

CIVIL AERONAUTICS BOARD
ACCIDENT INVESTIGATION REPORT

Adopted: November 25, 1953

Released: December 1, 1953

WESTERN AIR LINES, INC., DC-6B, SAN FRANCISCO BAY, CALIFORNIA,
APRIL 20, 1953The Accident

Western Air Lines' Flight 636, a Douglas DC-6B, N 91303, crashed in San Francisco Bay approximately midway between San Francisco International Airport and Oakland Municipal Airport at about 2308 PST^{1/}, April 20, 1953. Two of the 10 occupants, a stewardess and a male passenger, survived. The aircraft was demolished and sank.

History of the Flight

Flight 636 originated in Los Angeles for Oakland, California, with an intermediate scheduled stop at San Francisco, California. Captain Robert E. Clark, First Officer Robert C. Jacobson, Flight Engineer Robert R. League and Stewardesses Barbara Brew and Beverlee Nelson comprised the crew. There were 35 passengers upon departure from Los Angeles and 2,165 gallons of fuel. The gross weight was 83,952 pounds, 3,925 pounds less than the allowable maximum, and the load was properly distributed with respect to the center of gravity of the aircraft.

Weather conditions over the route Los Angeles-San Francisco-Oakland were well above prescribed minima and forecast to remain so for the duration of the flight. A flight plan was filed with Air Route Traffic Control at Los Angeles, and the flight was cleared on an Instrument Flight Rules flight plan from Los Angeles to San Francisco via Airways Amber 8, Victor 27, Victor 25 and Blue 54, to cruise at 13,000 feet MSL. Elapsed time to San Francisco was estimated as one hour and 30 minutes. Visual Flight Rules were specified for the San Francisco-Oakland segment. Oakland and Sacramento were chosen as alternate airports for San Francisco.

Departure from Los Angeles was at 2100. The flight proceeded in a routine manner at its assigned altitude arriving at San Francisco at 2240.

Thirty passengers deplaned, five remained aboard for Oakland and no other passengers boarded. During the stop at San Francisco, a walk-around inspection of the aircraft was performed by the flight engineer and a Western Air Lines mechanic; it revealed no discrepancies. Fuel aboard was 1700 gallons; none was added nor was maintenance accomplished at San Francisco.

The weather observations for the San Francisco Bay area at about the time of takeoff from San Francisco were:

^{1/} All times herein are Pacific Standard and are based on the 24-hour clock.

San Francisco -

2300 - Measured ceiling 800 feet, broken clouds. Visibility
10 miles, wind west-southwest 7, altimeter setting 29.89.

2315, 10 minutes after takeoff:

San Francisco - Measured ceiling 900 feet, broken clouds. Visibility
10 miles, wind west-southwest 10, altimeter setting 29.88.

Oakland -

2300 - Measured ceiling 700 feet, overcast. Visibility
10 miles, wind west-southwest 4, altimeter setting 29.89.

2312, seven minutes after takeoff:

Oakland - Measured ceiling 800 feet, overcast. Visibility
10 miles, wind west-southwest 4, altimeter setting 29.89.

Flight 636 was cleared direct to the Oakland tower, to remain clear of clouds at a minimum altitude of 500 feet. Takeoff was on Runway 28R at 2305.

Two minutes later, at 2307, the flight called Oakland, advised that it was on a trans-bay clearance to the Oakland tower and requested further clearance to the airport. Oakland tower cleared Flight 636 to enter the traffic pattern for landing on Runway 27R, and gave the wind west at 10 miles per hour. Acknowledgment was the last contact with Flight 636.

Investigation

Testimony of witnesses firmly established the fact that Flight 636 was normal and routine in all respects between Los Angeles and San Francisco. A walk-around inspection of the aircraft at San Francisco and the absence of any complaints of mechanical or other difficulties by the captain, indicates that N 91303 was airworthy upon departure from that station. It is therefore unnecessary to dwell further on this phase of the flight.

On departure from San Francisco, the gross weight, fuel aboard and the weather conditions were well within the limits prescribed by the Civil Air Regulations and Western Air Lines.

