December, Swissair aircraft HB-ILE took off with eleven crew and twenty passengers for New York, U.S.A. via Geneva, Switzerland; Shannon, Ireland; Gander, Canada.

The aircraft left Shannon for Gander at 2128 hours GMT on 12 December 1950 with Stephenville, Newfoundland, nominated as the alternate airport. Due to the weather at Gander, diversion to Stephenville was considered and rejected in favour of proceeding to Sydney and using Moncton as the alternate airport. The estimated time of arrival over Sydney was 0950 hours GMT. During the period between 0924 hours GMT and the time of the accident, the flight was advised of the weather conditions, including fog, at Sydney and cleared by Moncton ATC to Sydney and to descend and remain at 4,000 feet. After establishing contact with the Sydney Tower, normal routine clearances were obtained by the flight up to and including clearance to land. Between 0954 and 0958 hours GMT the flight advised: "we can see all lights", after which, at 0958 hours GMT the flight advised: "on final"; to which the Tower replied: "clear to land". The Captain had decided, in view of the visibility over the town of Sydney, and on the downwind leg, that he could carry out a landing by visual means.

Investigation and Findings

During the last stages of the final approach to land, the First Officer noticed that the aircraft was too low in relation to the approach lights and applied backward pressure to the Control Column, at the same time advising the Captain that they were too low. Simultaneously, the Captain noticed the approach lights and took corrective action and the First Officer released the Control Column. The aircraft then struck an approach light pole between numbers 1 and 2 engines, cutting off the top of the pole with one of the propellers. The aircraft continued ahead, striking two more approach light poles and breaking them off. Full power settings were applied to all engines after striking the first pole. Difficulty was experienced in maintaining directional control of the aircraft due to complete or partial failure of No. 1 engine and malfunctioning of No. 2 engine. Subsequent examination of numbers 1 and 2 propellers indicated that serious damage resulted to both from impact with the approach light poles. The propeller blades were found to be at different pitch angles, (one blade of each propeller was in the featherred position), causing low thrust from numbers 1 and 2 engines when full power was applied. This, in turn, caused the aircraft to swing to the left. Efforts to right the aircraft were unsuccessful and it continued to the left, lost height, and struck the ground in a left-wing-low attitude.

After the left wing touched the ground, the aircraft continued along the ground out of control, shearing off the left wing just inboard of the left main gear attachment fittings, and finally came to rest approximately 400 feet from the point of initial contact with the ground, facing 190° approximately from the direction of approach. The fuselage, right wing, and right main landing gear remained intact and engines numbers 3 and 4 were still operating at full power

after the aircraft came to rest. Engines 3 and 4 were shut down by the First Officer and all passengers were successfully evacuated through the main door.

After the aircraft came to rest, small fires started in the centre section on the left side. These were put out by the crew, using aircraft fire extinguishers. Between 25 and 35 minutes later, fire again broke out in the centre section but the crew was unable to control it as all extinguishers had already been discharged. Fire spread rapidly, destroying the major portion of the fuselage and completely consuming the crew compartment, cockpit and nose section of the aircraft.

Conclusions

The Captain, after using up his Regular (Gander), and Alternate (Stephenville), Airports, exercised his prerogative and decided to land at Sydney.

The cause of the accident was the impact of the aircraft with the ground while out of control due to failure on the part of the Captain to maintain sufficient height to clear the approach light poles, three of which were struck by the aircraft. After striking the approach light poles, the Captain and First Officer were unable to maintain control of the aircraft due to the malfunctioning of numbers 1 and 2 engines and structural damage to the left wing and flap.

ICAO REF: AR/126

CANADA

Canadian Pacific Air Lines, Douglas DC-3 Aircraft, CF-CUF, crashed at Okanagan Mountain, B.C., on 22 December 1950

Circumstances

At 1248 hours PST on 22 December, aircraft CF CUF took off with three crew and fifteen passengers from Vancouver Airport, B.C., for Penticton, B.C.

The flight, designated Trip 4, was flight-planned to cruise from Vancouver to Penticton at 11,000 feet and later revised to 15,000 feet. Routine progress reports were received from the aircraft by radio, the last of which was at 1337 hours PST and at which time Air Traffic Control cleared the aircraft to Penticton Airport. The aircraft was due at Penticton at 1345 hours PST.

On the aircraft being five minutes overdue, Canadian Pacific Air Lines declared an emergency and the Air Traffic Control Centre, Vancouver, alerted the RCAF Rescue Co-ordination Centre at 1450 hours PST. At 2040 hours PST, Canadian Pacific Air Lines requested the RCAF to commence the search.

The searching aircraft located the wrecked aircraft on the northeast side of Okanagan Mountain at an elevation of about 4,500 feet during the night of 22/23 December 1950, by means of signal fires set by survivors of the accident.

Investigation and Evidence

The accident occurred at approximately 1353 hours PST. The aircraft struck trees while in cloud and travelling on a heading of 173°T, (150°M), at an airspeed of at least 120 m.p.h. The aircraft was southbound on the north leg of the Penticton Radio Range and descending on its approach to the Radio Range Station.

The area of Okanagan Mountain where the aircraft crashed is approximately 4,500 feet above sea level, to protect aircraft against this hazard, a fan marker is installed as a navigation aid. The minimum altitude authorized at this fan marker is 6,500 feet. Great care has to be taken to ensure that an aircraft has actually passed the fan marker before the let-down to the radio range is commenced. The let-down to the range then is rapid, i.e. 700-800 feet per minute.

The port tail plane and elevator were almost immediately sheared off by the trees while the port wing struck a large tree shearing the wing off outboard of the centre section attach angles after the aircraft had travelled about 200 feet. This started the aircraft into a violent rotation to the left, grinding the nose section and engines off into the ground. At the same time, the aircraft continued to slide along the ground, coming to rest on a heading of 353°T, (330°M), at approximately 400 feet from the first contact with the trees. Both the co-pilot and pilot-in-command sustained fatal injuries.

Examination of torsional bends on the airscrew blades, together with marks made by the airscrews on the ground, indicated that both engines were developing power at the time of impact.

All radio equipment and two altimeters were salvaged for detailed examination.

Later examination of all radio equipment indicated no unserviceability other than slight damage believed to have occurred in the accident.

For an undetermined reason, after being cleared by Air Traffic Control to Penticton, the aircraft did not follow usual practice and give its position when by the Penticton Radio Range.

The altimeters were both found to be inoperative and, while one was damaged more than the other, both had the rocking shaft pivot sheared off at the point of contact with the jewel. It is considered that the damage to the altimeters was caused by the impact of the aircraft at the time of the accident. Barometric settings on the altimeters were found to be 29.92" Hg. The discrepancy between the altimeter setting at Penticton and that actually set on the altimeters at the worst is 2/100" Hg. = 20 feet error. Altimeter temperature correction for -11°C at 6,500 feet indicated would give a true altitude of 6,200 feet, i.e. the aircraft would be 300 feet lower than indicated.

The engine control pedestal and control cables were too badly damaged for their settings prior to the accident to be determined. The engines showed no evidence of malfunctioning prior to the accident. Engine log books and aircrew log books were all up to date and in order.

There was ample fuel for the aircraft to complete the flight as the port front main fuel tank was approximately three-quarters full and the rear port fuel tank was approximately one-quarter full (total of 168 gallons approximately).

The flaps and undercarriage were both in the retracted position.

The Journey and Aircraft Log Book was up to date and in order. The pilot-in-command held a valid Public Transport Pilot's Licence (No. 346), and a valid instrument rating and he had a total flying time of 8655 hours and 29 minutes, of which 64 hours and 58 minutes were obtained in the month of December 1950.

During 1950, he had been employed mainly on the Vancouver-Calgary route where he had acquired 308 hours and 39 minutes as First Officer and 560 hours and 58 minutes as pilot-in-command.

The co-pilot held a valid Public Transport Licence, (No. 318), and had a total flying time of 5594 hours and 9 minutes, of which 63 hours and 4 minutes had been obtained in December 1950. During 1950, he had acquired 838 hours and 22 minutes as First Officer.

Conclusions

The aircraft struck Okanagan Mountain as a result of being below the minimum altitude permissible when passing through the Greata fan marker during an instrument approach procedure on the Penticton Radio Range.

ICAO REF: AR/127

CANADA

De Havilland DH82C Aircraft CF-COM, crashed near Glenorchy, Ontario, on 3 April 1951

Circumstances

Aircraft CF-COM took off with pilot and one passenger from Atikokan, Ontario, for Fort Frances, Ontario. While en route and in the vicinity of Glenorchy, Ontario, engine trouble developed causing the pilot to try to execute a forced landing. The pilot turned off both the gasoline and ignition and, during the process of losing altitude by means of gliding turns, the aircraft stalled and struck the ground in a nose-down attitude. The passenger was killed and the pilot received serious injuries.

Investigation and Evidence

The pilot was properly licensed and had accumulated a total of approximately 39 hours' flying time. The weather was favourable and had no bearing on the accident.

Nothing was found as a result of examination of the wreckage to indicate any structural failure or malfunctioning of the flying controls of the aircraft.

The aircraft engine was dismantled and the left-hand magneto was found to be defective. The spark plug of No. 2 cylinder, operated by the right-hand magneto, was found to be unserviceable. This gave rise to the loss of power and excessive rough-running of the engine which resulted in the firing of unburnt fuel mixture in the exhaust manifold.

Conclusions

Due to engine trouble, the pilot attempted an emergency forced landing during the course of which the aircraft was allowed to stall. There was insufficient height for a recovery to be made from the ensuing dive and the aircraft struck the ground in a nose-down attitude, killing the passenger and seriously injuring the pilot.

ICAO REF: AR/128

CANADA

United UH-12 Helicopter, CF-GKG, crashed near Oshawa, Ontario, on 8 March 1951

Circumstances

United UH-12 Helicopter, CF-GKG, took off with pilot and one passenger from Oshawa Airport, Oshawa, Ontario, and while proceeding at a low altitude,

struck two steel telephone wires which were strung between poles hidden from the pilot's vision by trees. The wires first contacted the cyclic control column and then, being broken, became entangled with the main and tail rotor blades rendering the controls of the aircraft inoperative. The aircraft swung to the right and, facing the opposite direction, crashed upside down in a ditch seriously injuring both the pilot and passenger.

Investigation and Evidence

The pilot had accumulated a total of approximately 2060 hours of flying time of which 335 hours was flying time on rotary wing aircraft.

There was no evidence of malfunctioning of either the aircraft or engine and the weather at the time of the accident was sunny and clear.

Conclusions

The aircraft became out of control through collision with telephone wires and struck the ground seriously injuring both the pilot and passenger.

ICAO REF: AR/129

CANADA

Scandinavian Airlines System, Douglas DC-6 Aircraft, SE-BDE, crashed on landing at Goose, Labrador, on 23 February 1951

Circumstances

Aircraft SE-BDE took off with six crew and eight passengers from Idlewild, New York, for Gander, Newfoundland, Canada, en route overseas.

On arrival at Gander the aircraft was diverted to Goose as Gander was below limits. The weather at Goose at the time was well above alternate limits and forecast to remain that way.

When the aircraft arrived at Goose the weather had dropped to below alternate limits but was still above the GCA minima. Permission for a GCA approach to be made was requested by the Captain and granted. The first two approaches were unsuccessful and the GCA Controller suggested that the aircraft proceed to another alternate. In view of the diminishing fuel supply this was not possible.

On the third attempt when the GCA minima were reached (ceiling 400 feet and visibility 1 mile), the aircraft was instructed to pull up and go around again. This instruction was not heard by the crew on the aircraft and the aircraft continued to let down to 400 feet indicated without change of course. The Captain sighted the lights of runway 27 to the right of the aircraft, flaps were lowered, and turns to the right and then left were made to bring the aircraft into line with the runway.

The wind was N.N.W. at 8 mph. and the aircraft first struck the runway while drifting to port. Corrections with the rudder and steering gear were made without success; the aircraft bounced and the port wheel struck the snow on the south side of the runway. The nose-wheel was torn off and the aircraft finally came to rest to the left of the runway at 2309 hours GMT on the main wheels and the nose. The passengers were uninjured as were the crew except for one member who received minor scratches and cuts.

Investigation and Evidence

The altimeters of the aircraft were set to 1013.5 millibars which is the equivalent of the altimeter setting given by the tower and the GCA Controller at 29.93 ins. Hg.

Communication had been established between the aircraft and GCA on the international emergency frequency (121.5 Mc/s), but due to an unreliable receiver in the GCA hut, the tower monitored transmissions and relayed them to GCA, when necessary.

Through the unserviceability of the lights on runway 35, runway 27, which was slippery on account of light snow, had to be used with a crosswind of nearly 70°. The windspeed was 8 mph.

The aircraft suffered substantial damage.

Conclusions

The immediate cause of the accident would appear to be the failure on the part of the Captain to compensate for wind conditions prior to touch down together with the ineffectiveness of the steering gear after touch down due to slippery runway conditions.

ICAO REF: AR/130

CANADA

Luscombe 8A Aircraft, CF-EJC, crashed on the S.E. arm of Trout Lake, Ontario, on 3 February 1951

Circumstances

Aircraft CF-EJC took off with pilot alone from Trout Lake, Ontario, for Parry Sound, Ontario. Just before take-off, a passenger on the in-bound flight to Trout Lake assisted in freeing the skis from the sticky snow by pushing on the port wing strut. As the aircraft moved off he was knocked unconscious by a blow in the back from the tailplane. When he regained consciousness, the passenger who was the last known person to see the aircraft in flight, stated that he saw it at tree-top height in a steep nose-down attitude after which it struck the ice on the lake. The pilot died as a result of multiple injuries received in the crash.

Investigation and Evidence

The aircraft had ample fuel in the tanks for the flight. Examination of the wreckage indicated that the engine was developing considerable power at the moment of impact. There was no evidence that would indicate malfunctioning of either the aircraft or engine prior to the accident. The pilot held a valid licence and had accumulated approximately 250 hours' flying time, of which 40 hours had been obtained within the last six months.

Conclusions

The aircraft struck the ice in a nose-down attitude for reasons that have not been determined.

ICAO REF: AR/131

CANADA

DeHavilland DHC-2 Aircraft, CF-FHG, crashed at Lake Tessier, P.Q., on 29 January 1951

Circumstances

On 29 January 1951 aircraft CF-FHG took off with pilot, helper and two passengers from Caupichigau for Oskelaneo.

As the aircraft was not due back at its base until 31 January 1951, no concern was felt for the aircraft until this date. After preliminary inquiries on 31 January 1951, established that the aircraft was missing, a search was commenced by the RCAF. Search and Rescue Organization which lasted for four days when the wreckage of the aircraft was found on Lake Tessier.

Investigation and Evidence

The pilot held a valid Commercial Licence and had accumulated a total of approximately 1400 hours of flying time.

Examination of the wreckage indicated that the aircraft struck the ice while in a steep right-hand spiral dive. The impact was such that the engine had broken through 3 feet of blue ice.

The weather in the area was bad with large patches of ground fog covering areas of 4 to 5 miles and which extended up to 3,000 to 4,000 feet in height. Visibility was 3/4 of a mile at the most and the temperature was about -50°F.

The last radio contact with the aircraft was at 1515 hours EST at which time the pilot reported that he was about half way between his point of departure and Oskelaneo.

Only the bodies of Gilbert Comtois and Charlie Neepush were recovered. The bodies of Elzear Comtois and Mrs. John C. Neepush are still missing.

Conclusions

For undetermined reasons, the aircraft struck the ice on Lake Tessier while in a steep spiral dive.

ICAO REF: AR/132

CANADA

Noorduyn Norseman VI Aircraft, CF-CPS, crashed at Kirkness Lake, Ontario on 23 December 1950

Circumstances

Aircraft CF-CPS took off with pilot, one passenger and freight from Red Lake, Ontario for Pekangikum, Ontario.

In the vicinity of Kirkness Lake, Ontario, the pilot flew into a region of bad weather including heavy snow, with reduced visibility, violent turbulence and very strong northerly winds.

The aircraft was not seen due to the weather conditions but could be heard circling the lake where it crashed between 1100 and 1130 hours CST.

Investigation and Evidence

The aircraft was completely destroyed on impact with the ice. Amongst other parts, the aircraft engine and airscrew went through the ice to the bottom of the lake through the force of the impact.

The aircraft and engine were airworthy for the flight and had only recently undergone complete overhaul for the renewal of the Certificate of Airworthiness.

The pilot held a valid commercial licence and had accumulated approximately 4800 hours' solo flying time some of which was night flying. Although the pilot did not hold an instrument rating, he was considered to have a good knowledge of instrument flying.

There was ample fuel on board the aircraft for the flight.

Conclusions

Through continuing VFR flight into unfavourable weather the aircraft struck the ice at Kirkness Lake, Ontario, in a nose-down attitude. This resulted in the destruction of the aircraft and the death of both the pilot and the passenger.

ICAO REF: AR/111

DENMARK

A French registered aircraft, F-BAYM, type SO 30P, collided with Danish Airlines DC-4 whilst taxying out for take-off from Copenhagen Airport, Kastrup, 26 July, 1950.

