Headquarters
New Zealand Defence Force
Defence House
Private Bag 39997
Wellington Mail Centre
Lower Hutt 5045
New Zealand

OIA-2023-4701

18 May 2023

[redacted]

Dear [redacted]

I refer to your email of 19 April 2023 requesting, under the Official Information Act 1982 (OIA), *the official crash report regarding the death of Flt Lt John Dick on 25th of March 1981, when his TA-4K Skyhawk NZ6253 crashed in the Ruahine Ranges about 25 kilometers from Taihape.*

A copy of the Court of Inquiry Report you have requested is at Enclosure 1. This is a summary of the proceedings of the Court of Inquiry and does not include evidence given or submissions made to the Court of Inquiry in accordance with the OIA.

For your information, a safety publication reported on the 1981 TA-4K Skyhawk NZ 6253 crash and an article on the incident was published in 1982. A copy of the article is provided at Enclosure 2.

You have the right, under section 28(3) of the OIA, to ask an Ombudsman to review this response to your request. Information about how to make a complaint is available at www.ombudsman.parliament.nz or freephone 0800 802 602.

Please note that responses to official information requests are proactively released where possible. This response to your request will be published shortly on the NZDF website, with your personal information removed.

Yours sincerely

AJ WOODS
Air Commodore
Chief of Staff HQNZDF

Enclosures:
1. Court of Inquiry into the TA-4K Skyhawk NZ 6253 aircraft incident
2. Article from a safety publication on the TA-4K Skyhawk NZ 6253 aircraft incident

ROYAL NEW ZEALAND AIR FORCE

PROCEEDINGS OF A COURT OF INQUIRY OR INVESTIGATION INTO AN AIRCRAFT INCIDENT

Before completing this form reference should be made to NZAP 201, Chapter 5.

Assembled on 26 March 1981 (Date) at RNZAF Ohakea (Place)

By order of Air Officer Commanding Operations Group RNZAF

To inquire into the incident involving aircraft TA4K NZ6253 (Type and Number) on 25 March 1981 (Date)

1. Composition of Court

Duty	Rank, Initials, Name, Decorations, and Number	Branch	Unit
President	Wg Cdr R.J. Klitscher, DFC, AFC (A926772)	GD	OPHQ
Members	Sqn Ldr K.A. Jones (P80536)	GD	14 SQN
	Sqn Ldr D.J. Dilks (B81559)	ENGR	3 SQN
In Attendance	Sqn Ldr C.F.I. Jenks (U78862)	GD	Air Staff
	Sqn Ldr J.G. Faris (Y134434)	MED	DSMU

2. Full Terms of Reference

(Including whether recommendations are to be made and whether the evidence is to be taken on oath. (see RP 128)

A. Determine the cause of the accident and any contributing factors.

B. Determine the cause of the death of Flt Lt Dick.

C. Determine the extent of damage to NZ6253.

D. Establish whether Flt Lt J.N. Dick was on duty.

E. Ascertain the nature and extent of any damage to private property.

F. Determine the purpose of the flight and whether it was properly authorised and briefed.

G. Determine whether supervisory procedures in No 75 Sqn were adequate.

H. Ascertain if all relevant orders and instruction were complied with.

I. Ascertain whether relevant orders are adequate and properly framed.

J. Determine whether the SAR response was adequate in respect to this accident.

K. Allocate responsibility where appropriate.

L. Make appropriate recommendations.

All evidence to be taken on oath.

6. Details of Aircraft

Category of Damage 5

Details	Permissible Limits		At Time of Take-off	At Time of Crash (Estimated)
	Max Take-off	Max Landing		
All Up Weight	24500 lb	16000 lb	21000 lb	[illegible] lb
	Forward	Aft		
Centre of Gravity	223.5 in	238.4 in	233.86 in	233.25 in

7. Details of Airframe

Type	Mark	Service Number	Solo or Dual Fitted	Total Hours Flown	Hours Since Last Check/Group Servicing	Date of Manufacture	Category of Damage
TA-4K		NZ6253	Dual	2317.4	Grp B 238.5 Dal 15.3	Feb 1970	5

8. Serial Nos and Classes of Relevant Airframe Modifications Embodied and of SI's and STI's Complied With

All SMIs complied with. NZM/SKY/68 (Class 3) not called up at last engine change.

9. Reasons for Non-embodiment of Relevant Modifications or Non-compliance with SI's or STI's

NZM/SKY/68 was overlooked by TSPO.

10. Details of Engines

DETAILS (Delete Headings as Necessary)	1. Single			
	1. Port		2. Starboard	
	1. Outer	2. Inner	3. Inner	4. Outer
Type and Mark	J52-P-8B			
RNZAF No.	As below			
Maker's No.	5684397			
Category of Damage	5			
(Data below only required if technical failure occurred or suspected)	N/A			
Date Engine Last Installed				
Date New or Reconditioned				
Hours Run Since New or Reconditioned				
Hours Run Since Last Check/Group Servicing				

11. Serial Numbers and Classes of Relevant Engine Modifications Embodied and of SI's and STI's Complied With

12. Reasons for Non-embodiment of Relevant Modifications or Non-compliance With SI's or STI's

13. Rank and Name of Person Who Authorised the Flight

Wg Cdr G.J.[illegible] Gollsmith, OC 75 Sqn

14. Purpose of Flight, with Pertinent Details of Briefing

4V2 ACM with a planned simulated strike in the inland low flying area, red and gold formation briefed together for rules of engagement for the ACM sortie, then briefed individually for the simulated strike.

