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American ARC DC3

REPORT OF THE CIVIL AERONAUTICS BOARD

Of the investigation of an accident
involving civil aircraft of the United
States NC 25663 which occurred near
St. Thomas, Ontario, Canada, on
October 30, 1941.

I.

CONDUCT OF INVESTIGATION

An accident involving aircraft NC 25663, while operating in scheduled air carrier service as Flight 1 of American Airlines, Inc. (hereinafter referred to as "American"), occurred in the vicinity of St. Thomas, Ontario, Canada, on October 30, 1941, at approximately 10:10 p.m. (EST), ^{1/} resulting in destruction of the airplane and fatal injuries to the crew of 3 and the 17 passengers on board.

The Washington office of the Civil Aeronautics Board (hereinafter referred to as the "Board") was officially notified of the accident about 12:30 a.m. Immediately after receiving this notification, the Board initiated an investigation of the accident in accordance with the provisions of Section 702 (a)(2) of the Civil Aeronautics Act of 1938, as amended. As the accident, although it involved aircraft of United States registry, occurred in the Dominion of Canada while the aircraft was being operated between the intermediate points of Buffalo, New York, and Detroit, Michigan, the Civil Aeronautics Board sought and was granted permission by the Canadian Government to participate in the investigation at the scene of the accident. Personnel of the Board were sent immediately to the scene of the accident, the first of the investigators arriving there about 5:25 a.m.

Throughout all phases of the investigation, the Canadian authorities extended every courtesy. The closest cooperation existed between the investigating bodies of the Canadian and American Governments, with the result that all evidence, exhibits, etc., were freely and mutually interchanged.

Provincial police of the Province of Ontario and members of the Royal Canadian Air Force arrived at the scene within 20 minutes of the time of

^{1/} Unless otherwise indicated all times hereinafter referred to will be Eastern Standard Time.

the accident and immediately established a guard around the wreckage. They maintained constant guard until the arrival of inspectors of the Civil Aviation Branch, Department of Transport, Dominion of Canada, ^{2/} and the Board's investigators. Thereafter, members of the Royal Canadian Air Force remained on duty until the wreckage had been carefully examined by the representatives of the Canadian Government and of the Board and the condition of all parts of the airplane had been ascertained.

The engines and propellers were removed from the scene of the accident to the Technical Training School, Royal Canadian Air Force, St. Thomas, Ontario, Canada, in order that they might be inspected more thoroughly. During the transportation of this equipment, it was under constant guard of an inspector of the Civil Aviation Branch. Certain other parts of the aircraft and its equipment were sent back to the United States for analyses and tests. Some of these parts were transported personally by an investigator of the Board and the remainder was shipped under seal. The examination of the wreckage and disassembly of the engines and propellers were under the direct supervision of an inspector of the Civil Aviation Branch and an investigator of the Board. All tests subsequently conducted in the United States also were personally supervised by an investigator of the Board.

After the inspection of all parts of the aircraft (excepting those obtained for tests) was completed by the Board and the Canadian officials, the aircraft was released to American on November 5, 1941.

^{2/} Hereinafter referred to as the Civil Aviation Branch.

Public Hearing

In connection with the investigation of the accident, a hearing was conducted in St. Thomas, Ontario, Canada, on November 2, 3 and 4, 1941, by the Civil Aviation Branch, before Wing Commander D. G. Joy, District Inspector, Civil Aviation. Edward Warner, Vice Chairman; Jerome Lederer, Director of the Safety Bureau; Robert W. Chrisp, Chief, Accident Legal Section; and Allen P. Bourdon, Senior Air Safety Investigator, were present as representatives of the Board. Depositions were taken in Cheektowaga, near the City of Buffalo, New York, on November 6, 1941, and in New York, New York, on November 24, 1941, before Robert W. Chrisp, acting as examiner for the Board. A public hearing was held in New York, New York, on November 18 and 19, 1941, at which Robert W. Chrisp acted as presiding examiner, and the following personnel of the Safety Bureau of the Board participated: Jerome Lederer, Director; Frank E. Caldwell, Chief, Investigation Division; Allen P. Bourdon, Senior Air Safety Investigator; and Ervin N. Townsend, Air Safety Investigator. As a part of the investigation was conducted in the Dominion of Canada and part in the United States, the Board invited representatives of the Canadian Government to attend the Board's proceedings. Wing Commander D. G. Joy was present at the hearing representing the Canadian Government.

All of the evidence available to the Board at the time was presented at the hearing. Twenty-four exhibits were introduced and eighteen witnesses testified, including personnel of American, the United States Weather Bureau, the Civil Aeronautics Administration, the Civil Aeronautics Board, and other experts in the various technical subjects involved in the investigation.

While the examiner and the representatives of the Safety Bureau were the only ones designated to ask questions directly of the witnesses, the presiding examiner, acting under instruction of the Board, announced at the opening of the hearing that any person who had any evidence, questions, or suggestions to present for consideration in the proceeding might submit them in writing to the examiner. No such questions were submitted during the hearing.

Upon the basis of all the evidence accumulated in both investigations and hearings, the Board now makes its report in accordance with the provisions of the Civil Aeronautics Act of 1938, as amended.

II.

SUMMARY AND ANALYSIS OF EVIDENCE

Air Carrier

American, a Delaware corporation, was operating at the time of the accident as an air carrier under certificates of public convenience and necessity and air carrier operating certificates issued pursuant to the Civil Aeronautics Act of 1938, as amended. These certificates authorized it to engage in air transportation with respect to persons, property, and mail between various points, including the co-terminals New York, New York, and Newark, New Jersey, and the terminal Chicago, Illinois, via intermediate points including Syracuse, Rochester and Buffalo, New York; Windsor, Ontario, Canada; Detroit and Battle Creek, Michigan; and South Bend, Indiana, a route known as AM. 7.

Flight Personnel

On the flight in question the flight crew consisted of Captain David I. Cooper, First Officer Richard L. Owens and Stewardess Mary E. Blackley.

The record shows that Captain Cooper, aged 34, at the time of the accident, held airline transport pilot certificate 12278 with 4M Land rating, and had a total of 5929:50 hours flying time. He had been employed by American and its predecessor company since July, 1931. His total flying time with American was 5369:50 hours, of which 2914:15 hours had been as first officer and 2455:35 hours as captain. He had accumulated approximately 3702 hours in Douglas DC-2 and DC-3 equipment.

Captain Cooper had logged, during his employment with American, approximately 387 hours of instrument time and 244:23 hours of hood time. During the month of October, 1941, he had flown 76:30 hours and his rest period prior to leaving New York on Flight 1 of October 30, was approximately 23 hours. His last line check was given on July 14, 1941, and the check pilot reported that the results of this test were "excellent". Mr. Roy L. Mitchell, Assistant Operations Manager of American, testified that he had on several occasions flown with Captain Cooper and that he considered his ability as a captain above the average. The record shows that Captain Cooper had been flying over AM. 7, the route involved in the accident, since May 30, 1940.

Captain Cooper's last physical examination required by the Civil Air Regulations ^{3/} was taken on June 6, 1941, and showed him to be in a satisfactory physical condition. In addition, and in accordance with the established procedure of American, he had been subjected to a thorough physical examination by a company physician on March 31, 1941. Although Captain Cooper had been off duty for six days during the week of October 20, suffering from wryneck, American's Assistant Flight Surgeon at New York City on October 27 examined the captain and certified that he was fit to resume his usual duties.

3/ The holder of an airline transport pilot certificate is required by Section 21.252 to take a prescribed physical examination every 6 months.

First Officer Owens, 30 years of age, was the holder of commercial pilot certificate No. 44041 with single engine 0-675 h.p. land and instrument ratings. He first soloed at Alice, Texas, on March 27, 1939, and subsequent to that date had been employed as a pilot with various aeronautical companies. Although he had logged 1065 hours of flying at the time of his employment by American on August 19, 1941, he was required to take a pilot training course at the company's school in New York. This course consisted of instruction in DC-3 airplane equipment, radio equipment, meteorology, general operations procedures, navigation, and radio code, together with a course in flight training and flight procedures. As a part of the course he had had 25 hours 50 minutes of instrument time in a Link Trainer and approximately 22 hours of flying time as a third member of the pilot crew on DC-3 airplanes operating under the New York-Chicago Division.

In addition, First Officer Owens had instruction in the operation of all of the controls of the engines, propellers, automatic pilot, radio and fuel systems and other controls of DC-3 aircraft. Night flying, except that obtained as a third member of the pilot crew, was not included in the course.

At the conclusion of the course he was given a two-hour flight test in a DC-3. This test consisted of such maneuvers as stalls, straight and level flying with the landing gear and flaps extended, take-offs and landings, and various other maneuvers required of airline pilots. Assistant Chief Pilot Boyd for American at LaGuardia Field, on October 29, 1941, certified that Owens was qualified to perform the duties of a first officer. Mr. Owens was designated a first officer on that date.

