SA- 352

File No 1-0002

CIVIL AERONAUTICS BOARD

AIRCRAFT ACCIDENT REPORT

ADOPTED: July 26, 1960 **RELEASED:** July 29, 1960

NATIONAL AIRLINES INC , DOUGLAS DC-6B,
N 8225H, NEAR BOLIVIA, NORTH CAROLINA, JANUARY 6, 1960

SYNOPSIS

At approximately 0238 e. s t., January 6, 1960, a National Airlines DC-6B crashed in a field approximately 1-1/2 miles northwest of Bolivia, North Carolina All 29 passengers and the crew of five were killed.

Flight 2511 of January 5, 1960, departed New York International (Idlewild) Airport at 2334 on an IFR clearance scheduled as a nonstop flight to Miami, Florida. The flight proceeded routinely in accordance with its flight plan until shortly after passing Wilmington, North Carolina.

At 0231 Flight 2511 contacted the company radio station at Wilmington while over Carolina Beach at 18,000 feet, and transmitted a routine progress report. Shortly after the completion of this radio contact a dynamite explosion occurred in the passenger cabin. Following this explosion the aircraft entered a wide descending right turn and crashed 1-1/2 miles northwest of Bolivia at 0238 some 16 miles west of its intended flight path.

No reference is made in this report concerning the placing of the dynamite aboard the aircraft or of the person or persons responsible for its detonation. The malicious distruction of an aircraft is a Federal crime. After the Board's determination that such was involved, the criminal aspects of this accident were referred to the Department of Justice through its Federal Bureau of Investigation

INVESTIGATION

The Flight

Flight 2511 of January 5, 1960, was one of two aircraft used as replacements for Flight 601, which was scheduled as a nonstop Boeing 707 jet flight to depart Idlewild at 2115, 1/ utilizing Pan American Aircraft N 710PA under a lease agreement.

Owing to the late arrival of N 710PA from Miami, the flight was rescheduled to depart at 2215. During the turnaround inspection on N 710PA it was discovered that the copilot's No. 3 aft window was cracked and would require replacement. Since it was estimated that the replacement time would be about eight hours a National Lockheed Electra, N 5003K, and a National Douglas DC-6B, N 8225H, were substituted.

1/ All times herein are eastern standard based on the 24-hour clock.

Passengers originally ticketed on Flight 601 were enplaned on a first-come, first-served basis on the Electra and then the DC-6B. Seventy-six passengers boarded the Electra, which departed New York International Airport at 2334 The remaining 29 passengers boarded the DC-6B which left the terminal at 2334. The flight plan filed by Captain Southard requested routing as follows Radar vectoring to Coyle VOR, V-1 airway to Wilmington, North Carolina, control 1150 to West Palm Beach, Florida, and V-3 airway to Miami, Florida, requesting an altitude of 18,000 feet

Following receipt of taxi clearance, flight 2511 taxied to runway 31 left. Flight 2511 then received the following clearance from Idlewild clearance delivery on 121.6 mcs., "National twenty-five eleven ATC clears you to the Wolf intersection via Idlewild radio beacon, Idlewild VOR one three zero radial, Victor sixteen, cross Wolf at, and maintain three thousand, cross Idlewild radio beacon at two thousand." The clearance was read back by Flight 2511 and acknowledged. The flight then contacted Idlewild tower on 119.1 mcs., and was cleared for takeoff. After takeoff Flight 2511 contacted departure control and was radar vectored to Victor 16 airway and then contacted New York Center on 124.1 mcs., which radar vectored the flight to a position six miles east of Point Pleasant and cleared it to navigate direct to Coyle VOR. During the departure the flight was given successively higher altitudes and reported over Coyle at 16,000 feet New York Center then cleared the flight to 18,000 feet, which was the requested flight plan altitude.

Flight 2511 proceeded in a routine manner in accordance with its flight plan and clearance, and reported to Washington Center over the Wilmington (North Carolina, VOR at 0227, 18,000 feet, estimating Azalea intersection at 0302 and Gateway intersection as the next reporting point.

During the flight from Idlewild in addition to the communication contacts with FAA centers, Flight 2511 maintained contact with National Airlines company radio stations located at Idlewild, Washington, and Wilmington. It is the practice of the company to have its pilots make their position reports to ARTC.

