

Department of Trade

ACCIDENTS INVESTIGATION BRANCH

Piper PA25-235 G-ASVX

Phantom FGR2 XV493

Report on the collision at Fordham Fen,

Norfolk on 9 August 1974

List of Aircraft Accident Reports issued by AIB in 1975

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2/75	Westland Sea King MK 41 89-61 at Yeovil Airfield, Somerset January 1974	May 1975
3/75	Piper PA-23 Series 250 (Aztec) G-AYDE and BAC 111 Type 518 G-AXMJ at Luton Airport, Beds April 1974	June 1975
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5/75	Rollason Druine D31 (Turbulent) G-APLZ at Grange Farm, Latchingdon, Maldon, Essex April 1974	July 1975
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Department of Trade
Accidents Investigation Branch
Shell Mex House
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20 June 1975

The Rt Honourable Peter Shore MP
Secretary of State for Trade

The Rt Honourable Roy Mason MP
Secretary of State for Defence

Sir,

I have the honour to submit my report on the circumstances of the accident to Piper PA25-235 G-ASVX and Phantom FRG2 XV493 which occurred at Fordham Fen, Norfolk on 9 August 1974.

I have the honour to be
Sir
Your obedient Servant

W H Tench
Chief Inspector of Accidents

Accidents Investigation Branch
Aircraft Accident Report No 9/75
(EW/E16)

<i>Aircraft: (1)</i>	Piper PA25-235 G-ASVX
<i>Engine:</i>	Lycoming 0.540 B2 B5
<i>Owner and Operator:</i>	ADS (Aerial) Ltd, Southend, Essex
<i>Crew:</i>	One pilot – Killed
<i>Aircraft: (2)</i>	Phantom FGR2 XV493
<i>Engines:</i>	Two Rolls Royce Spey 20202
<i>Owner and Operator:</i>	Ministry of Defence (Air)
<i>Crew:</i>	One pilot – Killed One navigator – Killed
<i>Place of Accident:</i>	Fordham Fen 2.4 nm south of Downham Market, Norfolk 52° 34'N 00° 24'E
<i>Date and Time:</i>	9 August 1974 at 1408 hrs
	All times in this report are GMT

Summary

The Phantom aircraft was on a low level navigation and reconnaissance exercise and the PA25 aircraft, having completed a crop spraying operation, was in transit to its local operations centre on a track approximately at right angles to the Phantom. Neither pilot saw the other aircraft in time to take avoiding action and the two aircraft collided at about 300 feet above ground level (agl), while flying in visual meteorological conditions. The pilot and navigator of the Phantom and the pilot of the PA25 were killed; both aircraft were destroyed in the collision. The Phantom aircraft caught fire in the air and continued to burn after ground impact in open farmland; the ground fire was limited to the wreckage and standing crops. There was no other damage to persons or property.

1. Investigation

1.1 History of the flight

The PA25 left Southend Municipal Airport, its company headquarters, at 0818 hrs on 9 August 1974 and flew to the disused airfield at Broomhill, near Downham Market, which was to be used as the operations centre for replenishing loads of pesticide and for refuelling the aircraft while crop spraying in the area. The aircraft was under charter to Farmwork Services (Eastern) Ltd for this purpose and the operator had received the necessary Aerial Application Permission from the Civil Aviation Authority.

Agricultural operations commenced at approximately 0930 hrs under the supervision of the charterer's representative, who briefed the pilot on the anticipated crop spraying programme. Although the briefing included information that military low flying routes existed in the area, demanding a high degree of vigilance, no information was available about the position, height or frequency with which low-flying military aircraft might be encountered. At about 1404 hrs, having sprayed his load of pesticide on a field 6.5 nm south of Broomhill, the pilot set course for his local operations centre to reload, and in all probability climbed only to a height from which a radio mast, a prominent navigational feature situated close to his destination, would be visible. Assuming the desired track to be 022° (T) and the aircraft to have a TAS of 95 knots, the wind velocity prevailing at that time would have necessitated flying a course of 011° (T) with an associated ground speed of 112 knots.