First Officer Owens had taken the physical examination required by Civil Air Regulations on September 19, 1941, and a company examination on July 26,

1941, both of which indicated that he was in a satisfactory physical condition. Prior to departure from New York on Flight 1, Owens had had a rest period of approximately 29 hours.

Thus, it appears from the evidence that both Captain Cooper and First Officer Owens were physically qualified, held the proper certificates, and by reason of their training and experience, were qualified for the flight and equipment involved.

Miss Mary E. Blackley, aged 27, had been employed by American since February 10, 1941. She graduated from the nursing course at St. Elizabeth's Hospital, Washington, D. C., in 1938, and after satisfactorily completing the company stewardess training course on April 10, 1941, was placed on duty as an air stewardess.

Airplane and Equipment

The airplane involved in the accident, aircraft NC 25663, was a Douglas DC-3, Serial No. 2207. It was manufactured by the Douglas Aircraft Company, Inc., of Santa Monica, California. It was completed on March 16, 1940, and was delivered to American by the manufacturers on March 21, 1940. The airplane had accumulated a total of approximately 3868 hours of flying time. At the time of the accident it was equipped with two Wright Cyclone G-102 engines, rated at 1100 horse power each. The left engine, Serial No. 22863, had accumulated a total of about 11,027 hours. This engine was originally a G-2 engine and was converted to a G-102 on March 15, 1940, so that the horse power could be increased from 1000 to 1100. In order to make the conversion, Wright Aeronautical Corporation, the manufacturer, supplied the necessary parts, including all link rods and master rods, crankcase and cylinders. This engine had accumulated a total of about 3811 hours since it was

converted to a G-102 model. The right engine, Serial No. 34464, was originally and remained a G-102 model, and had a total of about 2633 hours.

The engines were equipped with Hamilton Standard constant speed, hydro-matic, full-feathering propellers. The left propeller hub and blades each had accumulated a total of about 3876 hours. The right propeller hub and two blades each had a total of about 7354 hours. The third blade had a total of about 4808 hours.

Complete de-icing equipment was installed on the airplane as well as a full complement of the necessary instruments and radio equipment required by the Civil Aeronautics Administration. In addition, the airplane was equipped with a Sperry aircraft gyropilot, model A-2.

At the time of the accident aircraft NC 25663, equipped as above described, held a currently effective airworthiness certificate which authorized the transportation of 21 passengers and a crew of 4 and the operation of the airplane at a standard weight of 24,546 pounds and a provisional weight of 25,346 pounds.^{4/}

It appears from the record that the airplane and its equipment had received the overhauls, inspections and checks which are provided for in company practice and approved by the Civil Aeronautics Administration. American in its maintenance letter of competency is required to overhaul its aircraft at or before the completion of each 5000 hours of flight time. Since aircraft

^{4/} The "standard weight" of an airplane is the maximum allowable weight for landing, while the "provisional weight" of an airplane is the maximum allowable weight for take-off. When an airplane takes off with a weight in excess of the designated standard weight, the weight of the airplane must be reduced by gasoline consumption, prior to arrival at its next scheduled stop, to the extent necessary to bring it within the standard weight for landing. If sufficient gasoline has not been consumed between time of take-off and any emergency landing, gasoline can be dumped by the use of tested and approved dump valves in order to reduce the total weight to the approved weight for landing.

NC 25663 had logged only 3,868 hours of flight time and was relatively new, it had not reached the required time for overhaul. An engine and propeller overhaul is required at or before the completion of each 725 hours. However, it has been American's policy to use 700 hours as a normal overhaul period, and 725 hours as the maximum, for the entire power plant assembly. Each engine had accumulated 689 hours and 51 minutes since its last overhaul.

From the records of all the inspections and checks which were made of aircraft NC 25663 since the last major inspection on October 4, 1941, it appears that all reported deficiencies were promptly remedied.

American also requires its flight personnel to file at the end of each trip a pilot's maintenance report in which they make any comments they may have as to the operation of the aircraft, engines, instruments, and radio. An inspection of the maintenance reports for the last 68 trips made by NC 25663 (covering period since last major inspection) showed that they contained only a few minor criticisms. These concerned the operation of the engines and controls and it appears from these records that the necessary adjustments were promptly made. No criticisms were recorded on the pilot's maintenance report of the performance of the aircraft, engines, instruments or radio on the flight which was made by NC 25663 from Boston to Washington and return to New York on October 30, 1941, which terminated at 5:15 p.m., approximately 44 minutes prior to the departure of the airplane for Chicago.

In addition, the airplane had been given a line inspection just prior to leaving Boston on the morning of October 30 and it had been given the regular service inspections at each intermediate point. The record of these inspections indicates that the airplane and its equipment were in proper condition at the conclusion thereof.

Thus, from all the evidence available to us, we find that the airplane and its equipment had been properly maintained and were in an airworthy condition at the time of take-off from New York for Chicago on October 30, 1941.

History of the Flight

American's Flight 1 of October 30, 1941, originating at LaGuardia Field, New York, New York, as a scheduled air carrier operation from New York to Chicago, Illinois, with intermediate stops at Newark, New Jersey; Buffalo, New York; Detroit, Michigan; and South Bend, Indiana, was scheduled to depart at 5:50 p.m..

Prior to departure from New York, Captain Cooper, with the assistance of the company meteorologist and the assistant flight superintendent, prepared a flight plan for the route from New York, New York, to Detroit, Michigan. This flight plan was based on the trip forecast and terminal forecasts prepared by the company meteorologist using weather data issued by the United States Weather Bureau for various points along the route.^{5/} The fact that the captain's flight plan did not include South Bend and Chicago was due to the uncertainty of weather conditions forecast for the area west of Detroit at the time that the flight would arrive in that vicinity.

The weather forecast indicated overcast conditions on the route from New York to Chicago with ceilings 800 to 1200 feet in the Buffalo area lowering

^{5/} See Appendix A for American's forecasts.

to 600 to 1000 feet near Detroit and to 400 to 600 feet near South Bend and Chicago. Visibilities were expected to lower to one to two miles near Buffalo and to be reduced by intermittent light rain and drizzle to $3/4$ to $1-1/2$ miles near Detroit, South Bend, and Chicago. The cloud conditions between Buffalo and Chicago were expected to consist of many variable and indefinite layers with ceilings ranging from 400 to 1000 feet, and with intermittent light rain to occasional light drizzle from the lower clouds. Temperatures were forecast to be above 30 degrees below 10,000 feet, and above 40 degrees below 6000 feet between Buffalo and Detroit. The flight was cleared only to Detroit since a lowering of ceilings to below the minimums in the Chicago and South Bend area was expected. The Weather Bureau forecasts^{6/} also indicated ceilings 400 to 800 feet near Detroit with visibility of one mile or less by 8:00 p.m. and ceilings 1000 to 2000 and visibility of one mile or less in the vicinity of Buffalo. Forecast for London, Ontario, approximately 17 miles north of St. Thomas, Ontario,^{7/} indicated intermittent light rain with visibility one-half to one mile improving to one to three miles after 8:00 p.m. with overcast to broken clouds at 1000 to 2000 feet after 8:00 p.m.

Captain Cooper's flight plan called for a cruising altitude of 1500 feet for the New York-Newark portion of the route, 6000 feet Newark-Buffalo, and 4000 feet Buffalo-Detroit. His flying time was estimated as nine minutes from New York to Newark, 1 hour 54 minutes from Newark to Buffalo, and 1 hour

^{6/} See Appendix B for United States Weather Bureau forecasts.

^{7/} St. Thomas, Ontario, is on the airway between Buffalo, New York, and Detroit, Michigan, and is approximately 125 miles west of Buffalo.

38 minutes from Buffalo to Detroit. Airway Traffic Control^{8/} at New York approved the flight plan and clearance, authorizing instrument flight to Buffalo, with Rochester, New York, as the alternate airport.

Flight 1 departed from the loading ramp at LaGuardia Field at 5:59 p.m. after a delay of 9 minutes waiting for American's connecting Flight 18-97. Flight 1 was off the ground at LaGuardia at 6:03 p.m. and proceeded normally to Newark, arriving there at 6:16 p.m.. The flight departed from Newark at 6:41 p.m. after a delay of 9 minutes in awaiting American's passenger automobile from New York City. The flight proceeded normally toward Buffalo making the regular position reports as required by the Civil Air Regulations and company procedure. At 8:23 p.m. the flight requested and was given the latest Buffalo weather which indicated a ceiling of 3700 feet, overcast, visibility 2 miles, light fog, light smoke, temperature 47, dew point 44, wind ENE 3 m.p.h. A normal descent was made and after contact with the Buffalo control tower^{9/} a landing was effected on the airport at 8:47 p.m. Immediately after the arrival of Flight 1 at the loading ramp, the usual service inspection of the aircraft was made.

^{8/} The Airway Traffic Control staff, a part of the Civil Aeronautics Administration, regulates the flow of traffic over a civil airway during instrument weather conditions in order to eliminate the possibility of collision between aircraft. Before flying on a civil airway under instrument weather conditions, clearance must be secured from Airway Traffic Control for the flight, including the altitude at which it is to be flown.

