

C I V I L A E R O N A U T I C S B O A R D  
A I R C R A F T A C C I D E N T R E P O R Tdated: **March 19, 1963**Released: **March 22, 1963**

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UNITED AIR LINES, INC., VICKERS-ARMSTRONGS VISCOUNT, N 7430,  
NEAR ELLICOTT CITY, MARYLAND, NOVEMBER 23, 1962

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SYNOPSIS

United Air Lines Flight 297, a Vickers-Armstrongs Viscount Model 745D, N 7430, crashed in a wooded area six miles west-southwest of Ellicott City, Maryland, at approximately 1224 e.s.t., on November 23, 1962. All thirteen passengers and a crew of four were fatally injured.

Flight 297 was en route from Newark, New Jersey to Washington, D. C. The flight was operating at an assigned altitude of 6,000 feet when it apparently penetrated a flock of Whistling Swans. At least two of these swans were struck by the aircraft. One swan collided with the right horizontal stabilizer inflicting superficial damage only. The other bird punctured the left horizontal stabilizer, traveled through the structure, and dented the elevator as it egressed. The weakened structure failed in this area, rendered the aircraft uncontrollable, and resulted in the aircraft striking the ground in a nose-low inverted attitude.

The Board determines that the probable cause of this accident was a loss of control following separation of the left horizontal stabilizer which had been weakened by a collision with a Whistling Swan.

### Investigation

United Air Lines Flight 297, a Vickers-Armstrongs Viscount, Model 745D, N 7430, was a regularly scheduled passenger flight from Newark, New Jersey to Atlanta, Georgia, with planned en route stops at Washington, D. C., Raleigh-Durham and Charlotte, North Carolina. It crashed at approximately 1224 <sup>1/</sup> on November 23, 1962, in a wooded area six miles west-southwest of Ellicott City, Maryland. All thirteen passengers and a crew of four were fatally injured.

An Instrument Flight Rules clearance was issued, clearing the flight in accordance with its flight plan, to Washington National Airport via direct Solberg VORTAC, Victor 3 to the Westminster VOR, the 202-degree radial of Westminster to Potomac Intersection, direct Washington. The estimated time en route was one hour at a true airspeed of 260 knots. The aircraft was properly dispatched and the captain and first officer were properly certificated.

Flight 297 departed Newark at 1139. Following a position report at West Chester VORTAC at 1203, control of the flight was transferred from the New York Air Route Traffic Control Center to the Washington Center. The flight progressed normally and at 1214, was cleared to descend from 10,000 to 6,000 feet. The following advisory was issued to United 297 at 1219: "Be advised there's been numerous reports of considerable amount of ducks and geese around this area." This report was acknowledged, and a radar handoff to Washington Approach Control effected at 1220. After reporting level at 6,000 feet, Flight 297 contacted Washington Approach Control on the assigned frequency of 120.8 mcs. At 1222 the following transmission was made by approach control: "United 297, radar contact, turn left heading two zero zero, radar vector omni final approach course

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<sup>1/</sup> All times herein are Eastern Standard based on the 24-hour clock.

via Alexandria Intersection, landing runway three six, wind northwest ten, altimeter three zero three seven." This transmission was acknowledged and the altimeter setting verified. An additional vector to 180 degrees was transmitted at 1223; however, there was no reply from the flight. At 1224 it was determined that radar contact had been lost.

The nearest official weather observing station to the scene of the crash was at Friendship International Airport, Baltimore, Maryland. The 1200 report indicated scattered clouds at 5,000 feet, 20 miles visibility. This was followed at 1300 by a report of clear, and 20 miles visibility.

Statements were obtained from several eyewitnesses to the accident. Their vantage points bracketed the crash site. A consensus of their observations is that N 7430, when first sighted, was at a very low altitude turning to the left on an east or southeast heading. The aircraft abruptly rolled inverted and disappeared through the trees in a near vertical attitude. Some shiny objects, later identified as parts of the aircraft, were observed falling in the immediate area of the crash. The attention of some witnesses was attracted to the aircraft initially by an unusual noise, the origin of which has not been determined.