Circumstances

Aircraft F-BAYM, operated by Cie Aigle-Azur on a charter flight, Le Bourget - Lyons - Amsterdam - Stockholm - Copenhagen - Paris, with freight, landed at Copenhagen at 2112z on 26 July 1950 and parked in front of hangar B for removal of freight. After completion of unloading and loading the pilot at 2231z asked the ATC for taxying instructions for take-off. Clearance was given and the aircraft was directed towards the taxi-line along the apron. According to the pilot he headed for some red flashing lights (actually obstruction lights marking the VHF tower) mistaking these lights for the beginning of Runway 22. Although the taxi-line curves south in order to clear parked aircraft, the pilot continued in his original direction. The aircraft collided with Danish Airlines DC-4 OY-DFI parked at point 8 with position lights on and floodlit by projector No. 2 from the Administration Building. The position lights of OY-DFI were mistaken by the pilot of the French aircraft for various obstruction lights beyond the aircraft. The port wing tip of F-BAYM struck the port outer wing of OY-DFI causing considerable damage to both aircraft.

The pilot is further reported to have stated that he attempted to discontinue the flight at Stockholm, as he had never operated into Copenhagen before, but that he was pressed to continue the flight (by whom was not established).

Probable Cause

The accident was due to the pilot's failure to follow the correct taxi-line and to pay sufficient attention to the position lights of OY-DFI so that he taxied F-BAYM too close to OY-DFI.

These errors must presumably be attributed to the pilot's ignorance of the local conditions of Copenhagen Airport (the pilot had never previously operated into Copenhagen Airport, nor had he endeavoured to obtain information before taxying out) coupled with the fact that the crew had been on almost 24 hours' continuous duty, including about 9 hours' flying, which must have contributed to fatigue.

ICAO REF: AR/64

NETHERLANDS
(See Government of India Report in List No. 12 Doc 7026, AIG/513)

KLM Constellation, PH-TDF, near Santa Cruz (Bombay) Airfield on 12 July, 1949. (Netherlands Report)

(This summary is given in considerable detail by reason of its technical importance.)

Circumstances

On 12 July 1949, at 0039 hours GMT, a Netherlands Lockheed Constellation transport aircraft, registered PH-TDF, of KLM took off from Palam Aerodrome (Delhi) for Bombay, on a special flight from Batavia to Amsterdam via India. The aircraft carried a crew of 11 and 34 passengers.

At 0322 hours GMT the aircraft arrived, by means of the MF beacon, over Santa Cruz Aerodrome at an altitude of 7,000 feet. It was then brought down through the clouds by means of the MF beacon to a height of 500-600 feet above the aerodrome.

The aircraft was then advised that it was approaching the aerodrome from the north-westerly direction from whence the ground could be seen. The landing gear and flaps were lowered. Flying at a low altitude in an easterly or north-easterly direction, the aircraft began a turn in order to land on runway 23. At approximately 0350 hours GMT, however, it crashed into a 674 foot mist-shrouded hill located three miles east-north-east of the aerodrome. The aircraft was totally destroyed and all occupants were killed.

The Board investigating the accident considered itself fortunate in having at its disposal the information available in the excellent report prepared by the Indian authorities in their inquiry into the accident.

Consideration of the circumstances has led to the following comments:

a) ENE of Santa Cruz aerodrome there is a line of hills, the highest point of which is 674 feet high and lies 3-1/2 miles approximately ENE of the aerodrome. This was mentioned in the documents carried on board the aircraft, but not in accurate detail, as there were inconsistencies in the various documents. These reference documents consisted of an aerodrome chart on which, near runway 05-23, an arrow, pointed in the 05 direction with the inscription "Hills 690 feet 2.5 miles". Although this indication was not in itself correct, the Board was of the opinion that the charts gave a clear warning of the danger of collision when flying over the terrain ENE of Santa Cruz aerodrome.

Before departure from Palam aerodrome near Delhi, the pilot was shown by the official on duty a chart which gave complete and accurate details of the terrain at Santa Cruz. Furthermore, an aerial photograph displayed in the air traffic control station gave an accurate picture of the group of hills. It has not been ascertained, however, whether the pilot had looked at this photograph. In any event his attention was not specially drawn to it.

On the basis of these various considerations, the Board came to the conclusion that it was unlikely that the pilot was not aware of the existence of the hills.

b) The weather forecast received by the pilot at Delhi was more favourable than the actual weather prevailing on the arrival of the aircraft at Bombay, at least insofar as the height of cloud base was concerned. It is confirmed that the aircraft received weather reports from Bombay at 0126 and 0230 hours. It was also ascertained, from the portions of the log book which were found, that a weather report was received from approach control at Santa Cruz at 0316 hours, according to which the visibility was down to 300-600 yards on account of heavy rain. At 0322, approach control reported that visibility was 500-700 yards and improving, and that the cloud base was at 600 feet. There is little doubt that the pilot, on arrival over the aerodrome, had accurate knowledge of the prevailing weather conditions.

c) KLM had laid down no minima for operations at Santa Cruz aerodrome since the latter does not lie on the route usually flown by its aircraft.

It is customary for the pilot, in the case of a scheduled landing at an aerodrome for which his company has prescribed no weather minima, to adopt the weather minima laid down by airlines whose aircraft frequently land on the aerodrome.

It appears that weather minima for Santa Cruz aerodrome were laid down by three airlines: Air India International, British Overseas Airways Corporation and Transcontinental and Western Airlines. The BOAC and TWA minima are more or less identical, i.e. visibility 2 miles and cloud base 1,000 feet. Air India prescribes a visibility of 2,500 yards and a 600 feet cloud base, but requires that the 674 foot hill be free of cloud for landings on runway 23.

This difference is readily explained by the fact that the Air India minima apply to pilots who fly regularly into Santa Cruz, whereas the TWA and BOAC minima apply to pilots who, admittedly, have not such extensive experience of Santa Cruz as the Air India pilots.

It was therefore recommended to pilots who had never flown into Santa Cruz to observe the TWA or BOAC minima.

It was not definitely ascertained from the investigation whether the pilot of aircraft PH-TDF had obtained information on this matter. The Commission which conducted the local investigation considered it likely that the pilot was unacquainted with the minima. The Board considered, however, that an experienced pilot would have ascertained them.

It is confirmed, however, that even the lowest minima laid down were not complied with and that the landing procedure (the break-through) was carried out under conditions which were less favourable than the Air India minima and very much less favourable than the BOAC and TWA minima.

d) R/T communications on 6440 kc/s were normal. When flying over the beacon at 7,000 feet at 0322 hours, the aircraft received instructions on the course to be flown during the break-through to 3,000 feet, and later, at 0332 hours, to 1,500 feet.

These instructions were complied with by the aircraft.

There is no indication, however, of there having been any discussion between the tower and the pilot as to whether it was advisable to land under the prevailing conditions.

In view of the nature of the terrain in the neighbourhood of Santa Cruz, the weather conditions on arrival over the aerodrome and the above-mentioned weather minima, the Board is of the opinion that the pilot must have decided to delay the landing until visibility and ceiling had improved sufficiently,

otherwise to divert to another aerodrome. He did not request permission of the local air traffic control to do this. On the contrary, he simply took the normal holding altitude of 3,000 feet, which the Board considered to be an error of judgment on his part.

The Board notes, in this connection, that no advice was given by traffic control which could have deterred the pilot from this intention to land immediately. When giving its instructions, air traffic control apparently did not take into consideration the fact that the crew, unlike the crews of other scheduled aircraft, did not know the local conditions from experience, and that, for this reason, it was desirable to assist the crew with more than the normal amount of advice.

Although the Board considered the decision to carry out the landing unwise, in view of the foregoing, that decision was not necessarily the cause of the accident, since the pilot still had the possibility of breaking off the landing procedure, climbing to a safe altitude and clearing all the terrain ENE of the aerodrome. The Board considers the following facts to be of importance in considering what happened during the latter stage of the landing procedure.

1) After having received from the tower the regular instruction to descend to 500 feet, the aircraft made visual contact with the ground at 0345 hours at a height which, according to witnesses' estimates was between 500 and 600 feet, which height corresponded to the cloud base reported by the tower. It was observed that the undercarriage was down. The aircraft turned to the right around the aerodrome and then headed over the aerodrome in an easterly direction. Its height at that time (again according to witnesses' estimates) was approximately 300 feet. The aircraft remained in sight for about three minutes and then disappeared in the clouds to the east of the aerodrome. The three minutes must have been sufficient to give the pilot a clear picture of the weather conditions above and in the neighbourhood of the aerodrome, and to permit him to estimate the possibilities of making a landing.

During the time the aircraft was in sight, the rain, which shortly before had reduced the visibility at the aerodrome, was to the east of the aerodrome. Consequently, the hills were no longer visible from the aerodrome, and the pilot could therefore certainly not have seen them.

2) The aircraft collided with the highest point of the hill at an elevation of approximately 600 feet. From the tracks made, it appears that the aircraft was turning to the left at the time. It was

ascertained from the wreckage that, at the time of the crash, the undercarriage was still down and that the flaps were half down, i.e. approximately in the take-off position. It was not possible to ascertain anything definitely from the apparent setting of the engine controls. It appears likely, however, that the controls were set for normal gradual - not rapid - climb. According to one of the experts who was heard at the investigation in India, it could be deduced from the position of the aircraft and from the probable position in which the engines were found, that the rate of climb must have been approximately 200 feet per minute. From the difference between the height of the point where the crash occurred and the altitude at which the aircraft flew over the aerodrome it follows that the aircraft must have been climbing gradually when it flew over the aerodrome.

A much greater rate of climb would have been obtained if the power had been increased and the undercarriage retracted.

3) The radio communications which took place during the latter portion of the flight are known only from the ATC log, as the part of the aircraft log recovered runs up to 0316 only. It is certain that the original entries in the log were in part erased and new wording introduced. This is not surprising. It is common knowledge that R/T communications are carried out rapidly and in a very abridged form, making it extremely difficult for the operator to record immediately what is being said or heard. Under these circumstances, it is not unusual to find omissions in the record since the data are transcribed from memory after the conversation has taken place. The data in the log must therefore be considered as a briefly written synopsis made by a person whose veracity there is no reason to doubt.

To this must be added the fact that Beewan, the radio operator concerned, and Pigott, his immediate superior on duty at the time, stated, under oath, at the preliminary investigation in India, that the log provides an exact transcript of the conversation that takes place. On the other hand, the Board does not attach such importance to this as to consider the entries to be an exact reproduction of the messages exchanged. In this connection, it is significant that the witness Antia, second pilot of an Air-India aircraft, who overheard the radiotelephony instructions except during a short interruption, stated that he had not understood several of the messages.

It is possible to ascertain the following only from the log: after the aircraft had reported, at 0347, that its undercarriage was extended, the tower gave instructions to land on runway 23 and warned that the wind was SW 15 knots. Thereafter, the log contained the part in which the above-mentioned alterations had been made:

"desc. to 500 ft. Caution hills ENE 674 ft. O 347½ you may land on 05 QAN SW km O 349 over the airfield. R Climb 800 ft. base leg
O 350½ no contact on 6440 when it was observed that he was proceeding to base leg of 23."

As already stated, it is doubtful whether this last report was actually received. In connection with the instruction to descend to 500 feet, it should be noted that this instruction cannot have been given at the appropriate location, since the aircraft was already at this height at 0347.

The clearance to land on runway 05 had to be given, since the aircraft was making a right turn round the field. It is uncertain whether this clearance was received by the pilot. It can, however, scarcely have been taken into consideration by the pilot since a landing with a tail wind of 15 knots is considered by experts to be out of the question. As the aircraft did not appear to land on runway 05, the instruction was apparently given to climb to 800 feet - in view of the apparent hazard which the hills presented - which altitude, in view of the proximity of the hills, cannot be considered sufficient.

4) Santa Cruz aerodrome has three runways. Runway 09/27 was unavailable owing to construction work which has been duly notified. A cross-wind of 15 knots was blowing across runway 14/32. According to the manufacturer's specifications, a Constellation can make a safe landing with a cross-wind of 20 mph (17 knots). The third runway, 05/73, is the one referred to in the above-mentioned log entry.

In considering the sequence of events during the last part of the manoeuvre, the Board again pointed out that the pilot committed an error of judgment in not concluding, through visual reference to the ground, that it was imperative for him to climb as rapidly as possible to a safe altitude, if he was to avoid the hilly terrain.

Before making his turn around the aerodrome, the pilot should have requested clearance to do so. He apparently did not request this clearance, but flew in the direction of the rain and of the hills, climbing gradually, thereby losing visual contact with the ground as well as the possibility of making a visual landing on runway 23, since there were no facilities for making an instrument landing on that runway. The most likely explanation that the Board could give for this behaviour is that the pilot, although he heeded the warning from control to climb to 800 feet, was not sufficiently aware of the presence of the dangerous hills during the short time available to him to come to a decision.

The Board observed, moreover, that no advice based on the prevailing conditions was given by air traffic control. The instruction to land on runway 23 was a dangerous one in view of the fact that the low cloud made the approach to the runway inaccessible. In particular, it should be recalled that the pilot cannot have been considered to be acquainted with the local conditions.

Air traffic control appears later to have realized the danger, given the warning concerning the hills and given the instruction to climb to 800 feet. Even if these instructions were actually received, which is open to doubt, it must be considered that the warning was extremely tardy and that the instruction to the pilot to climb to 800 feet clearly must have been too late. Since 800 feet is not a usual height to use in air traffic control instructions and in view of the fact that it provided very little clearance of neighbouring hills, the instruction may have led the pilot to believe that he should not climb any higher on account of the possible presence of other aircraft.

The Director General of the Department of Aviation further stated, at the sitting, that decisions concerning initiation, continuation or termination of flights rest entirely with the company or its authorized agents, in whose capacity the captain frequently acts. This is what is known as "operational control". In this connection, the Board made the following comments:

> In the first place, the Board could not escape the impression that, even internationally, this term had still not any generally accepted meaning. Moreover, compliance with faulty instructions from the tower may definitely be construed as an error on the part of the pilot. It may also happen, however, that the circumstances are such that no blame whatsoever attaches to the pilot. Another entirely different question arises, however, and that is whether the pilot, even though he has committed no error, can be held otherwise responsible, insofar as discipline is concerned, for having acted on inaccurate advice from the tower. The Board was not competent, however, to give answers to these questions.

Conclusions

In view of the foregoing, the Board was of the opinion that two successive errors of judgment were committed by the pilot. These were as follows:

1) he initiated a landing procedure at an aerodrome with which he was not acquainted, in weather conditions which were lower than the minima prescribed for landings on that aerodrome;

2) on arrival over the aerodrome, he flew at too low an altitude over a terrain which he must have known to include a hill which constituted a hazard for his aircraft, which hill he was not able to see, on account of the poor visibility and low cloud.

The Board further considered that the following factors contributed towards the accident to a considerable extent:

a) air traffic control did not advise the pilot to delay his landing until the weather conditions had improved, or otherwise to divert to another aerodrome;

b) air traffic control designated a runway for the landing which necessitated the aircraft venturing low over dangerous terrain as indicated in 2) above.

ICAO REF: AR/104

NETHERLANDS

KLM Constellation PH-TEN crashed near Prestwick, Scotland, on 20 October 1948. Report issued by Netherlands and released 3 July, 1950.

(Secretariat note.- A report on the accident was also issued by the United Kingdom. See List No. 10, AR/56 Doc 6951, AIG/511.)

Circumstances

On 20 October 1948 at 2111 hours GMT the Dutch public transport aircraft registered as PH TEN type Lockheed Constellation, owned by Royal Dutch Airlines Ltd, took off from Schiphol Airport for a flight to New York during which an intermediate landing was to be made at Prestwick Airport. On board there was a crew of 10 persons and 30 passengers.

At an altitude of 9,000 feet the aircraft established radio communication with the air traffic control of Prestwick Airport at 2255 hours, after which it was directed to the approach to runway 32 with the assistance of the GCA.

The pilot however decided to perform a landing with visual approach on runway 26. After having overshot runway 32, the aircraft, while flying at low altitude, turned to port at the intersection of the two runways.

A few minutes later at 2332 GMT, the aircraft whilst at an altitude of 440 feet, collided with the high tension cables of the national Grid System running from Kilmarnock to South Scotland at about 3-1/2 miles east of the centre of Prestwick Airport, as a consequence of which the aircraft caught fire. It is probable that the aircraft then flew a complete left turn; a short time after the collision, in dense fog, it crashed into the ground.

All persons on board were killed and the aircraft was completely destroyed.

Probable Cause

The Board was able to avail itself of the detailed and clear report drawn up by the Court of Inquiry set up for that purpose by the British Ministry of Civil Aviation.

The terrain east of the airport and within 3 miles slopes upward to a height of nearly 500 feet. There were on board maps giving details of this terrain and advising great caution when landing on runway 26. The pilot was very familiar with the airport and surrounding terrain. At 2236 and 2306 the pilot was notified by RT in code that visibility was deteriorating with low cloud 300 feet (90 metres) 4/10. At 2308 GMT a weather report was broadcast to the aircraft. There was conflict of opinion as to the contents of this message or messages as the ground services gave a very much lower visibility figure than the 3,900 yards (3,600 metres) agreed by the Board as the actual figure broadcast.

A weather report made at 2320 hours GMT, twelve minutes before the accident, showed that the weather had deteriorated below the minimum established by KLM for a night landing with visual approach. Unfortunately this report did not reach the pilot, as it was broadcast at 2336 GMT.