^{9/} Airport control towers are erected and maintained at various municipal airports for the purpose of regulating the flow of air traffic in the vicinity of the airport, in order to eliminate the possibility of collision between aircraft. These towers are normally equipped with radio receivers tuned to air carrier company frequencies, as well as those frequencies used by military and privately-owned aircraft. They are also usually equipped with a transmitter which operates on 278 kilocycles.

At this point, in accordance with American's procedure, it was necessary for the flight to obtain a new clearance from the flight superintendent in Chicago before continuing to Detroit. American's office at Buffalo had been previously advised by the flight superintendent that it would be necessary to delay the flight at Buffalo in order that the 8:30 p.m. weather sequence reports could be checked. While awaiting receipt of the clearance, Captain Cooper also checked the 8:30 p.m. weather reports apparently to determine the condition of the weather west of Detroit. The report showed that the weather conditions over the Buffalo-Detroit portion of the route were satisfactory.^{11/} At 8:50 p.m. the Buffalo office was advised by the flight superintendent at Chicago that Trip 1 was cleared to Detroit with Toledo, Ohio, as the alternate airport. The airplane had been serviced with 117 gallons of gasoline and 18 quarts of oil making a total on board of 507 gallons of gasoline and 160 quarts of oil. This was ample fuel for the flight from Buffalo to Detroit at normal cruising speed and thereafter to Toledo, its alternate airport, with enough reserve fuel remaining to enable it to cruise for about 3-1/4 hours.

Flight 1 departed from Buffalo at 9:07 p.m., the additional delay having been caused by the captain's checking the weather. The total weight of the airplane on departure from Buffalo, including mail, express, company material, fuel, 17 passengers and a crew of 3, was 24,541 pounds, which

10/ American has two dispatching points on Route AM. 7; one is located in New York and the other in Chicago. The New York flight superintendent maintains supervision over the flight from New York to Buffalo but not including Buffalo. The Chicago flight superintendent maintains supervision over flights from Buffalo west on Route AM. 7.

11/ See Appendix C for the 8:30 p.m. United States Weather Bureau sequence reports for the Buffalo-Chicago area.

is five pounds within the approved standard weight and 805 pounds below the maximum weight allowed for take-off.^{12/} The records show that the airplane was loaded so that the center of gravity was within the limitations prescribed by the Civil Aeronautics Administration.^{13/}

Immediately after the take-off, Flight 1 made a radio check with American's Buffalo station to make sure that the aircraft's transmitter and receiver, used for communication with American's ground stations, were operating normally on 3432.5 kilocycles to which they had been changed at Buffalo. This radio check was satisfactory and at 9:18 p.m., American's Detroit station transmitted to the flight and received an acknowledgement of the Airway Traffic Control clearance approving the flight to Detroit. No traffic was reported on the airway. At 9:42 p.m., Flight 1 reported that it passed over Jarvis, Ontario (approximately 67 miles west of Buffalo), at 9:39 p.m. at 4000 feet and estimated arrival at the Florence, Ontario, intersection (west leg of Strathborn, Ontario, range and the northeast leg of the Windsor, Ontario, range)^{14/} at 10:20 p.m. at 4000 feet. This was one minute behind the estimate given the Buffalo station on the clearance. At the time of this contact, Flight 1 requested advice as to the disposition of the flight at Detroit. At 9:44 p.m., American's Detroit station informed the flight that it was still subject to instructions pending the receipt of information from the flight superintendent for the Detroit-Chicago portion of the flight. This was the last radio contact that was acknowledged by Flight 1.

^{12/} See footnote 4 on page 8.

^{13/} The center of gravity limitations prescribed by the Administrator for this airplane were: Forward 11%; Rearward 28%.

^{14/} See map on opposite page.

Neither the flight superintendent at Chicago nor American's Detroit station became concerned over Flight 1 until it failed to report over the Florence intersection at 10:20 p.m. The Detroit radio operator broadcast to the flight at 10:38 p.m. the Detroit Airway Traffic Control clearance for Flight 1 clearing it to the Detroit control tower to make a standard approach. Following this broadcast numerous attempts were made by both American and Civil Aeronautics radio stations at Detroit, Buffalo and Chicago to contact the flight but none of these attempts was successful.

At 11:10 p.m. a pilot officer of the Royal Canadian Air Force near St. Thomas, Ontario, called Detroit by telephone and advised American's station manager that Douglas NC 25663 had crashed near St. Thomas, Ontario, about 10:10 p.m. (See map opposite page 14).

Final stages of the flight are described in detail by the testimony of witnesses on the ground. A number of these witnesses residing near the scene of the accident saw the airplane descend and strike the ground.

Mr. Fred Bogart, who lives approximately one mile east of the scene of the accident, first saw the airplane when it passed over headed west. He said that he had been listening to a radio program which ended at 10:00 p.m. and that he was going to the barn when he looked up and saw the red and green lights of an airplane as it was proceeding west. The airplane appeared to him to be quite high and the engines sounded normal. Mr. Bogart stated that he was familiar with the transports which operate back and forth between Buffalo and Detroit and considered this airplane to be one of them. According to his statement, a few minutes later while returning to the house, his attention was attracted by a loud noise. Upon

looking up, he observed the airplane descending in right turns and while it was circling, it appeared to be "raising up and going down". Mr. Bogart estimated that the airplane made three or four circles before striking the ground. He, with five other persons who were in the house, got in his car and drove immediately to the scene of the accident. He said that although a drizzling rain was occurring at the time, he could see lights at least two miles away.

The Reverend Glen Taylor, who lives in the town of Lawrence Station, Ontario (approximately 1/2 mile west of the scene of the accident), saw the accident from in front of his house. His attention was first attracted by the noise of the airplane and it appeared to be directly overhead. He ran out to the road in front of his house where he could get a clearer vision and saw the airplane circling. He said the right wing of the airplane was down at an angle of about 45 degrees and that on the south side of the circle the airplane came quite low and then as it continued around to the north it gained altitude (demonstrating a roller coaster movement). During the last circle the airplane passed almost directly over Mr. Taylor at which time he said he could see the lights in the cabin. This circle was almost completed and the airplane was approaching directly toward the witness when it appeared to gain some altitude and then dived directly to the ground. Mr. Taylor's testimony was corroborated by several witnesses who also lived at Lawrence Station.

Another witness, Mr. Henry Oldham, a farmer who lives approximately 3/4 mile southeast of where the accident occurred, also stated that his attention was attracted by the noise of the airplane. He stated that he was standing on his farm and that he saw the airplane approaching from

a northerly direction and that it appeared to be in a right turn and was banked very steeply. He testified that he observed only 2-1/2 circles, all to the right, and that the airplane seemed to be going up and down while in a steeply banked attitude. According to Mr. Oldham's testimony, the airplane continued in this attitude until it dived to the ground.

Miss Doris Imlay, a school teacher, saw the airplane during the final stages of its descent from her position on the front porch of her home, which is located approximately 1/2 mile east of the scene of the accident. She said that when she heard the noise she rushed outside and saw the airplane very low, traveling west. It then made a circle to the left and just before the impact the airplane was going away from her toward the west and was in a diving attitude. Although flames from the wreckage were easily discernible, Miss Imlay was prevented from seeing the actual crash due to a slight rise of the terrain between her house and the scene of the accident.

Mrs. Viola Howe, on whose farm the airplane crashed, testified that she had been listening to a news broadcast and had turned off the radio at exactly 10 o'clock. Approximately five minutes later she heard a plane go over. She said, "I didn't pay any particular attention to that plane and then I would say there was no passing of time until I heard . . . a greater volume of noise. Then I thought it was several planes coming and I thought there was going to be something to see . . . so I ran to my west kitchen window. I had my face right against the pane of that window . . . I could see the plane very distinctly. It did not appear to be so very large at that time . . . What drew my attention, I immediately saw three lights, a red light on the top and two green ones. The nose was a little more down and at that moment he was just zooming, making a terrific noise,

just right down." She stated that the airplane was going very fast "like they do when they dog fight", that it came down and around and that on about the second turn she ran to the back door, which is on the east side of the kitchen. Just as she opened the door she said that the cement step and the ground was yellow, "like almost the color of a pumpkin but hardly so deep, but a very yellow glow of light". She continued to the corner of the house and while looking in a southeast direction, she observed the airplane coming right down to the earth. The airplane crashed in a wheat stubble field approximately 1150 feet southeast of her home.

Mr. Ward Willson, a farmer, who was drying beans on the Livingston's farm (approximately 1-1/2 miles northwest of the scene of the accident), also observed the aircraft when it first started its descent from an altitude which he estimated as 4000 or 5000 feet. He said, "I went into the kiln to check the heat and came out and heard the plane coming and looked at it. It was coming directly towards me from the east. Just how many seconds I was looking at it, I can't tell. I watched it come and there was absolutely nothing the matter with the plane, just another airline plane going over. I could see the running lights. I was going to read a magazine and got in my car and just as I got in . . . I heard the airplane motors more or less the same as bombers doing a slight dive, surging, and I got out of my car and started to look at the plane again and when I saw it . . . it was on a vertical angle with the left wing down turning back south and it swung-- around from south, east, north and so on and all the time it was turning it was in this bank." He said that the airplane made three or more circles before it struck the ground and that during the descent the motors were surging and the plane was up and down (demonstrating a steep banked left hand turn with coaster movements up and down). Trees and a slight rise in terrain prevented Mr. Willson from seeing the accident.