At 0213 Flight 2511 established contact with the company radio at Wilmington on 128.7 mcs At this time the flight reported it was over Kinston at 0210, 18,000 feet, and estimated Wilmington at 0230, with Azalea as the next checkpoint. At this time the Wilmington operator informed the flight that the Wilmington altimeter setting was 30.17

At 0231 Flight 2511 reported to company radio at Wilmington as over Wilmington at 0227, at 18,000 feet, estimating Azalea at 0302, with Gateway as the next checkpoint. The flight reported that at the time of this radio contact they were over the Carolina Beach radio beacon (an "H" facility which is located 16 nautical miles from the Wilmington VOR on a heading of 200 degrees), that the flight had been on instruments to Cofield (VOR), then in and out of the clouds, and was now on top for the first time. The company radio operator logged the time of the termination of this message as 0231. This was the last contact with Flight 2511.

At apporximately 0700 a telephone call was received by the National Airlines radio operator from a Richard Randolph of Bolivia, North Carolina, advising that there was airplane wreckage in the field near his house 1-1/2 miles northwest of Bolivia. This wreckage was later identified as that of N 8225H.

Structures

Initial examination of the main wreckage scene showed that the major portion of the aircraft was scattered over a large area in the vicinity of Bolivia, North Carolina. In addition, reports were received of wreckage being located at Kure Beach approximately 16 miles east of the Bolivia site.

It was apparent from the initial examination at the scene that a sizable portion of the fuselage was missing and as a result of this initial examination it was evident that a three-dimensional reconstruction of the fuselage and center wing wreckage was necessary to fully explore the aircraft disintegration pattern The wreckage therefore was removed to a hangar at the Wilmington Airport where a chicken wire and wood framework was constructed, and which corresponded to the contour and size of a DC-6B fuselage.

All of the wreckage found at Kure Beach was found to be from the fuselage or from structure attached to the fuselage. There were two relatively large sections of the fuselage sidewall structure from the right side just aft of the lavatory, and two sections of interior hatrack structure from the same area. Also found at the Kure Beach area was a section of the wing fillet structure which attaches to the fuselage directly below the hydraulic compartment area, a section of the right side-wall of the hydraulic compartment, 3 of the 4 cabin oxygen bottles and one triple seat unit. Other pieces found at Kure Beach included pieces of fuselage frames, portions of plexiglass from cabin windows, pillows, seat cushions, window curtains, the right ice light, a life jacket, pieces of the right lavatory door and aft partitior

Examination of the aircraft structure and the wreckage distribution indicated that an inflight disintegration of the aircraft had occurred, which initiated at a point in the fuselage near the leading edge of the right wing on the right side of the passenger cabin. The portions of wreckage recovered in the Kure Beach area were all from this general location.

After the fuselage wreckage was positioned on the mockup, it was found that approximately 90 percent of the fuselage plating or skin had been recovered and identi-fied Most of the missing pieces of the fuselage apparently came from an irregular-edged, triangular-shaped area above and extending forward from the leading edge of the wing on the right side of the fuselage. Numerous small fragments of upper fuselage shell structure from this triangular area, totaling about 20 square feet of surface were found, and identified, but their small size prevented their being positively located within this area.

A portion of fuselage between stations 238 and 260 was found to contain some 13 propeller cuts. All of these cuts were staggered and were positioned progressively forward as they progressed upward. The lowest cut, which was at station 25 between stringers 17 and 18, distinctly showed marks indicative of high-speed feathering of the metal, and it was evident that subsequent to the initial fuselage failure this portion was forced out and into the No. 3 propeller plane.

The fuselage flooring was relatively intact except for a missing area extending approximately 50 inches inboard from the right side of the fuselage and extending forward from station 410 about 14 inches. This missing area of flooring comprised the flooring between seat rows No. 6 and No. 7. The edges of the flooring adjacent

to the missing area were irregular and extensively deformed. Five adjacent pieces of flooring from this area were recovered from the main wreckage area. All of the floor carpeting between the seat tracks was recovered except for a portion corresponding to the missing flooring on the right side forward of the front spar.

The carpeting immediately forward and aft of the missing area was cut and torn in numerous places and upon X-ray examination was found to contain numerous foreign objects which included pieces of .025 inch wire, rivets, and rubber-backed nylon material similar to that used in the manufacture of an airline type flight bag. Manganese dioxide deposits were also found on this carpeting

Eight heavy electrical cables are contained in three conduits which connect the right wing junction box in the hydraulic compartment to the main junction box in the cockpit and which run through the area of the missing portion of the fuselage and adjacent to the missing portion of the floor These cables were severely damaged and had numerous separations and cuts, and the conduits were found to be separated in numerous places.