In accordance with the pilot's intention to land on runway 26 the aircraft, after having overshot runway 32 at a low altitude, turned to port above the intersection of the two runways to carry out a visual approach on runway 26. Less than three minutes later the aircraft collided with high tension cables. From the wreckage it appeared that the aircraft was headed in a direction of about N 40° E and had apparently already started its turn to the left. It was therefore concluded that the pilot started his turn into base leg of runway 26 too far east and, consequently, too late.

The Board took for granted that the pilot, at the moment that he should have commenced his turn into base leg of runway 26, had lost visual contact with runway 26 and was, therefore, unable to use this as a check. The pilot, in these circumstances, should have abandoned his intention of landing on runway 26 and carried out a steep climb to avoid the high ground. The Board, however, considered that the pilot did not abandon the landing and therefore decided that the pilot must have delayed his turn into base leg for some reasons unknown but which might be explained by assuming that the pilot, having lost sight of the lights of runway 26, waited a short while hoping to regain his reference. Further, the tail-wind (in the direction of the aircraft's first turn) may have been greater than estimated by the pilot. The Board, however, was of the opinion that this could only partly explain the delayed action. Another likelihood was engine failure which might have diverted the attention of the pilot from his procedure and with flaps and landing gear down presented considerable difficulty for a steep climb.

Evidence showed that No. 2 propellor was set at 61° (feathering 81°) whilst the other propellers were set at 24°. In addition the distributor value of the fire extinguisher was set for No. 2 engine. There was however no further evidence to support this theory as the remains of No. 2 engine were removed and were not available for further examination.

Conclusions

1. That when the pilot started his landing manoeuvre for runway 26 of Prestwick Airport the weather conditions were already below the limits for this manoeuvre but that from the weather forecasts received this could not be known to him and that this could not be personally judged at the time.

2. That, although the landing on runway 26 under the weather conditions, as far as these were known to the pilot, required the greatest caution, the pilot could not be blamed for having commenced that landing - procedure.

3. That, flying too long on the downwind-leg of runway 26 caused the accident.

4. That, if no unknown circumstances contributed to the extension of the flight on the downwind-leg of runway 27, the extension was due to the delayed action of the pilot after he lost visual approach.

5. That it was not impossible that a stronger wind than the pilot accounted for contributed to the extension of the flight on the downwind-leg of runway 26.

6. That the possibility of other circumstances as mentioned under 4 could not be ruled out, but that no data was available which could give cause for the supposition that they contributed to the extension of the flight at a low altitude on the downwind-leg of runway 26.

ICAO REF: AR/101

SWEDEN

Svensk Flygtjanst, Ltd., Firefly SE-BRF crashed at Hellested, 16 miles south of Køge on January 13, 1950.

Circumstances

The flight originated on 13 January at the military airfield of Valkenburg in Holland. The purpose of the flight was to deliver the aircraft to Svensk Flygtjanst in Stockholm.

On approaching his destination the pilot encountered bad weather with only half an hour's fuel remaining, and observing a cloudless area of about 5 square km approximately 16 km to the southwest of Kastrup, decided to make a forced landing in a field. The landing itself passed off smoothly, but in the final landing run, the ground being very soft, the aircraft was bogged and turned over on its back.

The investigation revealed that the weather reports for the route in question, as received in Holland, were not in full agreement with those issued by the MET office at Kastrup. It must be considered that the pilot, if he had knowledge of the weather forecasts in the form in which they had been issued by the MET Office, Copenhagen, would have postponed take-off.

Probable Cause of the Accident

The accident was due to the fact that the aircraft during the forced landing on a soft field bogged and thereby turned over on its back.

The forced landing was made because on arrival at the terminal weather conditions were found to have deteriorated so that a landing could not be made there. The aircraft did not carry any instrument landing equipment. The accident might have been avoided if the pilot, on encountering bad weather conditions at Vordingborg, had turned back and attempted a landing at Holland or Fehman which appeared to have been feasible at that time.

ICAO REF: AR/94

UNION OF SOUTH AFRICA

Miles Gemini, VP-RBK, Rand Airfield Transvaal on 1 April 1950.
Aircraft Accident Report No. 28/50. Released: 15 June 1950.

Circumstances

The aircraft took off at 1240 hours with three passengers and an overload of 167 lbs. On take-off the flight ran 435 paces along the runway before becoming airborne, it was then airborne for a further 455 paces which brought it almost to the aerodrome boundary by which time it was about 50 feet above the ground. After crossing the boundary the aircraft was seen to sink with its nose well up in the air, it managed to clear some trees but then the starboard wing dropped and struck the ground. The aircraft was completely wrecked. The conditions prevailing at the time were - pressure, 8343 mbs. and temperature 75.5°F. This gave an equivalent density altitude of 7,500 ft. and a corresponding decrease of 24 per cent in the engine power available, compared with the sea level power. This coupled with the overload resulted in the aircraft being unable to gain height and in ultimately stalling.

Probable Cause

The probable cause of this accident was stated to be that:

a) the aircraft was overloaded 167 lbs;

b) the pilot caused the aircraft to become airborne and to climb with insufficient safe margin of airspeed above the stalling speed of the aircraft for the pressure and temperature conditions prevailing at the time.

These factors combined with a climbing turn to the right to avoid obstructions, caused the airspeed to fall to stalling speed which culminated in the aircraft crashing.

Contributory causes were possibly the comparative inexperience of the pilot on the type of aircraft and the take-off along the particular runway of the airfield, the peculiarities of which are generally appreciated. Lack of airmanship was displayed by the pilot in that he did not take advantage of the briefing facilities available and that he failed to use the full length of the runway available for his take-off.

ICAO REF: AR/115

UNION OF SOUTH AFRICA

Aircraft Piper Cub ZS-BAH, engaged in crop dusting, crashed after flying into telephone wires at Letaba, TVL, on 12 September 1950.

Circumstances

On 12 September 1950 a licensed pilot flying Piper Cub ZS-BAH was engaged in aerial dusting an orange plantation. He had been flying on and off for a number of hours above a line of telephone wires and at approximately 10 feet above the trees.

About 1600 hours the pilot started to dust another area of younger trees, containing a telephone line on rising ground. Due to the fact that the trees were shorter in this particular area, the difference between the original height of the aircraft and the new trees had increased, which necessitated the pilot flying lower, during which the aircraft wheels struck the telephone wires and the aircraft crashed into the trees.

Investigation

The accident was not investigated in situ. The weather was good. The pilot's total flying experience was 900 hours of which 110 were on Piper Cub aircraft. He had only 9 hours crop dusting low altitude flying experience.

Probable Cause

The probable cause was error of judgment on the part of the pilot when low flying. Fatigue due to concentration on low flying for a number of hours previously during the day was probably contributing. The dust collects in the cockpit, and working in this atmosphere for a number of hours might possibly have affected his vision and judgment.

ICAO REF: AR/116

UNION OF SOUTH AFRICA

Aircraft Bonanza ZS-BXM, crashed on take-off from an unlicensed airfield at Pomfret, S.W.A., on 28 September 1950.

Circumstances

On 28 September 1950 at about 1500 hours a licensed pilot and 3 passengers attempted to take off from an unlicensed airfield in Bonanza ZS-BXM. The pilot stated that after running along the ground for some distance (10 degree flap) the aircraft left the ground and then sank back. On touching down it swung violently to the left, into thorn trees and finally into a hole in the ground when the nose gear assembly collapsed.

Investigation

The accident was not investigated in situ. The weather was good. The pilot's total flying experience was 940 hours, of which 280 were on Bonanza aircraft. The flight was for hire and reward.

Probable Cause

The ground surface is soft and sandy and is 3,600 ft. A.M.S.L. At 1500 hours it would be very hot. The aircraft was heavily loaded. The probable cause was error of judgment on the part of the pilot in attempting to take off under these conditions. He probably attempted to become airborne too quickly.

ICAO REF: AR/103

UNITED KINGDOM

BEAC Viking B "Vigilant" G-AlVL sustained an explosion approximately 30 miles south of Hastings, Sussex on 13 April 1950. M.C.A.P. No. 86.

Circumstances

When about halfway across the channel during a scheduled flight from Northolt to Paris an explosion occurred in the rear of the aircraft. Thinking that it had been struck by lighning and being told of extensive structural damage and serious injuries to the Stewardess, the Captain returned to Northolt. The Captain found that the rudder controls and the rudder and elevator trim controls failed entirely to respond and that there was greatly reduced elevation movement. The ailerons also appeared less positive than usual. Although the first landing attempt failed due to the unusual load necessary to move the control column, the second attempt was successful.

The Stewardess recollected that just before the explosion, whilst sitting on the seat in the pantry, she was conscious of a faint but unfamiliar smell described as being an odour which she associated with acid. Investigation on the following day made it clear that there had been an explosion of an infernal machine in the lavatory resulting in a ragged hole 5 ft by 5 ft 7 ins. being torn in the rear port side of the fuselage opposite the lavatory. On the starboard side next to the toilet compartment, a similar hole of even greater dimensions, 5 ft 2 in. at the top and 8 ft 2 in. at the bottom, had been blasted. A considerable amount of damage was done internally and to the rear controls.

Nothing was found that could be definitely said to be part of an explosive object, its detonator or tuning mechanism. The explosive used had not been determined up to the time of the report.

Conclusions

The damage to the aircraft was the result of an explosion of an infernal machine in the toilet compartment. The probable location of this destructive agent was in the used paper towel receptacle.

ICAO REF: AR/105

UNITED KINGDOM

Fairflight Ltd., Tudor V G-AKBY crashed at Llandow on 12 March 1950. Ministry of Civil Aviation Report 88.

Circumstances

On 10 March 1950 the Tudor V aircraft G-AKBY, owned and operated by Fairflight Limited, left Llandow airfield for Dublin on a charter flight with five crew and seventy-eight passengers. On 12 March, the aircraft with the same crew and passengers took off from Dublin with the intention of returning to Llandow. While making an approach to land on runway 28 at Llandow the aircraft entered a steep climb with engines full on, apparently stalled, fell away to starboard and crashed. All the crew and seventy-five of the passengers were killed.

The main problem of the inquiry was to determine how the aircraft, apparently making a normal approach in what were described as ideal conditions for landing at Llandow, suddenly got into such an attitude beyond the correction of an experienced pilot. Evidence showed that during the approach there was a slight tendency to undershoot and that when 800 yards from the runway and at a height of 150 feet there was an additional use of power followed by the sudden application of full throttle, concurrent with which the aircraft rose steeply to 300 feet presenting its fuselage at an angle of about 35 degrees to the vertical. Engine noise then ceased abruptly and the aircraft fell to the ground.

The findings of the report are divided into four parts, Parts I and II being devoted to particulars of the aircraft's history, the crew and the organization. Part III is solely concerned with the position of the centre of gravity at the material time, showing that it was located at least 9 inches aft of that permitted and that the pilot was misinformed of a most critical dimension, the "mean passenger arm".

Consideration of seven theories complete the report. Of these theories only two were not dismissed by the Court. One was suggested by the Managing Director of Fairflight Ltd. who attributed the accident to the displacement of the pilot's seat upon the sudden use of power, but this theory was regarded as "inherently improbable". The remaining theory was that the aft displacement of the centre of gravity beyond the compulsory limits resulted in there being insufficient angular movement of the elevators left to neutralise the climbing tendency which occurred, and that in any case an acute degree of instability would exist near the stall. The Court finally accepted this theory and concluded that the most probable cause of the accident must be found in the loading conditions of the aircraft which gave a centre of gravity position too far aft and outside the limit permitted in the relevant Certificate of Airworthiness. The report terminated with criticisms of the passenger and luggage loading arrangements.

ICAO REF: AR/109

UNITED KINGDOM

North East Flying Services Proctor 3,-G-AJCU at Brock Thorn Farm, West Riding, Yorkshire on 24 June 1950. Ministry of Civil Aviation Report No. C. 562.

Circumstances

The aircraft had been chartered to fly three people to Blackpool from West Hartlepool. About an hour after take-off the pilot lost his bearings, landed in a field and enquired from the local inhabitants as to his approximate position. He said his radio was not functioning. At the time of the landing the visibility was poor and there was low cloud. About an hour later, after the weather had improved, the pilot commenced to take off

and after the aircraft had crossed the field from the NW to SE corner it struck a 5-foot wall adjoining the southern boundary. It crashed in the adjoining field and caught fire. All the occupants were killed. The field was 475 yards long but the width, for the major part, was less than half this distance. The surface consisted of meadow grass 12 to 18 inches high. From the northwest end there was a slight up-hill gradient which changed to a down-hill one towards the south from approximately the centre of the field.

The report concluded with the opinion that the accident was due to an error of airmanship by the pilot in attempting to take off under the conditions which prevailed.

ICAO REF: AR/96

UNITED STATES

American Airlines, Inc. DC-6 N-90728 crashed at Love Field, Dallas, Texas on 29 November 1949. CAB Accident Investigation Report No. 1-0120. Released: 30 August 1950.

Circumstances

The aircraft was on a flight from New York to Mexico City via Washington, D.C. and Dallas, and was carrying 46 passengers.

At 2147 on 28 November the flight left New York arriving at Washington after an uneventful journey. At Washington a flight plan was filed and approved specifying Instrument Flight Rules to Dallas, Wichita Falls as the alternate and a cruising altitude of 18,000 ft.

At 0206 the flight was granted permission to change its flight plan to VFR. At 0254 a position report was received over Nashville at 16,000 ft. and a descent to 6,000 ft. was started. As the flight approached Nashville, No. 1 engine started backfiring at intervals of about 20 seconds. Despite various corrective measures including the application of alcohol and carburetor heat and the richening of fuel mixture, the backfiring continued. At approximately 0300 and 25 miles southwest of Nashville, No. 1 engine was feathered and at 0429 when the flight was in the vicinity of Altheima, Ark., the crew advised its company that a change of aircraft was necessary at Dallas. When nearing Dallas the captain and the flight engineer conferred regarding the return of No. 1 engine to service and decided against it. No attempt was made to transfer fuels, resulting in 1400 pounds more weight on the left side of the aircraft on arrival at Dallas.

At 0536 the aircraft was 15 miles northeast of Dallas and was given permission to enter the traffic pattern at Love Field with a righthand turn and instructed to land on runway 36. The altimeter setting and the weather, which included unlimited ceiling, visibility of 15 miles, wind at 5 MPH, were given to the flight. In the final approach, at an altitude estimated by the captain at 1200 ft. and the first officer at 800 ft. above aerodrome level, and at a distance of about 1-1/2 miles from the approach end of the runway,

the landing gear and flaps were extended. Shortly thereafter the flaps were fully extended. The turn to final placed the aircraft left of the runway and to correct this an S turn was made, during which the aircraft skidded to the left, the airspeed dropped abruptly and the aircraft settled rapidly. The captain in an attempt to maintain control increased power to engines Nos. 2, 3 and 4. The aircraft cleared the 30 ft. obstruction poles 800 ft. south of the approach end of the runway by approximately 75-100 ft. and continued across the airport in a tail-low attitude, on a heading of about 40° to the left of runway 36. The airspeed continued to fall and its attitude became increasingly nose-high until the aircraft stalled just before striking a hangar and other buildings on the airport. Fire followed at once.

The Board in its report on the investigation said that on final approach and when the aircraft was approximately at the proper altitude to start flaring out, the flight engineer saw a warning light flicker and the fuel-flow meter of No. 4 engine reading zero. He immediately notified the pilots that No. 4 engine was cutting out, and the captain told him to put the booster pump to it. The flight engineer did so. Full throttle was then quickly applied to engines Nos. 2, 3 and 4. The captain stated that No. 4 engine came in with a "terrific" surge of power (overspeeding), the left wing dropped, and the aircraft started to turn left.

He then retarded throttles Nos. 3 and 4 in an attempt to raise the left wing with No. 2 engine. When the wing was partially up he opened throttles Nos. 3 and 4 and called for gear and flaps up. The Board said the first officer raised the gear but did not raise the flaps. He then observed that No. 4 tachometer indicated only 1,200 r.p.m., noted that the fuel pressure to that engine was zero, and immediately feathered No. 4 propeller.

In an analysis of the investigation, the Board said: "The decision to land with No. 1 engine inoperative placed certain added responsibilities upon the crew. First, it is vitally necessary to plan an engine-out (three engines) approach with extreme care and thought concerning altitude, air speed, rate of descent, and distance from approach end of the runway, all of which should be determined at a greater distance from the airport than for a normal, 4-engine landing. In addition, it is important that the aircraft be in close alignment with the runway well before beginning descent into final approach, making any further turning unnecessary.

"The turn into final approach was made about 2 miles from the end of the runway. Since the aircraft was not lined up with the runway a flat 'S' turn was attempted to correct this error. During this 'S' turn, the aircraft skidded, resulting in a loss of air speed which was augmented by the fully

extended flaps. It is vitally important to use proper flap settings to complete an engine-out approach."

In a summary of what it said "seems to be the most plausible reconstruction of events immediately preceding the accident," the Board continued: "The turn into final approach was misjudged, requiring first an extension of the right-hand turn, and then a left-hand turn, to align with the runway. Such turns were made while the aircraft, according to ground witnesses, appeared to be kept quite level laterally. To change direction from a right turn to a left turn, with the aircraft being kept approximately level would necessitate a large amount of left rudder control to start the left turn, together with considerable right aileron control. Such control caused the aircraft to skid to the left and then to the right. The relatively small amount of fuel in No. 4 main tank, due to improper fuel management, would move centrifugally to the right during the right skid, or away from and uncovering the outlet of the tank which is at the inboard, or left, side of the tank. No. 4 engine did not respond because it had no fuel at the moment. When it did respond, almost immediately, it surged (oversped) and the resulting strong unbalance of thrust caused the aircraft to yaw to the left and the left wing to drop - the dropping tendency being aggravated by the approximate 1,400 pounds of fuel differential in the left tanks.