The clearance under which this flight departed San Francisco is known as "Visual Trans-Bay" and is used for traffic between San Francisco and Oakland. It is issued when the ceiling and visibility at both airports is less than 1,000 feet and/or three miles visibility and a minimum combination of ceiling and visibility (sliding scale) is required for its issuance. This procedure was established through the medium of a Joint Operations Letter Revised effective April 10, 1952, for the purpose of expediting traffic between San Francisco and Oakland. The applicable parts of this letter are set forth

below.^{2/} The ceiling and visibility at San Francisco was 800 feet and 10 miles 700 feet and 10 miles at Oakland.

2/ Dept. of Comm. - CAA - LAX - Region Six - "Joint Operations Letter - Revised effective April 10, 1952. Oakland Air Route Traffic Control Center No. 18. Oakland Airport Traffic Control Tower No. 7. San Francisco Airport Traffic Control Tower No. 4. SUBJECT: CONTROL OF TRANSBAY TRAFFIC - SAN FRANCISCO AND OAKLAND.

"1. GENERAL

The following procedures are established for the purpose of expediting the flow of transbay traffic between the Oakland and San Francisco Airports under certain IFR weather conditions. Control procedures will be applied in conformance with the ANC Manual of Operations, Procedures for the Control of Air Traffic, except for the deviations contained in these instructions.

"2. CONTROL AUTHORITY

Authority for the control of transbay flights is delegated to the San Francisco and Oakland Towers under the following conditions:

A. Visual Flights

- (1) Whenever the ceiling or visibility is less than 1,000 feet and/or three miles, a clearance will be required for all transbay visual flights. Flight altitudes during these weather conditions shall be not more than 1,000 feet and not less than 500 feet.
- (2) Transbay visual flights shall not be conducted under weather conditions less than the following sliding scale minimums:

Ceiling	1,000 feet	minimum	visibility	1 mile
"	900	"	"	"
"	800	"	"	2 miles
"	700	"	"	3 "
"	600	"	"	4 "
"		"	"	5 "

"4. MISSED APPROACH PROCEDURES - TRANSBAY VISUAL FLIGHTS

A. In the event a transbay visual flight is unable to maintain visual contact with the land or water, such flights will immediately advise approach control at the destination airport and execute the following procedure:

- (2) San Francisco to Oakland Flights: Proceed on a heading to intercept the northwest course of the Oakland range, climbing to missed approach altitude of 2,000 feet and hold northwest of the Oakland range station in a one-minute elliptical holding pattern, all turns west of course."

Flight 636 took off on Runway 28R at 2305, turned to its right in the direction of Oakland Airport and two minutes later reported to Oakland tower at 2307: "Oakland tower this is Western 636, off San Francisco, Trans-Bay, landing instructions, over." The Oakland tower replied by issuing the following clearance: "Western 636, Trans-Bay, cleared to enter traffic pattern, Runway 27 Right, wind west one zero." The flight acknowledged these instructions.

It is to be noted that at 2301, four minutes before 636 took off from San Francisco, the San Francisco tower called Oakland tower on the interphone and requested a trans-bay clearance for this flight. The Oakland tower replied by issuing the following clearance: "Western 636 is cleared to the Oakland tower via the direct route, remain 'clear of clouds'." The distance between the two airports is approximately 11.5 statute miles. Tower operators in both places stated that they could see the lights of the opposite airport clearly and distinctly at the time.

The Oakland surveillance radar detected Flight 636 just as it was completing the right turn toward that airport and continued to observe it until it was within range of the six-mile scale at which time it was followed on the shorter range scope. At about 2308 tower operators in both Oakland and San Francisco saw a large orange colored flash in the direction of the aircraft's track. The target disappeared from the radar scope at this moment and the radar operator marked its last position as 5.5 miles, on a bearing of 217°, from the Oakland radar. Attempts to contact Flight 636 by both San Francisco and Oakland towers were unsuccessful.