The Phantom took off from Royal Air Force station Coningsby at 1351 hrs, the crew (pilot and navigator) having been authorised and briefed for a low level navigation and reconnaissance flight. The authorisation limited the aircraft's height to not less than 250 feet agl and the briefing included the stipulation that a speed of 420 knots was to be maintained.

The low flying orders applicable to the crew of the Phantom contained an instruction to contact Marham Approach on frequency 254.8 MHz when abeam Swanton Moreley but no call was received by Marham from XV493 during this flight. The Aerodrome Controller on duty at Marham saw a Phantom south of Marham in a position consistent with its being on the low-level route, along which he had frequently seen such aircraft fly before. He considered this aircraft to be flying lower than most he had seen. The route to be followed included a sector of 11 nm on a track of 293° (T) starting from the area of the village of Methwold and passing 2 nm south of Downham Market. Based on the time of the controller's sighting of the aircraft it can be deduced that this was XV493 and that it entered this section of the route at approximately 1407 hrs. About one minute later, approximately 1,000 m west of the village of Hilgay, the Phantom struck the PA25 on its right side. The PA25 immediately disintegrated whilst the Phantom continued on its heading, on fire and shedding parts of its structure before striking the ground inverted, some 1,000 m further on.

The pilot and navigator of the Phantom and the pilot of the PA25 were killed at the time of collision. The impact caused the navigator's seat structure to be displaced to such an extent that the seat from the primary firing unit was withdrawn, which resulted in the navigator being involuntarily ejected through the canopy of the Phantom. A plot of the most probable tracks is given in Appendix I.

1.2 Injuries to Persons

<i>Injuries</i>	<i>Crew</i>	<i>Passengers</i>	<i>Others</i>
Fatal	1 (Piper PA25) 2 (Phantom)	—	—
Non-fatal	—	—	—
None	—	—	—

1.3 Damage to aircraft

Both aircraft were destroyed.

1.4 Other damage

Both aircraft crashed on farm land: there was considerable damage to crops.

1.5 Crew information

Piper PA25

The pilot, aged 24, was employed by ADS (Aerial) Ltd. He held a New Zealand Commercial Pilot's Licence No 2694 which was validated by the UK Civil Aviation Authority and was current. The validation included a type rating for PA25 aircraft restricted, while under contract to ADS (Aerial) Ltd, for crop spraying in the UK and the Sudan.

His total flying experience amounted to 856 hours of which 266 hours had been flown in PA25 aircraft. He had flown a total of 11 hours 35 minutes in the last seven days. His last medical examination was on 13 May 1974, when he was assessed fit to exercise the privileges of a Commercial Pilot's Licence.

Phantom

The pilot, aged 42, was a Royal Air Force Officer and had flown 4,080 hours, of which 269 hours were in Phantom aircraft. He held an A2 Instructor Category and a Master Green instrument rating. His last medical examination was on 2 October 1973 when he was assessed as fully fit for flying duties. He had flown a total of 1 hour 30 minutes in the last seven days.

The navigator, aged 28, was a Royal Air Force Officer and had a total of 1,733 hours, of which 602 hours were in Phantom aircraft. He had flown a total of 3 hours 55 minutes in the last seven days. His last medical examination was on 6 June 1974, when he was assessed as fully fit for flying duties.

1.6 Aircraft Information

1.6.1 *The Piper PA25-235*

The aircraft, a single-engined, single-seat, low wing monoplane, was specifically designed for agricultural operations, in particular crop spraying. It was constructed in 1964, in the United States of America, had a valid United Kingdom Certificate of Airworthiness

in the Special Category, and had been maintained in accordance with a UK CAA (Airworthiness Division) approved maintenance schedule. It had flown a total of 3,256 hours since manufacture, 41.50 hours being subsequent to a Check II inspection carried out on 17 July 1974. No defects had been reported.