A statement was also obtained from a pilot who was flying in the vicinity of Beltsville, Maryland, at approximately 1230 on the date of the accident. He reported sighting a flock of approximately 50 very large white birds flying in trail, and estimated their altitude to be 5,500 feet, level with him in an area bounded by Ellicott City, Savage, and Clarksville, Maryland. This position would place the birds within a maximum distance of eight miles from the crash site. He was uncertain of their flightpath, because of insufficient relative motion.

There were also reports from airline pilots flying in the area, that radar contacts reported to them by Washington Center were in fact large flocks of birds. In addition to these reports, the Weather Bureau radar log at Washington National Airport indicates echoes described as "birds" or "angels" <sup>2/</sup> which were sighted throughout a period from 0815 until 1705. At 1245 these echoes were described as scattered over a 30 mile radius from the station moving from the north-northeast at 30-40 knots. The crash site is approximately twenty-three miles from the radar site.

A plot showing the location of eyewitnesses, as well as a triangle representing the estimated position of the flock of birds sighted at 5,500 feet, is included in this report as Attachment A.

Examination of the main wreckage site, six miles west-southwest of Ellicott City, Maryland, indicated the aircraft struck the ground in an inverted attitude, at an angle of 46 degrees measured from the horizontal. The heading at impact was 132 degrees. There was no evidence of in-flight fire, but a severe ground fire following impact consumed the major portion of the fuselage, right wing, and the left wing inboard of the No. 1 engine. Parts of the left and right horizontal stabilizers and elevators separated in flight. The left horizontal stabilizer and elevator parts were located in an area ranging from 930 feet on a magnetic bearing of 29° counterclockwise about the main crash site to 2,050 feet on a magnetic bearing of 347°. The right horizontal stabilizer and elevator parts were recovered in an area ranging from 2,908 feet on a magnetic bearing of 278° to 1,272 feet on a magnetic bearing of 211°.

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<sup>2/</sup> Contacts of unknown origin, not associated with precipitation, thought to be birds or insects.

Bird remains were found on both horizontal stabilizers, indicating two distinct bird strikes on these surfaces. Superficial damage occurred on the right horizontal stabilizer, 22 inches outboard of the fuselage. This strike was a glancing blow and did not result in penetration. The other strike was on the left horizontal stabilizer, approximately 49 inches outboard of the fuselage. <sup>3/</sup> In this instance the bird penetrated the leading edge and passed through the leading edge member. Continuing aft the bird fractured the spar web, partially separating it from the top and bottom caps, and then made final contact with the lower leading edge of the elevator, which resulted in denting but no penetration.

The left horizontal stabilizer and elevator failed along a chord plane generally following the travel of the bird through the structure. The direction of failure was downward and slightly aft. In addition to this failure, the right horizontal stabilizer and elevator separated downward and aft approximately 57 inches from the fuselage. Subsequently, the weakened inboard portion of this horizontal stabilizer also failed.

The severe ground fire damage following impact eliminated any possibility of discovering evidence of additional bird strikes which might have occurred on other portions of the aircraft.

All four engines and associated propeller assemblies were recovered at the main crash site. Subsequent teardown and detailed examination of the powerplants revealed that the propeller blade angles were in the flight power regime, above the flight-fine-pitch setting. All four reduction gear coupling shafts had extensive multiple spiral type fractures, further indicating power at impact.

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<sup>3/</sup> See Attachment B.

There was no evidence of bird ingestion or any abnormal conditions in the operation of any of the engines prior to impact.

Subsequent to the accident, a partial bird carcass consisting of a large piece of skin covered with white feathers was found 10 feet from the separated section of the left horizontal stabilizer. The skin measured 19 inches in length and 9 inches in width. Specimens of feathers, tissue and blood were obtained from the separated parts of the aircraft, and that portion of the horizontal stabilizer still attached to the fuselage. The Chief Medical Examiner for the State of Maryland determined these tissue and blood specimens to be of bird origin. The specimens and carcass were then taken to the Fish and Wildlife Service of the U. S. Department of the Interior. They identified the bird by examination of feathers and bones to be an Olor Columbianus (whistling swan). The largest concentration of these birds on the North American Continent at this time of year is in the Chesapeake Bay area. The average weight of the birds available at the Fish and Wildlife Service was 14 pounds for the male and 11.5 pounds for the female; however, they are known to attain weights in excess of 18 pounds.

