

amsl and tracked 200°M, at approximately 17 to 20 kt. About 25 minutes into the flight, as the balloon crossed the A30 trunk road, the pilot reported that he observed two military jet aircraft flying over and around the eastern side of Bodmin Moor. The balloon descended to 2,000 ft amsl as it skirted the eastern side of Bodmin Moor, and the pilot stated that the military aircraft could still be seen flying abeam and to the south of the balloon, at a distance of about 2 to 2.5 nm and at very low level.

After the balloon was clear of the moor, and had passed over the village of St Cleer, the pilot commenced a further descent to approximately 800 ft agl. Prior to this the passengers had rehearsed the position they were to adopt for the landing, under the pilot's instruction. This was in addition to the briefing and rehearsal that the pilot had conducted before the takeoff.

The pilot reported that the military jets continued to carry out very fast, low level runs but, because the balloon was lower, their horizontal proximity was more apparent. He also stated that the tree tops showed noticeable signs of disturbance in their wake.

By this stage the balloon had been airborne for about one hour and was approaching the town of Liskeard. The pilot instructed the passengers to assume their landing positions because he could see that they were flying towards an area of grass fields, immediately beyond a wooded area, about 1 nm to the north-west of Liskeard. Earlier, he had started a descent towards another field but had abandoned that approach when he decided that the field was unsuitable for a landing. He reported that as the balloon crossed the wood, at a height of 400 to 500 ft agl and a rate of descent of 200 fpm, two military jet aircraft flew across in front of the balloon, from east to west, at approximately the same level and about ½ nm to the south. They then disappeared from view behind

the balloon's canopy. At the same time, the balloon's vertical speed indicator instantaneously showed a 600 fpm rate of descent and, despite the application of full burners, the balloon appeared to be 'knocked' onto the ground with significant force.

A few seconds prior to the impact, when it was obvious to the pilot that he could not arrest the rate of descent, he turned off the burners and took hold of the red, rapid deflation line. As the balloon landed, the pilot activated the rapid deflation mechanism. The basket was dragged at speed along the ground for 80 m, on its side, until it struck a wall at the far end of the field. The balloon then took off again, despite the vent at the top of the canopy being open. The pilot partially closed the top of the canopy and operated the burners in an attempt to stabilize the situation. However, he reported that too much heat had been lost from within the canopy and the balloon started to descend again. It flew another 100 m over the next field, missing a line of telegraph wires adjacent to its far side, cleared a country lane and landed for the second time on a wall on the far side of the lane.

When the basket landed on the wall it started spinning, as if the occupants were in a 'tumble drier'. In the process, three of the passengers were thrown out while the basket was dragged for about 60 m across the corner of the field beyond the wall. One of these passengers became entangled with a rope which slipped free as the basket struck another field wall. The basket cleared that wall and came to a halt about 10 m on the other side, in a fourth field. The rapid deflation was now complete and the balloon canopy lay on the ground, in the same direction in which it had been travelling, on the far side of the basket.

One of the passengers, who had been thrown out of the basket, and a crew member who remained within the

basket received serious injuries. All the other passengers and the pilot, who was supported by a harness, received minor injuries. There was no fire and the pilot reported that the balloon and its equipment were undamaged. He estimated that the balloon landed at between 1925 and 1930 hrs.

A member of the public arrived at the scene shortly after the landing and called the emergency services. The time of that call was recorded as being made at 1941 hrs. Two ambulances attended and, after initial treatment, took the seriously injured to hospital.

Other statements

With one exception, the nine passengers and two crew members assisting the pilot were consistent in their accounts of the last few minutes of the flight. They had been instructed to take up the landing position, as briefed earlier, and were all in this position as the balloon descended towards the ground. Although they had seen, and sometimes heard, military jet aircraft earlier in the flight, they did not hear any aircraft as they were approaching the field where they landed. One passenger, however, stated that he could still hear the jet aircraft flying around at the time that they were landing.

Before the landing, one of the passengers recalled the pilot instructing them to hold tight because they were likely to be dragged along after the landing. All of the passengers were conscious of the high horizontal speed, which seemed to increase the closer they got to the surface, but considered that the rate of descent was steady, not fast and it caused them no concern. One of the crew members considered that the rate of descent was quite fast and the other could feel the balloon descending faster once she had adopted the landing position.

They all described the landing as very hard and three of

the passengers recalled that the balloon's burners were operated during the ensuing ground slide before it took off again. On this occasion, the sensation of vertical acceleration in the climb was more pronounced than at the beginning of the flight.

It was estimated that the balloon climbed to at least 200 ft agl, before descending and landing a second time; this landing was described as hard. Following this the basket was reported to have tumbled as if the occupants were 'in a washing machine'. Three of the passengers fell out as the basket was dragged across the third field, base first, before it stopped in the fourth field in an upright attitude.