15. Particulars of Flight

Stage	Time	Place or Position	Height AMSL
Take-off	Red 251028M Mar 81	RNZAF Ohakea	
Incident	-	-	-
Crash or Landing	1055 - 1104	39403 176102	3300 FT

16. Weather Conditions

At the Time and Place of Take-off				At the Time and Place of the Incident			
Details from 1100 hrs Ohakero							
Cloud Base	18000	W/V	060/05	Cloud Base	5500-6000	W/V	L&V
Cloud amount	See Below	Light		Cloud Amount	0'Cast	Light	Diffuse
Visibility	50K	QNH	1024.6	Visibility	20KM+	QNH	NK

General: Cloud

c at 4000
3/8 at 3000
8/8 at 1800

General:

Good Vis
Overcast
No cloud on ridge tops or forming in the valleys
No noticeable turbulence
Sun not visible

17. Details of Fire

Stage of Occurrence	Source	Extent to Which it Developed
Post-Crash	Impact and Fuel	Variable and considerable
Did the Fire Warning Device Operate?	N/A	

18. Functioning of the Automatic System

How Operated — N/A

Did Extinguisher Bottles Discharge? — N/A

Effect on Fire:

N/A

19. Flying Experience of Pilot Prior to this Flight

Rank	Initials	Name	Number	Branch
Flt Lt	J.N.	Dick	U85647	GD(P)

Instructor Category	Instrument Rating	Medical Category	Age	Most Recent Flying Training Particulars	
				Unit	Assessment
Nil	Green	A13121	26	75 Sqn	High Average

	Type of Aircraft		Day plus Night Hours			Night Hours (for night incidents only)			By Instruments	Link Trainer
			1st Pilot	2nd Pilot	Dual	1st Pilot	2nd Pilot	Dual		
	On Which the Incident Occurred	A	60.7	Nil	1.4				2	
		B	486	Nil	26				7513	
Similar Types		A								
		B	384.7	0.8	38.2		N/A		49.2	
		A								
		B								
	Total (for all aircraft)	A	60.7	Nil	1.4				2	
		B	916	3.0	232.4				104.4	

A = Previous 3 months. B = Total to date.

20. Flying Experience of Other Crew Members

Rank, Initials, Name, Number, and Branch	Crew Duty	Hours on Type		Hours on All Types	
		Last 3 Months	Total	Last 3 Months	Total
Nil					

21. Particulars of All Occupants of Aircraft

Rank, Initials, Name, and Number	Unit	Duty	Position	Extent of Injury
Flt Lt J.N. Dick U85647	75 Sqn	Pilot	Front seat	Killed

22. Particulars of Non-occupant Casualties

Rank, Initials, Name, and Number	Unit	Duty	Position	Extent of Injury
Nil				

20 pads/1/72—3168 W K

23. Remarks of Court After Examining the Following Documents

Document	Remarks
Form RNZAF 700	Satisfactory
Airframe and Accessory/ Component Log Cards	Log cards were in order, however the component control Vardex has not been revised to account for changes in component lives as a result of IMP.
Servicing Schedules	Satisfactory
Technical Order Book	Satisfactory
Flight Authorisation Book	Satisfactory
Pilot's Flying Log Book	Satisfactory
Flying Order Book	See recommendations and observations
Work Records (RNZAF 432, Work Cards)	Some RNZAF 432 not correctly filled out (blocks left blank) work cards satisfactory

24. Material Facts Found During a Visit to the Scene of the Incident Before/After the Aircraft had Been Removed

Refer separate page

24. Material Facts Found During Visits to the Scene of Accident Before and After the Wreckage had been removed, and from Technical Analyses of the Wreckage Elsewhere

PREAMBLE

Note 1: To improve readability all references to witnesses' statements, photographs, technical reports and other supporting material appended to this Report have been removed from the text proper. Instead, references are listed in the left-hand margin against the relevant part of the text. The convention used is as follows:

A - Appendix

p - Photograph

W - Witness statement

Q - a specific question and answer relating thereto.

Thus, A1 means Appendix 1. A2B means the document at Folio B of Appendix 2. A2Bp5 (or pE) means photograph 5 (or E) attached to that folio. W12Q4 means the fourth question asked of the twelfth witness.

Note 2: Accidents of this severity and character are rare in the RNZAF. In the arts of investigation, although they are largely a matter of balanced professional common sense, method, logic and an eye for statutory requirements, we are amateurs. Believing that it is worthwhile taking the trouble to record for future reference the path taken and the many lessons which emerged, the Court presents a Report which might be more full than is absolutely necessary to arrive at the principal conclusions concerning the crash itself. A second factor in this approach is the very wide Terms of Reference directing the Court to attend to matters of peripheral concern, with and without causal connection. Readers not concerned with narrative technical detail may wish to proceed directly from paragraph 2 of this section to paragraph 1 of Section 25.

Note 3: The reader will need to have available a 35mm slide projector or other slide reader for a slide sequence and narrative beginning at paragraph 16 of Section 25.

/General Description

General Description of Site

A5 1. Location. The wreckage of TA4K NZ 6253 was located on a densely wooded ridge line within Grid Square 6219 on map NZMS 1, 1:63,360, Sheet N133 WAKARARA, Second Edition 1977. The position transforms to 3940S 17610E on the 1:500,000 Aeronautical Chart NZMS 242A Sheet 2 dated 14 June 1977.