The Oakland tower immediately alerted the San Francisco Coast Guard station and the Alameda Naval Air Station. The Coast Guard quickly dispatched two helicopters and three airplanes to the area, the helicopters being guided by Oakland radar. They illuminated the scene with landing lights and directed the aircraft to a position over the overcast directly above the floating debris from which flares were dropped. The fixed wing aircraft came below the overcast and reported its base as 500 to 600 feet above the water, with visibility restricted to approximately two miles. A helicopter pilot reported that visibility below 300 feet was 12 miles or better and that he could clearly see the lights on both sides of the bay. One stewardess and a male passenger were rescued by a Coast Guard boat and six bodies were recovered by Coast Guard and naval vessels. Bodies of the captain and the flight engineer were not found.

The crash occurred in water averaging 30 feet in depth at mean low tide. A variety of relatively small parts of the aircraft were recovered, the largest of which was the wing center section with the two main landing gears attached. Inspection revealed that the landing gear was fully retracted at impact. One propeller hub with the blades bent and broken was recovered but was damaged to such an extent that blade pitch settings and RPM at the time of impact was indeterminable. The four engines were not recovered because of deep, soft mud on the bottom.

Stewardess Nelson stated that she was seated in the aircraft's lounge at time of takeoff from San Francisco, and that the takeoff appeared to be normal in all respects. She did not notice whether the "No Smoking" sign

was on or not. When about five minutes out she sensed what she thought was the beginning of a gradual descent. She said she thought the aircraft had some degree of flap owing to the sound of the slipstream, and at this time she heard a decrease in power such as she was accustomed to hearing in the course of a normal landing. She then heard and felt what she presumed to be the nose-wheel striking the runway though she thought it was too soon to be landing at Oakland. Miss Nelson said she was in the water for about one hour before her rescue.

The passenger, Vilas F. Adams, stated that the takeoff from San Francisco was normal and that he could see the lights on both sides of the bay. When over the water, he said, the aircraft banked to the right and headed for Oakland. After about two minutes, Mr. Adams stated that he was still looking at the lights ashore and judged the aircraft to be about 500 feet high. Then, the next thing he noticed was that "we were about 20 feet off the water -- and it appeared that we were below the lights, like we were under them." He then said that in "maybe 15 seconds" the aircraft was down about 10 feet. Following this, he said he unfastened his seat belt and stood up, whereupon the crash occurred, accompanied by a blinding flash. Mr. Adams also stated that the flight was well below the clouds at all times and that the surface of the water appeared smooth. No turns nor abnormal maneuvers were made, after the right turn to get on course, according to this witness. The wings were level, he said, with the nose slightly down. There was no backfiring nor coughing of the engines and they were all running smoothly at the time of impact, he added. Mr. Adams estimated that he was in the water about 50 minutes before his rescue.

Complete disintegration of the cabin allowed Miss Nelson to step out of the rear section of the cabin and into the water, and Mr. Adams was thrown out as the cabin broke open on impact.

The rescuing helicopters reported that at 2330 there were scattered to broken clouds in the area of the crash scene at about 400-500 feet, and that it was necessary to descend from their cruising altitude of 600 feet in order to stay clear of clouds, at which altitude the visibility was about two miles. In the immediate vicinity of the crash scene, at altitudes of 300 feet and below, visibility improved and lights on both sides of the Bay were plainly visible. The air was smooth below the overcast.

Crews of other flights operating trans-bay within the hour before and after the accident reported ceilings varying from 400 to 1,000 feet and visibilities 12 to 15 miles.

The pilot in command, Captain Clark, had a total of about 79 hours in Douglas DC-6B type aircraft and approximately two and three-quarters hours of instrument time thereon. He had recently been transferred to the Los Angeles-San Francisco route and had made 12 trips between San Francisco and Oakland. Whether these flights between these two places were made under VFR, IFR or Visual Trans-Bay could not be determined. He had been flying Douglas DC-4 and Convair 240 aircraft on his prior assignments. (See Supplemental Data)

Analysis

From the testimony of the two survivors, it is apparent that the accident

resulted from the pilot's failure to maintain sufficient altitude to avoid contact of the aircraft with the water. The precise reason or reasons for the pilot's action or lack of action in allowing the aircraft to descend into the water is a matter of conjecture. However, there were several pertinent conditions and circumstances that can be considered as contributory factors. These were the type of operation being conducted, the weather conditions that existed over the Bay and the sensory illusions that can occur under certain conditions.