A witness, who lived on the north-west edge of Liskeard, saw the balloon making its approach to land and commented that it appeared to descend from a height of about 300 ft agl. He saw the balloon land initially and, after travelling through a hedge, take off again before landing a second time. He described the weather as fine with a very gentle wind. He did not recall seeing or hearing any jet aircraft.

Following the landing, a lady walked up the field from a nearby farmhouse after having the balloon's presence drawn to her attention by her husband. He had noticed the stationary, collapsed canopy and the basket from an upstairs window in the farmhouse. Earlier, both of these people had heard jet aircraft flying past but neither of them had seen the aircraft, nor did they see the balloon landing.

Other aircraft and recorded data

Four Tornado jet aircraft were notified as operating at low level in the area during the balloon flight. One of these was operating as a singleton and had cleared the area by 1855 hrs.

The other three Tornados were part of an exercise and were notified as operating in the area between 1910 hrs and 1930 hrs, between heights of 200 ft and 2,000 ft agl. As the aircraft transited from north to south towards the area where the balloon was operating, the lead aircraft split off and took a more westerly route down the east side of Bodmin Moor. The other two aircraft, operating as a pair, followed a track down the east side of the River Tamar valley. Some of the aircraft's movements were recorded on radar. However, as they descended to a lower height, beneath the radar horizon, they disappeared from its view. In addition to the radar recordings, two of these aircraft had on-board equipment which also recorded the flights. The third and last aircraft, which followed the second aircraft as part of the pair, was unable to record its flight because its Head Up Display (HUD) was unserviceable.

The radar and on-board recordings were compared. They agreed with each other and also confirmed the routings which had been planned before the three Tornados took off. The radar recordings are shown on Figure 1. The first and second Tornado aircraft tracks near to the balloon's landing site, which were reconstructed from the on board equipment recordings, are shown at Figure 2. The more westerly and lead aircraft passed 1.9 nm to the north-west of the balloon's landing site, south bound, at approximately 450 ft agl, at 1917:35 hrs, before turning away to the west. The second aircraft passed 0.6 nm to the north of the balloon landing site, west bound, at 1919:39 hrs, at about 350 ft agl and approximately 420 kt. The third aircraft was reported as being 2 nm astern of the second aircraft and slightly to the north of its track. On that basis, this third aircraft would have passed about 0.6 nm to the north of the landing site, at a similar height and speed to the second aircraft, at approximately 1919:56 hrs.