According to most witnesses the airplane's landing lights were not turned on at any time, no flares were dropped, and each circle appeared to be smaller as the airplane descended to the ground. Most of the witnesses believed that there was no fire on the aircraft while in flight.

Weather Observations

The Water Works Superintendent of St. Thomas, who is employed to take weather observations by the Meteorological Service of Canada, stated that an average temperature of 45 degrees was recorded at St. Thomas during the 24-hour period of October 30 and that the sky was overcast. Although he made no visibility recordings for that period, he testified that while driving from London, Ontario, to St. Thomas about 9:00 p.m. on the evening of the accident, the visibility was poor. There was no fog on the ground but there was a misty condition prevailing and he said that he could not see more than a mile distant. However, two Royal Canadian Air Force pilots who arrived at the scene of the accident within 20 minutes of its occurrence, stated that the visibility was good and that they could observe the fire of the wreckage and lights at least five miles away. Their testimony was substantiated by that of the lay witnesses who observed the aircraft in flight. All of them stated that the sky was overcast, the night was very dark but that no ground fog or haze obscured their vision.

Two other American flights traversed the same route within three hours preceding the time that Flight 1 crashed. Flight 4, eastbound from Chicago to New York, arrived in Detroit about 7:00 p.m. Shortly thereafter,

the flight departed for Buffalo, the next scheduled stop. Captain Brook, in charge, testified that the flight was normal from Detroit to Buffalo and that the weather conditions were good. Ceilings ranged from 4000 feet at Detroit to 7000 feet (his cruising altitude) over the airway. Outside temperatures recorded in flight indicated 42 degrees at 7000 feet over Florence, 46 degrees over Jarvis increasing to 50 degrees on the ground at Buffalo. He stated that during the flight from Detroit to Buffalo no ice was encountered at any altitude.

Flight 41, a non-stop flight from New York to Detroit, departed from LaGuardia Field at approximately 5:30 p.m. The flight checked by radio over Buffalo at 7:43 p.m. and after receiving the latest weather report ^{15/} from American's Buffalo ground station, continued toward Detroit. Captain Williams of this flight testified that most of the flight across Canada was made at an altitude of 6000 feet and that the temperatures were running between 40 and 45 degrees during that portion of the route. The flight arrived in Detroit at 9:15 p.m. and the trip was considered a normal operation. Captain Williams stated that no ice was encountered during the flight.

No turbulence was encountered by either flight between Buffalo and Detroit, and both flights were flying contact while in the vicinity of the point where the accident occurred.

Examination of the Wreckage

During the investigation of the accident the question necessarily arises as to whether any abnormal functioning by the airplane or its equipment had contributed to the accident, or if a collision occurred

^{15/} See appendix B.

while in flight with some external object. A thorough inspection was made of the wreckage of aircraft NC 25663 and a substantial amount of testimony was received at the hearing as the result of this examination.

The position and appearance of the wreckage indicated that the aircraft had struck the ground at an angle of approximately 70 degrees with the horizontal. First contact was made by the nose of the fuselage and leading edges of the wings with the left wing slightly ahead of the right. The airplane was subsequently damaged by fire. The engines had penetrated the earth at the point of impact, remaining in the same positions with relation to each other that they occupied on the wing. The fuselage had telescoped forward and to the left as had the center section and wings. The empennage, nearly intact, had shifted forward approximately 30 feet, relative to the engines, and slightly to the left, and was resting on the left stabilizer tip. The left wing tip was broken just outboard of the wing tip attachment rib. The appearance of the collapsed structure of the broken portion definitely indicated that the breakage was caused by the inertia forces and whipping action at impact. The internal structure in both wings had collapsed until the rear and front spars of the wing panels were nearly together. The position of the center section and wings indicated that a slight shift to the left had occurred. The leading edges of the wings remained in line with each other. The general center line of the aft section of the fuselage was offset from its normal line of symmetry with the wings and formed an acute angle with the left wing. Both engines were buried in the earth until only the rear parts of their starters were visible at the ground level. A number of clay clods were found

distributed over a fanshaped pattern to the rear of the engines and extending about 115 feet behind the empennage. The aircraft wreckage was well confined to the immediate area surrounding the single point of impact. There was no indication of ice on the wings or other surfaces of the airplane.

It appears that all major parts of the airplane were accounted for except for a central portion of the fuselage, side and top structure, along with their supporting members which were partially destroyed by fire; however, the appearance and relative positions of various parts of the structure, along with adjacent attachments remaining, definitely indicated that the missing portions were present prior to the impact and fire. Furthermore, no parts were found along the flight path, thus leading to the conclusion that no parts of the airplane failed and broke off in flight.

The engine controls; gauges, flight instruments and related equipment in the cockpit section were so damaged by impact and fire that their original condition and position could not be determined; however, they were all found whole or in part and were identified. There was no evidence to indicate that a control failure had occurred, for while the control surfaces were damaged, it was clearly indicated that the damage resulted from the impact and fire, and while some of both the main and auxiliary control cables were broken, the characteristics of the breaks definitely indicated that they were broken under an impact tension load.

The right down elevator cable was found off the pulley and jammed between the pulley hub and the right fork of the mounting bracket, located just forward of the tail wheel spindle mounting bulkhead, which apparently had been torn from its mounting gusset by impact. Furthermore, a portion of the outboard flange of the micarta pulley had broken off with that portion of the cable forward of the pulley bracket under tension and that portion to the rear in a slackened condition.

The cable, pulley and mounting bracket were removed intact as an assembly and reinstalled in their normal location in another DC-3 aircraft for tests to determine the following information:

- (1) The forces required at the control column to overcome jamming of the right elevator down cable and pulley;
- (2) The forces and action necessary to break the pulley flange and force the cable off and into the space between the pulley and bracket;
- (3) The force necessary at the control column to actuate the cable through the normal travel range after it was lodged between the pulley hub and the mounting bracket fork.

The results of these tests indicated that jamming of the cable and pulley bracket assembly located at the station tested (Fuselage station 623-625), such as occurred in NC 25663, can be overcome by the application of normal force on the control column. Furthermore, it appeared from the tests that this abnormal pulley and cable condition was probably caused by the right end of the tail wheel spindle bulkhead being jammed through the right side of the fuselage during impact, carrying the cable with it under tension, breaking the pulley flange and tearing the mounting bracket from its anchorage.

Also, there were some control cable guide pulleys and mounting brackets normally located under the floor along the fuselage, particularly those located in the center section, which were completely destroyed by fire and were not available for inspection. However, the control cables were inspected at the points where the missing pulleys and brackets would have been located together with those where only the micarta pulley had been consumed by the fire leaving the metal hub and bracket. While the cables indicated heat at these points, there was no evidence in the form of frayed strands or scuffing to indicate that a possible jamming of control cable had occurred. Furthermore, a series of tests was conducted on a similar aircraft to determine the possibility of jamming the elevator controls in the "up" position by objects in the cockpit. These tests failed to reveal any condition under which such jamming might reasonably be expected to occur. In fact, there was no evidence found in the entire control system to indicate that a jamming of any of the controls had occurred.

The various units of the automatic pilot were thoroughly examined. While many parts were severely damaged, it appeared that in all probability the damage had resulted from impact and the subsequent fire. Nothing was found to indicate that any malfunctioning of the automatic pilot had occurred during flight. The servo unit was removed and subjected to tests to determine whether any jamming condition existed in the cylinders. The results of these tests were entirely negative. While it is conceivable that an automatic pilot might become jammed in such manner as to make it impossible for the human pilot to assume control of the airplane, this possibility appears to be extremely remote.

The effect of a failure in the expansion tank assembly of a DC-3 steam heating system was tested by duplicating the steam heating system and surrounding companionways in the cockpit in relation to the captain's and first officer's position and by breaking the water glass and releasing a normal head of steam into the companionway. From this test it appeared quite improbable that any such break could result in a situation that would imperil either crew member, or that either crew member could not easily correct without injury to himself.

The landing gear hydraulic retracting struts were found in the fully retracted position indicating that the landing gear was in the full up position. The appearance and position of the hydro piston rod and assembly in the flap diamond linkage indicated that the flaps were in a full up position at impact. The appearance and condition of the chemical refuse tank located in the lavatory at the rear of the cabin, together with the appearance of the fuselage skin over head, showed that the aircraft had not been inverted in flight.

The appearance of the engine compartment cowl, which was protected from the main fire, together with the felt lined cockpit hatch, top cabin skin, the rear baggage compartment and fuselage skin, definitely indicated that there had been no fire in these sections prior to impact. Had any fire occurred in these sections during flight, the protecting finish on their interior portions would have shown the effects of the fire by heat, smoke, and smudge marks. Such indications were not present on any of the surfaces above mentioned.