All of the interior furnishings aft of the lavatory area of the fuselage were examined for foreign deposits or debris or for evidence of any unusual conditions. Particular emphasis was placed on the area just forward of the wing since this appeared to be the focal point of the fuselage disintegration. Numerous tiny pieces of wire approximately .025 inch in diameter and necked down at each end were found scattered throughout this area. Deposits of sodium carbonate, sodium nitrate, and complex mixtures of sodium-sulfur compounds were found in the air vent in the hatrack section from the right side of the cabin in the area of the focal force of the initial disintegration.

One of the triple seats which was installed in the right side of the passenger cabin, and which was recovered at the main crash site exhibited damage which was somewhat different from that found on most of the other seats. This seat was severely damaged and had numerous bends, failures, and buckling of its structure Also evident were areas of both heavy and light pitting of the structure and there were numerous small indentations and some large ones. One of the seat belts was missing and portions of the upholstery material were missing with the material adjacent to the missing portions showing a shredded appearance. Some of the seat webbing material was torn and cut; however, most was missing. The bottom of this seat assembly was splattered with a black substance which was identified as manganese dioxide.

Many articles and portions of the fuselage or interior furnishings from this area were collected and submitted for laboratory examination for evidence of explosive residues or foreign object damage, and numerous particles of wood, wire, metal particles, and other objects found to have penetrated various of the interior furnishings in the cabin in the area surrounding the initial airframe failure were subjected to laboratory examination

Extensive damage was initially observed in the wing center section and fuselage hydraulic compartment area, however, the reconstruction of this area showed no failure or malfunction which could be considered as a causal factor of this accident.

Two pieces of the hydraulic compartment center wing structure were recovered

from Kure Beach. Except for these two pieces all the rest of the structure recovered from this compartment was located at the main crash site. There was no evidence of fire or vapor explosion, and no arcing of electrical wiring in the hydraulic compartment area.

All flight logs for a six-month period prior to the accident were reviewed. Items affecting airworthiness were cross-checked against the inspection supplements to determine corrective action.

All inspection supplements for the six-month period were studied for airworthiness items such as cracks, corrosion, rigging, fuel leaks, seeps and/or stains. Malfunctions of the hydraulic system, flight surfaces, cabin heater system, air conditioning, and pressurization system over the previous six months were also reviewed.

All Airworthiness Directives, Engineering Orders, and Manufacturer's Service Bulletins applicable to N 8225H were reviewed for compliance and were found to be current. All engine records and the last overhaul records were reviewed. The propeller records were researched back to the date the propellers were received by National Airlines.

The comprehensive study of the maintenance records and maintenance history of N 8225H, its engines, and propellers revealed no data that could be related to any structural weakness or deterioration

Powerplants

The Pratt and Whitney R-2800-CB16 engines installed on N 8225H sustained severe impact damage and were recovered on the outer perimeter of the wreckage area. They were widely separated from the area which contained the forward and aft fuselage sections.

Nos. 1 and 2 engine assemblies remained attached to the left wing until ground impact, at which time they broke off. They were recovered, severely impact damaged, from water-filled craters approximately 1,900 feet from the forward and aft sections of the fuselage and in the opposite direction from the locations of powerplants Nos. 3 and 4.

The Nos. 1 and 2 powerplant assemblies showed no evidence of fire in flight or of burning after impact. The aocessory section and the nacelle structure of No. 2 engine did, however, show light soot deposits.

The Nos. 3 and 4 powerplant assemblies were located approximately 2,150 and 2,025 feet, respectively, from the area containing the forward and aft fuselage sections. These two powerplant assemblies had separated from the right wing with their nacelle structures still attached to the engine and mount assemblies.

No. 3 engine was recovered in a nosedown and inverted position in a crater approximately four feet deep. Severe fire damage was found to the rear section of this engine. The lower inboard and outboard sections of the antidrag cowling were detached at impact and were found approximately 25 feet from the engine. Both these cowl sections were found to be moderately sooted on their inside surfaces. The nacelle

structure was severely crushed at impact. The firewall was ruptured at two places in the lower inboard area as a result of impact. The ground fire had entered zone 3 through these openings and burned part of the propeller control relay junction box. No other zone 3 components were fire damaged. The firewall contained no evidence of fire burning through the structure itself.