The aircraft was equipped with a Lockheed 109C flight recorder. It was recovered at the main crash site and removed to the Board's headquarters in Washington, D. C., for readout. Information obtained from this recorder indicates heading, airspeed, vertical acceleration, and altitude traces became suddenly excursive at approximately the same time. In less than one minute from this point the altitude went from approximately 6,000 feet to ground level and the airspeed increased from 240 to 365 knots IAS and then dropped sharply into an unreliable range. During this same interval the heading varied erratically

generally in an area of 210 degrees to 180 degrees, and the vertical acceleration changed from a reading of 1.7 positive to a variable 3 negative G's.

A detailed study of the current flight logs and maintenance records, engineering releases, and airworthiness directives was conducted. This reflected the aircraft to have been continuously maintained in accordance with FAA airworthiness standards and United Air Lines' policies and procedures.

### Analysis

Flight 297 progressed according to flight plan, with no indication of any mechanical difficulty being disclosed in their many communications with ground stations en route. The weather along the route of flight is not considered a contributing factor to the accident.

As a result of the numerous radar contacts by Washington Center, which were identified as bird flocks, other pilot reports and ground observers sightings of flocks in the entire general area of the accident, there is no doubt that a definite hazard of in-flight collision with birds existed at the time of the accident.

Investigation disclosed that N 7430 struck two birds, one on the left horizontal stabilizer and one on the right. The damage inflicted by each of these birds is at great variance, and therefore was the subject of close examination. The determining factor in the degree of damage was the angle of impact in relation to the surface of the airfoil at the point of impact. If the bird's line of force were elevated above or below the most forward point of the leading edge of the horizontal stabilizer, the angle of contact would become more oblique, thereby diminishing the force imposed, and consequently the likelihood of penetration.

The bird impacting the right horizontal stabilizer struck the leading edge surface 2-3 inches above the most forward point of the leading edge. Curvature of the airfoil in this area resulted in impact on a surface sufficiently oblique to the line of force to produce bird deflection rather than penetration. The result was superficial damage only.

In contrast to this, the bird strike on the left horizontal stabilizer was concentrated nearly at the most forward point of the leading edge. At this point the angle between the line of force and the stabilizer skin resulted in penetration. The damage sustained in this instance weakened the structure so that the normal down load initiated immediate failure of the horizontal stabilizer and elevator along a chord plane directly aft of the initial impact point. As these parts failed downward and slightly aft, a violent instantaneous nose-down pitching moment was generated. During the left horizontal stabilizer failure sequence, the elevators were displaced beyond their limit, trailing edge upward, thus imposing a severe down load on the right horizontal stabilizer which also failed downward. As the outboard 11 feet of the right horizontal stabilizer and elevator were in the process of separation they weakened the structure of the remaining inboard stabilizer section, which subsequently separated prior to impact. This breakup rendered the aircraft uncontrollable.

#### Discussion of the Bird Strike Problem

Collision with birds has, of course, been a problem for many years, but during aviation's formative years it was predominantly one of nuisance. The speed of earlier aircraft was such that damage was usually minor. This slow speed also resulted in slow rates of closure and short maneuver distance so that some degree of evasion was possible. Even then, however, it was recognized that airplanes had a prime point of vulnerability -- the windshield, and following



several years of study and testing, regulations were promulgated to require a measure of protection through the use of strengthened windshields.

One of the more notable studies was conducted by the Civil Aeronautics Administration between the years 1942 and 1946 during which time bird strike data were collected, collated and analyzed. The resulting report <sup>4/</sup> showed that of all bird strikes to all areas of airplanes, 28 percent were to windshields and that, of the strikes resulting in damage classified as severe, windshields were involved in 37 percent of the cases. The report further produced some additional figures which indicated that strikes to other parts of the aircraft did not pose a serious hazard:

<u>Strike Area</u>	<u>Percent of Total Strikes</u>
Fuselage	31
Powerplant	9
Wings	23
Other	4
(e.g. antennas, landing gear, and empennage <sup>5/</sup> )	

In consideration of the fact that serious damage to such items as antennas, dents and even holes in wings, cowlings, and fuselage do not in themselves render an aircraft incapable of further flight, the industry was justifiably satisfied at that time that further "birdproofing" requirements were unnecessary. This is not to imply that progress ceased, for certainly the industry has constantly strived for and achieved product improvement and increased safety levels, but following the windshield program there was no industry-wide, concerted effort toward further "birdproofing," nor was there any indication of its necessity.