"The aircraft was then in a position from which recovery was impossible. The almost immediate feathering of No. 4 engine by the first officer, because be believed it inoperative, had no bearing on the accident".

ICAO REF: AR/97

UNITED STATES

Air Transport Associates, Inc. C-46F N-5075 crashed after take-off from Boeing Field, Seattle, Washington on 19 July 1949.
CAB Accident Investigation Report File No. 1-0056.
Released: 30 August 1950.

Circumstances

At 2043 the flight, scheduled to fly Seattle, Washington, to Chicago, Ill., taxied from the loading ramp to the south end of runway 31 where there

was a delay of 13 minutes for the before take-off check. The aircraft total weight was within the allowable limit and was properly loaded. 91 and 100 octane fuel were carried, the run up being carried out on 91 octane fuel.

At 2058 the flight received clearance from the tower and began take-off using 91 octane fuel because of failure of the left centre fuel pressure boost pump. One of the engines was heard to splutter and backfire and an unusual amount of torching or exhaust flame was seen coming from both the engines. At approximately 3,500 feet down the runway, the aircraft became airborne but the left engine did not seem to be developing full power, and the pilot therefore retarded the throttles and the aircraft settled back on the runway. At the time of the accident the green threshold lights had been moved in for repair purposes so that the runway was reduced by 1,700 feet to 5,800 feet in length. The pilot considered this insufficient space to accomplish a safe stop, advanced the throttles to the limit of 52 inches, both engines responded but the left continued to misfire, and the aircraft became airborne at an air speed of 105 miles per hour. The flight passed the end of the runway at a height of about 50 ft. above the ground in a nose-high attitude. However there was insufficient altitude to fly over the power lines and poles thus the aircraft struck a 56 ft. pole (2 feet from its top), 1,500 ft. beyond the end of the runway. A second and third pole were struck, 1,480 ft. and 200 ft. after each other. As a result the aircraft rapidly lost altitude and crashed into a three-storey house coming to rest in a single-storey brick dwelling.

The investigation found the probable causes of this accident were pilot indecision and the use of 91 octane fuel for take-off. A contributing cause was that the runway threshold lights at the far end of the runway had been moved in, making the runway appear shorter than the actual usable length. The investigation further found that none of the three pilots on board had received training or a flight check on this type of aircraft; take-off power settings used were far above those allowable for 91 octane fuel; engine was obsolete and no instructions other than army technical orders were published for maintenance of the engine and these were difficult to obtain.

ICAO REF: AR/98

UNITED STATES

Mercer Enterprises, Cessna T-50 N-61503 at Los Angeles on 1 October 1949. CAB Accident Investigation Report File No. 2-0700. Released: 6 September 1950.

Circumstances

The aircraft was on its return flight from Palo Alto to Burbank, Calif. carrying 5 passengers. The pilot estimated the consumption on the first half of the trip as 30 gallons an hour, or total of 60 gallons. This was half the 120 gallons of fuel carried. Another 35 gallons was put in before the return flight.

The aircraft left Palo Alto at approximately 1835 having filed a flight plan with San Francisco radio for VFR to Burbank at 7,000 ft. The flight plan also indicated 2 hours' flight time with sufficient fuel for 3 hours.

The flight proceeded without incident until about 61 miles from Burbank when the pilot was concerned as to whether he would have sufficient fuel; however, as his fuel gauges indicated 35 gallons (1 hour's flight) and Burbank was 30 minutes' flight time away he decided to continue. At 2056 the pilot requested the shortest route to Burbank and asked if there were any lighted fields between Newhall (16 miles north of Burbank) and Burbank. The control tower replied that there were no lighted fields and the shortest route was 124°. After passing Newhall the flight began descent from 7,500 ft. Approximately 9 minutes later the aircraft emerged from a layer of clouds 3,000 ft. over downtown Los Angeles. The pilot made a turn to go back to Burbank approximately 8-1/2 miles to the northwest. During the turn, however, both engines ceased to operate through lack of fuel and the pilot attempted an emergency landing on Beverly Boulevard. At 50 ft. the aircraft hit 3 power lines and crashed out of control to the street.

Probable Cause

The investigation found that the probable cause of this accident was the exhaustion of fuel prior to arrival at the intended destination, due to improper flight planning and operation.

The investigation also found that the total weight of the aircraft was approximately 272 pounds more than its certificated weight when it departed Palo Alto. The flight overflew the destination and the engines failed due to fuel exhaustion; the pilot did not determine the actual fuel consumption of the engines (estimated as 34.4 gallons per hour); no attempt was made to utilize the available radio facilities for the purpose of orientation.

ICAO REF: AR/99

UNITED STATES

Eastern Air Lines, Inc. DC-4 and a P-38 collided near Washington National Airport on 1 November 1949. CAB Accident Investigation Report No. 1-0138. Released: 26 September 1950.

Circumstances

The Eastern Air Lines DC-4 Flight 537 was being landed at Washington Airport after a flight from Boston and the P-38 was being test flown in the vicinity of the Washington Airport.

Clearance for landing was given to Eastern when on its downwind leg west of the field. Eastern made a continuous turn from its downwind leg west of the field to a final approach to runway 3. During this turn, the P-38 was south of the end of runway 3 on a high straight-in approach for landing on the same runway on which Eastern had been cleared to land - Runway 3.

Following the DC-4's clearance to land, instructions were given to the P-38 to enter the left traffic pattern and to call the tower when west of

the field. These instructions, although repeated by the tower, were neither acknowledged nor complied with. Instead, the P-38 started a straight-in approach on an approximate heading of 20 degrees. The P-38 was then requested to make a 360-degree turn to the left and to land number two following the Eastern DC-4 turning on final approach below him.

As the Eastern DC-4 rolled out of its left turn onto final approach, approximately 3/4 mile from the end of runway 3, and as the P-38 continued to descend above and behind the DC-4, the tower transmitted to the P-38 either, "Turn left, turn left," or "Clear to the left, clear to the left." Since the P-38 still did not comply, and a collision now appeared imminent, the tower switched to the DC-4 frequency and instructed the Eastern crew to turn left because a P-38 was on the approach behind them. The Eastern flight responded immediately by applying power, levelling off, and turning left. But, before more than 5 degrees of turn was made, the two aircraft collided at a point in line with and 1/2 mile from the approach end of runway 3 at an altitude of 300 feet. All of the 51 passengers and the crew of four in the DC-4 were killed and the pilot of the P-38 was seriously injured.

The report states that the testimony of the control tower personnel and that of the pilot of the P-38 were in conflict.

Prior to taking off the pilot of the P-38 had notified the control tower through a second party of his intention to make the test flight and that he would communicate with the tower control over VHF radio channel "B" on 126.18 megacycles. He stated he had asked the second party to also notify the tower control to signal by light if radio contact was not established. The tower control did not receive this last message and the second party denied hearing the pilot make this second request. During the ground operation and clearance for take-off no difficulty was experienced in communications by the tower control or by the pilot in the P-38. His testimony included the statements that during manoeuvres shortly after take-off erratic operation of the right engine occurred and he decided to land as soon as possible. He transmitted a message to the tower stating that he had engine trouble and requested landing instructions, but received no immediate answer, neither did he observe any light signal from the tower. He is reported to have said that shortly afterwards the tower control queried his call and gave him instructions as "Bolivian P-38 cleared to land number two on runway 3" but he was not informed that the aircraft ahead of him was an Eastern DC-4. According to the tower control the controller instructed the P-38 "to enter a left traffic pattern for runway 3 and to report when west of the tower on downwind leg". When the instruction was not acknowledged by the P-38 it was repeated. The pilot of the P-38 stated that whilst on his base leg he observed a C-60 or

C-45 complete its landing and turn off the runway. He also stated that after completing a left turn from the base leg to an approach course for landing on runway 3 he transmitted a message to the control "Bolivian P-38 on approach" and received an answer from the control tower "Bolivian P-38 cleared to land on runway 3". He also heard the tower control say "Clear to the left, clear to the left" but he did not know for whom it was intended because no call sign was used. Almost immediately afterwards he felt the shock of the collision with the DC-4. The report states that the P-38 was never given a clearance to land number one. The report implies that the pilot of the P-38 reporting what he considered to be the number one aircraft, a C-46 or C-60, land, may have been confused by a B-25 that did make a simulated instrument approach to runway 36. Airport observers and the tower records did not report a C-46 or C-60 landing during this period.

It is conceived that a good part of the control tower instructions to the P-38 may not have been received as transmission and reception on any one particular radio frequency cannot be effected simultaneously hence the pilot of the P-38 would not have received intended messages from the control tower if he had been calling at the same time that the control was attempting to give him instructions.

In a footnote it is recorded that there were no recordings of any of the conversations with the P-38 because they were made from the "A" position (Local Control Position) which had no recording apparatus. The P-38 was on a frequency of 126.18 megacycles, while Eastern was on a frequency of 119.1 megacycles, consequently, neither plane could hear the transmissions between the tower and the other plane. However, simultaneous transmissions could have been made on both frequencies if the operator had simply held two frequency toggle switches "on" instead of one.

The captain of the DC-4 was advised by the tower that the P-38 was in the traffic and later warned to lookout for it. Evidently time was too short to take successful evasive action when as he was headed in for the landing and the final warning was given to turn left, with the P-38 on the approach behind, and with rear visibility in the DC-4 restricted. The forward visibility in the P-38 was also limited unless the aeroplane was manoeuvred to see ahead.

The Board while imparting poor judgment to the tower personnel in adhering to the single course of guiding and corrective action which was selected, even though normally they had the right to expect such action to be effective, did not, considering all the circumstances and particularly

the pilot of the P-38's unpredictable actions, assert that a different or additional course of action by the tower in the time available to it to reasonably select such action, would have averted the accident.

It is stated in the findings that the tower did not act with the requisite alertness and promptness in communicating to Eastern the position of the P-38 in the critical traffic situation which confronted it, but this cannot be said to have contributed to the cause of the accident.

Probable Cause

The Board determines that the probable cause of this accident was the execution of a straight-in final approach by the P-38 pilot without obtaining proper clearance to land and without exercising necessary vigilance.

ICAO REF: AR/100

UNITED STATES

Transocean Airlines, Inc. DC-4 N-79998 near Lurga Point on the Irish Coast on 15 August 1949. CAB Accident Investigation Report No. 1-0086. Released: 15 September 1950.

Circumstances

The aeroplane departed Rome, Italy, on a non-scheduled flight to Shannon, Ireland at 1608 GST, 14 August 1949. There were 49 passengers and a crew of nine on board. The report describes the lack of coordination of the work undertaken in the pre-flight planning by the various flight crew members, who did not have any agreement or accurate knowledge as to the route, fuel on board, fuel requirements, or duration of flight. The captain failed to examine any of the documents before take-off. The crew discovered that there were only 2200 gallons of fuel on board which on the basis of a consumption rate of 200 gallons per hour, a standard estimate of the company, provided for 11 hours range and was not sufficient for the required fuel

reserve of two hours' normal cruise after flight to Shannon. The original flight plan prepared by the navigator was based on 12 hours' fuel over an indirect route via airways and Paris with Orly airport as the alternate aerodrome. This was discarded for one via the direct route from Marseille with Dublin as the alternate aerodrome, but the change was not transmitted to the Rome ATC. The lack of precision in navigation is described at length in the report. Relatively clear weather with light to moderate winds existed over the route between Rome and Shannon. The flight forecast given to the crew at Rome covered the indirect route to Shannon via Paris and did non contain specific wind information for the direct route.

The navigator drawing the courses of the Shannon radio range when an "A" signal of this radio aid was being received in the aircraft, erroneously labeled the southeast sector of the range "A" instead of the proper designation "N". He believed, because of the "A" signal, that the flight had not passed Shannon.

A celestial fix obtained by the navigator at about 0030 GST, when plotted, placed the aeroplane at a position 175 miles northeast of Shannon. Courses on different bearings were then flown until the west leg of the Shannon radio range was intercepted. At this time only about 1-1/2 hours fuel remained. The aeroplane had been airborne a total of 9 hours six minutes. At 0106 GST the flight alerted the Air-Sea-Rescue facilities at Shannon giving the aeroplane's position as 100 miles west of Shannon flying inbound on a track of 80° with ground speed estimated at 140 knots. The flight continued toward Shannon until 0240 GST when all fuel was exhausted at which time the aeroplane was ditched in the sea at a position about seven miles northwest of Lurga Point on the west Irish coast.

It is significant that no use was made by the flight of 500 kc/s. the International Distress Frequency.

The aircraft remained afloat for about 15 minutes, during which time the crew and passengers removed and manned all but one of the life rafts. Aircraft circling over the life rafts were able to direct the British trawler "Stalberg" to the scene. All rescue operations were completed shortly after daylight of 15 August 1949. Seven passengers and one crew member died as a result of exposure or drowning; all others were successfully rescued.

The report in summary states that there can be little doubt that the flight met with disaster because of inadequate flight planning and haphazard performance of flight duties. During the planning stage of the flight the

crew did not confer with one another and they had no agreement nor accurate knowledge of route, fuel hours on board, fuel requirements, nor duration of flight. The weather information obtained was not applicable to the route which was actually flown, and no attempt was made en route to secure this information. Accurate hourly positions of the aircraft were not determined and plotted. Radio facilities, in particular the Shannon radio range, were not used to their best advantage. And, finally, celestial navigation was not used as a means of routine position determination though the stars were visible at all times.

It is apparent from the various errors and omissions of the crew, that the captain did not supervise either the flight planning or the flight duties as his responsibilities required. As a result, the aircraft was flown beyond its destination and fuel was exhausted before the return to Shannon could be completed.

Probable Cause

The Board determines that the probable cause of this accident was the failure of the captain to exercise the proper supervision over his crew during flight planning and while en route.

ICAO REF: AR/102

UNITED STATES

Privately owned Consolidated Vultee BT-15 NC-63418 crashed in residential area of Pasadena, Calif. on 28 April 1950. Civil Aeronautics Board Accident Investigation Report No. 4-1993, Released: 3 December 1950.

Circumstances

At approximately 1405 the aircraft took off with two occupants from East Los Angeles Airport en route for Oroville. A flight plan was filed indicating that the pilot would proceed in accordance with VFR. At 1417 the

aircraft was observed spinning just below a 2,500 ft. overcast. The aircraft completed two turns of a spin, but at about 400 ft. from the ground recovered to enter a steep climb, however, the aircraft again stalled and control was lost for a second time and the aircraft crashed into a house on a hill at an elevation of about 1,100 ft. Both occupants were killed. The weather at the time of the accident was variable ceiling 2,500 ft. and visibility of 5 miles, with the mountain in the direction of the intended flight covered by cloud. It was not established whether the pilot obtained a weather report before taking off.

The aircraft was fitted with flight instruments which included a directional gyro and artificial horizon. The pilot had approximately 300 flying hours but there was no indication that he had ever flown solely by instruments, or that he had received any instrument training whatsoever.

Probable Cause

The probable cause of this accident was loss of control of the aircraft by the pilot while flying into an overcast.

ICAO REF: AR/106

UNITED STATES

Northwest Airlines, Inc. Flight 307 Martin 202 N-93050 crashed approximately 4 miles west of Minneapolis, Minn. on 7 March 1950. Civil Aeronautics Board Accident Investigation Report No. 1-0031 Released: 14 December 1950.

Circumstances

On 7 March 1950, the aircraft with 13 occupants began its flight Washington - Winnipeg. Scheduled stops were Detroit, Mich., Madison, Wis., Rochester, Minn. and Minneapolis, Minn. At Detroit the flight was held up an hour and a half for the replacement of a ring seal in the hydraulic system.

At 2023 the aircraft reached Rochester but due to light freezing rain did not attempt a landing. At 2035 a report was received from over Stanton, a radio beacon 30 miles south of Minneapolis airport, and at 2041 the control tower was contacted for landing clearance.

The flight was informed of existing weather conditions, precipitation ceiling at 900 feet, visibility 1/2 to 3/4 mile, wind north 27 mph with gusts up to 40 mph. As the aircraft reported over the outer marker 4.7 miles south of the approach end of the runway the visibility was 1/2 mile and the flight was given clearance to land. The aircraft was not seen from the tower but was heard passing over the control tower at which time the following message was received - "I have got to get in". Clearance was again given, whereupon the flight advised that it would climb to 2,400 feet on the northwest course of the Minneapolis radio range. After a pause a second message was received - "We are going in, we are going in". After flying over the field the aircraft was observed flying straight and level 3.8 miles north-west of the aerodrome. A wing was seen to fall away and then the whole aircraft dived almost vertically from about 300 feet into a house. All occupants of the aircraft and two in the house were killed.

The main wreckage was situated 4-3/8 miles north-east of the airport whilst the left wing outboard from station 252 was located 3.8 miles north-east of the airport. The wing showed that, after being cut or torn through the forward section, it had rotated upward and rearward and, as a result of this twisting action, separated from the remainder of the wing. A tapered steel flagpole located 4,180 feet south of the approach end of the runway and 650 feet west of the centre line of that runway and extending to a height of 70 feet above ground was damaged and bent in an azimuth of 17 degrees.