The design of the cockpit glazing provides large areas of transparency to the front and sides of the pilot which affords an extremely good field of vision. The aircraft is fitted with an anti-collision beacon situated on top of the cockpit canopy which is normally switched on throughout all stages of flight. The weight at take-off was below the maximum total weight authorised of 2,900 lb and the centre of gravity was within the permitted limits of 88.42 inches and 90.30 inches aft of datum.

1.6.2 *The Phantom FGR2*

The aircraft was manufactured in the United States of America by McDonnell Douglas Inc. and had been maintained in accordance with Royal Air Force standards. It had flown a total of 1,121 hours since manufacture, 365 hours subsequent to a major servicing. It carried no significant unserviceabilities.

The cockpit design is such that the pilot's vision envelope is obstructed at about 10°-12° either side of the centre-line by a canopy member. (See General Arrangement in Appendix II.) The navigator has no forward vision, this being fully obstructed to 22° either side of the centre line by navigational equipment. The aircraft was camouflaged in keeping with its low level tactical role and was fitted with an anti-collision light at the junction of the tail fin and fuselage. It is RAF policy to have this light switched on throughout all stages of flight. At the time of the accident it was carrying external stores in addition to two wing tanks. The weight at take-off was below the maximum total weight authorised and the centre of gravity was within permissible limits.

1.7 Meteorological information

The Royal Air Force forecast for the Phantom, for the period 1300-1600 hrs indicated the following:

Wind at 2,000 ft amsl	– 280°/20 knots
Weather	– Isolated showers
Visibility	– 20-30 km, reduced to 8-12 km in showers
Cloud	– 2/8-4/8 cumulus 2,500 feet and 3/8-6/8 strato cumulus 5,000 feet becoming 7/8 cumulus 1,800 feet in showers
Minimum QNH	– 1,007 millibars

The actual weather report issued by Royal Air Force Marham, about 8 nm north-east of the accident area, at 1351 hrs was:

Cloud base	– 3/8 3,500 feet (estimated) 3/8 25,000 feet (estimated)
Surface	– 250°/17 knots
Visibility	– 50 kilometres
Temperature	– + 20° C
QNH	– 1,007.2
Weather	– Nil

The height of Marham is 80 feet above sea level.

Another Phantom, flying on the same route and with a similar flight plan to XV493, noted the weather at approximately 1430 hrs as being 3/8 cloud at 5,000 feet with visibility in excess of 30 kilometres.

The wind velocity at that time, as established from an Inertial Navigation System, was from a westerly direction at 25 knots.

1.8 Aids to navigation

Not applicable.

1.9 Communications

The reason XV493 failed to contact Marham Approach is not known but it is not considered significant in this accident.

1.10 Aerodrome and ground facilities

Not applicable.

1.11 Flight recorders

Neither aircraft was fitted with a flight recorder, nor were they required to be fitted.

1.12 Wreckage

1.12.1 PA25

The PA25 aircraft wings and centre fuselage, including the cockpit area, were totally destroyed and scattered over a large area. Two large sections, the engine and the empennage, fell to the ground close to the collision point. Examination of the right elevator indicated that it had been struck a glancing blow from behind the lateral axis of the aircraft. The wreckage and its distribution indicated that the nose of the Phantom, travelling at high speed, had struck the PA25 fuselage below centre-line between the right wing root and right tailplane.

Neither the flight instruments nor the anti-collision beacon were recovered.

1.12.2 Phantom

The Phantom's nose radome and canopies were shattered at the collision point and the forward fuselage was substantially damaged. The aircraft continued on its original heading and caught fire rolling to the left and shedding the external tanks, pylons, reconnaissance pod and the right stabilator outboard section before impacting the ground inverted, right wing low, some 1,000 m from the collision point. The aircraft broke into many fragments on ground impact and spread over a large area on fire. No significant flight instruments were recovered and it was not possible to establish whether or not the anti-collision warning light was operating at the time of impact. It was not possible from the wreckage distribution to establish the height at which the collision occurred.