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4/ Kangas and Pigman, Collision of Birds with Aircraft in Scheduled Commercial Operations in the Continental United States, TDC Report No. 62, CAA, 1949.

5/ Only 1 of 473 reported collisions caused considerable damage to a tail surface.

The referenced report, written in 1949, contained among its conclusions one which remained valid for many years.

"No record exists of any fatality in air carrier operations in the United States caused by collision of aircraft with birds."

The validity ended with the crash of a Lockheed Electra at Boston, Massachusetts on October 4, 1960. This accident clearly demonstrated that even small birds, if in sufficient numbers, could precipitate a chain of events which could render a modern aircraft uncontrollable.

A series of tests and studies were initiated shortly after the Boston accident ranging in subject from the specific engine involved to general analyses of bird populations on and near airports and how best to cope with them. In regard to the latter, the United States Department of Interior issued a short, highly informative report <sup>6/</sup> which should be of interest to anyone associated with the problem.

Following the initial engine tests referred to above, the Federal Aviation Agency, on the Board's recommendation, started a more extensive test program into turbine engine bird ingestion, and the resulting power loss and recovery patterns. The Board is hopeful that this program, still in progress, will lead to developments which will further improve the already high safety level of the turbine engine.

The Viscount accident of November 23 has, in the opinion of the Board, revealed a more perplexing problem. The Board determined that the probable cause of the Boston Electra accident was the unique and critical sequence of the loss and recovery of engine power following bird ingestion, resulting in loss of

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<sup>6/</sup> Aldrich, et al., Bird Hazard to Aircraft, Wildlife Leaflet 429, U.S. Dept. of Interior, Fish and Wildlife Service, Washington 25, D. C., January 1961.

airspeed and control during takeoff. One might even reason, and with some logic, that if the initiating conditions were to be repeated over and over, another accident probably would not result. In the instant case, however, one bird caused immediate separation of a horizontal tail surface, rendering the aircraft permanently out of control. Unlike the Boston case, the ensuing chain of events was a product of, instead of contributory to, the cause of the accident, and no change in these events would have altered the outcome to any meaningful degree.

The Board, in the analysis of this accident and its effect on the industry and the public, has made the following observations which it considers to be most appropriate to the bird strike problem:

1. The low incidence of tail strikes noted in CAA TDC Report 62, 1949, may no longer be true as a result of the changes in aircraft design. The horizontal stabilizers of transport aircraft of that early era were shielded by propeller discs and wings and were relatively protected from strike damage. Many of the prop-jet aircraft have the tailplanes mounted higher than the top of the propeller discs; the jet aircraft, of course, have no discs and their high mounted tails make them even more vulnerable. The trend toward the T-tail and the canard supersonic designs is interesting in that the horizontal stabilizer has no protection afforded by the fuselage, wings, and powerplants.
2. The considerably higher climb and descent speeds of current generation aircraft can result in a higher percentage of severe structural damage strikes than reported in the earlier survey.

3. Although the subject strike involved failure of a tail surface, conceivably tomorrow some other vital component such as a spoiler, wing flap, control surface, control tab, etc., could be involved. Impairment of a vital control function could have equally catastrophic consequences. Clearly, therefore, consideration should be given to broadening the present requirements to insure overall protection against catastrophic damage from bird strikes.

4. CAA TDC Report 62 has been of considerable value in evaluating the importance of the bird strike problem. Unfortunately, however, it is outdated and a new study, based on the currently operating aircraft and the greater traffic density, is indicated.