A7p2 2. Nature of Site. The site lies in the catchment of the Mangatera River in the area locally known as Colenso. At 3,500 feet AMSL it is elevated some 500 feet above a valley floor in the junction of two mountain streams each rising within a mile respectively to the east and the north. A main ridge of the Ruahine Ranges lying north-south reaches to just over 5,000 feet a mile and a half to the east. A number of high spurs run from it to the west. The site is about 80-100 feet below the crest of a minor ridge jutting southward from one of these spurs into the northern flank of a valley lying east-west. The valley is steep along its axis and very steep in cross-section. To the west the site is dominated by A7p1 another ridge lying north-south and rising to near 4,000 feet within 1,000 yards. In the direction of flight the crash scar runs through the forest from east to west across the minor ridge. Despite its elevation above the streams in the valley, the site itself is deeply enfolded in the major hills and spurs looming above it close by in every direction.

Effects of Location and Terrain on Investigation

3. Eyewitnesses. Although the site is only twenty miles directly from Taihape, the area is wild and desolate. Signs of game are few. There is no permanent habitation. Bar a wayward tramper or hunter who has not come forward there could be no expectation of finding eyewitnesses to the accident.

A6 4. Wreckage Plot. Destruction of the aircraft was extreme, with many small pieces of wreckage and some larger ones distributed along a trail for about 260 metres. The forest is virgin native with very large and old individual trees, a thick overhead canopy, and dense undergrowth tangled with bush lawyer. The ground underfoot is uneven and broken, sloping steeply to the south for most of the wreckage trail but almost vertically away to the west at the western end. There is a shallow but steep-sided ravine running laterally through the middle. Plotting the wreckage, or even finding much of it, was impeded by the environment. Stringing a nylon line down the centreline to act as a reference - and a safety homing line for personnel - offered a partial solution but only within a very few metres each side of the line itself. The effort of making an accurate plot would have been quite out of keeping with the likely gain to the investigation. Consequently, except for some items and areas of particular interest, the plot is a generalised one based upon 50-metre parallel lateral zones each handed left or right of the central line but with

/only

only rough estimates of distance from it.

5. Wreckage Inspection in Situ. With such a broken aircraft and wide dispersion of parts, and with difficult movement and restricted visibility, any attempt at detailed analysis of the wreckage in place was out of the question. It would have to be removed to more hospitable surroundings and assembled and examined there. Before authorising removal, however, the Court made extensive notes and photographed key items to preserve any information that might be surrendered but lost in transit. The photographs not appended to this Report are held for reference at Central Photographic Establishment.

6. The Removal Problem. The only reasonable access to the area is by helicopter. For the first five days on site even this was limited to the slow and not risk-free procedure of winching from heights of 60 to 80 feet. Recovery of wreckage only by that method would have been impossible; a landing site was essential. A pad was cut on a shelf at the western extremity of the trail by an Army team from Waiouru on 29 and 30 March 1981. Then, manhandling the larger pieces and containers of smaller pieces through the bush to the pad presented a further problem. The principal wreckage of immediate interest was recovered to Ohakea on Wednesday 1 April. Follow-up began on Thursday 9 April but was stopped by widespread North Island storms until return was possible a week later on Wednesday 15 April. Practically, the only solution to the problem of finding small items germane to the investigation was not to mount individual searches, but to sweep the entire area as cleanly as possible and sift the wreckage at Ohakea.

7. Security. A security party provided by RNZAF Base Ohakea was in place from 26 March, the day following the accident. It could not establish directly on site, but mounted its vigil from the riverbed below. There it also provided a haven in case of day parties becoming weathered in on the hillside. It was withdrawn on 2 April after confirmation that the wreckage retrieved the day before contained the major parts of critical interest to the Court.

8. Safety. Matters involving the safety of field parties included concern to limit numbers particularly while the only access was by helicopter winch, providing a nearby haven in case of bad weather, locating and making safe the 41 small explosive devices distributed somewhere along the wreckage trail (the aircraft carried no weapons), preventing individuals becoming 'bushed' on site, and wariness of the many parts of sharp-edged debris still precariously suspended in the tree

/canopy

canopy overhead. RNZAF armourers made safe some of the explosive devices and marked the locations of others. 35 were eventually accounted for (4 from seat + 2 lost). The problem of hung debris was twofold: not only was it a hazard to ground parties, but the Court also wished to retrieve the larger parts thought to be pieces of structure or control surface. Most of the smaller pieces and those least secure were dislodged by using the Iroquois downwash, which alleviated the safety problem. But some sections of aircraft skin remained firmly in place and could not be approached closely enough either from above or below for precise identification or examination. From later inventory, little of import now remains.