The type of operation being conducted was somewhat of a special nature wherein flights between the Oakland and San Francisco Airports are permitted to fly at altitudes below the minimums normally prescribed for scheduled airline operations and also below the normal Visual Flight Rule weather minimums. This has been authorized to expedite traffic between these two airports in view of the short distance involved and the fact that such flights are made entirely within controlled airspace. Special procedures have been established in the form of sliding scale minimums for various combinations of visibility and ceiling values. Also, aircraft must remain clear of clouds and fly not less than 500 feet above the surface. If unable to remain clear of clouds at 500 feet or if unable to maintain visual contact with the surface, such flights are required to climb to 2,000 feet, intercept the northwest course of the Oakland range and hold for clearance to make a standard instrument approach. It is evident that, at the time of the subject flight, the cloud base was lower than 500 feet over portions of the Bay area. Reports indicate that the ceiling in the area of the accident was approximately 400 feet. It was also found that the visibility was at least 12 miles at an altitude of 300 feet.

It therefore appears that in proceeding over the Bay, the subject flight encountered a cloud condition lower than indicated from preflight reports and that the pilot, endeavoring to stay clear of clouds as required for this operation, descended below the minimum altitude of 500 feet. In doing so, the pilot may have lost visual reference to the surface both with respect to the lights on shore and to the surface of the water. As the waters of the Bay were reported as smooth, a condition existed that made it extremely difficult if not impossible to judge distance above the water especially as it was at night and when no other means of reference were available for visual orientations.

In this connection, the third condition enters the then existing situation. This is a condition wherein an erroneous belief of an aircraft's altitude can occur when attempting to maintain orientation by means of visual reference to distant lights. In this case the aircraft was approaching the shore some five miles distant where there were numerous lights. But the concentration of the much stronger lights at the airport proper could well cause that cluster of lights to appear as a single foci, and thus bring into being the condition so aptly described by P. P. Cocquyt's^{3/}"The Sensory Illusion of Pilots." Therein, the author explains the condition necessary to cause a pilot to believe that he is higher than he really is, and so invite quick disaster if at extremely low altitude, as was the case in the subject flight. Briefly, the error in estimate of altitude stems from the fact that a nosed-up

attitude of the aircraft causes a distant light or concentration of lights to appear lower (and the aircraft thus higher), and vice versa. This simple false illusion has demonstrably caused a number of accidents, and many near-accidents, under conditions of light and weather similar to those being encountered by Flight 636. Refraction, and apparent displacement, of lights through windshields, with many conflicting and confusing reflections, is another element that may have been involved. Another contributory factor could have been the unlighted water surface offering little or no visual stimuli for estimating altitude.

Notwithstanding the points mentioned above, there remains the fact that the pilot had two altimeters in the cockpit. It was disclosed that prior to landing at San Francisco the flight received and acknowledged the San Francisco barometric pressure of 29.90 inches. There was no appreciable change in pressure between this time and the time of departure from San Francisco when both airports reported the pressure at 29.89 inches. Therefore, it can be concluded that there was no possibility of erroneous altimeter setting existing as a factor in the accident. Why the pilot did not refer to the altimeter is unknown. Pursuing this trend of thought, there arises the question as to why the pilot did not follow the prescribed procedure of climbing to 2,000 feet and intercepting the northwest leg of Oakland range when he found it impossible to maintain visual contact at 500 feet.

In reviewing this accident, the Board concludes that the crew was definitely qualified to operate the aircraft. The evidence is conclusive that the aircraft was in an airworthy condition. It is, therefore, reasonable to assume that in the conduct of the flight the pilot permitted the aircraft to descend into the Bay under a low and spotty overcast while maintaining visual reference to the distant shore, in the belief that he still was safely above the water. Obviously the pilot must have been misled by some form of optical illusion relative to altitude.