From examination of other equipment salvaged from the wreckage it was established that at two positions earlier in the flight the aircraft had been flying at 260 feet agl and 220 feet agl.

1.13 Fire

The Phantom exploded and caught fire during the collision. The subsequent ground fire was confined to the wreckage and the immediate area of standing crops. There was no evidence of fire in the scattered wreckage of the PA25.

1.14 Survival aspects

The accident was not survivable.

1.15 Tests and Research

In an attempt to establish the exact position and height of the collision, three eye-witnesses were positioned where they had been on the day of the accident and at approximately the same time of day. On the instructions of the witnesses, through two-way radio communication, a helicopter was then manoeuvred as near as possible to the point at which they considered the collision had occurred. The positions gave a scatter of about 1,000 feet laterally and 130 feet vertically, as shown in Appendix I.

1.16 Other information

1.16.1

The Royal Air Force has a requirement to train in the low level reconnaissance and attack role and to accommodate such training a number of low flying areas have been designated in the United Kingdom. These areas are linked by low flying corridors which are normally unidirectional, and three miles wide and are flown at heights which may vary between an upper limit of 2,000 feet agl and a lower limit of 250 feet agl. The link route being followed by the Phantom at the time of the accident had an upper limit of 1,000 feet agl. The areas and link routes in the southern half of the UK form a widespread and complex pattern and in total represent an area equivalent to about one quarter of the surface area. With minor exceptions, such as the area surrounding the London TMA, it is difficult to make a cross-country flight of any significant distance in any direction at less than 2,000 feet agl without entering one of the areas or link routes; indeed, some civil aerodromes lie within a low flying area.

The military authorities utilise maps which indicate the positions height limits etc of the low flying areas and link routes. These maps are classified as 'Restricted' and are not available to civil pilots or the general public. Low Flying Handbooks are maintained at the military bases and contain information and instructions pertinent to the individual low flying areas and related link routes including, where appropriate, information on crop spraying or other light aircraft activity likely to be encountered. These handbooks are also security classified. When a low level exercise is planned, part of the authorisation requires completion of a clearance form defining the proposed route and confirmation from the Military Air Traffic Organisation Low Level Co-ordination Centre of the low level reservations which have been requested.

The Low Flying Handbook used to brief the crew of the Phantom aircraft contained information that crop spraying aircraft might be encountered between ground level and 250 feet, especially during the period February to September, in an area in which the Phantom had been flying prior to entering the link route in which the accident occurred. There was also a warning that light aircraft activity could be expected near to a small civil aerodrome which is close to an earlier portion of that link route. The handbook did not contain any information that crop spraying or any other light aircraft activity was to be expected in the vicinity of the position where the accident occurred. No indication of such activity on any part of the proposed flight was provided by the Military Low Level Co-ordination Centre which gave clearance for the flight.

1.16.2

The 'Permission' granted for crop spraying operations includes a requirement that advance notification of at least 24 hours of each proposed operation and the type of chemical to be used shall be given to the local office of the police authority for the area. Farmwork Services had fulfilled this requirement. This information enables the police to maintain an oversight of the operation and, amongst other things, to evaluate complaints of low flying which sometimes arise from crop spraying operations. The information is not passed on by the police to any authority concerned with the military low flying activity, nor was it intended to be used in this manner.

When operating in close proximity to an aerodrome or controlled airspace, common sense airmanship dictates that a crop spraying operator shall notify his proposed operations to the authority for that airspace and co-ordinate his activities with those in the airspace concerned. Other than this, there is no requirement for the crop sprayer to inform military or civil aviation authorities as to his intended operations. Nevertheless, as had been their practice for some 20 years, Farmwork Services had informed RAF Marham that they would be carrying out crop spraying in an extensive area of Norfolk, which included the accident site and the entire link route used by the Phantom, from June to the end of August 1974.