9. Progress and Early Lessons. The terrain, the extreme breakup of the aircraft, the weather, the need to limit the size of parties on the ground for practical and safety reasons, the tediously slow winching procedure at first obligatory, the labour necessary to prepare the pad and recover wreckage, competing demands on limited helicopter time and space, and competing requirements for the Court itself to be on scene and to begin taking down perishable evidence at Ohakea all conspired to make overall progress slow. Court (or Court agency) control of operations on the hill was essential lest evidence be inadvertently destroyed. The absolutely essential worth of portable radios for intra-site communication was an early and obvious lesson; in this regard the Tait 'Miniphone' portables performed particularly well. No less important to both utility and safety was the need to net in the site parties, the security party, the helicopter and oneof the Base Ohakea and Auckland Stations; for this a variety of HF (Syncal), UHF (PRC 66) and VHF (FM) (PRC 77) sets were used but, as might be expected, lack of speaker output kits limited the effectiveness of some of these items or tied needed manpower to the sets. Good photographic support was also at a premium. Although most problems were overcome as they arose, many took disproportionate time and effort and it became clear that a comprehensive standard 'crash site investigation kit' would have eased much delay and frustration.

EXAMINATION OF THE SCENE BY THE COURT

10. The Court proper was winched in on Thursday 26 March just over 24 hours after the accident, having been preceded the same day by the two officers in attendance, SQN LDR C.F.L. JENKS (AFSO) and SQN LDR J.G. FARIS (CO DEMU). Also on site were a small party from Ohakea headed by WG CDR J.F. KELLY (COTW), two policemen from Taihape, and five members of the standing SAR team from Waiouru. The focus of activity

/was retrieval

was retrieval of the Skyhawk pilot's body from a fork in a tree 65 feet above the ground. The Court was briefed by WG CDR KELLY and SGT TIKITIKI (NZ Police), and began walkthrough and inspection. None of the wreckage had been W26 disturbed save for small items examined by the police the day before in the attempt to find the pilot and establish his condition. On that day the RNZAF and civilian/police ground party had been extracted by Iroquois late in the afternoon in deteriorating weather. It had rained overnight. On this second day with the Court in place the Ohakea party was released and the task of retrieving the body using climbing equipment and line firing equipment and ropes continued under medical and Police supervision. It took until near dusk, and, with Court members, the body was then flown to Ohakea where it was handed over to Palmerston North mortuary officials.

11. Friday 27 March was devoted to specialist briefings, preliminary interviews and very necessary planning as to line of approach. The Court intended to return to the site with the Army helicopter pad preparation team on the following day, Saturday 28 March, but the sortie was frustrated by weather. Thus the first opportunity for methodical examination and recording activities on site did not occur until Sunday 29 March, four days after the crash. The Court is satisfied, however, that except for some trapped fluids which had suffered contamination from rainwater in the intervening period, all of the material signs originally there were still there to A1 be read. By invitation, Mr Milton Wylie of the Auckland office of the Inspector of Air Accidents was in attendance variously on site, at Ohakea and at Woodbourne from 30 March to 3 April inclusive.

Facts Found on Site

12. Orientation. The entry swathe began in large trees below the crest of the ridge on a bearing measured at 295 degrees A6 magnetic in the direction of flight. From the point of first ground impact, about 40 metres on from the first tree strike, the bearing of the wreckage trail shifted left ten degrees A7p1 to 285 magnetic. Parts of the front cockpit furnishings, the pilot's body and deployed parachute and items of personal flying clothing and equipment were distributed along a line tending slightly farther to the left. For reference henceforth let the point of origin be the point of ground impact and be called ground zero. Let the directional datum before that point be the measured 295 degree flight line. After ground zero let

/the directional

the directional datum be 285 degrees magnetic. Before ground zero distance will be given as a negative quantity; after it as a natural positive quantity. 'Left' and 'right' will be used relative to the bearings 295 before ground zero and 285 after it. If any other convention is used it will be specified in context.

13. General Distribution. Nothing was found short of the beginning of the initial swathe at minus 40 metres approximately; terrain prevented accurate measurement of the distance. A few fragments of wing extremities were found up to ground zero; at ground zero impact had unquestionably been violent with some fragmentary remains left in the zone; beyond ground zero wreckage of various shapes and sizes was distributed out to the engine at about 220 metres; beyond that again some engine accessory gearbox parts were found in the north-south stream bed, having been thrown over the rim of the cliff. Left and right, although some items had crossed the centreline, a great majority of the wrecked parts were lying handed consistently in the normal sense. Short of the site the Court searched up the 295 degree reciprocal in a fan to the head of the valley but for reasons which will become clear concentrated on a ridge descending into the valley from the south side. The objectives were earlier tree strikes or detached parts of airframe. This extended search, though far from perfunctory, was necessarily conducted from the helicopter over the steep and heavily forested country. It was repeated by various members and advisers at various times in varied light conditions from varied profiles. Nothing was found.

A7p5

14. The Initial Swathe. First strike had evidently been a brush with forest canopy at about minus 40 metres, followed at minus 25 metres by solid collision with substantial tree trunks in centre swathe. These trees had been severed at mid-height. Their upper parts had been carried with the aircraft to lie close to ground zero, eventually falling backward along the entry path. The right-hand fin of the left-hand drop tank was embedded in the high-standing stump of one of these trees. Further into the swathe were four standing trees, two on each side, each trunk bearing witness marks unmistakeably imprinted by the wing extremities - the Skyhawk aileron wraps outboard of the wing tip proper and is faired diagonally into it. In sequence relative to the 295° datum:

A7p3,4,8, 9,10, 12,13, 14.