The Board recognizes that any project established to evaluate and attempt solution of catastrophic bird strike damage will be a colossal undertaking, but the problem is no less colossal. Accordingly, the Board has recommended to the Administrator that the program already underway in this regard be expanded to include consideration of broadening the present bird strike requirements. It has been further recommended that physical testing be included to corroborate any analytical studies, and that a new survey of bird strikes be made along lines similar to those reported in TDC Report No. 62. The Administrator has advised the Board that the Federal Aviation Agency is now formulating a series of bird strike tests, and that it is exploring all aspects of the overall problem from both the engineering and operational point of view.

Probable Cause

The Board determines that the probable cause of this accident was a loss of control following separation of the left horizontal stabilizer which had been weakened by a collision with a Whistling Swan.

BY THE CIVIL AERONAUTICS BOARD:

/s/ ALAN S. BOYD  
Chairman

/s/ ROBERT T. MURPHY  
Vice Chairman

/s/ CHAN GURNEY  
Member

/s/ G. JOSEPH MINETTI  
Member

/s/ WHITNEY GILLILLAND  
Member

## S U P P L E M E N T A L D A T A

### Notification

The Civil Aeronautics Board was notified of this accident at approximately 1240 e.s.t., November 23, 1962. An investigation was immediately initiated in accordance with the provisions of Title VII of the Federal Aviation Act of 1958.

### Air Carrier

United Air Lines, Inc., is a Delaware corporation with headquarters at O'Hare International Airport, Chicago, Illinois. The company holds a currently effective certificate of public convenience and necessity issued by the Civil Aeronautics Board, and a current air carrier operating certificate issued by the Federal Aviation Agency. These certificates authorize the operation over a number of routes including the one here involved.

### Flight Personnel

Captain Milton J. Balog, age 39, held current airline transport pilot certificate No. 171307 with a type rating in Vickers-Armstrongs Viscount. His last first-class FAA physical examination was September 17, 1962. His last proficiency check was on July 18, 1962.

First Officer Robert J. Lewis, age 32, held airline transport pilot certificate No. 1023402; however, because his last FAA physical was dated November 9, 1961, it was not current for pilot-in-command duties. Under these circumstances his certificate was valid as a commercial pilot certificate and he was qualified for the flight. His last proficiency check was on November 10, 1962.

Stewardess Mary Kay Klein completed her company training on June 11, 1962, and was assigned to the line on June 21, 1962.

Stewardess Kaaren G. Brent completed her company training on August 6, 1962, and was assigned to the line on August 16, 1962.

### The Aircraft

N 7430 was a Vickers-Armstrongs Viscount Model 745D, serial number 128 manufactured June 30, 1956. It had a total flying time of 18,809:34 hours with 68:59 hours since the last No. 2 inspection, 258:48 hours since the last No. 4 inspection, and 1400:02 hours since the last block overhaul.

The aircraft was powered by four Rolls-Royce Model Dart 510 engines. The total time since overhaul for No. 1 was 1,951:25 hours; No. 2: 1,956:28 hours; No. 3: 1,305:05 hours, and No. 4: 2,412:58 hours.

The propellers were ROTOL Limited Model R130/4-20-4/12E with total time since overhaul on No. 1: 4,401:58, No. 2: 3,524:53, No. 3: 1,315:17, and No. 4: 1,935:06.

**CRASH SITE**

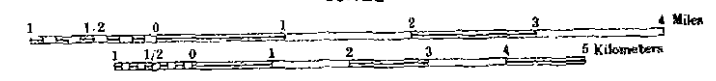
*Estimated position of birds sighted  
by pilot at approximately 1230,  
November 23, 1962*