1.16.3

Evidence given during this investigation indicates that both in military and civil aviation circles there has been a misunderstanding of the meaning of Rule 5(1)(e) of the Rules of the Air. The relevant part of the Rule is as follows:

'An aircraft shall not fly closer than 500 feet to any person, vessel, vehicle or structure.'

Neither the Rule itself nor any related legislation requires or suggests that a civil aircraft shall not fly at less than 500 feet agl unless in doing so it would come closer than 500 feet to a person, vessel, vehicle or structure. In July 1973 the subject of possible hazard arising from conflict between low flying military aircraft and civil crop spraying aircraft was discussed between the Directors of Flight Safety of the Royal Air Force and the Civil Aviation Authority. It was concluded that crop spraying aircraft usually operated below 250 feet agl, the minimum operating height of military aircraft, and that during transit flights between the spraying area and the local base, crop spraying aircraft should normally be above 500 feet agl if they were to be sure of avoiding infringements of Rule 5(1)(e). It was believed that the significant risk was confined to the period of climb or descent between transit altitude and the spraying site.

This discussion was confined to the context of aircraft engaged in agricultural operations and, therefore, did not take account of the possibility that there would be other civil

aircraft properly authorised to carry out low flying such as helicopters inspecting power cables or pipe-lines, nor did it take account of private or club aircraft engaged in training pilots to carry out forced landing procedures.

According to evidence submitted to this investigation, the discussions between the two Directors of Flight Safety were held against the background of the firm policy of the Ministry of Defence not to publish details of the low flying areas and link routes and the absence of any reported airmisses between agricultural aircraft and low flying military aircraft. It was concluded that any attempt to introduce a centralised co-ordinating system for civil and military aircraft movements in the low flying areas and link routes would entail such an amount of communication and cross-checking that the system could well contain a possibility of error sufficient to result in a risk level not significantly less than that which already existed without it. No recommendation was made for the introduction of such a system.

1.16.4

At the time of this accident the relevant rules for avoiding collision in the air were contained in Section IV of the Rules of the Air and Air Traffic Control Regulations, 1972 and the relevant parts fall within Rule 18 as follows:

(1) General

- (a) Notwithstanding that the flight is being made with air traffic control clearance, it shall remain the duty of the commander of the aircraft to take all possible measures to ensure that his aircraft does not collide with any other aircraft.
- (b) (Not relevant).
- (c) (Not relevant).
- (d) An aircraft which is obliged by these Rules to give way to another aircraft shall avoid passing over or under the other aircraft, or crossing ahead of it, unless passing well clear of it.
- (e) An aircraft which has the right-of-way under this Rule shall maintain its course and speed.

(2) Converging

- (a) (Not relevant).
- (b) when two aircraft are converging in the air at approximately the same altitude, the aircraft which has the other on its right shall give way.'

The principles contained in Rule 18 apply equally to civil and military aircraft. Since the date of this accident the Rules of the Air and Air Traffic Control Regulations 1974 have been brought into effect but the Rule for avoiding aerial collisions and the governing principles involved remain unchanged.

1.16.5

On 20 September 1974 the Chief Inspector of Accidents sent a letter to the Ministry of Defence drawing attention to the urgent need for the publication of appropriate information concerning the position and vertical extent of the low flying areas and

link routes, together with the implementation of an advisory information service available to civil aircraft wishing to enter or transit such airspace. This letter was copied to the National Air Traffic Services and the Civil Aviation Authority.

2. Analysis and Conclusions

2.1 Analysis

2.1.1 *The collision*

The collision occurred in good visibility at an estimated height of 300 feet agl. The Phantom, flying at a speed of about 420 knots, struck the PA25 on its right side whilst the latter was in transit from the spraying area to its local operations base. There is no evidence to suggest that medical incapacity of either of the pilots or any pre-crash defect or malfunction in either aircraft was a contributory factor to the accident.