/Left Side

A6
A7p3,4

	Left Side	Right Side
A7p15	At minus 22 metres was a tree with a shallow gash which appeared to have been cut by the tip extremity. About ten centimetres above it fragments of red transparency were embedded. The line of the gash was measured at 10° above the horizontal.	
A7p11		At minus 20 metres was a deep trunk gash, but this one could not be inspected closely without unnecessary risk to life and limb. Neither could its line through the trunk relative to the horizontal be measured.
A7p16	At minus 15 metres on a line inclined 12 degrees above the horizontal from the first was a similar but less organised mark on another tree, from which a single small cross-head countersunk screw was recovered. There was no clear third mark on the left; only a mess of shattered smaller branches.	At minus 15 metres lay the barely recognisable remnants of the starboard intake lip.
A7p6,10		At minus 13 metres was a tree showing gross scrape marks consistent with the passage of an already shredded wingtip. Embedded in it was a fragment of red painted leading edge skin from extremity of the wing proper under the slat. Sighting up this right-hand side with an inclinometer, these two marks and a third (broken branch) fell into the same straight line depressed at approximately 4 degrees below the horizontal in the direction of travel.

/Thus

Thus, the left side marks climbed at about 10 - 12 degrees above the horizontal while the right side marks descended at 4 degrees below the horizontal. The opening pair, left and right, lay in a plane inclined 13 degrees laterally to the left relative to the 295° reference azimuth. Because of the gross nature of the second mark on the right no useful lateral inclination could be measured from the other pair, except to say that a very slight tilt to the right could be inferred. The 'gate' presented by the opening pair in the plane perpendicular to the reference azimuth and in the 13 degree left-inclined plane was calculated at approximately 26 feet 3 inches. The Skyhawk span is 27 feet 6 inches.

A7p17

15. Zone Ground Zero. Ground zero consisted not of earth but a bank of soil-covered irregular rock about three metres high. Viewed horizontally along the azimuth 295° it presented an oblique face averaging a slope 48 degrees away in side elevation and 45 degrees away to the left in plan. Evidently the aircraft had struck this face with force but no part of it had penetrated even where the covering over the rock was thickest. No precise impact scar could be seen but the gouging was coherent. A possible line of fuselage belly could be seen - the photograph seems to make this more clear than it was in fact. But overall the scene suggested pulverisation of an essentially complete aircraft against the bank and was certainly inconsistent with any notion of an earlier and advanced breakup of the airframe. It was not possible to measure from the centroid of the gouging any well-defined line which might show the entry path in elevation, but from the severed trees in centre swathe a line approximating the horizontal could be seen. Laid back at the foot of the bank were the above-mentioned topped trees, together with some which had been uprooted rather than severed, presumably having been growing from the bank itself. Close to it these tree trunks had suffered surface burning and their foliage had been charred but nowhere was there sign of fire having taken firm or sustained hold in the zone. Under the trees at about minus 13 metres the drag chute was found. The items of wreckage in the zone just short of the bank and upon it had come from the underside of the aircraft. A fragment of rear fuselage skin, positively identified by part of the rear fuselage serial number, was embedded in a tree stump a few inches above ground level at minus 7 metres. Slightly right of the centroid was the top of the right-hand undercarriage leg. Slightly left were the remnants of a drop tank. The remaining pieces of both drop tank tail fins were found in the zone short of the bank. Encircling one of the uprooted trees was what had been a circular drop tank internal former. The radar nose cone was lying on the bank. On the right, speared into the bank by its pointed leading balance weight, was the starboard aileron tip; on the left similarly was the port aileron tip. Each still

/carried

carried a foot or so of aileron inboard and each tip showed substantial crumpling with wood splinters embedded in the folds. Also in the zone were sundry small fragments of slat, flap, and the remainder of the ailerons.

16. The Near Middle Zones. From ground zero along the left-stepped reference line 285°M an opening had been forced upward through the forest canopy in the region of 20° above the horizontal. The upper foliage of the trees in the immediate vicinity of ground zero on both sides and extending upward through this opening had been extensively scorched, but none of it had actually been kindled into fire. Around the undergrowth, the trunks and the lower foliage, there was little sign of burning or scorching and neither was there physical damage suggesting passage of wreckage beneath the canopy. Out to about 130 metres, left and right variously, were found small fragments of wing and parts of aileron, spoiler, slat, flap and speed brake. Some were suspended high in the treetops (and some of those remain there), but others had reached the ground or were later dislodged by using the helicopter's downwash. Heavier items such as a section of drop tank at 60 metres andthe twisted tailpipe at 90 metres had caused kinetic damage to the trees and had scorched the foliage as they fell back through the canopy. Throughout the region were scattered many small pieces of canopy perspex. None were more than a few centimetres square. Some were still clear but most showed heat crazing on one or both surfaces. None that were found showed sign of bird strike.

17. The Far Middle Zones. At about 120 metres and about 25 metres left the body of the pilot had been found in the tree, wedged in a fork some 65 feet off the ground and with the parachute fully deployed over the same tree. Foliage above the body had been scorched, as had the trunk and branch in the fork, but there was no scorching below that. The body and the parachute were not connected together because parts of the parachute harness and lower risers had been burned through. Fragmentary items of flying clothing and personal equipment found on the ground near the tree had also been burned. The parachute ballistic spreader had operated cleanly from apparently normal firing pin action, later confirmed. It had not been a sympathetic detonation from fire, and the parachute itself was untouched by fire. At about 140 metres but some 20 metres right of centreline lay a small concentration of wreckage which included the canopy frame, the enclosed rear canopy fairing, the pilot's left boot, the right-hand canopy sill which had been torn from the airframe, and the laminated glass windscreen. All showed fire damage; none of the exposed soft linings nor the

A7 p18,19

W27

W26

W27

A7 p20,21, 22

/escape

escape system piping remained attached to the canopy frame. A significant particular exception was that the canopy sill top surface retained no products of combustion. The canopy latches on the right sill were in the locked (extended) position, all six being held there by the distorted and firmly jammed cam carrier rod. Alongside the sill lay the windscreen, starred right through but intact except for marginal burning down the right-hand edge. No canopy perspex remained in the frame. No sign of bird remains, even charred, was found among these components.