A large ornamental American eagle which had been mounted on the top was found 20 feet south of the pole's base while the red neon marking lights were found 40 feet to the north. It was apparent that the aircraft had struck the pole during the attempted approach.

It was established that when the aircraft struck the pole it was 128 feet below the ILS glide path, 650 feet west of the centre line of the runway and flying a course 17 degrees to the right of the runway heading.

As far as could be determined, there was no defect in the operation of the ILS equipment, or in any of the other landing facilities on or near the airport at the time of the accident. Furthermore, no defects are known to have existed in any of the aircraft flight instruments or related equipment.

It was established that the pilot was particularly expert in landing the Martin 202 and in the execution of ILS approaches. (He had made over 200 ILS approaches to the Twin Cities Airport.) It was therefore assumed that the pilot attempted to complete his landing visually and did not use the ILS, otherwise he would have been warned of his position by the ILS indicators. It was concluded that falling snow restricted visibility thereby obstructing the neon obstruction lighting on the pole. It was probable that the propeller blast of an aircraft which took off just previously raised both the height and density of the snow condition.

Probable Cause

The probable cause of this accident was the attempt to complete a landing approach by visual means during which time visual reference to the ground was lost.

ICAO REF: AR/107

UNITED STATES

Private Aircraft Cessna 140 N-2923N and Piper PA-11 N-4545M collided near Miami, Fla. on 22 January 1950. Civil Aeronautics Board Accident Investigation Report File No. 3-0006. Released: 18 October 1950.

Circumstances

The Cessna, carrying two persons, left Jacksonville, Fla. on 22 January on its way to Miami. An intermediate stop was made at Melbourne for refuelling. At approximately 1540 hours the Cessna reached Sunny South Airport and was informed that a right-hand traffic pattern existed when the surface wind was in an easterly direction.

At approximately 1530 the Piper took off in an easterly direction with the pilot and one student pilot on board, for the purpose of a final check ride before the latter took his flight examination.

Between 1540 and 1545 both aircraft followed the correct traffic pattern but on converging courses. The Piper was observed making a right turn prior to the final approach leg while the Cessna was making a straight in approach from a westerly direction. The collision occurred at an approximate height of 200 ft. One occupant of the Piper survived.

Probable Cause

The probable cause of this accident was, primarily, the failure of the Cessna pilot to observe and avoid another aircraft while making a landing approach; and, to a lesser degree, the failure of the instructor pilot in the Piper to remain vigilant at all times for other aircraft in the air even though he had the right of way.

ICAO REF: AR/110

UNITED STATES

Northwest Airlines, Inc. C-54A-DC. N-95425 crashed into Lake Michigan on 23 June 1950. CAB Accident Investigation Report No. 1-0081. Released: 18 January 1950.

Circumstances

At approximately 1931 hours the aircraft left New York en route for Seattle via Minneapolis and Spokane. On board were 58 passengers, a crew of three, weight being less than the maximum permissible take-off weight and properly distributed.

The flight plan specified a cruising altitude of 6,000 ft. to Minneapolis although a request had been made for one of 4,000 ft. owing to forecast of thunderstorms, however, ARTC refused this because of other traffic at this level. At 2149 when over Cleveland the aircraft again requested a cruising altitude of 4,000 ft. which was this time approved.

At 2229 the flight was requested by ARTC to descend to 3,500 ft. because of the difficulty of an eastbound flight to maintain its assigned altitude due to severe turbulence. At 2251 a report was received to the effect that the flight was over Battle Creek at 3,500 ft. and would be over Milwaukee at 2337. At 2313 the flight when near Benton Harbour made a request for permission to descend to 2500 ft. This was refused by ARTC because of other traffic in the vicinity and acknowledgment of the latter message was made by the aircraft at 2315 which was the last communication received.

At 2337 the Milwaukee Radio advised New York and Chicago that the flight was 10 minutes overdue. At approximately 2345 all the CAA radio stations tried to contact the flight on all frequencies. At 2358 all air-sea rescue facilities in the area were alerted. After an extensive search, an oil slick, aircraft debris and the aircraft log book were found approximately 18 miles north north-west of Benton Harbour.

At the approximate time of the accident a line squall with widespread thunderstorm activity extended from southern Wisconsin eastward into lower Michigan with its southern edge located west of Benton Harbour. Later evidence indicated that the squall line was quite severe.

Impact damage found in fragments of the aircraft that were recovered showed that the aeroplane struck the water with considerable force.

No definite conclusions were drawn from the evidence available. A possibility that the accident resulted from mechanical failure was remote. The evidence however indicates that the accident probably resulted from either a structural failure caused by turbulence or because control of the aeroplane was lost.

ICAO REF: AR/113

UNITED STATES

Regina Cargo Airlines Inc. C-46F, N-9406H, crashed about a half mile from Teterboro, New Jersey Airport on 27 May, 1950. CAB Accident Investigation Report No. 1-0078. Released: 10 April 1951.

Circumstances

The flight, carrying two crew and a miscellaneous cargo, originated at Teterboro, New Jersey. At 1727 the aircraft was cleared to runway 19. Take-off was estimated as longer than usual and several witnesses saw puffs of black smoke coming from the port engine immediately after take-off. At an altitude estimated as 200-300 feet the left engine started to misfire. This condition became worse and the left propeller was feathered. At 400-500 feet a left turn was started as if to return to the airport during which the air-speed fell to 85-90 mph and the aircraft settled in a stalled condition striking the ground laterally and longitudinally level. The aircraft was completely wrecked and the captain killed.

Inspection of the engines disclosed that the port engine ignition showed abnormalities; six spark plugs were defective, five plugs exceeded the specified limits when tested for gas leakage. The electrode gaps of the 32 plugs tested varied from 0.014 inches to 0.023 inches (normal 0.012 inches). The breaker points of both magnetos were burned and oily. Both of these magnetos were improperly timed. The starboard engine also had a number of ignition abnormalities but to a lesser degree than the port engine. The company which had three aircraft employed two mechanics who also assisted in loading the aircraft. Records showed that the aircraft had flown 92 hours 55 minutes since the last 80-hour inspection and was therefore overdue for its next 80-hour inspection. No cargo manifest was prepared and subsequent investigation showed that the aircraft was 5,000 lbs. overloaded.

The report points out the careless manner in which the company conducted its operations and states that both the company and the pilot, as commander of the aircraft, are to be severely censured for permitting the flight to depart in its overloaded condition, without a flight manifest and with the 80-hour inspection overdue.

The Board determined that the probable cause of the accident was overloading of the aircraft due to faulty loading and dispatch procedures, coupled with engine malfunctioning due to inadequate maintenance.

ICAO REF: AR/114

UNITED STATES

New Tribes Mission Douglas DC3, M-16030 crashed and burned on the Serrania de Valledupar Range, Colombia, South America on 9 June 1950. CAB Accident Investigation Report File No. 4-1673. Released: 9 April 1951.

Circumstances

The aircraft was on a flight from Miami, Florida, to Maracaibo, Venezuela via Kingston, Jamaica, carrying a crew of three, twelve passengers and cargo. The flight departed Kingston on an instrument flight plan of four hours, to cruise at 9,000 feet direct to Maracaibo with Barranquilla, Colombia, as an alternate.

The flight progressed satisfactorily and radio contacts were made at 1558, 1658 and 1752 hours. At 1802 Balboa, Canal Zone, sent a message to the flight advising it that the Maracaibo radio was already closed on FA (air to ground) and closing shortly on FX (point to point). It was therefore suggested that Balboa be contacted when the flight landed at Maracaibo in order to close the flight plan. At 1852 the flight advised Balboa that it was "over the coast line at 5,000 feet and descending VFR". This was the last message received from the aircraft which never reached Maracaibo.

The owners became concerned when they had no news of their aircraft and on June 14 a communications search was instituted when it was revealed that the flight plan had never been closed and the aircraft was unreported since its last message quoted above.

The report continues that on June 18, since it was apparent that the aircraft was missing, search procedure was initiated. The search was unsuccessful and was called off on 28 June. The New Tribes Mission, however,

continued the air search using a Stinson aircraft and on July 6 spotted the wrecked aircraft near the top of a mountain at an elevation of 4,400 feet, approximately 42 miles west of the direct Kingston-Maracaibo course.

A reconstruction of the probable course followed by the aircraft showed that, had the aircraft followed a direct course from Kingston to Maracaibo, it would have intersected the Colombian coast line near the village of Tucuracas, approximately 95 miles northwest of Maracaibo, from which position on to its destination no point of the terrain exceeds 1,000 feet elevation. However, it appears likely that the flight intersected the coast line near the village of Rio Hacha instead, which is approximately 30 miles west of Tucuracas. To have continued the southerly heading from this position would have brought the aircraft to the point where the wreckage was found. The last message from the aircraft indicated that they did not know they were off course and descent was therefore begun. It was established that darkness had fallen at the time the aircraft is estimated to have crashed.

The Board found that there was not sufficient evidence upon which to make a determination of the probable cause.

ICAO REF: AR/117

UNITED STATES

Northwest Airlines Inc., Martin 202, N-93051, crashed on take-off from Billings Airport, Montana, on 4 September 1950. CAB Accident Investigation Report No. 1-0094. Released: 28 February 1951.

Circumstances

The aircraft had completed the first half of the flight from Minneapolis, Minn. to Seattle, Wash. and was taking off from Billings, Mont. for the rest of the journey to Seattle. The aircraft was loaded properly and well within its allowable limit. There were 16 passengers and a crew of 3.

The pilot parked the aircraft to the southwest end of runway 4 and completed his pre-take-off check. Having been cleared for take-off by the tower, the pilot advanced the throttles, but before the aircraft had rolled far, blue smoke was noticed between the rudder pedals on the left side of the cockpit. When about one-third of the way down the runway (length of runway is 6,000 feet) and at a speed of approximately 80 mph, a large puff of blue smoke, accompanied by a sharp smell of burning, filled the cockpit. Throttles were retarded and brakes applied immediately with only slight deceleration resulting. The runway has a downhill gradient of 1.9% at the approach end which increases to 3.119% at the north-east end so that the aircraft was increasing speed even though take-off had been discontinued. The pilot then applied full reverse thrust and instructed the co-pilot to steer the aircraft by the nose wheel control. However, the nose wheel steering control, as were the brakes, was totally ineffective. At this time the hydraulic pressure in the main and emergency systems was noted at zero. The aircraft left the paved area and ran over the hard, dry ground. The application of reverse thrust slowed the aircraft to 15 mph but, after that, the reverse thrust appeared to be ineffective. The aircraft struck a cement culvert and a light standard causing the right main landing gear to fail and permit the right wing to touch ground swinging the aircraft to a stop. The passengers and crew escaped through the forward cargo door and emergency exits. The main cabin door and ramp could not be lowered since the tail section where the ramp is located was resting on the ground.

No evidence of braking action was found in the examination of the tire tread marks, either on the runway or dirt surface, nor was evidence of fire found in the aircraft. However, considerable hydraulic fluid was found in the nose wheel compartment and this was traced to a separation of the tubing from the reducer fitting in the hydraulic line from the emergency accumulator to the emergency pressure gauge in the cockpit.

In the Martin 202 the emergency accumulator is charged from the same line which supplies the main accumulator. The two accumulators are separated by a check valve which prevents the fluid from returning from the emergency system. The fitting which failed in this case was located in the line between the emergency accumulator and the emergency power brake valve. When the failure occurred fluid from the main accumulator flowed through the check valve into the emergency accumulator and from there out of the open line where the fitting was located. As a result, all pressure was lost from both accumulators, and neither the brakes nor the hydraulic nose-wheel steering mechanism could be actuated.

Northwest's Maintenance Manual includes detailed instructions for the installation of the type fitting involved, the trade name of which is "Ermeto".

Briefly, these instructions provide for tightening of the parts so as to collapse a metal sleeve around the end of the tube or line to be joined. When the work is properly done the sleeve actually cuts into the tubing and, in effect, becomes a part of it. Instructions then require that the fitting be disassembled so as to determine whether or not the sleeve has cut into the tubing. Examination of the failed fitting in this case showed that the sleeve had not cut into the tubing. As a result, the necessary holding power of the fitting was never obtained when it was installed.

In October of 1949, Northwest Airlines experienced a similar failure. In this case an "Ermeto" fitting, located at the same position as the one which failed at Billings, separated while the aircraft was in flight from Minneapolis to Chicago. The result was the same. All hydraulic pressure was lost from both the main and the emergency accumulators. This incident, which occurred almost one year before the Billings' accident, demonstrated that one single failure could result in the loss of both the main and emergency brake systems.*

Following the Chicago incident, the Administrator, Region I, notified the Glenn L. Martin Company of this condition in the model 202 hydraulic system. To correct the defect the manufacturer, on 21 February 1950, issued Service Bulletin No. 105. This bulletin described the installation of a hydraulic "fuse" in the line between the main and the emergency accumulators. The fuse was, in effect, a spring-loaded valve designed to prevent a substantial flow of fluid from the main accumulator to the emergency accumulator.

Service Bulletin 105 was considered to be satisfactory by the Civil Aeronautics Administration; however, Northwest Airlines did not believe that the fuse gave complete protection since it required a substantial flow of fluid to actuate the fuse and consequently did not protect against small leakage in the system. According to tests of the fuse made by Northwest Airlines, a quarter of a gallon per minute could pass through it without causing it to close. The company, in turn, suggested that a manual shut-off valve be installed to separate the two systems.

---

* Section 4b.337 of the Civil Air Regulations provides: "...(2) The brake system shall be so designed and constructed that in the event of a single failure in any connection or transmitting element in the brake system (excluding the operating pedal or handle), or the loss of any single source of hydraulic or other brake operating energy supply, it shall be possible to bring the airplane to rest under conditions specified in 4b.122..."

The modification incorporating the shut-off valve was to be the subject of Martin's Service Bulletin 107. This bulletin was never issued for the reason that the substantiating test data required by the Administrator was not furnished by the manufacturer and the Administrator did not issue an airworthiness directive requiring northwest to install the fuse described in Service Bulletin 105.

Tests were made by the Glenn L. Martin Company to determine the effectiveness of reverse thrust in stopping the aircraft. The tests showed that on a level runway and with calm wind conditions, the aircraft could be brought to a complete stop from a rolling speed of 80 miles per hour in 1,750 feet if the throttles were placed in the first detent of the reverse thrust throttle quadrant. This would be using approximately 750 brake horsepower per engine. Tests conducted by the Martin Company further showed that at high speeds reverse thrust was as effective as wheel brakes in reducing the speed of an aircraft, but that at low speeds wheel brakes were much more effective.

Tests were also conducted by Northwest Airlines at the time the reverse thrust feature was added to the 202's. It was found that the airplanes could be brought to a full stop without brakes by use of reverse thrust. These tests were conducted on a level runway at the Minneapolis and St.Paul airports.

Analysis

It is apparent from the facts described above that this accident occurred as a result of an improperly installed "Ermeto" fitting. Because the fitting was not properly installed, it separated; and the separation permitted all pressure in the main and the emergency hydraulic systems to escape. Without hydraulic pressure, the aircraft could not be stopped by brakes, nor could it be steered. The only means of control that remained was reverse thrust.

Reverse thrust served as a secondary safety device, though the aircraft was not completely stopped until it struck the cement culvert and the light standard. By this means the crew was able to decelerate the aircraft from 80 to approximately 15 miles per hour, and they might have stopped it completely if it had not been for the downhill gradient of the runway. A more positive determination in this respect is not possible, since the available test information, referred to above, does not take into account such variables as runway gradient and aircraft weight.

Underlying the immediate cause of this accident, the separation of the hydraulic fitting, is the fact that this accident should not have occurred if the requirement of Section 4b.337 of the Civil Air Regulations had been satisfied. As previously stated, this regulation provides in effect that a brake system be designed so that the aircraft can be stopped even though there is a single failure, such as occurred in this case. Compliance with this regulation was required before the Martin 202 was certificated. After the similar failure on the flight to Chicago, which was almost a year before this accident, the government, the manufacturer, and the operator were fully aware that the design of the Martin 202 hydraulic system did not satisfy the regulation inasmuch as the separation of the fitting that occurred on that flight resulted in a loss of pressure in both the main and emergency hydraulic systems the same as it did at the time of this accident. Accordingly, it is concluded that the failure of the manufacturer to comply with Section 4b.337, the failure of the government to require compliance at the time of certification, and the lack of positive corrective action required by the government, all were contributing factors.

One month after this accident occurred, the Administrator of Civil Aeronautics required by an airworthiness directive that the hydraulic fuses be installed as described in the Glenn L. Martin Service Bulletin 105.

Findings

The Board found that:

1) The carrier and the crew were properly certificated.

2) The aircraft was not properly certificated in that Section 4b.337 of the Civil Air Regulations was not complied with.

3) An "Ermeto" reducer fitting in the hydraulic line between the emergency accumulator and the emergency accumulator gauge was not properly installed, and, as a result, it separated. This separation resulted in the loss of pressure in both the main and emergency hydraulic systems.

4) Although a similar failure occurred one year prior to the time of this accident, no positive corrective action was taken by either the government, the manufacturer or the operator.

5) Reverse thrust was a substantial safety factor in this accident in that it permitted the deceleration of the aircraft from 80 to 15 miles per hour.

Probable Cause

The probable cause of this accident was the failure of an "Ermeto" hydraulic fitting due to improper installation.