The outboard sections of the accessory cowlings remained on the engine and were severely fire damaged. The inboard accessory cowlings were detached at impact. They were excessively oil coated on the inner surfaces but showed no evidence of fire damage.

The No. 4 powerplant was located approximately 600 feet southwest of the No. 3 engine. This powerplant was buried approximately six feet in a water-filled crater and was found in a nosedown and inverted position. This powerplant had separated with its nacelle structure attached to the engine mount. There was no evidence of fire either prior to or after ground impact.

All of the powerplant and propeller assemblies evidenced severe ground impact damage. Upon disassembly and inspection, however, no evidence was found of internal failure, operating distress, or other malfunction. All of the main bearings, master rod bearings, and other bearings were found to be in place and adequately lubricated. Examination of the main screens and sump plugs failed to reveal any evidence of any foreign material or contamination.

All of the propeller assemblies remained in place with their respective engines. All blades exhibited impact damage in varying degrees and two blades of the No. 3 propeller assembly evidenced paint smears on their face side as a result of contact with fuselage structure.

The four propeller assemblies all evidenced severe ground impact damage. Examination of the dome assemblies, pitch changing mechanisms, stop levers, barrel halves, and spider assemblies failed to show any evidence of any malfunctions or pre-impact failures. Examination of the slip ring assemblies, thrust bearings, and washers, and remaining components of the propeller assemblies showed no indication of inservice difficulty.

The blade shims and shim plates of the four propeller assemblies showed that the respective blade angles at ground impact were: 30 degrees, 30 degrees, 45 degrees, and 34 degrees. The No. 4 propeller assembly showed light impact markings on the shim plates at 50 degrees and also had heavy indentations at approximately 34 degrees.

The No. 1 propeller governor was broken from its pad at impact and was not recovered intact. The No. 2 propeller governor was examined and the speeder rack spring measurement was equivalent to 2240 engine r p. m. The No. 3 propeller governor speeder rack spring position also indicated 2240 engine r. p. m. The speeder rack spring in the No. 4 propeller governor was intact in its housing and measurement of the rack spring position indicated 2240 engine r. p. m also.

Fuel System

The fuel tank compartments in the wings were damaged to various degrees at impact. The fuel tanks in the entire left wing area between the front and center spars were severely broken apart at impact. The fuel tank compartments in the right inner wing were also severely damaged. The fuel tanks in the wing outboard of the No. 4 engine

and the tanks aft of the center spars were severely broken apart at impact. The fuel tank compartments in the right inner wing were also severely damaged. The fuel tanks in the wing outboard of the No 4 engine and the tanks aft of the center spar in the left wing were, however, relatively intact

Examination of the fuel tank areas showed no fire damage prior to or after ground impact. The fuel tank structure showed no evidence of fuel leakage except that there was evidence of a heavy fuel seep at the No. 4 dump valve manifold fitting at the center spar adjacent to the No. 4 nacelle. Examination of the fuel drain valves, fuel selectors, and crossfeed valves showed no leakage or other malfunction except for impact damage

Weather

At the time of the accident, there was a low pressure area centered in the Gulf of Mexico, with a quasi-stationary front extending eastward from this low across the Florida Peninsula just north of Melbourne and into the Atlantic. A ridge of high pressure existed on the north side of this front extending from the Virginia Capes westward through the Ohio Valley to the central Plains.

Associated with the frontal structure described above, precipitation was falling throughout Virginia, the Carolinas, and Georgia. This precipitation was mostly in the form of rain except for snow in northern and western Virginia and western North Carolina.

The freezing level in the vicinity of the crash was between 10,000 and 12,000 feet, with multiple layersof clouds extending from below 1,000 feet to approximately 18,000 feet. Rain and fog existed at the accident site. Some difficulty with engine icing was reported by aircraft flying in clouds and precipitation several thousand feet below the cruising level of National Flight 2511 (18,000 feet). No difficulties because of icing would have been encountered at 18,000 feet over eastern North Carolina nor were any reported.

In view of the relatively stable upper air conditions over the area, no significant turbulence would have existed at 18,000 feet nor was any reported.

Strong west-southwesterly winds were present over the accident site. At 18,000 feet, the velocity would have been slightly in excess of 100 knots with high velocities (85 knots plus) reported at all altitudes between 18,000 and 12,000 feet. A sizeable reduction in velocity occurred in the level between 12,000 and 10,000 feet (Norfolk reporting 85 knots at 12,000 and 52 knots at 10,000 feet). Thereafter, the wind decreased gradually from 10,000 feet to the surface.