According to the rules for the avoidance of collision in the air, the PA25 should have given way to the Phantom, since the latter aircraft was on its right. The assessment of the relative position of the two aircraft indicates that the Phantom did not take up its final heading until about 30 seconds before the collision and at that time the PA25 was on a heading such that to have seen the approaching Phantom the PA25 pilot would have had to be looking to his right and almost exactly abeam. There is no evidence that he had any reason to concentrate his attention in that direction and, assuming he maintained a normal lookout scanning cycle, it would have been quite fortuitous if he had seen the Phantom exactly at the start of its 30 second closing flight path. At its closing speed of about 400 knots it was then 3½ miles away. Application of the rules for the avoidance of collision would have required the PA25 pilot, after having assessed the Phantom as closing at a 90° constant bearing, to turn right or left to allow it to cross his own track, the amount of turn being sufficient to ensure safe separation and to show clearly to the other pilot that avoiding action had been taken. There can be no doubt that the time available for the PA25 pilot to assess the situation and execute the manoeuvre was, at best, minimal.

Although, during the final 30 seconds, it became the responsibility of the PA25 pilot to give way to the other aircraft, the pilot of the Phantom also had the responsibility to take all possible measures to ensure that his aircraft did not collide with the PA25. Specifically this was true at the time he turned on to the final collision course and it must therefore be presumed that he did not see the PA25 which, so far as is known, was then flying on a constant northerly heading. Subsequently, as the pilot having right of way, the rules specify that he should have maintained his course and speed. Presumably it was only if the aircraft obliged to give way was seen to have failed to alter course that any evasive manoeuvre by the Phantom would have been justified. Clearly, the time element appropriate to the application of these rules and the somewhat theoretical character of their content is of an order altogether different from the practicalities involved in this accident. It may well be desirable to amend the rules in the light of the speed of present-day aircraft to take advantage of the three-dimensional characteristic of the element in which aircraft operate. It is for consideration whether the rules should permit the aircraft which has the right of way to climb without having to wait to establish whether the aircraft obliged to give way does, in fact, alter course.

The concentration required of pilots conducting military low level exercises is necessarily intense. Only about 30 seconds before the collision the pilot of the Phantom had completed a turn of about 65° at a speed of about 420 knots whilst flying at very low level and simultaneously maintaining a precise track. During the final run before impact, his field of vision along the line of constant bearing to the PA25, about 15° to his left, was to some extent interrupted by a canopy frame. It may also be significant that the outstanding navigational features on his track were predominantly ahead and to the right of the Phantom; this may have influenced the pilot to concentrate his attention, at least momentarily in that sector.

In these circumstances, it is understandable that the pilot of the Phantom did not see the PA25 in sufficient time to assess it as being on a collision course and take effective avoiding action.

Both aircraft were operating to procedures approved by their respective civil and military authorities and both pilots had fulfilled the obligations required of them by those authorities. The Phantom had also received clearance for the flight from the military Low Level Co-ordination Centre. However, since the notification to the police required of the PA25 was neither intended nor used for air traffic control purposes and since there was therefore no co-ordination of low flying activities between civil and military authorities, this combination of notification and permit was ineffective as a means of safeguarding either the crews of the two aircraft or the general public over whom they were flying.

Maps of the low flying areas and link routes were not available to the PA25 pilot, nor was there any means by which the information they contained could have been conveyed to him. Consequently, he was not able to know that he was crossing a potentially dangerous one-way corridor. Even with such a map he could not have had the additional information necessary to predict when or at what height he might encounter a military aircraft; however, he might well have been influenced to look more particularly to his right whilst crossing the corridor. Had he done this the possibility exists that he might have seen the Phantom in time to take successful avoiding action. To this extent the policy of deliberately restricting the availability of the maps may be said to have contributed to the cause of the accident.