The safety plug of the oxygen bottle was intact. The outlet connection, however, was damaged by impact and all the oxygen had been discharged. The valve outlet fitting was damaged and partially melted away by fire. There was no indication of malfunctioning of this unit.

An indentation was found on the under side of the left stabilizer, commencing at a point on the leading edge approximately 48 inches outboard from the butt line, extending further outboard approximately 20 inches and to the rear approximately 24 inches. The point of maximum indentation, the depth of which was about 2 inches, was located on the under skin of the leading edge about 58 inches outboard of the butt line. The skin surrounding this area of indentation contained a series of smaller impact points well distributed. It was definitely indicated by the appearance of the area, the material found deposited thereon, and the pieces of clay varying in size from chunks of 6 x 6 x 8 inches to small pellets, which lay directly underneath the area, that the indentations were caused by the clay chunks being thrown back by the propeller and the engine displacement at impact. Had the indentation on the left stabilizer leading edge and skin been caused by impact with some object while in flight, it is believed that the aircraft could have been controlled and a safe landing made. The damaged stabilizer was submitted to the National Advisory Committee for Aeronautics for examination and analysis. The Committee subsequently reported that it appeared that aside from damaging effects in structural strength, the most severe dent found on the stabilizer specimen would not seriously affect the flight characteristics of the airplane.

Although a number of small, medium and large pieces of human bone with portions of flesh attached had survived the fire and were found in the cockpit section, no indication of a fowl was found in the wreckage. Had a fowl struck the windshield and passed into the cockpit, it is reasonable to assume that a portion of it would have survived the fire and could have been identified. The windshield frame, including the center post, and several pieces of windshield glass were found and checked for visual evidence of fowl impact. None was found. However, if a fowl or other external object had struck the upper half of the forward windshield glass and been shunted upward over the top of the

cockpit hatch, no fowl or other evidence would have been found in the wreckage. The shattered glass from the back side of the windshield could have been sprayed back into the faces and eyes of the crew, resulting in their incapacitation.

Through the courtesy of the University of Toronto and Dr. I. H. Erb, Pathologist, Coroner's Department, Toronto, the windshield frame, windshield glass and specimens of foreign material removed from the skin of the empennage, vertical fin and part of the cockpit hatch were analyzed for indications of fowl impact. All laboratory tests in this regard were negative.

The radio receiver and transmitting equipment were so damaged by the impact and subsequent fire that nothing of any consequence concerning its condition and original position could be determined.

As previously stated, the engines and propellers were disassembled and inspected at the Technical Training School, Royal Canadian Air Force, at St. Thomas, Ontario. Although the inspection revealed severe breakage and damage of various parts, it was concluded that all such breakage and damage resulted from impact and subsequent fire. No evidence to indicate malfunctioning of the engines was found. On the contrary, the condition of the propellers, stationary reduction gears, bent crank shafts and impeller drive gears indicated that considerable power was being delivered by both engines at impact.

The master ignition switch assembly was found somewhat protected from the impact and fire. This switch was found in the on position and both individual engine switches were on "both magnetoes".

The fuel tanks were empty and severely damaged. Their appearance definitely indicated that the contents had been catapulted from the interior at impact. Furthermore, the severe damage by fire and intense localized heat around the center section and engines were evidence that considerable fuel had burned.

Four buckles of passengers' seat belts were found. On two of them portions of the belt were held in the latch grips, indicating that the belts were buckled at impact.

There was no evidence to indicate that there had been a structural failure of any component of the aircraft prior to impact. The examination of the wreckage did not reveal any evidence that the aircraft or its controls had been tampered with prior to the accident. No failure of any kind was discovered which could not reasonably be accounted for as a result of the crash or fire.

Conduct of the Flight

The operation of Flight 1 from New York City to Buffalo, New York, was normal with the exception of a slight delay at New York and Newark, New Jersey, due to connections. The dispatching of the flight from New York to Buffalo was in accordance with proper procedure. On the basis of current weather reports and forecasts, clearance was properly issued for instrument operations between these points. Required radio reports were made en route and a normal landing was made at Buffalo. The elapsed flying time required for this portion of the route, considering the winds encountered and the cruising speed of the airplane, was consistent with American's schedule, thus indicating that Captain Cooper did not increase engine power in an effort to make up time lost. Had any untoward event occurred on board the airplane while en route to Buffalo, it should have been reported by radio; certainly it would, in ordinary practice, have been reported upon arrival at Buffalo. No such report was made.

Investigation disclosed that the usual routine procedure was followed during the time Flight 1 was on the ground at Buffalo. In preparing the airplane for the flight to Detroit it was serviced with fuel^{16/} more than sufficient for its destination and alternate airport. Mr. David Cummings, the mechanic on duty, performed the usual service inspection on the airplane. Mr. Cummings, an experienced mechanic, is the holder of an airplane and engine mechanic certificate issued by the Civil Aeronautics Administration. He had been employed by American as a mechanic for 11 years and was personally acquainted with Captain Cooper. In fact, on this night, as well as others, they chatted for a few minutes while the airplane was being inspected. Mr. Cummings said that the captain was normal in all respects. During the time that the airplane was on the ground neither the captain nor the first officer reported that the airplane or its equipment was not functioning satisfactorily. Mr. Cummings' inspection of the aircraft also indicated that it was airworthy prior to departure.

The passengers who left the aircraft at Buffalo, as well as those waiting to go on board, were in personal contact with American's personnel at the ticket counter. The personnel at the ticket counter reported that

^{16/} A test of the gasoline in the truck used to service the airplane was made subsequent to the accident for any water content. A few drops were found in 1250 gallons of gasoline, including that found in the water traps, sumps, etc. This would not be sufficient to affect the efficiency of the operation of the engines.

this part of the operation was routine and that the conduct of the passengers was entirely normal. This evidence is supported by the testimony of a Buffalo police officer who was on duty at the airport terminal at the time. He stated that he observed the incoming and outgoing passengers and that there was nothing unusual in their attitude and conduct.

Investigation was also made as to the baggage and express on board the airplane at the time the accident occurred and the manner in which it was loaded. Only American's personnel are permitted to load the airplane. Furthermore, the distribution of mail, baggage and express that was loaded at Buffalo was directed by First Officer Owens, whose duty it was to remain on board the aircraft and supervise the loading thereof. All the baggage loaded on the aircraft at Buffalo was placed in the forward baggage compartment adjacent to the pilot's cockpit. This placing of the load at Buffalo was in conformity with the loading chart computed by American's personnel at Buffalo and approved by Captain Cooper. There was nothing about the baggage or express that caused the loading personnel to become suspicious or concerned.

The Board having concluded that Flight 1 was dispatched from New York City in accordance with proper procedure, the question arises as to whether the flight was properly dispatched from Buffalo. Investigation disclosed that it was. In fact, the evidence clearly shows that the flight superintendent performed his duties in a most satisfactory manner. He had made a study of the weather conditions existing over the route between Buffalo and Chicago and his decision to clear the flight only as far as Detroit was consistent with safe operating procedures and demonstrated good judgment on his behalf. Although the United States Weather Bureau forecasts and

company forecasts and the weather reports submitted by the captains of Flights 4 and 41 indicated that the weather conditions were satisfactory for operation between Buffalo and Detroit, the flight superintendent nevertheless held Flight 1 at Buffalo until the latest weather sequence reports could be checked. Since these reports showed that the weather was conducive to safe operation as far as Detroit, with Toledo as the alternate airport, Flight 1 was cleared to take off. Captain Cooper had also made a study of the weather reports while at Buffalo and he too was in agreement with the flight superintendent that the weather was satisfactory between Buffalo and Detroit and that the flight should not be cleared beyond that point unless the weather improved.

Captain Cooper, having received the flight superintendent's authorization to continue the flight, obtained his clearance from the company operations agent with the pertinent weather reports attached and took off at 9:07 p.m. Immediately following the take-off Flight 1 called the Buffalo radio station to see that its transmitter and receiver were functioning properly. As previously stated, the transmitter and receiver had been changed to the company's night frequency at Buffalo. This contact was normal and Flight 1 proceeded on its course. In accordance with the dispatching procedure, all radio contacts after leaving Buffalo, with the exception of the radio check, were to be made with American's Detroit station; however, this procedure did not prevent the captain from contacting any of American's stations on the route if it became necessary. At 9:18 p.m. the Detroit station transmitted to Flight 1 the Airway Traffic Control clearance which authorized Captain Cooper to cruise at 4000 feet until the flight reached the vicinity of Florence, Ontario, at which time he would start to descend for Detroit.