Human Factors

From the passenger manifest it was determined that 29 passengers and a crew of five were aboard the aircraft. Initially, two of the passengers' bodies could not be located. Both of these bodies, however, were found later; one was in the main wreckage area, and the other was recovered from Snow's Marsh on the west side of the Cape Fear River some 16 miles from the main wreckage area.

The local coroner ordered post-mortem examinations of the passengers and crew as deemed necessary to determine the cause of death of each.

The body recovered from Snow's Marsh was identified as that of Mr. Julian A. Frank. The autopsy conducted on the body of Mr. Frank showed extensive avulsion (tearing away) of the lower extremities, and X-rays showed numerous foreign objects to be imbedded in its tissue. In view of the nature of the injuries to Mr. Frank, it was determined that further examination of the body was necessary to assure complete documentation of the injuries sustained. Accordingly, a second examination of the body revealed many additional foreign particles imbedded in the body and further documented the injuries sustained by this body.

Some of the more significant facts determined during the examinations of Mr. Frank's body are as follows:

1 Irregular erythematous (reddened) areas of skin on the face.

2 Dislocation of the right humerus without apparent fracture.

3. Fragments of steel-colored wire imbedded in the superficial flexor muscles of the right forearm.

4. Partial avulsion of soft tissue of the right thumb, index finger, and middle fingers with partial denuding of skin of the fingers and palmar surface of the hand.

5. The left hand was extensively mutilated, with multiple skin lacerations and absence of the distal portions of all fingers.

6. A small piece of brass was found imbedded in the muscle mass below the left elbow

7. Left fibula missing and left tibia amputated at lower third. Extensive mutilation and fragmentation of muscle tissue manifested by tears in a longitudinal direction with the loss of much skin.

8 Right tibia amputated a few inches below the condyles at the knee and the fibula amputated below its head. Below the upper fifth of the thigh posteriorly, and below the lower thigh anteriorly, there was mutilation of the muscles similar to that found in the left lower extremity.

9. X-ray examination revealed small opaque particles in the right wrist. These were found to be wire particles similar to those found in the right thigh.

Miscroscopic examination of the body tissues revealed other significant facts:

1. The right hand was found to have concentrated blackened areas which were also present on the fingers and wrist. The blackened areas consisted of granular particles of varying size and shape. The right palm had many particles imbedded in or attached to the epidermis.

2. The right anterior surface of the forearm had heavy deposits scattered over the surface which were similar to powder residues from a gunshot at close range both from microscopic character of the deposit and the way in which the particles were attached to the epidermis.

3. Several areas on the right arm just above the wrist were darkened but were not similar to the carbon black of the outer areas These areas were reddish-black, similar to an abrasion, but the epidermis was intact The skin was toughened in these areas suggesting coagulation of the protein material.

4. Microscopic examination of the fractures of the fingers of the right hand showed splinters of bone in random directions to the main shaft. There were several areas of split bone with osseous strands bridging the separated bone sections.

5. Microscopic examination of the right hand revealed numerous fibers adhering to the surface and imbedded in the tissue One fiber was observed protruding from the epidermis like a growing hair. The surrounding tissue was relatively free of foreign matter. Upon pulling the single fiber a whole bundle about 2 mm. in diameter emerged from under the skin The epidermis then retracted leaving a pinpoint hole with an underlying pocket lined with clean subcutaneous tissue

The foreign particles removed from the tissues of the body of Mr. Frank were mostly quite small in size but included one object 7.2 cm in diameter. The majority of these particles were examined in the laboratories of the Federal Bureau of Investigation.

Some of the more significant particles included:

1. Small metal wires .025 inch diameter, imbedded in the right wrist.

2. A small piece of brass was found in the left forearm, several pale greenish-brown threads about 10 cm. long, and also some balled-up fine fibers.

3. From the right knee, thigh, and hip over twenty separate items were removed. These included, wires, fibers, and a number of other different colored materials not identified.

4. From deep within the left leg, five small items were removed. In addition two pieces of a woman's hat ornament were found in the muscle tissue of this left leg. One was circular in shape 1.4 cm. in diameter and 1 mm. thick; the other was 7.2 cm. in diameter and 1 mm. thick. Both pieces were grey-tan in color and were of coarse velvet-like material. Attached to the longer piece was a piece of a woman's hat veil 8 by 2 cm. in size

5. Metal particles were also found in the chest tissue, and a number of fibers were found in the tissue of the face.

Extensive search for evidence within the fuselage of the aircraft resulted in the finding of four human bone fragments which were identified as from tubular type bones such as the tibia or femur. A fragment of bone 10-1/2 inches long was found at station 350 in the hatrack area. This bone was identified as a left fibula, distal end, with the distal articulations intact. In the tissue attached to this bone fragment were pieces of olive-drab cloth, a brass plate similar to the front brass retainer plate of a Westclox "Travette" alarm clock, and miscellaneous other foreign material.