18. The Far Zones. Also at 140 metres, but on the left in line with the parachute and across the lateral shallow ravine lay the pilot's shattered helmet, unaffected by fire. None of the visor material was found, but a portion of visor track was found elsewhere. Again, there was no sign of bird strike. Up a tree a little farther on in the same line were the remnants of the front cockpit seat back complete with the unfired ballistic initiator and rocket catapult (ROCAT). Near it on the ground was the seat pan bottom; the RSSK 8 seat pack had been demolished and its contents scattered widely. The seat stabilisation lanyards had not been withdrawn. The seat ejection initiation handles were not found. Close on the right of centreline at 150 metres was the after fuselage section and empennage, relatively complete but broken. It had also damaged trees from above as it fell. The rudder had been curled back on itself by a blow from the trailing edge. The rudder and elevator power packs and rudder trim mechanism were still in place. With this wreckage was found part of the front cockpit instrument panel. About 50 metres farther on was the main part of the centre fuselage and cockpit enclosure. It had been badly damaged by impact and fire. It had caused foliage scorching on its descent, and localised sympathetic burning on reaching the ground. It contained remnants of instrument panels, all badly impact damaged and burned, some panel ladder lights and glareshield warning lights in good enough condition for technical analysis, and the rear seat complete. Though the seat was burned out otherwise, neither the ballistic initiator nor the ROCAT had fired. Because the rocket tube had been forcibly extended by about ten centimetres, however, the stability of the combination was uncertain. Using explosive cord on site the initiator and the rocket motor were separated without touching off either. With that expert success the front initiator and ROCAT received identical treatment later after retrieval from the tree by the helicopter. The rear parachute had burned but was still in the pack with the seat, although the ballistic spreader had been initiated in the fire. Close by this section there were on the lip of the steep drop into the western stream a number of impact-damaged trees and deep gouges in the earth. This was where the heavy

A7 p23

A2M p8

A7 p24,25

A7 p28

/engine

A7 p29

engine had landed after its 200 metre 'flight' from ground zero, and it had then rolled over the cliff to come to rest against a tree some 150 feet down the slope. The secondary impact had evidently scraped off most of the accessory components and ejected them clear over into the stream bed far below, where some of them were later found. As with all the other major parts, the engine had burned externally for a time, particularly from the ruptured oil tank where oil had leaked and run under the engine as it lay. But yet again the sympathetic burning of bracken was very localised. Despite the damage to the other accessories, however, the Constant Speed Drive (CSD) unit was found back at the top of the cliff separately and in good external condition. Further, within the fuselage section, the Engine Pressure Ratio (EPR) electromechanical transducer was found still in place and relatively undamaged.

Tentative Conclusions Drawn from Site Examination

19. Before proceeding it is convenient, even necessary, to draw together a number of tentative conclusions arising from the above-listed catalogue of facts. These conclusions are presented without prejudice, and will tend to be confirmed or denied by evidence to be adduced later, but in order to make any sense at all of what will follow it is necessary to have some matters disposed of early.

20. Airspeed. Most obviously this had been a high-energy impact. Large trees had been neatly cut as a rotary scythe cuts grass. Large and heavy pieces of wreckage had been thrown 200 metres after driving upwards through thick forest canopy and arcing clear above the forest; the throw would have been even longer had it not been uphill. More will be brought forward below in confirmation, but the Court was confident that it was considering no possibility of uncontrolled flight arising from slow speed aerodynamic departure.

21. Longitudinal Attitude. There was very little of the aircraft wreckage at or short of ground zero; and most that was there was from the underside. Most of the heavier underwing and underfuselage skin had been reduced to confetti. The aircraft had not penetrated the bank, but had bounced off it upwards approximately 20 degrees and left 10 degrees, and catapulted that 200 metres above the forest canopy shedding parts as it went. A high nose-up attitude was thus strongly indicated.

22. Lateral Attitude. Lateral attitude is less amenable to such direct induction, although it is beyond doubt that the aircraft had been right way up. At the time the aircraft entered the opening tree pair 'gate' the left wing tip, from the mark in the left tree, was already on the rise by some 10° above the horizontal. That trend seemed to have continued to