**CONVENTIONAL SIGNS**

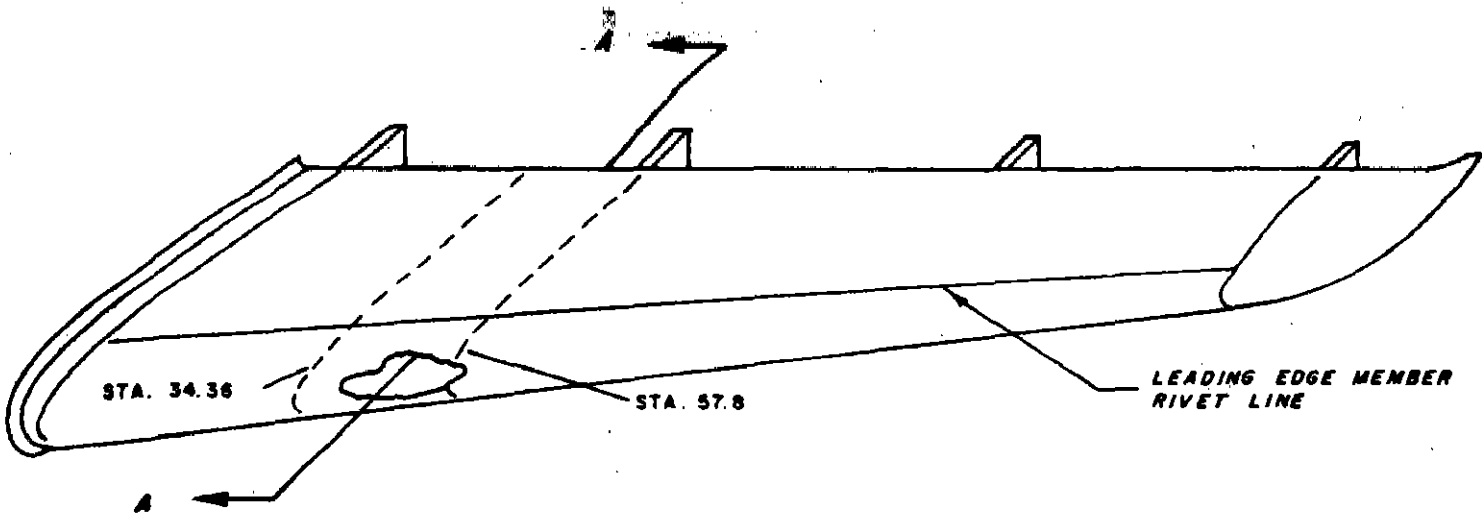
**CULTURE**  
*(marked as block)*


**WITNESSES LOCATION MAP  
UNITED AIRLINES ACCIDENT  
VISCOUNT N7430  
NOVEMBER 23, 1962**

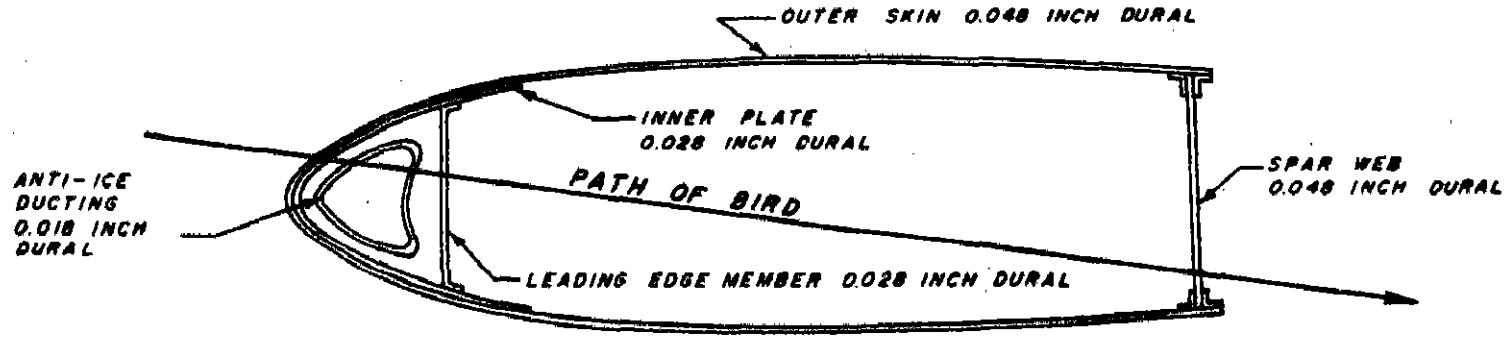
**SCALE**







LEFT HORIZONTAL STABILIZER



SECTION A-A

CROSS SECTIONAL VIEW OF STABILIZER IN BIRD STRIKE AREA

NOT TO SCALE