Since we have determined that the flight was properly dispatched from Buffalo, the question arises as to whether Captain Cooper complied with the requirements of his flight plan and clearance. The evidence so indicates. Flight 1 reported that it was over Jarvis, Ontario, which is directly on the course, at 9:39 p.m., approximately on time, cruising at 4000 feet and estimated arrival at the Florence intersection at 10:20 p.m. This radio message was not only received by the Detroit station but was intercepted by American's Buffalo and Chicago stations, who, according to normal procedure, have a receiver tuned to the same frequency as Flight 1 and record all messages intercepted. A few minutes later at 9:44 p.m. Flight 1 was again in contact with the Detroit station, at which time the captain was advised that, since weather conditions beyond Detroit had not changed, continuance of the flight beyond that point was doubtful. An examination of the radio records of these stations introduced at the hearing showed the time as well as the exact context of the messages sent and received by Flight 1. The evidence is clear that at no time during the radio conversations did either the captain or first officer indicate that anything was wrong on board the airplane. It is, therefore, reasonable to believe that the flight was proceeding normally at 9:44 p.m., the time of the last radio contact.

An examination of timepieces found in the wreckage, together with the testimony of witnesses, indicates that the accident occurred about 10:10 p.m., 26 minutes after the last radio contact. Since Flight 1 had reported over Jarvis at its proper altitude and approximately on time, and the time estimated for arrival over the Florence intersection seemed normal, there was no reason for the ground stations to become concerned with the flight

until after it was due over the Florence intersection, at which time another report would be expected. Unless the captain or the ground stations have information to transmit to each other, radio contacts with the ground are made only upon arrival over pre-designated positions as the flight progresses along the airway.

Inquiry was made into the possibility of deviation from the normal course between the time that the airplane passed over Jarvis and the time that it arrived in the vicinity of the point where the accident occurred. A number of persons who lived along the airway between Jarvis and the scene of the accident were contacted but none recalled seeing or hearing the airplane pass over. This could be attributed to the fact that it was night and also that numerous aircraft are constantly flying over this area night and day. However, other evidence accumulated during the investigation indicates that the airplane was on its course and at its proper altitude. This conclusion is reached by taking into consideration the time of the last radio position report, the distance covered by the airplane at the time it was observed over the vicinity of St. Thomas, the cruising speed of the airplane, and winds encountered. Moreover, the accident occurred on the airway and approximately 1-1/2 miles to the right of the "on course" signal.

As previously indicated, there is some conflict in the testimony of the witnesses as to the exact conduct of the flight immediately prior to impact. It seems clear, however, that when the airplane arrived in the immediate vicinity of the village of Lawrence Station, Ontario, it deviated from its normal course of flight.

As formerly described, the weather at this point, while not completely clear, afforded ample visibility for safe flight under ordinary operating conditions, and would therefore not appear to have been a substantial factor contributing to the cause of this deviation. No indication of ice on the surfaces of the airplane was observed by persons who arrived at the scene of the crash a few minutes after it occurred. Although this fact alone might not be sufficient to eliminate the possibility of ice, because of the intense heat of the fire which occurred immediately after impact, the fact that no ice was encountered by two flights which had been made over the same route a short time preceding the crash supports the conclusion that no ice was accumulated on the surfaces of the airplane involved in the accident.

The evidence discloses that no other aircraft was in the vicinity of the accident near the time when it occurred. Canadian Government Authorities and representatives of the United States Civil Aeronautics Administration at Buffalo and Detroit reported to this effect, and there were no records of customs clearances along the Canada-United States border at any neighboring points near the time of the accident.

From all the accounts of the witnesses who saw and heard the airplane in flight immediately before the accident, it appears that the airplane was at least partly out of control during its descent. The testimony indicates that the flight path of the airplane from the time it was observed near St. Thomas until the time of the accident was confined to a roughly circular area approximately one and one-half

miles in diameter. There is a conflict of testimony as to whether the airplane circled to the right or to the left upon reaching this area. Although it is possible that the airplane could have been making figure-eight turns, thus indicating to some witnesses that the turns were to the right and to others that they were to the left, a preponderance of the evidence indicates that the airplane was turning steadily to the right. The evidence is also conflicting as to the number of turns which were made before the crash, varying from two to four; and as to the angle at which the airplane made contact with the ground, varying from 45 degrees to 90 degrees. It seems evident from the testimony that the airplane made at least two and perhaps three or four complete circuits on a progressively diminishing radius, apparently banked normally for the radius and speed, alternately losing altitude and regaining it in part, and that it struck the ground at an angle of approximately 70 degrees.

Impressions of witnesses with respect to the flight path of an airplane, based upon visual observation, may easily be erroneous as a result of parallax deception. In the present case, however, the gyrations of the airplane during its descent were quite similarly described by several witnesses whose observations were made from different positions with corresponding differences in directions of view. Under these circumstances, we conclude that the flight path actually executed by the airplane was substantially as previously described.

The manner in which the descent was begun cannot be definitely established. It seems apparent from a consideration of the flight path that, at least during the first part of the descent, the airplane was not in a spin. The evidence indicates that at the time the flight path last appeared to level out before the airplane struck the ground, the airplane probably

stalled. In any event, it seems clear that immediately after levelling out, and perhaps executing a slight climb, the airplane dived to the ground. If the airplane was stalled, the subsequent dive to the ground might well have been the beginning of a spin which was prevented from developing completely into a spin only by the proximity of the ground.

The possibility that some difficulty might have developed in the fuel system as a result of turning the fuel selector valve, in the vicinity of the point at which the airplane descended, for the purpose of using gasoline from a different tank, has been considered. Assuming that the flight had been operating on the left auxiliary tank after take-off from Buffalo, it appears that the gasoline supply of that tank would have decreased to approximately 10 gallons when the flight arrived at a point perhaps 5 to 8 miles east of the scene of the accident, at which time, according to the testimony of one of American's officials, it would have been normal procedure to change to another tank. If such change were not made, the left auxiliary tank probably would have become empty approximately at the point where the descent was begun.

A preponderance of evidence, however, indicates that both engines were operating until the airplane struck the ground. Although three witnesses believed that only one engine was operating, most of the witnesses believed that the sound which they heard was that of two engines. Moreover, the conditions observed during the examination of the wreckage at the scene of the accident and during the subsequent disassembly and inspection of the engines and propellers support the probability that both engines were operating normally.

The fact that the airplane descended with considerable speed in an abnormal attitude, without landing lights on and with flaps up, indicated that a landing was not being attempted. There were several nearby landing areas known to Captain Cooper for which he could have headed had he wished to land. The fact that the ignition switch was found in the "on" position tends to indicate either that the captain and first officer were making every effort to the very end to keep the airplane in flight or that they were unable, as a result of incapacitation, to cut the switch.

A lack of radio communication immediately prior to the time of the accident indicates either that the radio ceased to function or that trouble developed so suddenly and so violently that there was no time to use the radio. However, the fact that all of American's stations concerned with the flight, even Chicago, had been receiving messages from Flight 1 without difficulty indicated that the radio transmitter had been functioning normally.

The singular flight path and attitudes of the airplane immediately preceding the impact, especially in view of the apparent spiral character of the maneuvers described, would seem to lead most naturally and reasonably to the conclusion that a failure or jamming of some element or elements of the control system occurred. The behavior of the airplane during the descent strongly indicates that it was under partial control at the time and suggests a situation in which the pilot might have been unable completely to straighten out the flight path because of a failure of some particular control to respond in the normal manner to his manipulations. As previously stated, however, a thorough examination of all control elements found in the wreckage not only failed to reveal any evidence of breakage, jamming

or other malfunctioning during flight, but on the contrary, gave considerable indication that all such control elements had been in satisfactory working condition until the airplane struck the ground. It appears probable, therefore, that if any failure of the control system occurred it was in some portion which was completely destroyed by fire and the condition of which it was impossible to determine. Whether any such failure occurred, and, if so, what particular element was affected necessarily remains within the realm of speculation.

Assuming that there was no mechanical or structural failure of the airplane or any of its controls, the possibility that the captain and first officer might have become disabled suggests itself.

The hypothesis of complete disability is refuted by the indication that the airplane was at least under partial control. The evidence indicates that the captain and first officer each occupied his usual seat on the left and right side of the airplane, respectively. The condition of the seat belts of both the captain and the first officer indicated that they were fastened at impact. Moreover, a portion of the control wheel was found still grasped by the left hand of Captain Cooper, substantiating the belief that he was manipulating the controls until the moment that impact occurred. Although the evidence has not indicated any particular occurrence that might have resulted in partial disability of the captain and first officer, such an occurrence is of course possible. A control knob (the cold air duct nose valve control knob), normally located adjacent to the right side of the control pedestal, was found imbedded in the captain's right leg. Although this suggests that, at the time of impact, the captain might have had his right leg extended to his right so that it reached into the first officer's side of the cockpit, it is impossible to determine whether the leg was in that position or the knob was inexplicably driven into the leg at an angle.

The body of Captain Cooper was in such condition that it was impossible to establish the exact cause of his death. The Supervising Coroner for Ontario stated that specimens of blood and urine were taken from the body and examined for carbon monoxide and alcohol and that the report of the examination revealed that there was no alcohol present in either blood or urine. The blood specimens were unavoidably in such a state that it was impossible to ascertain whether carbon monoxide was present or absent. The body of First Officer Owens was in such condition that no specimens could be taken.