/the second

the second tip strike on the left, the line between the two being inclined upward from horizontal by 12°. On the right the tip seemed to have held consistently to a 4° depression below horizontal. There are two possibilities which would allow this geometry. Either the wing(s) had begun to part company with the aircraft allowing the left to rise at a faster rate than the right fell, or the bodily flight path was also on the rise accounting for the same thing. For the moment, let it be assumed that the aircraft's wings did not begin to fold upwards. Bear in mind too that the measurements between the telltale tip marks in the trees could not be made directly in some cases because they could not be reached even by ladder; instead measurements had to be taken at points on the trunks below the marks and adjusted by eye. The trees would also, one supposes, have bent outwards in reaction to glancing blows. And bear in mind that the geometry is dynamic and to be rigorous would need to take account of rolling wingtip arcs about a lateral centre of gravity which would itself describe a lesser arc. But using a simplified rectilinear geometry the apparent absurdity of disparate tip paths can be resolved if the centroid of the aircraft is allowed to rise along a path inclined approximately 4° to 5° above the horizontal with the aircraft rolling right. A five degree climb is certainly not outside the bounds of possibility shown by the general path in elevation cut through the trees, and, added to a possible high nose-up incidence it aids the projection of wreckage off the slope of the bank. Unfortunately the roll rate cannot be calculated without knowing airspeed and even if the latter were known at the point of first entry into the trees the answer would always contain an element of uncertainty associated with the uncalculable deceleration at the earlier strikes which severed the trees. That factor could well be insignificantly small in view of the other source errors in the measurements, and it might be instructive later to calculate rate of roll from an assumed probable airspeed.

23. Airframe Integrity. The above conclusion of slight climb hinges upon the assumption that the airframe was substantially whole during the tip strike sequence, supported by the impression of the scarring at ground zero. But is that assumption reasonable? The presented 'gate' at the first tree pair as it stood was some 15 inches less than the span of the Skyhawk. The depths of the gashes in the trees and the crumpling of the tips equate quite well with that. It is also clear that there can be no suggestion of the wing(s) having separated earlier in flight; if they had then even the degree of tip path correlation seen could not be expected. Therefore the focus of attention has to be the severed trees early in the swathe. The one on the left closest to the centreline struck in a position such as to trap the inside fin of the port drop tank. The tree was severed and was anyway one of the smaller ones. It is unlikely that it cut the wing right off, else it would still be standing. If it had weakened the wing to cause it to fold upwards from a point just inboard of the drop tank - about six feet from

A7p13

/the

the aircraft centreline - the geometry would not allow the tip to strike the second tree on the left. On the right
A7p12 the larger severed tree struck the aircraft in the region of the intake lip where the wing chord is deepest. Being cleanly severed and with the upper part carried forward, again it was the tree that gave in first, not the wing. Complete separation of the right wing is therefore unlikely. More telling than that, however, is the consistency of the three identifiable tip strikes down the right-hand side. The first (a small branch) lay before the strike on the severed tree. There was no subsequent discontinuity; the three marks lined up at 4° depression, and the wing must have stayed
A7p15,16 in place throughout. As to the wing and aileron tips themselves, on the left the first cut was clean and shallow. The second was less clean, signifying some damage to the tip from the first strike, but the geometry required the tip still to be on the wing. The aileron tip was found in the bank, torn about a foot inboard. The conclusion that this separation
A7p10,11 happened at the second tip strike is reasonable. On the right, the first cut into a tree trunk was deep, deeper than anywhere on the left. The marking on the next tree was clearly caused by an already grossly torn wing end. It is believed that the right aileron tip, found speared into the bank, had separated at the first of these two strikes and, from the geometry again, had passed outside the second tree. It had unquestionably passed outside yet another tree standing unmarked on the same line closer toward the bank. Therefore, on this kind of evidence, the Court offers for later testing, if possible, the hypotheses that the major structure remained substantially intact right up to ground zero, that the aileron tips were both torn off by collision with three trunks well into the swathe, that the flight path was a slight climb (4° to 5°) through the swathe, and that the aircraft was simultaneously rolling to the right from 13° left wing down to 1° right wing down approximately in a distance of about 10 metres.

24. Yaw. Nothing conclusive could be drawn from the site examination in respect of yaw, except that around that axis as the aircraft bounced from tree to tree some zig-zagging might be expected.

25. Fire. Much of the wreckage had been alight as it arced above the trees and had scorched the foliage on re-entry. Evidence of explosion at ground zero adding to kinetic disintegration was abundant. Small fragments of wet wing with tank sealant still adhering were widely distributed down trail. Yet nowhere was there evidence of sustained fuel-fed wreckage fire nor of secondary bush fire of any size. Sympathetic fires in the undergrowth where major parts of burning wreckage had landed were very localised and had nowhere been intense, and none of the standing trees had been kindled into self-sustaining flame. Wiring insulation and other flammables where protected by aircraft structure or conduits had been heated but were not seriously burned or melted. Parts ripped free early showed no burning. But undoubtedly anything flammable or heat-sensitive which was exposed in its natural place or by breakup

and distortion of structure after impact at ground zero had been badly burned or melted. This extended to instrument faces where pointers and markings had been burned off. All of this seemed to point toward an explosive cataclysm at ground zero. It must have consumed virtually all of the fuel present because if it had not there would have been more evidence of sustained fire fed by liquid fuel. Liquid fuel burns, it does not explode. Yet none of the trees or undergrowth near ground zero showed such sign. Now, a necessary condition for fuel explosion is vaporisation forming a favourable mixture with the oxidant. In this crash, as will be shown later, there was fuel in the drop tanks - about half capacity. It is known that at least one of the drop tanks hit trees early in the swathe, and it is reasonable to suppose that the other did as well. It is also reasonable to suppose that, despite the argument above denying that the trees severed the wings, damage breaching the integral tanks was done by those trees. Fuel would thus have been released into free air, probably from all tanks internal and external. If the aircraft had exploded at that point, bearing in mind the evident violence involved, the scene would have shown greater evidence of incoherent impact at ground zero, there would have been earlier scorching of the trees, there would have been wider lateral distribution of wreckage under explosive forces, the tip strike marks would have been less consistent laterally, there would have been more evidence of penetration of parts and fire beneath the forest canopy rather than consistent evidence of fireball ejected only in an upward trajectory which must have been induced from the bank, and, as will be shown, there would have been different patterns of injury to the pilot and damage to his seat and parachute harness. It seems therefore that early damage to the aircraft's tankage had created an explosive fuel/air mixture in free air which was touched off when the body of the aircraft struck the bank, and, as it finally smashed to pieces under kinetic forces it sprayed the remainder of the fuel and glanced off the bank imparting the upward trajectory to wreckage and fireball alike. The explosion consumed most of the fuel with very little liquid residue to burn. Consultation with a technical officer from the Auckland office of Shell Oil elicited agreement that the above is a credible scenario as to fuel explosion chemistry.