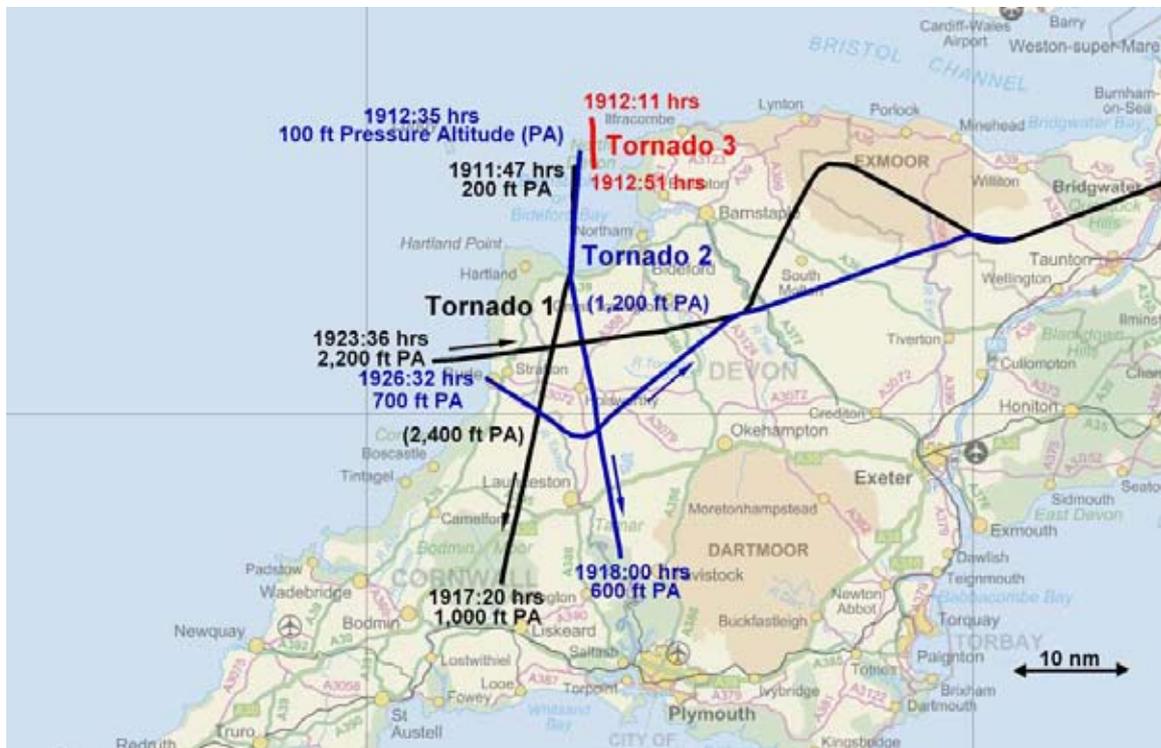


Figure 1

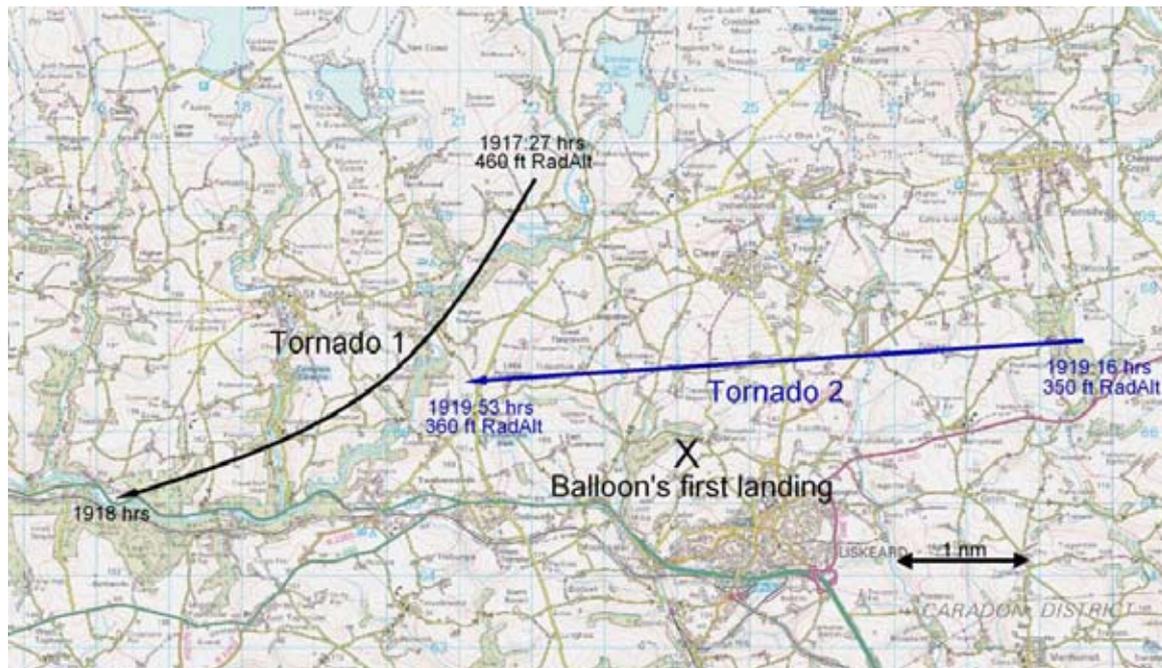


Figure 2

The balloon was equipped with hand held GPS equipment, which retains track information in its memory. The pilot was able to read the groundspeed from it during the flight. However, the memory was overwritten by subsequent flights, after the accident, and no data from the accident flight was retrievable. One of the passengers commented that he was told by the pilot that the GPS was switched off before the landing, so it was unlikely that it could have revealed an accurate time for the landing or the balloon's ground speed at that stage of the flight.

Another balloon took off from the same launch site 10 minutes after G-CDHN. It flew at lower altitudes, covered less ground and had a more south-easterly track. It was reported as making a 'stand-up' landing, with no ground slide, at 1935 hrs, about 9 nm to the north-east of G-CDHN. Neither of these balloons was detected by the radar.

The pilot reported that he made a mobile 'phone call at 1921 hrs, whilst airborne, to advise the ground crew that he would be landing in 5 to 10 minutes. The call lasted nine seconds. He stated that he made another call at 1938 hrs, after the balloon had landed and he had walked some 400 yards round to the next field where some of the passengers had been thrown out of the basket. During that conversation he advised the ground crew of the balloon's position and their situation. That call lasted five seconds.

Photographic evidence

The lead Tornado aircraft and most westerly of the three military jets, was recorded on a passenger's video camera. This enabled the balloon's position to be estimated as 1 nm to the north-east of the northern end of Siblyback Lake at 1917:15 hrs, as the military aircraft flew past on a southerly track down the west side of the lake. This put the balloon's location at approximately 3.7 nm to the north of its eventual landing site. The video also showed that the sun was approaching the western horizon at the time.