The possibility that the captain and first officer might have been affected by some sort of food poisoning, as a result of the meal which was eaten between Newark and Buffalo, has been considered. It appears, however, that the food supplied the crew was from the same containers as that which was served to the passengers. None of the passengers who deplaned at Buffalo reported any ill effects from the meal.

There was a conflict of testimony as to whether the ground in the vicinity of the scene of the accident was lighted up immediately prior to the accident. While some witnesses stated that they did not notice any light other than the navigation lights and lights from the windows of the airplane, others testified to seeing a yellow glow of light immediately prior to the crash. One witness stated that as the airplane passed directly overhead very close to the ground there was a flash of light which practically blotted out his vision for about 15 seconds and that about 30 seconds later the same light appeared again after the airplane had traveled further northeast. The conjecture was ventured that the light might have been caused by the dropping of a flare or the turning

on of the landing lights of the airplane. The probability that a flare was dropped is very slight since two flares, the normal supply of the airplane, were found in the wreckage. Although it is possible that the landing lights may have been flashed on prior to the accident in a vain effort to determine the proximity of the ground, this suggestion is contradicted by the positive statements of several witnesses that at no time were the landing lights turned on.

Three possible explanations of the observation of a glow or flash of light are apparent. As the airplane came close to the ground, light from the cabin shining through the cabin windows upon the light mist or suspended vapor condition commonly existing near the earth at the time of year involved would tend to produce a yellow glow. Another possible explanation is found in the exhausts of the engines which, with the airplane descending under power, would probably emit fairly steady flames resulting in an appreciable amount of light or glow when the airplane approached the ground. The third possibility is suggested by a fairly common experience in which the sudden appearance of a bright light creates the impression that the light existed prior to the actual occurrence. Thus, it is not unreasonable to suppose that the impressions of the witnesses with respect to a glow or flash of light may have been the result of the intense light caused by the subsequent fire.

The preponderance of evidence indicates that there was no fire during flight.

The possibility of sabotage has, of course, been considered and explored, but thus far no evidence pointing with any degree of probability to sabotage has been discovered. Investigation of this possibility, as well as others, however, will be continued.

III.

CONCLUSION

Findings

We find, upon all of the evidence available to the Board at this time, that the facts relating to the accident involving aircraft NC 25663, which occurred near St. Thomas, Ontario, Canada, on October 30, 1941, are as follows:

1. The accident which occurred at approximately 10:10 p.m., October 30, 1941, to American Airlines' Flight 1 of that date resulted in complete destruction of aircraft NC 25663 and fatal injuries to the 17 passengers and crew of 3.
2. At the time of the accident American Airlines held a currently effective certificate of public convenience and necessity and an air carrier operating certificate authorizing it to conduct the flight.
3. Captain Cooper and First Officer Owens were physically qualified and held proper certificates of competency to operate as air carrier pilots over the subject route.
4. Aircraft NC 25663 was currently certificated as airworthy at the time of the accident.
5. Flight 1 was cleared in accordance with company procedure from Buffalo, New York, to Detroit, Michigan, with Toledo, Ohio, designated as the alternate.
6. At the time of departure from Buffalo, New York, and at the time of the accident the gross weight of the airplane did not exceed the permissible gross weight and its load was properly distributed.

7. At the time of departure from Buffalo, New York, the airplane carried sufficient fuel to permit flight at normal cruising power to Detroit, Michigan and thereafter to permit it to proceed to its alternate airport with sufficient fuel still remaining in the tanks for about 3-1/4 hours of flight.

8. Weather conditions were satisfactory for the flight and had no causative relation to the accident.

9. Immediately prior to the accident the airplane was proceeding on its normal course and at normal altitude in accordance with the flight plan.

10. When Flight 1 arrived in the vicinity of the point where the accident occurred, the plane commenced to descend, circling to the right and apparently banked normally for the radius and speed of the turns. The diameter of the initial circle was approximately 1-1/2 miles; thereafter during the descent the radius progressively diminished. After completing approximately four circles, the airplane recovered from the spiral in close proximity to the ground, zoomed to an altitude of about 200 to 300 feet and probably stalled. It then dived to the ground, striking in a nose-down attitude at an angle of approximately 70 degrees with the horizontal, and immediately burst into flames.

11. During its descent the airplane apparently was partially but not completely out of control.

12. There was no fire in or about the airplane prior to impact.

13. No evidence of sabotage was discovered.

14. There was no power plant failure prior to the accident, and the engines were functioning normally at the time the airplane struck the ground. Nothing was found to indicate that there had been any structural failure or failure of the control system of the airplane. As a result of the complete destruction of some portions of the airplane, however, it is impossible to eliminate completely the possibility that such failure occurred.

Now, therefore, the Board finds that the evidence presently available and in possession of the Board is not sufficient to permit determination of the probable cause of this accident. The investigation will be continued and in the event of the discovery of further evidence which would enable the Board to ascertain the probable cause of the accident, an appropriate supplemental report will then be issued.

BY THE CIVIL AERONAUTICS BOARD:

/s/ L. Welch Pogue

L. Welch Pogue

/s/ George P. Baker

George P. Baker

/s/ Harilee Branch

Harilee Branch

/s/ Oswald Ryan

Oswald Ryan

/s/ Edward Warner

Edward Warner

APPENDIX A

"AMERICAN AIRLINES TRIP FORECAST ISSUED AT LA GUARDIA
AT 4:30 P.M., EST, OCTOBER 30, 1941.
COVERING ROUTE A.M. 7, FLIGHTS 41 AND 1 FOR THE NEW YORK--
CHICAGO AIRWAY AND COVERING THE PERIOD UNTIL 1:00 A.M. CST
OCTOBER 31, 1941.

"Terminal forecasts: Newark ceiling 2 to 3 thousand feet, overcast, lower broken clouds, visibility 3 to 5 miles; Buffalo ceiling 8 hundred to 12 hundred feet, overcast, lower broken clouds, visibility 1 to 2 miles, intermittent light rain; Detroit ceiling 6 hundred to 1 thousand feet, overcast, visibility $3/4$ to $1\frac{1}{2}$ miles, intermittent light rain and drizzle; South Bend and Chicago ceiling 4 to 6 hundred feet, overcast, lower broken clouds, visibility $3/4$ to $1\frac{1}{2}$ miles, intermittent light rain and drizzle; Cleveland ceiling 2 to 3 thousand feet, overcast, lower broken clouds, visibility 2 to 3 miles, intermittent light rain, ceiling and visibility lowering to 1 thousand to 15 hundred feet and 1 to 2 miles after 9:00 p.m. EST.

"Route forecast: New York to Buffalo: Overcast at 7 to 8 thousand feet with top of clouds 10 to 12 thousand feet. Scattered clouds variable to broken at 3 to 4 thousand feet with top 5 to 6 thousand feet. Air smooth to slightly rough with intermittent light rain. Ceiling in Buffalo sector lowering to 8 hundred feet to 12 hundred feet.

"Route forecast: Buffalo to Chicago: Many variable indefinite layers, ceiling 4 hundred to 1 thousand feet rather variable with top over all above 12 thousand feet. Intermittent light rain. Occasional light drizzle from lower clouds. Visibility $3/4$ to 2 miles. Air smooth to occasionally slightly rough.

"Upper winds: New York to Buffalo at 4 to 6 thousand feet wind from 240 degrees 30 to 40 miles per hour with air temperature 45 to 40. At 8 to 10 thousand feet wind from 250 degrees 50 to 60 miles per hour air temperature 35 to 30 degrees.

"Upper winds: Buffalo to Detroit at 4 to 6 thousand feet wind from 230 degrees 35 to 45 miles per hour air temperature 45 to 40. At 8 to 10 thousand feet wind from 260 degrees 50 to 60 miles per hour air temperature 35 to 30 degrees.

"Upper winds: Detroit to Chicago at 2 to 4 thousand feet wind from 200 to 220 degrees 20 to 30 miles per hour air temperature 50 to 45. At 6 to 8 thousand feet wind from 240 degrees 35 to 40 miles per hour air temperature 40 to 35 degrees. At 10 thousand feet wind from 250 degrees 50 miles per hour air temperature 30 degrees."