ICAO REF: AR/118

UNITED STATES

Moritz Flying Service, Aeronca Types 7AC (N-2427E) and ISAC (N-1086H), mid-air collision 8 miles NW of Sharon Springs, Kans., on 30 April 1950. CAB Accident Investigation Report No. 3-0251. Released: 18 January 1951.

Circumstances

Aircraft N-2427E was being used to practice "S" turns at 500 feet within the local practice area of Sharon Springs Airport. Aircraft N-1086H was apparently being used for pleasure.

Approximately 25 minutes after take-off both aircraft were about 8 miles NW of Sharon Airport (within the local practice area). Aircraft N-1086H performed a series of steep dives and climbs at low altitude, thereafter continuing eastwards straight and level. During the same period aircraft N-2427E executed "S" turns at 500 feet, also progressing eastwards. Immediately before the collision aircraft N-1086H seemed to be slightly below, ahead and to the right of aircraft N-2427E. Both aircraft turned left but as N-1086H turned at a considerably steeper angle than N-2427E, both aircraft collided.

Investigation

The investigation did not disclose any evidence of mechanical malfunctioning or structural failure, nor did it indicate that either of the aircraft was in an airworthy condition. Testimony was received that both windshields were clean and clear. At the time of the accident visibility and ceiling were unlimited.

Probable Cause

The cause of this accident was the failure of the pilot in aircraft N-1086H to properly clear his position before starting a steep left turn.

ICAO REF: AR/120

UNITED STATES

Northwest Airlines Inc., Martin 202, NC93037, crashed at Almelund, Minnesota, on 13 October 1950. CAB Accident Investigation Report No. 1-0119. Released: 23 April 1951.

Circumstances

The aircraft departed from Minneapolis - St. Paul International Airport in clear weather and unlimited visibility for purposes of a Pilot Six Months Instrument Competency Check. The aircraft was properly loaded well within its allowable limit and there were six occupants. The pilot was presumed to be flying the aircraft under the hood.

Following take-off two simulated ILS approaches to the airport were made, after which the control tower was notified by radio (last known contact) that this phase of the check flight was completed. Thereafter, 43 miles NW of Minneapolis, the aircraft was observed to execute a steep turn with landing gear down at an estimated altitude of 4/5,000 feet and then start a shallow climb. Throughout these manoeuvres the engines sounded normal.

A few moments later when next observed the aircraft was in a partially inverted position, starting a steep dive. After losing 2,500 feet, an apparently normal recovery was made to a level flight attitude, and the aircraft proceeded NE. Shortly afterwards the aircraft was seen to make two or three pitching oscillations about its lateral axis. During each oscillation approximately 400 feet was lost and a noise, usually associated with a surge of engine power, was heard.

Two miles south of Almelund, Minnesota, the aircraft was seen to make a shallow right turn of approximately 270° and return to a level attitude heading NW. Throughout the above-mentioned manoeuvres the aircraft was gradually losing altitude and, towards the latter part of the flight, the right propeller was observed to be turning slowly. Near Almelund, at an altitude of approximately 500/600 feet, a steep right turn was commenced. Altitude was lost rapidly and, after turning approximately 90°, the aircraft's right wing struck the ground. The six occupants were killed and the aircraft was demolished.

Investigation

Investigation did not reveal any evidence of structural failure of the aircraft prior to impact and there was no indication of fire either before or after the crash occurred. A teardown examination of the right engine failed to reveal any indication of structural failure, however, there were indications that at some time the engine had oversped. A functional test was made of the fuel feed valve, using a standard flow bench, and when the normal pressure of 10 PSI (pounds per square inch) was applied, the valve failed to maintain pressure, indicating that the valve was being held off its seat. On disassembly a small piece of phenolic resin of sufficient size to have caused the valve to stick open, if it had lodged in the seat or any other vital place in the valve mechanism, was found near the valve seat (phenolic resin had been used to coat the valve at the time of manufacture*). Failure of this valve would cause an unbalanced pressure condition in the carburetor, ultimately resulting in fuel starvation to the engine thus causing complete engine failure. It was determined that the crankshaft of the right engine was rotating in the proper direction at the time of impact and that little, if any, power was being developed.

Examination of No. 1 blade of the right propeller revealed that the blades of this propeller were 7° to 10° in reverse pitch at the time of impact. In addition, examination of the propeller dome disclosed that the stop levers were in the retracted position and that the piston sleeve had moved outboard over the levers to an extent corresponding to the reverse blade angle.

---

* A service bulletin was issued by the engine manufacturer on 17 February 1950 which advised all owners of this model engine that the phenolic coating on the fuel feed valve could be discontinued at overhaul. It further stated that any peeling of the phenolic coating on the valve due to poor bonding or deterioration could affect fuel valve and fuel slinger operation.

The cover plate of the right propellor governor solenoid valve, found damaged (depressed inwards 0.072 inches), was examined. Tests revealed that the damaged cover plate held the solenoid valve in a partially energized position and that under actual operating conditions the effect of such a damaged cover plate on the solenoid valve would be to move the blades of its propeller into the reverse pitch range after the engine had been running for a few moments. Other tests indicated however that the cover plate could not have been damaged prior to take-off without the crew being aware of an unusual propeller action. Examination of the engine and its nacelle failed to reveal any evidence that the engine, nacelle or solenoid valve had been struck by any object while in flight.

To determine what might have caused the right propeller to be in reverse pitch at the time of impact, a study was made of all possible conditions which would permit this to occur. It was found that several situations might have occurred such as:

a) the pilot, while being checked, intentionally placed the propeller in reverse thrust by means of manual manipulation of the controls. This possibility was discarded since the pilots were highly skilled and since such a manoeuvre would not be a part of a pilot's competency check because of the danger involved.

b) the observer sitting on the jump seat with an unfastened or loosely fastened safety belt, being thrown forward, as a result of any violent manoeuvre or unusual attitude of the aircraft, against the pilot's control pedestal on which are located pertinent propeller controls. It was determined that the observer's safety belt was buckled at the time of impact and the left side attach fitting was broken.

Particular emphasis was placed on studies relative to inadvertent or unwanted reversing as a result of electrical malfunctioning in flight under normal governing conditions, as well as when attempting to feather or unfeather. It was found that several situations might occur which would cause the propeller to reverse as a result of such malfunctioning, however the propeller electrical system was so extensively damaged at impact that it was not possible to determine if any of the envisaged possibilities occurred.

Note.- As part of the investigation it was learned that during a manufacturer's test flight of a Martin 202 a propeller was inadvertently reversed in flight. Study of this flight revealed that an aluminum propeller was on the right engine and a hollow steel propeller on the left. The aluminum propeller not being equipped with a reversing mechanism, a jumper wire was installed to ground in the junction box, thereby permitting the propeller to be unfeathered once it was feathered. In error a similar installation was

made to the circuit of the steel propeller which was equipped with reversing mechanism. At altitude 3,500 feet, airspeed 130 mph the pilot attempted to unfeather the left propeller by advancing mixture control and holding the feathering button in the unfeathered position until the propeller reached approximately 500 RPM. The engine, however, did not start, therefore the pilot momentarily held the feathering button out. The propeller surged slightly in RPM and apparently went a few degrees in reverse thrust, thereafter windmilling backwards slowly. The pilot, not certain that the propellor was rotating backwards, immediately pushed the feathering button to feather position without result. As a consequence of the windmilling propeller, power could not be increased and as drag became heavier it was necessary to dive the aircraft to maintain control. Altitude thus lost could not be regained. By using $12\frac{1}{2}^{o}$ flaps and METO (maximum except take-off) the pilot managed to maintain 1,500 feet and 120 mph airspeed, however, there was considerable rudder buffeting throughout this portion of the flight, therefore the pilot, considering that control of the aircraft was marginal, made an immediate forced landing.

Another propeller reversal occurrence on a similar Martin 202 was disclosed as a part of the investigation. In this instance the reversal occurred when the aircraft was on the ground and the pilot was performing the pre-flight check prior to take-off. Analysis revealed that the cause had been an intermittent electrical short in the junction box.

Findings

1. The carrier, crew and aircraft were properly certificated.

2. The fuel feed valve of the right engine malfunctioned when tested.

3. The right propeller was found in 7^{o} to 10^{o} of reverse thrust.

4. A review of the evidence of a similar occurrence indicated that with a propeller in the reverse thrust position the aircraft would assume dangerous flight characteristics.

5. The fact that the aircraft's wing flaps were retracted may have contributed to the uncontrollability of the aircraft at speeds below 140 mph.

Probable Cause

The probable cause of this accident was the unwanted reversal of the right propeller during flight, as a result of which the crew was unable to maintain control of the aircraft.

ICAO REF: AR/133

UNITED STATES

Pan American World Airways, Inc., Boeing 377 Stratocruiser Aircraft, N-1036V. Landing gear retracted during landing at Heathrow Airport, London, England, on 3 January 1951. CAB Accident Investigation Report No. 1-0002. Released: 10 May 1951.

Circumstances

Aircraft N-1036V arrived in the London Area on 2 January and was diverted to Hurn, due to the London weather being below the minima. A landing at Hurn was made at 0923 hours, and at 1100 hours the weather at London being still below minima, the decision was taken to send the passengers on to London by train, and to ferry the aircraft to Heathrow Airport the next morning to cover the return flight to the United States.

At 0803 hours on 3 January, the aircraft with nine crew departed Hurn for London. The take-off weight of about 103,576 pounds was approximately 42,000 less than the maximum permissible and the load was so distributed that the centre-of-gravity was within the certified limits.

At 0900 hours London weather was given as "high scattered, visibility 3,300 yards, wind 300/08, temperature 32.2". The flight plan carried this notation "runway braking conditions good at run-up or touchdown, to fair further down runway due to slush", which referred to the conditions at London where portions of runways were covered with three to four inches of snow and slush.

At 0850 hours a normal landing was commenced on runway 28, during the landing roll, however, the right main landing gear retracted permitting the plane to settle down on the No. 3 and No. 4 engine nacelles and the right wing. In this position it skidded to a stop, partly off the runway after turning approximately 110° to the right. There was no violent deceleration and only a slight change of direction down the runway. The crew of nine uninjured.

Investigation

Major damage to the aircraft was confined to the right wing tip, aileron and flap and to the propellers and nacelles of No. 3 and No. 4 engines. The runway along the portion over which the aircraft traveled was covered with slush which made it extremely difficult to establish the exact point of touchdown.

Due to the known condition of the runways it had been previously decided to use 30° flap on landing to prevent, insofar as possible, damage to the flaps, by snow and ice being thrown against them during the landing roll.

A smooth landing was made, initial touchdown being approximately 1,400 feet past the approach end of the runway. The nose wheel became grounded almost immediately and No. 2 and No. 3 propellers were reversed. After unreversing and noting the slush was getting deeper, it was decided to raise the flaps. Instead of actuating the flap switch, however, the captain mistakenly moved the landing gear switch to the "up" position.* Although it was immediately returned to the "down" position the landing gear warning horn sounded and shortly thereafter the right wing began to drop.

There is no testimony or evidence to indicate that the brakes were at any time effectively applied.

---

* The gear operating switch is located on the control pedestal approximately 24 inches forward of the flap switch. It is further protected against inadvertent movement by a hinged guard which must be raised before the switch toggle can be operated.

Examination of the right main landing gear and all its components was made, followed by operational and functional tests. No mechanical or electrical failure of the gear or gear control system was found and all tests indicated normal operation.

Each landing gear oleo strut is equipped with two micro-switches which are actuated when the landing gear wheel is grounded firmly enough to compress the strut approximately one-half inch of its travel. These switches are part of two entirely separate safety systems, the purpose of one being to prevent the throttles being moved into the reverse thrust position before the aircraft is grounded, and the purpose of the other to prevent an extended landing gear from being retracted after it is firmly grounded even though the landing gear control switch is placed in the gear "up" position.

However, it is not necessary that all three landing gear units be firmly on the ground before the throttles can be manually moved into the reverse thrust position. This can be accomplished as soon as any one of the landing gear units is supporting sufficient weight to actuate the appropriate micro-switch. However, if the landing gear control switch is placed in the gear "up" position during landing roll, any landing gear unit will unlock and retract if there is not sufficient weight maintained to hold the micro-switch in its actuated position.

The micro-switch concerned was removed, examined, and functional tests were made which found that all parts were in excellent working condition.

Probable Cause

The probable cause of the accident was the captain's action in mistakenly placing the landing gear control switch in the "up" position during landing roll.

THIS PAGE INTENTIONALLY LEFT BLANK

PART II

List of Laws and Regulations of the Contracting States containing provisions relating to "Aircraft Accident Investigation".

AUSTRALIA

1947	Aug. 6	Air Navigation Regulations, 1947, S.R. No. 112 - Part XVI. (Regulations made under the Air Navigation Act 1920-1947.)

BOLIVIA

1949	junio 18	Procedimiento para el informe de accidentes (Boletín Oficial)(Núm. 2 - Sec. OP-100).
1950	marzo	Reglas Generales de Operaciones (Provisional): Accidentes de Aeronaves (02.46-02.52).

CANADA

1948	May 11	Air Regulations, Order in Council P.C. 2129, as amended to 1950.

CEYLON

1937	Nov. 1	Air Navigation (Investigation of Accidents) Regulations, 1937. Sec. 6 - Preliminary investigation of accidents. (Made under Sec. 12 of the U.K. Air Navigation Act, 1920, as modified and extended to Ceylon by the Colonial Air Navigation (Application of Acts) Order, 1937.)
1950	March 29	Air Navigation Act, No. 15/1950 Part I. Air Navigation; Sec. 12. Power to provide for investigation into accidents.

CHINA

1946		Regulations covering accident investigation of civil aircraft.

COLOMBIA

1936	Dec. 18	Law No. 196: Accidents and insurance of technical personnel of civil aviation.
1948	March	Manual of Regulations - Part IV, Sec. I, 40.13.0: Accidents.

COSTA RICA

1949	Oct. 18	Ley de Aviación Civil - Parte I. Título Primero, Cap. 2, Sec. 8: Accidentes (Art. 45-47).

CZECHOSLOVAKIA

1947		Decree of Ministry of Interior on accident investigation (No. 1600/1947).

DENMARK

1920	Sept. 11	Air Navigation Regulations. Par. 22 - Notifications in case of certain aircraft accidents.

EGYPT

1939	January	Departmental Regulations issued by Civil Aviation Department including "Investigation of Accidents".

FRANCE

1937	Avril 28	Décret relatif à la déclaration des accidents d'aviation. (Bulletin de Renseignements CINA 780/3).

GREECE

1932	July 8	Decree relating to rules for prevention of air navigation accidents.

GUATEMALA

1949	marzo	Decreto Núm. 563: Ley de Aviación Civil. Capítulo X - De los siniestros aeronáuticos, (Art. 116-121).

HONDURAS

1950	marzo 14	Decreto Núm. 121: Ley de Aeronáutica: Cap. IV. Sec. Cuarta - Accidentes y Emergencias (Art. 70-88).

HONG KONG

Air Navigation Regulations of 1932.

INDIA

1934	Aug. 19	The Indian Aircraft Act, 1934, (corrected up to 1949) - Sec. 7: Powers of Governor General in Council to make rules for investigation of accidents.
1937	March 23	The Indian Aircraft Rules, 1937 (as corrected up to 1949 - Part X: Investigation of Accidents (Art. 68-77).

IRAQ

1939	August 6	Air Navigation Law No. 41/1939: Article 5 (h).

IRELAND

1928		The Air Navigation (Investigation of Accidents) Regulations No. 21.
1936		Air Navigation and Transport Act, No. 40. Part VII, Section 60: Investigation of Accidents. (This Act was amended in 1942 (No. 10) and 1946 (No. 23).)

IRELAND (Contd.)

1943		Air Navigation Regulations (Investigation of accidents) (Amendment - 1933 - No. 288 to Regulation No. 21 of 1928).

ITALY

1925	Jan. 11	Decree Law No. 356: Rules for Air Navigation - Chap. VII.
1942	April 21	Navigation Code, Second Part - Air Navigation. Book I, Title VIII - Investigation of Accidents (Art. 826-833).

LEBANON

1949	Jan. 11	Aviation Law: Chap. III. Flying., Sub. Chap. 2. Landing of aircraft (Art. 39).
1949	Dec. 27	Civil Aviation Law (replacing Book IV of Law concerning General Lines of Communications, Aerial Communications, 1940); Chap. XIV. Accidents, Search and Rescue (Art. 358-361).

MEXICO

1940		Law concerning General Lines of Communications, Book IV - Aeronautical Communications, Chap. IX (Art. 366-373).

NETHERLANDS

1936	Sept. 10	Act regulating the Investigation of Accidents to Civil Aircraft (Aeronautical Disasters Act S. 522 as amended on 31 December 1937, S. 527).
	Sept. 22	Order for the application of paras. 8 and 9 of Art. 1 and of par. 5 of Art. 32 of the Aeronautical Disasters Act (S. 579).
	Sept. 22	Order for the application of par. 2 of Art. 6 of the Aeronautical Disasters Act. (S. 579A).

NETHERLANDS (Contd.)

1937	Jan. 14	Decree of Ministry of Water Works regarding Art. VI of the Law of aviation accidents.
	Oct. 19	Decree of the Minister of Water Works regarding landing of civil aircraft outside the designated area, and accidents.