Another passenger took two still photographs. The first was taken a matter of seconds after the balloon had launched and showed the launch site. The second photograph showed the two masts on Caradon Hill, and was identified as being taken when the balloon was 0.75 nm north of the village of St Cleer and 2 nm north of the eventual landing site. According to the camera's clock, the second photograph was taken 62 minutes 4 seconds after the first. The time interval equated to an average straight line groundspeed for the balloon of 12 kt.

Meteorology

An aftercast for the evening of the accident showed that a ridge of high pressure extended across the county of Cornwall from the south-west. Surface visibility was estimated to be between 7 to 12 km and there would have been isolated patches of a few cumulus clouds with a base at 1,000 ft amsl. The estimated wind velocity at various altitudes was as follows:

Altitude (ft amsl)	Wind Velocity
2,000	030° at 18 kt
1,000	030° at 17 kt
500	030° at 08 kt
Sea level	360° at 03 kt or calm

The surface wind in the area of the accident at 1930 hrs would have approximated to the wind velocity between 500 and 1,000 ft amsl ie about 030° at 12 kt.

The air-to-ground visibility enabled passengers to report seeing both the north and south coasts of Cornwall at the same time during the flight. This indicated visibility in excess of 20 km. Video taken during the flight also showed that there was no cloud in the vicinity of the balloon.

The afternoon ballooning forecast for the south-west of the British Isles on 9 August 2005, for the period from midday to dusk, predicted a surface wind from 350°(T) at 05 kt but variable at 5 kt for a time around southern coasts. Moderate, locally strong, thermals were forecast to decay from 1800 hrs and no inversions or lee waves were predicted. 5 to 10 kt onshore sea breezes were forecast, mainly around southern coasts.

Sunset at Liskeard on 9 August 2005 was at 1949 hrs.

Limitations

The maximum surface wind speed for landing the balloon, as specified in the manufacturer's Flight Manual, was 15 kt.

Previous incidents

AAIB Bulletin No 12/2000 includes a report on an incident in which a Lindstrand LBL 105A Hot Air Balloon, registration G-BUZI, was affected by the wake turbulence created by an Airbus A310 aircraft. The pilot of that balloon reported that, after the A310 had flown over the balloon, he noticed a ripple in the balloon canopy, before the canopy was violently forced downwards below the basket. A few seconds later the canopy swung violently upwards and all the occupants of the basket were thrown to the floor. The report stated that the balloon continued to be affected by turbulence before the pilot managed to regain some control and carry out a gentle, emergency landing in a field. In the course of regaining control, the pilot had had to burn through the canopy material to get heat into the envelope because the mouth of the canopy had closed.

Analysis

The indications are that, at their nearest, two military jet aircraft had flown 0.6 nm to the north of the balloon's eventual landing site, from east to west, 17 seconds

apart, at about 350 ft agl and approximately 420 kt. The second aircraft probably passed that point at 1919:56 hrs when, at an average groundspeed of 12 kt - the mean over the majority of its flight - the balloon would have been 2.5 nm to the north of that aircraft and 3.1 nm north of the landing site. At that speed, the balloon would have touched down first at 1935:30 hrs; over 15 minutes after all the military aircraft had departed to the west. Therefore, the turbulent air, which the pilot saw around the tops of the trees after the jet aircraft had flown past the wood, would have had time to dissipate; its dissipation having been aided by the wind which was blowing the balloon southwards.

The pilot estimated that the landing time was earlier, between 1925 hrs and 1930 hrs. If so, the balloon's average ground speed over the last 3.7 nm, and therefore the average speed of the wind in which it was travelling, would have been between 17.4 kt and 28.6 kt. The direction of that wind would also have carried the wake turbulence, generated by the military jets, away to the south of the landing site. The earlier the balloon landed, the faster the wake turbulence would have moved south and the quicker it would have been dissipated.

There was little evidence to indicate that the military aircraft created the conditions which the balloon pilot reported whilst making his approach to the field. The report on a previous incidence of a hot air balloon being struck by wake vortices, albeit behind a larger aircraft, described that balloon being violently upset by the turbulence. That contrasted with the steadiness of the balloon in this event. The passengers, with one exception, two crew members and a witness on the ground who saw the balloon land, did not see or hear military jet aircraft at the time the balloon was landing. This was supported by the recorded data which was recovered after the accident.

It was not possible to determine the balloon's groundspeed at touchdown but the distance covered from the first touchdown until the balloon came to a stop, added to the retarding effects of striking the field walls, suggests that there was considerable forward momentum. It is likely that there was a local wind effect, which was not forecast, that created a particularly challenging situation on the final approach to land.