APPENDIX B

WEATHER BUREAU AIRPORT STATION, CLEVELAND, OHIO
AIRWAY FORECAST FOR THE PERIOD 5:30 P.M. OCTOBER 30, 1941
TO 1:30 A.M., EST, OCTOBER 31, 1941

"A flat low-pressure trough lies over the Great Lakes Region at 1:30 p.m. EST. An active low-pressure area centered over southern Texas at 1:30 p.m. EST will move northeastward into northern Texas or southern Arkansas by 1:30 a.m. EST and gradient will increase as far north as the southern Great Lakes Region with the advance of the low. Overcast with light rain or drizzle and fog over Michigan, northern Indiana and vicinity of Lake Erie. Ceiling generally 8 to 15 hundred over northern Indiana and Michigan but 4 to 8 hundred in places and lowering generally to 4 to 8 hundred after 8:00 p.m. EST. Visibility 1/2 to 2 miles but ceiling and visibility ZERO in patches by midnight. Ceiling 2 to 5 thousand over the Lake Erie Section with visibility 1 to 3 miles but ceiling lowering to 8 to 15 hundred along the north and northwest shores after 8:00 p.m. EST occasionally 4 to 8 hundred by midnight with visibility occasionally 1/2 mile or less. Mostly overcast at 3 to 6 thousand or higher over Ohio and eastward to the Coast with visibility 2 to 5 miles with haze and smoke occasionally 1 mile or less near industrial centers. Overcast with light rain over central and southern Indiana and Cincinnati--Nashville Airway. Ceiling 1 to 2 thousand and visibility 1 to 3 miles with fog lowering 3 to 6 hundred and visibility occasionally 1/2 mile soon after 7:00 p.m. EST. The rain and fog area with ceiling 4 to 8 hundred and visibility 1/2 to 2 miles will spread northeastward through Indiana, Ohio, and southwestern Pennsylvania by 1:30 a.m. EST with ceiling and visibility lowering to ZERO over the mountains, western Maryland, and southwestern Pennsylvania after midnight. Occasional moderate to heavy rain with near ZERO conditions Louisville--Nashville section after 8:00 p.m. EST. Icing conditions above 5 or 6 thousand over Michigan and extreme northern Indiana.

"Terminal Forecasts:

"Buffalo: Overcast with occasional drizzle or light rain and increasing fog; ceiling 2 to 4 thousand feet and visibility 1 to 2 miles lowering to 1 to 2 thousand feet and visibility 1 mile or less after 9:00 p.m. EST.

"Detroit: Overcast with intermittent drizzle or light rain and fog; ceiling 2 to 4 thousand feet and visibility 2 to 4 miles, lowering to 8 to 15 hundred feet and visibility 1 mile or less by 8:00 p.m. EST and ceiling lowering to 4 to 8 hundred feet after 10:00 p.m. EST; icing conditions above 6 thousand feet."

APPENDIX C

THE 8:30 P.M. EST WEATHER SEQUENCE BETWEEN BUFFALO
AND DETROIT CONSISTING OF OCCASIONAL OBSERVATIONS
OF THE UNITED STATES WEATHER BUREAU, OCTOBER 30, 1941.

BUFFALO, Classification Instrument	Ceiling 35 hundred feet, overcast, visibility 2-1/2 miles, light fog, light smoke, sea level pressure 1024.7 millibars, temperature 48, dew point 44, wind southeast. 3, altimeter setting 30.23.
DUNKIRK	Ceiling 5 thousand feet, overcast, lower broken clouds, visibility 5 miles, light fog, temperature 45, dew point 44, wind calm.
ERIE, Special Observation	Ceiling estimated 6 thousand feet, broken clouds, visibility 1-1/2 miles, light ground fog, sea level pressure 1025.1 millibars, temperature 48, dew point 46, wind calm, altimeter setting 30.25.
JARVIS	Ceiling 36 hundred feet, overcast, visibility 1-1/4 miles, light fog, sea level pressure 1024.9 millibars, temperature 44, dew point 44, wind north 4, altimeter setting 30.24.
GLENCOE	Ceiling unlimited, high overcast, lower scattered clouds at 55 hundred feet, visibility 1 mile, light fog, sea level pressure 1025.7 millibars, temperature 44, dew point 43, wind calm, altimeter setting 30.26.
PERRY	Ceiling 41 hundred feet, overcast, visibility 2 miles, light fog, temperature 49, dew point 47, wind calm.
CLEVELAND, Classification Instrument	Ceiling 36 hundred feet, overcast, visibility 1-1/4 miles, light smoke, sea level pressure 1024.4 millibars, temperature 53, dew point 48, wind calm, altimeter setting 30.23.
DETROIT CITY AIRPORT, Classification Instrument	Ceiling estimated 5 thousand feet, overcast, visibility 2-1/2 miles, light rain, light smoke, sea level pressure 1025.4 millibars, temperature 46, dew point 42, wind north 2, altimeter setting 30.26.

DETROIT
WAYNE COUNTY AIRPORT
Classification Instrument

Ceiling 5 thousand feet, overcast,
visibility 1-1/2 miles, light smoke, sea
level pressure 1024.7 millibars, temperature
45, dew point 43, wind north-northeast 8,
altimeter setting 30.23.

SELFRIDGE FIELD

Ceiling 35 hundred feet, overcast,
visibility 1-1/4 miles, light fog, light rain
shower, sea level pressure 1025.4 millibars,
temperature 45, dew point 44, wind north-
west 6.

MALTON

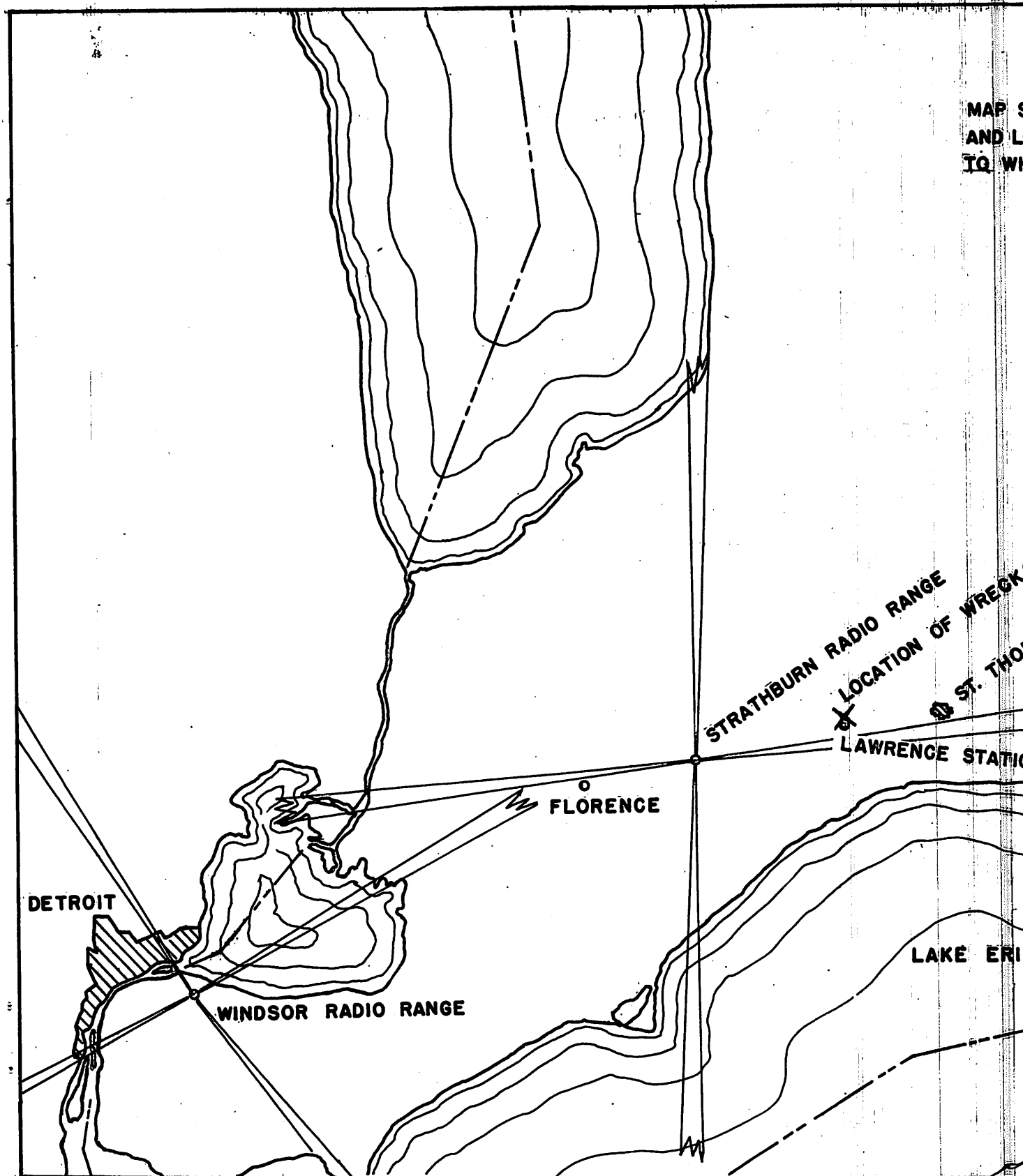
Ceiling 2 hundred feet, overcast, visibility
3/4 mile, light rain, light fog, sea level
pressure 1025.3 millibars, temperature 43,
dew point 41, wind calm, altimeter setting
30.24.

LONDON

Ceiling 8 hundred feet, overcast, visibility
2 miles, light rain, light fog, sea level
pressure 1025.4 millibars, temperature 44,
dew point 43, wind south-southwest 2,
altimeter setting 30.25, ceiling ragged.

WINDSOR

Ceiling 12 hundred feet, overcast, visibility
3 miles, light rain, hazy, sea level pressure
1025.4 millibars, temperature 46, dew point
44, wind northeast 4, altimeter setting 30.25,
ceiling ragged.



5-21000