The assessment of the collision risk in the low flying areas and link routes during the discussions between the two Directors of Flight Safety was confined to possible conflict between military aircraft and agricultural aerial work aircraft against a background of the firm policy of the Ministry of Defence not to publish maps of low flying areas and link routes for the information of civil operators. The assessment accepted that in order to comply with Rule 5(1)(e) aircraft engaged in agricultural operations should normally be above 500 feet agl during transit flights between the spraying area and base. Although it may well be prudent for a pilot to fly above 500 feet agl in order to ensure compliance with the Rule, there are many areas in the UK in which it is not necessary to do so. The two Directors appear to have overlooked the collision risk involved in the case of crop spraying aircraft in transit flying at less than 500 feet agl whilst maintaining a lateral distance of 500 feet from any person, vessel, vehicle or structure. In this case, although flying at about 300 feet agl, there is no evidence that the PA25 was closer than 500 feet to any person, vessel, vehicle or structure at the time the collision occurred and consequently no reason to consider that there was an infringement of Rule 5(1)(e) on the part of the pilot.

Civil pilots are given no information concerning the low flying areas and link routes and the information on civil aircraft movements which the military authorities receive is incomplete and unreliable because the civil pilots have no way of knowing when they might enter such airspace. It is, therefore, apparent that collision avoidance between military and civil aircraft in the low flying areas and link routes depends substantially, if not wholly, on the 'see and be seen' principle. This principle may have some validity at higher levels or at slower speeds, but as demonstrated in this accident it is inadequate

for the high speed, low level case where concentration on flying accuracy and other demands on a pilot's attention are important factors in relation to the time available for identification of a possible collision risk; assessment of its flight path and initiation of correct avoiding action.

Fortunately, accidents of this nature are rare, indeed this is the first collision between a civil and a military aircraft in the UK which can be directly related to military high speed, low level operations; at the same time there is reason to believe that there has been a number of near misses.

2.1.2 *Reduction of the collision hazard*

It is accepted that there is a military requirement to carry out low level high speed practice flying. However, to reduce the hazard of collision with civil aircraft using or wishing to use the same airspace, it is necessary that suitable action is taken as a matter of considerable urgency.

There is a substantial number of low flying areas in the UK in which military aircraft may be encountered flying low and fast or descending to or climbing from low level. It is therefore most desirable that civil aircraft should avoid flying in these areas altogether if at all possible. There is also an extensive network of link routes connecting the low flying areas which are sometimes used by aircraft flying very fast between 2,000 feet and 250 feet and these should also be avoided whenever possible. This accident has demonstrated the shortcomings of relying on the principle of 'see and be seen' to avoid collision in such areas and link routes, even when the pilots are well trained and currently practised in low flying. It is therefore fundamental that information regarding the location and vertical extent of these areas and link routes should be available to every civil pilot via the normal system for the promulgation of aeronautical information, in order that such airspace can be avoided.

In view of the extent to which the avoidance of these low flying areas and link routes by civil aircraft might encroach upon the freedom of air navigation, the military authorities should be required to keep under regular and frequent review the need to retain each section of them and they should withdraw any redundant section at the earliest opportunity, notifying the National Air Traffic Service as they do so, to enable the information to be promulgated without delay.

In order further to reduce the limitation on air navigation, the military authorities should examine the possibility of reducing the maximum height of the link routes from 2,000 feet to 1,000 feet. If it is essential that the link routes should extend above 1,000 feet, a maximum limit of 1,500 feet should be adopted if at all possible. This would enable civil aircraft flying cross country to keep clear of low flying military aircraft by flying above 1,500 feet.

There are some civil aircraft activities, such as crop spraying, pipeline and high tension cable inspection, etc, which necessarily involve flying at low altitudes and encroaching on low flying areas and link routes. To afford these aircraft protection, it is necessary that there should be an advisory service through which all civil and military flights in the low flying areas and link routes could be properly co-ordinated. Once an aerial work aircraft engaged in low level operations has been assured that it is safe to proceed, the obligation must then be upon the military to ensure that the civil aircraft's area of activity will not be encroached upon by military aircraft until expiration of the period notified. Finally, civil aircraft which must operate at low altitudes where low level high speed military aircraft are likely to be flying, should be made as conspicuous as possible, utilising vivid day-glo paint to the greatest extent possible and the brightest form of lighting, preferably of the strobe type.