With regard to Trans-Bay Operations, the Board, subsequent to this accident, inquired of the Administrator regarding the adequacy of the procedures prescribed for Visual-contact flight, particularly with respect to 4-engine aircraft. The Administrator has advised that this matter has been reviewed and re-evaluated both by the CAA and by a joint industry and CAA group since the accident, and they have concluded that the procedures in effect insure a reasonable degree of safety consistent with normal standards.^{4/}

^{4/} Section 61.261 of the Civil Air Regulations governing minimum flight altitudes specifies a minimum of 1,000 feet for VFR (Visual Flight Rules) operations "Provided, that other altitudes may be established by the Administrator for any route or portion thereof where he finds, after considering the character of the terrain being traversed, the quality and quantity of meteorological service, the navigational facilities available, and other flight conditions, that the safe conduct of the flight permits or requires such other altitudes."

This deviation authority has been exercised in four cases by the Administrator in authorizing lower VFR flight altitudes for the following routes:

1. Fort Worth and Dallas, Texas (day and night)
2. Spartanburg and Greenville, South Carolina (day and night)
3. Winston-Salem and Greensboro, North Carolina (day and night)
4. San Francisco and Oakland, California (day and night)

Nevertheless, the Board is of the opinion that this operation requires special attention to insure that no relaxation of safety standards occurs in the conduct thereof, and further, the Board now has under active consideration the present regulation and procedures to determine whether any additional measures are required to insure an adequate margin of safety in trans-bay operations.

Findings

On the basis of all available evidence the Board finds that:

1. The company, the aircraft and its crew were currently certificated.
2. The flight was dispatched in accordance with the provisions of the Visual Trans-Bay clearance as outlined in the Joint Operations Letter - Revised effective April 10, 1952.
3. The reported weather conditions at San Francisco and Oakland at the time of departure were above the prescribed minima.
4. Actual weather conditions over the Bay at the time and place of the accident were later determined to be below the prescribed minima for trans-bay clearance.
5. The pilot of the aircraft failed to comply with the instructions provided in the Visual Trans-Bay procedures which are to be followed in case ceiling and/or visibility below prescribed minima are encountered en route.
6. No evidence was found of mechanical malfunction of the aircraft or any of its components recovered.
7. The flight descended below minimum specified altitude in an attempt to maintain visual reference.

Probable Cause

The Board determines that the probable cause of this accident was the pilot's action in continuing descent below the 500-foot prescribed minimum altitude until the aircraft struck the water. A probable contributing factor to the aircraft striking the water was the sensory illusion experienced by the pilots.

BY THE CIVIL AERONAUTICS BOARD:

/s/ OSWALD RYAN

/s/ HARMAR D. DENNY

/s/ JOSH LEE

/s/ CHAN GURNEY

Joseph P. Adams, Member, did not participate in the adoption of this report.

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

Investigation and Hearing

First notification of this accident to the Civil Aeronautics Board was received by Investigator E. R. Mitchell at his home in Oakland, California, at about 2315 on April 20, 1953. An investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. A public hearing was ordered by the Board and was held at the Alameda Hotel, Alameda, California, on May 21 and 22, 1953.

Air Carrier

Western Air Lines, Inc., is a scheduled air carrier incorporated in the state of Delaware with its principal business office at Los Angeles, California. It operates under a currently effective certificate of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Civil Aeronautics Administration. These certificates authorize the company to transport by air persons and property over numerous routes within the continental limits of the United States and certain points in the Dominion of Canada, including that between Los Angeles, San Francisco and Oakland, California.

Flight Personnel

Captain Robert E. Clark, age 36, held a currently effective airline transport certificate with an appropriate rating for the subject aircraft. He had been continuously employed by Western Air Lines, Inc., since April 1940. His total flying time was 11,500 hours, of which 79 had been in Douglas DC-6B aircraft.

First Officer Robert C. Jacobson, age 32, held a currently effective airline transport certificate with appropriate rating for the subject aircraft. He had been employed by the company as a pilot since September 1946. His total flying time was 3,100 hours, of which about 38 had been as copilot on Douglas DC-6B aircraft.

The other crew members consisted of Flight Engineer Robert R. League, age 36, and Stewardesses Barbara Brew and Beverlee Nelson.

The Aircraft

N 91303 was a Douglas DC-6B, manufactured by the Douglas Aircraft Company in 1952. Its total operational time was 826.04 hours. The engines were Pratt & Whitney R-2800-CB16 equipped with Hamilton Standard propellers.