The wire fragments removed from the body of Mr. Frank were determined to be .025 inch diameter, low-carbon steel wire. Each wire particle was tension necked at both

ends. Similar wire particles were found imbedded in the seat belt of one of the right triple seats Similar wire particles were also found imbedded in the floor covering.

A small piece of brass was removed from the left forearm just below the elbow This piece, approximately 1/32 inch thick, 1/8 inch wide, and 1/8 inch long, was curved at one end and broken at a bend at the other end.

A lifejacket found at Kure Beach was found to have zipper teeth imbedded in it, and was penetrated by fragments of flesh-colored rubber and blue nylon fibers similar to those composing the airline zipper-type flight bags. Black deposits on this lifejacket were found to contain nitrate residues.

Black crusty particles removed from the right hand were found to be manganese dioxide, a substance found in dry cell batteries Manganese dioxide was also found on the underside of one of the right triple seats and on various parts of the airplane.

Analysis

The Aircraft

The examination of the aircraft wreckage disclosed no evidence of any malfunction or failure of the aircraft, its powerplants, propellers, or systems prior to the detonation of dynamite in the passenger cabin.

The review of the aircraft records and the maintenance and overhaul records showed that all work was properly accomplished and adequately supervised.

Human Factors

The finding of the body of one of the passengers some 16 miles from the main wreckage area, where all the other bodies were recovered, was considered significant in that it clearly showed that some type of cabin failure had occurred early in the sequence of events. Also, the examination of the fuselage in close detail indicated that the forces which caused the cabin wall failure emanated from within. The examination of Mr. Frank's body showed that the injuries sustained were significant in nature as they were not of the type normally associated with an aircraft accident. The existence of an explosive force in close proximity to this passenger is indicated by the avulsion injuries noted, the traumatic amputation of the lower extremities, and the fragmentation of muscle tissue manifested by tears in a longitudinal direction and loss of much skin, and the splinters of bone found in random directions to the main bone shaft of the fingers of the right hand In addition, the numerous particles of metal, fiber, cloth, wire, and other objects found in the body tissue could only have resulted from the detonation of an explosive in close proximity to this passenger. Medical experts with extensive experience with battle field "land-mine injuries" and other injuries resulting from explosives indicate that the injuries sustained by the body found at Snow's Marsh could only have been caused by an explosive blast.

Weather

Analysis of the weather existing prior to and at the time of the accident clearly indicates that weather was not a factor in this accident.

The winds aloft existing at the time of the accident, which were in excess of 100 knots from the west-southwest at 18,000 feet and in excess of 85 knots between 18,000 and 12,000 feet, clearly explain why many small light pieces of the aircraft cabin wall were not found. These parts drifted east-northeast from the point of the initial explosion and fell into the ocean. This is also verified by the subsequent finding of a number of these missing parts which had washed up along the beach.

Structures

A lengthy and detailed study of the wreckage was conducted to determine the cause of the initial aircraft structural failure. The possibility of several different failures was considered. These included: A fatigue failure of the cabin structure followed by explosive decompression; a propeller blade failure followed by cabin penetration and explosive decompression; the malfunction of the cabin pressurization system causing a structural failure; foreign object penetration; a lightning strike; fuel vapor explosion; oxygen bottle explosion; and the possibility of the detonation of an explosive substance within the aircraft.

The nature of the initial damage, the intensity of the force involved, and the location from which the force emanated, together with the check of the aircraft structure and its systems, eliminate the possibility of a fuel vapor explosion.

The study and analysis of the wreckage revealed information which in effect eliminated all of these possibilities except for the possibility of the detonation of an explosive substance within the aircraft.

The extreme force of the agent causing the initial cabin failure strongly indicates that a highly explosive substance was involved. The deformation of the structure surrounding the focal point of the damage was similar to that resulting from the detonation of a high explosive. The fragmentation of the cabin structures adjacent to the focal point of the structural failure also indicates that a high explosive was the causal agent.