NEW ZEALAND

1933	July 1	Air Navigation Regulations, 1933, as amended to 1950. Arts. 35 to 44 - Investigation of accidents.
1948	Aug. 26	The Civil Aviation Act, 1948. Article 8 - Power to provide for investigation of accidents.

NORWAY

1923	Dec. 7	Civil Aeronautics Act, as amended up to March 11, 1949 - Chapter II, Par. 46.
		Royal Resolution - Regulations on aviation enacted by the Department of Defence, 15 October 1932 and 11 December 1936, in accordance with the Civil Aeronautics Act of 7 December 1923 and the Royal Resolution of 22 April 1932 as amended up to 1947. VIII - Aircraft Accidents.

PAKISTAN

1934	Aug. 19	The Indian Aircraft Act, 1934, No. XXII (as adopted by Pakistan and corrected to 1947) - Par. 7: Powers of Governor General in Council to make rules for investigation of accidents.
1937	March 23	The Indian Aircraft Rules, 1937 (as adopted by Pakistan and amended up to 1949) - Part X: Investigation of accidents.

PHILIPPINES

1936	Nov. 22	Commonwealth Act No. 168. Chapter IV - Powers and Duties of the Director (Sec. 6 (g)) Investigation of Accidents.
1946	May 9	Civil Aviation Regulations - Chapter XVI: Aircraft Accident Investigations.

PORTUGAL

1927	April 27	Decree No. 13:537 Air Navigation Regulations - Chapter VIII.

SWEDEN

1928	April 20	Royal Proclamation No. 85 regarding Application of the Decree of 26 May 1922 (No. 383) on Air Navigation (amended up to 1946). Par. 28 - is relating to Notification of aircraft accidents.

SWITZERLAND

1946	Nov. 22	Decree of Federal Council regulating the procedure to be followed in case of aircraft accidents.
1948	April 20	Air Navigation Law - First Part, Title I - Chap. II: Articles 22-26.
1950	June 5	Règlement d'exécution de la loi sur la navigation aérienne (entrée en vigueur le 15 juin 1950): XIV. Accidents d'aéronefs (Arts. 129-137).

TUNISIA

1930	June 1	Air Navigation (Accidents).

UNION OF SOUTH AFRICA

1923	May 21	Aviation Act No. 16 - Article 10: Investigation of Accidents.
1949	Dec. 30	The Air Navigation Regulations, 1950 (came into operation on the 1st day of January 1950 and cancel the Air Navigation Regulations, 1935 and subsequent amendments thereto): Chap. 29. Investigation of Accidents (Reg. 29.1 - 29.7).*

UNITED KINGDOM

1922		The Air Navigation (Investigation of Accidents) Regulations, 1922 (S.R. & O. No. 650). Amended by the Air Navigation (Investigation of Accidents) Regulations of 1925 (S.R. & O. No. 1099); 1930 (S.R. & O. No. 840) and 1935 (S.R. & O. No. 381).
1938		The Aircraft (Wreck and Salvage) Order No. 136.
1949		The Air Navigation Order, 1949, Article 68 - Application of accident regulations to aircraft belonging to or employed in the service of His Majesty.

* The Civil Aviation Act, 1949 (12 & 13 Geo. 6. Ch. 67), repeals the "Air Navigation Act, 1920." Part II, Section 12 of the 1920 Act is replaced by: Part II - Section 10 - Investigation of Accidents, Civil Aviation Act, 1949.

UNITED KINGDOM COLONIES

Section 12 of the Air Navigation Act, 1920 (as amended by the Air Navigation Act, 1935) applies to the under-mentioned Colonies by virtue of "The Colonial Air Navigation (Application of Acts) Order, 1937":*

Aden (Colony and Protectorate)
Bahamas
Barbados
Basutoland
Bechuanaland Protectorate
Bermuda
British Guiana
British Honduras
British Solomon Islands Protectorate
Cyprus
Falkland Islands and Dependencies
Fiji
Gambia (Colony and Protectorate
Gibraltar
Gilbert and Ellice Islands Colony
Gold Coast -
- a) Colony
- b) Ashanti
- c) Northern Territories
- d) Togoland under British Mandate.

Hong Kong
Jamaica (including Turks and Caicos Islands and the Cayman Islands)
Kenya (Colony and Protectorate)
Leeward Islands
- Antigua
- Montserrat
- St. Christopher and Nevis
- Virgin Islands.

Malta
Mauritius
Nigeria
- a) Colony
- b) Protectorate
- c) Cameroons under British Mandate

---

* The Civil Aviation Act, 1949 (12 & 13 Geo. 6. Ch. 67), the text of which has just been received, repeals the "Air Navigation Act, 1920." Part II, Section 12 of the 1920 Act is replaced by: Part II - Section 10 - Investigation of Accidents, Civil Aviation Act, 1949.

UNITED KINGDOM COLONIES (Contd.)

North Borneo
Northern Rhodesia
Nyasaland Protectorate
Palestine (excluding Trans-Jordan)
St. Helena and Ascension
Sarawak
Settlements of Penang and Malacca
Seychelles
Sierra Leone (Colony and Protectorate)
Singapore
Somaliland Protectorate
Swaziland
Tanganyika Territory
Trinidad and Tobago
Uganda Protectorate
Windward Islands
- Dominica
- Grenada
- St. Lucia
- St. Vincent

Zanzibar Protectorate.

BRITISH GUIANA

1938	March 15	Air Navigation (Investigation of Accidents) Regulations (S.R.O. 1939, No. 41).

GAMBIA

1937	Nov. 15	Air Navigation (Investigation of Accidents) Regulations, No. 17/1937.

GOLD COAST

1937	Feb. 17	Aircraft (Accident) Regulations, No. 5 of 1937.

KENYA

1928	June 22	Air Navigation (Accident) Regulations.

MALTA

1938	March 22	Air Navigation (Investigation of Accidents) Regulations. (G.N. 131/38).

NIGERIA

1936	Oct. 7	Aircraft (Accident) Regulations, No. 33/36.

NORTHERN RHODESIA

1932	Feb. 26	Air Navigation (Accidents) Regulations (G.N. 14/32).
1948		The Air Navigation (Accident) Regulations (G.N. 171/48).

SIERRA LEONE

1938	June 13	Aircraft (Accident) Rules (No. 17/1938).

TANGANYIKA

1933	June 30	Air Navigation (Investigation of Accidents) Regulations. (G.N. 91/33).

TRINIDAD

1940	Oct. 26	Air Navigation (Investigation of Accidents) Regulations 1940 (revoking Air Navigation Regulations (Accidents), 1931) as amended on 16 August 1948, G. N. 139/48.
1948		Air Navigation (Investigation of Accidents) (Amendment) Regulations 1948 (G.N. No. 139/48).

ZANZIBAR

1937	Sept. 4	Investigation of Accidents Regulations (G.N. 41/37).

UNITED STATES OF AMERICA

1938		Civil Aeronautics Act - Title VII (Air Safety).
1947	Nov. 20	Civil Aeronautics Board: Organizational Regulations Part 302 - Description of Functions: Course and Method by which functions are channeled: Scope and contents of documents: Part 302.1.(b) (4); Part 302.2. Functions of Offices and Bureaux: (d) (2) The Accident Investigation Division (3) The Accident Analysis Division.
1949	May 1	Civil Air Regulations - Part 62. Notice and Reports of Aircraft Accidents and missing Aircraft.

THIS PAGE INTENTIONALLY LEFT BLANK

PART III

Miscellaneous Publications and Reports

ACCIDENT STATISTICS

AUSTRALIA

Statistical Analysis of Civil Aircraft Accidents and casualties 1948. Department of Civil Aviation.

Statistical Analysis of Civil Aircraft Accidents and casualties 1949. Department of Civil Aviation. Summary of accident and incident reports. March 1950-August 1950. Department of Civil Aviation.

Summary of Accident and Incident Reports Dec. 1949-Feb. 1950. Department of Civil Aviation.

CANADA

Annual Report on Aircraft Accidents 1950, Department of Transport, Air Service Branch, Civil Aviation Division, Ottawa.

SWEDEN

Statistics of Aircraft Accidents in Sweden 1950 and 1946-1950.

SWITZERLAND

Rapports et renseignements statistiques sur les accidents d'aéronefs, utilisés en service commercial, du 1er octobre 1947 au 31 mars 1949. Berne 1949.

UNITED KINGDOM

A survey of Accidents to Aircraft of the United Kingdom in the year ended 31st December 1949. Ministry of Civil Aviation 89. His Majesty's Stationery Office, London 1950.

UNITED STATES OF AMERICA

Resume of U.S. Air Carrier Accidents (Calendar Year 1949). Civil Aeronautics Board, Washington 25, D.C. Issued May 1950.

Non-Air Carrier Accident Trend Report (1st One Thousand 1950) Civil Aeronautics Board, Washington 25, D.C. Issued July 1950.

Non-Air Carrier Accident Trend Report (2nd One Thousand 1950). Civil Aeronautics Board, Washington 25, D.C. Issued September 1950.

Accidents in U.S. Scheduled Air Carrier Passenger Operations (Calendar Year 1949-1948). Civil Aeronautics Board, Washington 25, D.C. Issued July 1950.

Non-Air Carrier Accident Trend Report (3rd One Thousand 1950). Civil Aeronautics Board, Washington 25, D.C. Issued November 1950.

Comparative Safety Statistics in Operation of U.S. Scheduled Airlines (Calendar Year 1938-1949). Revised 22 June 1950. Civil Aeronautics Board, Washington 25, D.C.

Accidents in U.S. Scheduled Air Carrier Passenger Operations (1st and 2nd Quarters 1950 and 1949). Civil Aeronautics Board, Washington 25, D.C. Issued December 1950.

Accidents in U.S. Scheduled Air Carrier Passenger Operations (1st Three Quarters 1950 and 1949). Civil Aeronautics Board, Washington 25, D.C. Issued April 1951.

UNION OF SOUTH AFRICA

Aircraft Accident Review 1949. Department of Transport, Division of Civil Aviation.

RESEARCH

AUSTRALIA

Air Traffic Simulator by T.C. Newnham and Industrial Research Organization. Division of Radiophysics. RPR. 96. October 1949.

NEW ZEALAND

Installation and operation of V-G recorders in New Zealand Transport Aircraft and Analysis of twelve months recorded data from the Trans-Tasman route. Wellington, N.Z. 1950.

UNITED KINGDOM

The investigation of aircraft accidents involving airframe failure, by V.B.B. Owen and F. Grinsted. London 1949.

Experiments in Tail Flutter, edited by C. Scruton, London 1949.

UNITED STATES OF AMERICA

Technical Development Report No. 123 Airline Pilot Questionnaire Study on Cockpit Visibility Problem, by George L. Pigman and M. Edwards, Aircraft Division, Civil Aeronautics Administration, Technical Development and Evaluation Centre, Indianapolis, Indiana. September 1950.

Technical Development Report No. 134. An Investigation of the Crash-Fire problem in Transport Aircraft Fuel Tanks, by R.L. Field, Melvin F. Miller and George L. Pigman, Aircraft Division, Civil Aeronautics Administration, Technical Development and Evaluation Centre, Indianapolis, Indiana. January 1951.

Summary Report of Anti-Skid Braking. Boeing Airplane Co. Seattle Division, Washington.

Survey of Research Projects in the Field of Aviation Safety. Initial Report January 1951. The Danial and Florence Guggenhiem Aviation Safety Centre at Cornhill University.

ACCIDENT PREVENTION BULLETINS

UNITED STATES OF AMERICA

Accident Prevention Bulletins 1950 Series 18 - 28, 1951 Series 1 - 12 Distributed by the Flight Safety Foundation, 2 East 64th Street, New York 21, N.Y.

Special Aircraft Accident Bulletins 1950 Series 7 - , 1951 Series 1 and 2. Special Airport Fire Bulletin, 1950 Series 10 - 13.

Committee on Aviation and Airport Fire Protection, National Fire Protection Association, International 60, Batterymarch Street, Boston 10, Mass.

Safety Bulletin No. 185-51. Fuel Exhaustion in Flight; by Harold B. Carr. Civil Aeronautics Board, Bureau of Safety Investigation.

Aviation Safety Release No. 337. Pilot Static Systems. Civil Aeronautics Administration, Aviation Information Office, Washington, D.C.

"SOME BRITISH VIEWS ON FLIGHT SAFETY MEASURES"

The following paper was presented by Group Captain J. Veal, Director of Ops-Safety and Training, Ministry of Civil Aviation, United Kingdom, at the Third Annual Safety Seminar of the Flight Safety Foundation at Denver, Colorado on 30 October 1950.

INTRODUCTION

In this discussion I propose to limit myself to indicating briefly the manner in which follow-up action on aircraft accidents and measures for accident prevention in the United Kingdom have been developed and to mentioning a few of the items on which our attention is currently focussed. Before doing so, however, I would like to say how glad I am to have the opportunity of participating in this series of discussions arranged by the Flight Safety Foundation since I am convinced that an exchange of ideas and of experiences can make an invaluable contribution to the furtherance of our efforts to achieve safer air travel.

As you probably know, in the United Kingdom accidents are investigated by an Accidents Investigation Branch, of which the Chief Inspector of Accidents, Air Commodore Vernon Brown, is in charge. His responsibilities are exercised by virtue of a statutory authority so that he acts independently of the Ministry of Civil Aviation of which, administratively, the Accidents Investigation Branch is a part. The Chief Inspector, however, makes his report to the Minister.

Early after the war it became apparent that accident reports, when circulated, did not always achieve immediate correction of the situations conducive to accidents which were revealed. It was clear that there was a need for a co-ordinating section which would undertake a careful analysis of accident reports or of other matters relating to accidents which might come to attention, and, in the light of such an analysis, ensure that proper consequential action was taken. In the light of experience which has been gained from the treatment of accident matters in this way I believe that in the United Kingdom the fullest use is now being made of the experience which, however regrettable, is derived from aircraft accidents.

I should perhaps make it clear that this follow-up of accidents by the Administration is quite separate from the action taken by the Air Registration Board, the independence of which we feel it is most important to preserve. Equally, however, it is necessary to have a very close co-operation between the people responsible for follow-up action and the Accident Inspectors.

FOLLOW-UP ACTION

Our treatment of follow-up action breaks down into three phases. First there is the corrective phase. Under this the action which may arise is:

a) Criticism and correction of ground services arrangements.

b) Criticism and request for correction of operator's organization and techniques.

c) Re-qualification of personnel.

The question of airworthiness, as such, has so seldom arisen that I have not included this as an item requiring special consideration, but I believe it is necessary in almost every case to consider the standard and adequacy of equipment, since so easily is it possible otherwise to neglect the primary cause of crew failure.

Closely concerned with corrective action is the preventive effort which must arise from consideration of any accident. Here the main points which we consider are:

a) Regulatory action, whether operational or airworthiness.

b) Publicity for accident causes.

c) Improvement of standards, whether it be flight crews, ground services personnel, operational or airworthiness matters.

Our third category of action relates to accident survival. Although in the first flush of youth, we, like so many other people, felt that we ought not to accept that accidents will happen, we were forced inevitably to accept that they will and that we should make provision against them. Thus we have to consider in relation to accidents:

a) Improvement of crash worthiness.

b) Improvement of rescue facilities.

I feel it is most important there should be most careful consideration of all the details of individual accidents. A careful analytical approach will, in most cases, provide a clear indication of the form and extent of the corrective action which is necessary. It is equally important, however, that this consideration should be well balanced and that we should not rush into corrective action based on only weakly supported premises. I think that it is quite easy to remember a number of accidents in the past which have resulted in a demand for provision of specific aircraft equipment where, in fact, the true corrective action was far more fundamental.

This individual treatment of accidents in the United Kingdom is, in fact, partly forced upon us since the statistical approach offers little assistance due to the relatively small level of common operations and the diversity of aircraft types. This is particularly the case in non-scheduled operations and I doubt whether, unless the matter is put on an international basis, we shall derive any value whatsoever from the purely statistical approach. This does not mean, of course, that in the periodic survey of accidents which we conduct on an annual basis we do not attempt to group causes of accidents and endeavour to derive some indication of general corrective action from the list.

INCIDENTS AND DEFECTS

Investigation of accidents is, of course, only one source of information on which follow-up action in relation to accident prevention can be based, the other sources being incidents and defects. We define incidents as occurrences, which, but for fortuitous circumstances, would have resulted in an accident and we seriously considered, at one stage, the possibility of making the reporting of incidents mandatory. Closer examination of such a requirement, however, made it quite obvious that it was unenforceable and that the derivation of information on incidents by invitation to operators, pilots, etc. would be equally effective. Such a system now exists.

Aircraft and equipment defects are another matter and do not become directly my concern being reported, as appropriate, by the operators to manufacturers and to the Air Navigation Board for remedial action. As you are not familiar with the organization of the administration for civil aviation matters in the United Kingdom, I should perhaps say that the Air Registration Board is a

statutory authority independent of the Ministry of Civil Aviation with responsibility in regard to the design, construction and maintenance of civil aircraft. The Air Registration Board exercises these responsibilities by:

a) Prescribing the British Civil Airworthiness Requirements in respect of the design, construction and performance of aircraft, engines and ancillary equipment.

b) Recommending to the Ministry of Civil Aviation, based on these standards, the issue and renewal of Certificates of Airworthiness.

c) The approval and supervision of inspection systems.