2.2 Conclusions

(a) Findings

- (i) The documentation of both aircraft was in order and their weights and centres of gravity were within authorised limits.
- (ii) There was no pre-crash failure or malfunction of either aircraft.
- (iii) The pilots of both aircraft were properly qualified and sufficiently experienced to carry out their respective flights.
- (iv) The accident occurred in good visibility but the Phantom aircraft was camouflaged which made it less conspicuous. There is no reason to doubt that the anti-collision lights were operating on both aircraft.
- (v) The relative positions of the two aircraft and the demands on the attention of the military pilot were such that it would have been fortuitous if either of the pilots had seen the other aircraft in time to take effective avoiding action.
- (vi) Maps of military low flying areas and link routes are security classified as 'Restricted' and were not available to civil aviation users. No accurate information was available to the civil pilot regarding military low flying activity.
- (vii) Notification of crop spraying operations in the general area over an extended period had been made by Farmwork Services to the local police and to the military authorities. There was no system to ensure that this information was passed to the military authorities responsible for the low flying areas and link routes.
- (viii) The Military Air Traffic Control Low Flying Co-ordination Centre had confirmed the low level reservation which had been requested by the crew of the Phantom.
- (ix) The military crew had information of low flying civil aircraft activity in other parts of their route but no information of such activity in the area in which the collision occurred.
- (x) The 'see and be seen' principle associated with the Rules of the Air for the avoidance of collision is inadequate in the context of high speed, low level flying.
- (xi) The assessment of the potential collision risk in the military low flying areas and link routes was unrealistic because it did not take into account all the different types of civil aircraft operation likely to be using the airspace below 500 feet agl and because of the misunderstanding of the full implications of Rule 5(1)(e) of the Rules of the Air.
- (xii) Rule 5(1)(e) did not apply to the military pilot. He had been properly authorised to fly at not less than 250 feet by the military authorities and had maintained approximately this height throughout his exercise, which had included flight over a number of villages.

(b) Cause

The accident occurred because neither pilot saw the other aircraft in time to avoid collision. The 'see and be seen' principle was inadequate for preventing collision in

the circumstances that existed. A significant feature which contributed to the accident was the absence of any system for co-ordinating military and civil low flying activities in the low flying areas and link routes.

3. Recommendations

- 3.1 It is recommended that information concerning the location and vertical extent of the low flying areas and link routes should be made available to civil pilots via the normal system for promulgation of aeronautical information.
- 3.2 It is recommended that private pilots should be alerted to the nature of military flying activities which take place in low flying areas and link routes and to the need to avoid them altogether if at all possible.
- 3.3 It is recommended that an advisory service be provided to enable civil pilots who are unavoidably involved in operations in the low flying areas and link routes to co-ordinate their operations with the military authorities.
- 3.4 It is recommended that aerial work and other civil aircraft frequently engaged in low level flying activities within the military low flying areas and link routes should be painted as conspicuously as possible and fitted with high power collision warning lights, preferably of the strobe type. It is also recommended that the military authorities consider the fitment of high power collision warning lights of this type to military aircraft engaged in low level training.
- 3.5 It is recommended that the military authorities keep under regular and frequent review the amount of airspace allocated to low level high speed operations and withdraw any redundant sections at the earliest opportunity.
- 3.6 It is recommended that consideration should be given to the possibility of lowering the upper limit of the link route from 2,000 feet to 1,000 feet. If this is not possible, a maximum of 1,500 feet should be adopted if this is consistent with military requirements.
- 3.7 It is recommended that consideration should be given to amending the Rules of the Air in relation to the avoidance of collision in order to permit an aircraft which has right of way to climb and if necessary pass over the other aircraft.

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