The sodium carbonate, sodium nitrate, and complex mixtures of sodium-sulfur compounds found in the air vent of the passenger cabin are typical of the residues found after the detonation of dynamite. The presence of nitrate traces on a lifejacket found in the Kure Beach area also substantiates the fact that an explosive substance was set off in the passenger cabin. Manganese dioxide is commonly found only in the black mix portion of a dry cell battery. This substance, found on one of the cabin windows, and on the triple passenger seat indicates the presence of a dry cell battery within the immediate explosive force area. The blast damage pattern seen in the cabin structure and to the passenger seats shows that the focal point of the explosion was beneath the triple seat next to the right cabin window of seat row No. 7

The nitrate traces found on the lifejacket and the presence in the air vent of the residues usually found after the explosion of dynamite in addition to the other facts set forth conclusively show that a dynamite explosion was set off in the passenger cabin.

Conclusions

It is the Board's conclusion that Flight 2511 proceeded in a normal manner with-

operational difficulty, mechanical failure, or malfunction until shortly after sing the Carolina Beach "H" facility a short distance south of Wilmington, North olina.

At approximately 0233 a dynamite charge was exploded, initiated by means of a cell battery within the passenger cabin and at a point beneath the extreme right t of seat row No. 7.

Mr Julian A. Frank was in close proximity to the dynamite charge when the detion occurred.

The dynamite explosion severely impaired the structural integrity of the aircraft after making a wide descending right turn, it experienced inflight disintegration crashed 1-1/2 miles northwest of Bolivia, North Carolina, at 0238.

bable Cause

The Board determines that the probable cause of this accident was the detonation dynamite within the passenger cabin.

BY THE CIVIL AERONAUTICS BOARD:

/s/ WHITNEY GILLILLAND
Chairman

/s/ CHAN GURNEY
Vice Chairman

/s/ G. JOSEPH MINETTI
Member

/s/ ALAN S. BOYD
Member

/s/ J. S. BRAGDON
Member

SUPPLEMENTAL DATA

Investigation and Hearing

The Civil Aeronautics Board was notified of this accident January 6, 1960, by the Federal Aviation Agency and an investigation was immediately initiated in accordance with the authority of Title VII of the Federal Aviation Act of 1958. A public hearing was ordered by the Board and was held commencing March 22, 1960, at Wilmington, North Carolina.

The Carrier

National Airlines is a Florida corporation and maintains its principal offices in Miami, Florida. This corporation holds a current Certificate of Public Convenience and Necessity for scheduled and nonscheduled operations, and possesses valid Air Carrier Operating Certificates for these operations.

The Aircraft

N 8225H was a Douglas DC-6B aircraft, manufacturer's number 43742, fuselage number 300. The total time on the airframe was 24,836:49 hours, and the airframe had accumulated 11,284:13 hours since overhaul.

The engines installed were Pratt and Whitney R-2800 CB-16. No. 1 engine had a total time of 11,626:31 and 849:20 hours since last overhaul. Engine No. 2 had 21,583:37 hours total time and 1,274:28 hours since last overhaul Engine No 3 had 15,203:48 hours total time and 885:49 hours since last overhaul. Engine No. 4 had 7,509:24 hours total time and 1,730.00 hours since last overhaul

The propellers installed on N 8225H were Hamilton Standard 43E60 with 6859-8 blades.