AIR SAFETY BOARD

There is a second independent body which I might mention at this stage which is concerned with air safety and that is the Air Safety Board. This is a standing advisory body of technical experts appointed by the Minister with the function of undertaking the continuous review of matters concerning safety in British Civil Aviation both as regards the operation of British aircraft and the efficiency of the ground facilities provided in the United Kingdom for civil purposes. Its advice on a variety of problems in the past has influenced considerably the development of air safety policy.

ACCIDENT CAUSES

I think that one of the most difficult problems with which accident investigators are faced when considering most accidents is the extent to which the cause is attributable to an error of judgment on the part of the pilot. I know that this matter has caused considerable fluttering in the dove-cotes in many countries and, of course, the Flight Safety Foundation has recently been giving considerable attention to it in its bulletins. In the United Kingdom the British Air Line Pilots' Association has been by no means silent.

During the annual survey of notifiable accidents in 1949 in the United Kingdom the causes of which were determined, 55 percent had as their primary cause pilot error, and there is no doubt that if we are to make flying safer this must be the major line of attack. I know that, in many cases, there are other contributory causes arising from such things as design of equipment which makes it possible for a pilot to misinterpret some instrumental or other indication. Thus to reduce accidents we have got to see how we can make pilots less

prone to error. One line of attack, as evidenced by the contributory causes to which I have referred, is simplification of instrument presentation, proper grouping of instruments, standardization and prevention of fatigue.

On this point of prevention of fatigue, incidentally, I think there is no doubt that in the past some aeroplanes have been themselves inherently to blame for the fact that they crashed. It is no help to the preservation of a pilot's efficiency to be deluged with water through inadequate window sealing, struck by draughts from every angle, having his brain beaten into a senseless state by a comic cacophony of engine, aerodynamic and radio interference noises and given a vibro message through his hands, his feet and the seat of his pants. Happily, it seems that the new aeroplanes with pressurized flight decks, sound proofing, the use of more interference-free radio channels and vibrationless power plants in the form of turbines will improve the situation tremendously. Although we have given a lot of thought to the problem we have, for the moment, given up the idea which we once had of attempting to regulate against the possible onset of fatigue through restriction of flying hours, due to the many parameters which affect the figure which can be considered relatively safe. We are, however, continuing with research at the Cambridge Laboratory and it may be that with greater knowledge something more definite can be done. In this connection 29 percent of United Kingdom notifiably accidents in 1949 occurred in the final stages of flight and whilst in no case was there sufficient evidence to include fatigue as a contributory factor, this possibility has to be borne in mind, and we have the paradoxical situation that the pilot's efficiency tends to deteriorate at the very time that it is vital that he should be on the top line. For example, when letting down to landing at his destination at the end of a long stage flight through poor and worrying weather conditions.

Designers have a large part to play in the reduction of pilot error accidents through simplification of the pilot's task generally, whether it be in the design and reduction in numbers of instruments, switches, knobs and levers on the flight deck or the procedures which he has to follow. A great deal of work has, of course, been done on the military side on standardization of cockpit layout and although all this work may not be applicable to a civil aircraft there is no doubt, in my mind, that a certain measure of standardization ought to reflect some improvement in safety. In this connection we have, of course, got the prime example which exists today in standardized control movements. It has also been put forward in the United Kingdom that we ought to have complete standardization of control loading, that is to go further than prescribing maximum loading, but I suspect that this is too much for which to hope.

With the introduction of synthetic trainers, such as the Dehmel, the vista is opening up in which the mock-up, instead of being the lifeless thing which it is now, may become something which could make a real contribution to a practical

solution of cockpit layout from the pilot's point of view. In so many mock-ups in the past what has appeared to be a nice layout has been agreed only to find in service that part of the instrument or control arrangement affords a source of irritation or even perhaps danger.

An annoying, worrying and so unnecessary type of accident is that which arises from collision with terrain. We had three such accidents which occurred in bad weather last year, and although they formed but a small proportion of the total number of accidents during the year this type of accident has accounted for an unnecessarily high proportion of accidents in the past. Since 1946 we have had seventeen of this nature, nearly all of which could have been avoided by proper use of the equipment carried. This belies the belief so often put forward that if the pilot had had such and such an aid the accident would not have happened. The possibility of equipment failure in individual cases cannot, of course, be completely ruled out and regard must also be had to the fact that pilots may be working under conditions of particular stress. Notwithstanding this, however, the history of this type of accident underlines the need for special care in bad weather, particularly in selecting and maintaining altitudes for en-route flying which give adequate terrain clearance, allowing for possible errors in navigation in positively fixing the aircraft's position before letting down, and in so arranging altitudes during let-down that allowance is made for normal tolerances in the aid being used and errors in following the flight path which is marked by the approach and landing aid.

PRESSURIZATION SYSTEMS - EXPLOSIVE DECOMPRESSION

Pressurization in enabling aircraft to fly above the weather is a great step towards relieving the en-route stress imposed upon the pilot by meteorological conditions and improving the comfort of the passengers. But with the increases in operating heights with the introduction of jet aircraft, pressurization has certainly brought its own difficulties along with it. A great deal of work has been done in the United Kingdom in connection with the physiological aspects of explosive decompression arising from sudden pressure cabin failure and our physiologists started off with the obviously unacceptable advice, from the airlines point of view, that civil transport should not operate above 28,000 feet, or, if they did, that they should have no windows. The psychological aspect bore no weight. Why, they asked, should you have windows if you fly so high there is nothing to see except the clouds; if passengers want to see something, paint the clouds on the cabin walls! However since it was so obvious with the arrival of the jet that aeroplanes would fly high and have cabin windows in spite of their advice the carriage of oxygen against the possibility of pressurization failure was urged. But when you consider the risks

attaching to pressurization failure at high altitudes, this affords little amelioration, and the obvious answer is that transparencies in the cabins and flight deck in high-flying pressurized aircraft must be designed and constructed to a sufficiently high standard as to afford no risk of failure; if we are going to have safety in this regard we have to have standards similar to those we apply to the rest of the structure. The man who preached the provision of parachutes because a wing might fall off would get short shift!

Our designers have gone for the provision of double windows with a high factor of safety and, at the same time, a full investigation of fatigue of the particular designs is being undertaken. It seems, however, that with a small sacrifice of the aesthetic appeal, by the provision of metal lattice reinforcement outside the window, very considerable strength could be provided with a large saving in weight. Although the commercial sides of the airlines may not like this idea at the moment, I think it is not beyond the bounds of probability that this type of window may emerge in cabin transparencies if operating altitudes are further increased. Another line of attack, although it introduces some difficult design problems, would seem to be to arrange that all the material of the window is in compression.

SAFETY BELTS AND HARNESSES

We are shortly going to make the requirement as a safeguard against turbulence due to clear air gusts or other risks, or failure of the power operated controls and automatic pilots, due to which strong negative G might be set up, that at least one pilot shall be strapped in throughout every public transport flight. On new aeroplanes we now require the fitting of a shoulder harness to a pilot's seat as an additional safeguard, but in order to prevent undue restriction, we are recommending that the harness should be of the type in which leg straps can be worn as a belt. In fact, I believe that unless such an arrangement is made the introduction of the shoulder harness can lead to a reduction in safety due to the antipathy of pilots to over-restriction.

CRASH SURVIVAL

FIRE PRECAUTIONS

As I said earlier, at one time we thought that the big thing was to stop accidents and that that line of approach would leave us no worries about crash survival, but realism won the day and we appreciate that accidents are inevitable.

Mr. Hansberry has dealt with British fire precautions and it is sufficient at this stage to say that one of the objects of our fire precautions is, through the provision of crash operated switches, to prevent a fire happening when an aeroplane crashes. The record of accidents to British aircraft which have occurred since the war, during which time crash operated fire switches have been mandatory, gives us great hope that something concrete in the advance of safety has been achieved. We have initiated a further careful survey of accidents to get a further assessment of the value of these precautions.

FUEL TANKS

Elimination of the fire risk ought to result, we feel, in some 50 percent reduction of crash fatalities. In addition to fire suppression precautions, therefore, we believe that it is most important to pay close attention to fuel tank design. The possible dangers introduced by integral tanks have had protracted examination. At one stage there was strong pressure to ban them completely. However, we now take the view that providing good design standards are applied integral tanks should be accepted where they are placed outside the outer engine nacelles and that care should be taken in the arrangement of components to ensure that in the event of an accident they will not pierce the fuel tanks. General design requirements are, at the moment being drafted by the Air Navigation Board to cover these points.

REARWARD FACING SEATS

As in the United States of America, considerable research has been done into the possibility of reducing fatalities by the fitting of rearward facing seats in British aircraft. As you probably know, in the Royal Air Force Transport Command, the Hastings (this is a Handley Page 4-engined transport) has been fitted with rearward facing seats stressed to 25 G. Fortunately there have been no accidents to this aircraft which would indicate what has been gained from this innovation, but it is interesting to know that passengers travelling in them, although admittedly they have been Service personnel, have been very happy. I know that to achieve a similar innovation in civil aircraft is fraught with commercial difficulties. The immediate reaction from the airlines is that their machines do not crash and why should they do this or that which would have commercial repercussions and favour their competitors. It is claimed that the changeover will be partially achieved through the modern tendency to install the compartment type of seat but, if this is to be effective, care will have to be taken to achieve adequate strength of seat, safety belts and seat attachments, otherwise passengers sitting opposite those facing the rear might, in a serious crash, act as human projectiles.

Some amelioration of the situation might be achieved, by the fitting of stronger seats and safety belts, (without going to rearward facing seats) and stronger seat attachments and adequate floor strength, providing the design of seat backs is given sufficient attention as far as padding is concerned. Seat designers in the past have often been content to leave razor-like edges or strong and awkwardly shaped metal tubes in places where portions of passengers would make contact with them. Let me say at once that I am sure this does not apply to any designers who may be present today!!!

In a really serious accident, of course, it is likely that only passengers who are seated to the rear of the main spar would survive, even with rearward facing seats of adequate strength. It may interest you to know that in a recent accident in the United Kingdom with conventional seating there is no doubt that passengers were seriously injured through contact with the back of the seat in front of them. Whether this happened before or after their seats became datached from the floor is not of course known. Since the estimated deceleration at the back of the fuselage was estimated at 10 - 15 G it seems as though rear facing seats of adequate strength might in this case have led to some saving of life, and provides strong practical argument.

FIRE/RESCUE SERVICES

The larger the aircraft become the more catastrophic the result of crash fires and where these have occurred it is lamentable that rescue services have had to stand by helpless. Although bigger and better crash fire fighting vehicles have been developed capable of flinging CO2 (3000 lbs. per minute) at phenomenal rates at crash fires, we have still to have practical demonstration that they are capable of dealing with the serious petrol fire which sometimes happens when an aeroplane crashes. It is, of course, axiomatic that to be effective the crash tender must be on the scene as the crash happens. The introduction of the use of fuels low of volatility such as kerosene may well help to delay the spread of fire and thus make crash rescue vehicles more effective. In this connection, one of the difficulties in the past has been that of making rapid entry into crashed aeroplanes to rescue survivors where doors and other exits have jammed through distortion of the structure. The first line of attack is, of course, to design emergency exits and doors so that they do not jam, but from the rescue crew aspect the provision of some means of breaking into aircraft is obviously necessary.

Pressure cabins have, of course, introduced their own difficulties with increased thickness of cabin walls. In the United Kingdom development work is going on with power driven saws and it is hoped that these will provide an effective answer. To be fully effective, however, it is thought some system of marking break-in points may have to be evolved.

CONCLUSION

There is no doubt in our minds that with the realization on the part of everyone that careful attention to his own task is essential, together with a continued pursuit of high standards of proficiency, flying can be made a lot safer than it is today. Aviation has been pursuing for many years the apparent mirage of a safety fuel and whilst kerosene may be some way from being a complete answer we have every reason to hope that its use in the turbo jet aircraft, shortly coming into service on British Airlines, will be an important factor in reducing the danger of catastrophic post-fire crashes: coupled with what has been done regarding fire precautions the risk of such outbreaks should be greatly reduced. The simplicity which evolved from the use of the new propulsion systems, and the decrease in fatigue through the absence of noise and vibration will, we hope, rule out a further source of accidents and open up a new era of safety in the air.

MISCELLANEOUS EXTRACTS RE ACCIDENT PREVENTION

1.- A PLACE FOR EVERY TOOL, EVERY TOOL IN ITS PLACE

A wrench, a screwdriver, a pair of pliers inadvertently left inside an engine cowl, in a wheel well or in the control system may be more serious than a forceps, a sponge or a knife left inside a patient by a surgeon. One may kill fifty people, the other only one.

2.- PAPER WORK vs COLLISION

An airline pilot states that he orders his crew to cut out all paper work on take-off until he reaches cruising altitude - and on all let-downs from cruising altitude until he is safely on the runway.

3.- CREW TRAINING - DITCHING

The time to learn how your safety equipment works is before you need it, not while you are bobbing around in the water, hoping that someone will find you.

4.- FATAL TIRE EXPLOSION

Two mechanics were removing a wheel of the split type with the halves held together by tie bolts. One or more of the tie bolts had failed and the inflation pressure tended to expand the wheel halves so that the nut on the axle was actually doing most of the holding of the wheel together. Consequently the nut was hard to back off. The mechanics attempted to get the nut off by cutting it with a cold chisel. On the last chip, the nut

suddenly released and the pressure in the tire propelled the rim and tyre off with sufficient force to injure seriously one mechanic and throw the second mechanic over 60 feet, breaking most of his bones and blowing his head almost off.

Moral.- If a device does not work smoothly, find out "why" before forcing it.

5.- EMERGENCY CHECK LISTS vs TELEPHONE NUMBERS

Some pilots have found a new use for telephone address books (the kind where the cover springs up to the pre-selected letter when a tab is pressed). On the cover in place of the index letters, they paste the list of emergencies that call for immediate action but require a check list to be certain that no step is overlooked.

6.- OXYGEN BOTTLES

It is inadvisable to locate oxygen bottles in the plane of the propellers. Pieces of the prop might fly off and go through the bottle creating an explosion hazard and possible oxygen deficiency when oxygen might be most needed.

Oxygen bottles located near skin of the belly also can cause hazard. An instance is reported of a military aircraft in a belly landing, the skin was worn away by sliding along the concrete. This exposed the oxygen bottle which also was worn through by friction. The resulting release of oxygen on hot dural started a very hot fire. Plane was consumed.

7.- ELECTRIC SHORT BY WASTE WATER

A waste water tank strainer in the lounge of an air transport caused water to overflow which resulted in a shorted fire unit.

Remedy.- Drain holes were drilled around the screen retainer band of the waste water strainer. This allows waste water to drain into a water tank if the screen becomes clogged.

8.- CONTROL CABLE CAUGHT BY BOLT

After take-off ship went into abnormal climb and control column could not be pushed forward. Nose dropped and control column became free when power was reduced. Down elevator control cable had been caught in threaded end of a bolt in the control system.

Temporary remedy.- Bolt position changed so head of bolt faces cable.

Permanent remedy.- Present bolt to be replaced by a clevis bolt with recessed head.

9.- CO_2

An air transport made an emergency landing due to heater fire warning (caused by shorting of switch). CO_2 bottles discharged but pressure remained in system. Investigation revealed check valves down stream of CO_2 bottles were full of water, corroded and frozen in closed position.

Note.- Water may enter through CO_2 discharge nozzles - moisture laden air flowing by the nozzles could do this. This air flow may come from outside or be caused by differential air pressures within the aeroplane, especially pressurized aeroplanes.

Remedy.- Relocate CO_2 discharge lines so water will drain out of them instead of down into system, i.e., invert the lines.

10.- A WORD FROM THE WISE

a) Know where you are before you let-down.

b) Adhere to designated Instrument Approach Procedures.

c) Aircrew - keep your seat belts fastened.

d) Don't take off with frozen precipitation on the wings.

e) Take it easy on slippery runways.

f) Beware the effects of altimeter errors, clear air gusts, downdrafts, and all other factors that affect the aircraft's position in height.

g) One's nose can be a very sensitive detector of smoke (fire), smells (hazardous cargo leaking) and mechanical trouble (leaking fuel, hydraulic fluids, etc.).

h) Use windshield for purpose designer intended - Observation!

i) The definition of "Pilot Error" is debatable, however the results of same are often "Fatal".

j) "Absolute safety" is preferable to "Calculated risk".

k) If a pilot is where he thinks he is we would not have collisions with mountains.

11.- PLEXIGLASS TOPIC

The possibility of static discharge caused by cleaning plexiglass becoming a fire hazard is removed if cleaning takes place after refuelling.

12.- TRANSPORT OF DANGEROUS GOODS

The official inquiry into the forced landing near Tangali, in East Bengal, of a DC-3 belonging to Airways (India), Ltd., last December, has resulted in a verdict of lack of caution on the part of the company and "gross negligence" of its booking section.

A wooden crate containing chemicals emitted fumes and caused a fire in the luggage compartment while the aircraft was en route from Calcutta to Gauhati on 17 December. There was no damage to the aircraft nor were any of the occupants injured in the landing, but later two passengers and two members of the crew died from the effects of the poison fumes.

- END -

PRICE: $0.15 (Cdn.) (Montreal)
Equivalents at date of publication:

50 m/m	(Cairo)
2.25 soles	(Lima)
1s. 0d.	(London)
1s. 3d.	(Melbourne)
50 francs	(Paris)