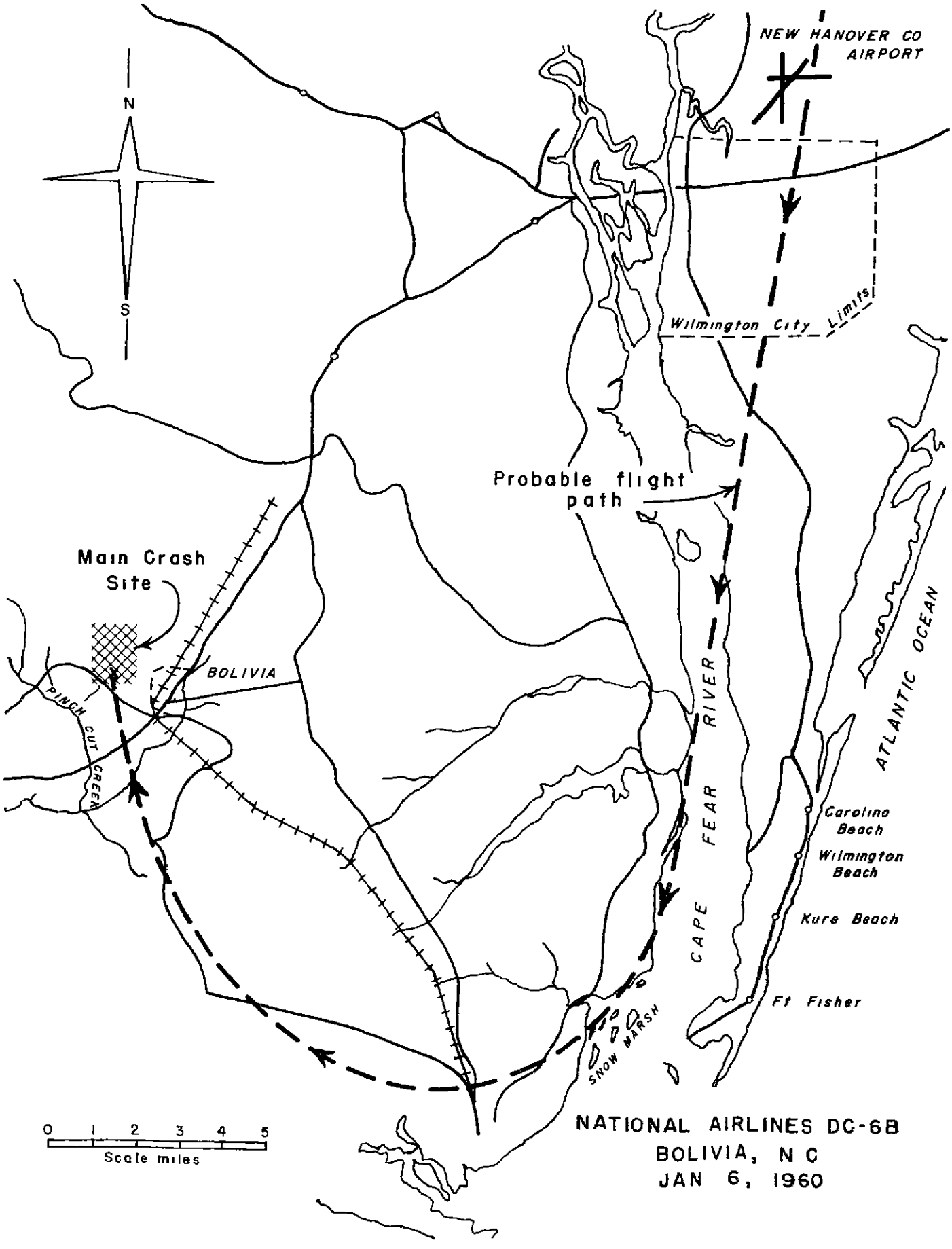
Flight Personnel

Captain Dale H. Southard, age 46, was employed by National Airlines December 2, 1942. He held a current airman certificate with an airline transport pilot rating. He had a total flight time of 16,117 hours, 8,234 of which were in DC-6 aircraft. He satisfactorily passed his last FAA first-class physical examination November 24, 1959. His last line check was completed July 8, 1959, and his six-month instrument check was completed July 6, 1959.

First Officer Richard L. Hentzell age 31, was employed by National Airlines September 30, 1954. He held a commercial pilot certificate and an instrument rating. His total flight time was 3,863 hours, 723 of which were in DC-6 equipment. His last FAA first-class physical examination was passed on September 4, 1959. His last line check was completed October 22, 1959.

Flight Engineer Robert R. Hallickson age 35, was employed by National Airlines November 20, 1954. His total flight time was 3,187 hours, of which 3,074 were in DC-6 equipment. He held a current flight engineer's certificate and an aircraft mechanic's certificate with airframe and powerplant ratings His last second-class FAA physical examination was passed on December 22, 1959, and his last line check was completed November 21, 1959.

Stewardess Valerie E. Stewart, age 25, was employed by National Airlines November 1, 1957. Stewardess Marilu L O'Dell, age 23, was employed by National Airlines November 1, 1957. Both had received stewardess training, including emergency procedures and ditching.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Probable flight path
Main Crash Site
BOLIVIA
PINCH CUT CREEK
CAPE FEAR RIVER
ATLANTIC OCEAN
Carolina Beach
Wilmington Beach
Kure Beach
Ft Fisher
SNOW MARSH
0 1 2 3 4 5
Scale miles
NATIONAL AIRLINES DC-6B
BOLIVIA, N C
JAN 6, 1960