FACTS FOUND FROM TECHNICAL ANALYSES AFTER REMOVAL OF THE WRECKAGE

General Procedural Note

26. The engine, remnants of accessory gearboxes and some of the instruments were forwarded for analysis to the repair point at No 1 Repair Depot. The Court was initially represented there by the RNZAF AFSO and the MOT Air Accident Inspector

/in the capacity

in the capacity of observers; both gentlemen are graduates of the USAF Jet Engine Accident Investigation Course. The recovered instrument panel caution lights and cockpit glareshield warning lights, a sample section from the engine exhaust, and samples of hydraulic oil were forwarded to the Defence Scientific Establishment's laboratories. The fluid samples were not thought likely to be productive of good information. It had rained (twice) at the site before the samples were taken and with so many fractured lines open to the elements not only could water have entered the systems but also in doing so it would have washed vegetable debris and dirt into them. In respect of fuel samples, other evidence would deny contamination. The CSD was stripped and examined at the Ohakea repair point - the Engineer Member had established that facility in 1972. The EPR transducer repair agency is the US Navy, but because it is a relatively simple device which had the potential to offer powerful evidence quickly, it was opened and inspection at Ohakea by the Engineer Member. Explosive components from the escape system were examined and analysed by RNZAF explosives inspectors under Court supervision at Ohakea. Mechanical components from the escape system were similarly inspected and some were opened (necessarily being damaged in the process) under direct Court supervision. The remainder of the airframe wreckage was assembled at Ohakea and examined by the Court and its advisers in attendance, with expert assistance where required from Ohakea. With regard to the MOT Air Accident Inspector's remarks concerning application of engineering resources, with respect it must be observed that he misses a point or two. Considerable engineering and scientific resources external to the Court were used where it was necessary. But apart from that, this aircraft was exceptionally badly broken up. Solution would depend not upon establishing probabilities directly, but upon a methodical process of eliminating possibilities and evaluating the residue; a much more difficult process to accomplish. Linkages of lateral thought connecting clue to clue was essential. With more than one principal at work these linkages could easily be lost. Thus, supervision of the main wreckage examination was given over to the Engineer Member and the escape system to the General Duties Member. They would draw on outside expertise where necessary, and the Court would collectively settle upon interpretations and weigh the many contradictions found. The penalty of the single-mind approach was of course slow progress, but it was methodical and seemed to be a lesser penalty than the possibility of missed critical evidence or missed connections between evidential points. Other accidents could require a different approach; this one required the above. By tenacious attention to detail in sifting through the wreckage, and with expert assistance where necessary, the two Members succeeded in finding and 'reconstructing' a surprising quantity of useful material from the piles of rubbish on the hangar floor.

Al

Cover

/The Engine

The Engine and Accessories

A2C

27. CSD. Witness marks on the CSD toroids defined a probable roller angle on impact shock. Analysis yielded an indication of the CSD recovering from an underspeed condition equating to an N1 spool speed of 7000 RPM. The data available locally linking N1 and N2 speeds are tenuous, but a 78% gauged cockpit engine RPM reading was calculated. This suggested an engine throttled below normal cruise power or running down after failure. It is not believed, however, that an approach to the manufacturer on the matter of N1 and N2 relationships is necessary. The CSD was found in the ambit of the heavy gouging on the cliff edge. It is probable that the engine flew its arc above the trees still as a more or less collective entity with and protected by the centre fuselage section, and broke out finally on secondary impact with the trees and ground. It is probable therefore that the witness marking of the toroids was implanted as the CSD broke away from the engine during the secondary impact. The marks would thus record instantaneous RPM in an engine which had been separated from its fuel source in the explosion at ground zero and had run down subsequently as it flew through the air. Alternatively the 1RD thesis of violent stoppage early could be true. However, if asked, the Court would prefer its own reconstruction of events. On either basis engine RPM actually at first impact would have been above 78% N2.

A2D

28. EPR Transducer. The EPR transducer was found in place in the fuselage centre section. Its core is a beam influenced by pressure capsules. A fulcrum positioned by an electrically actuated worm drive moves to maintain beam balance and provides an analogue of engine pressure ratio for transmission to the cockpit gauge. If electrical power is cut off the fulcrum should freeze in position. In this accident, provided there were no signs of distortion or disengagement of the worm drive gears or dislodgement of the fulcrum mechanism itself, the considerable mechanical advantage of the worm over the follower should have ensured that the latter would be in its last commanded position before electrical power was cut. The mechanism was in good condition with all gears and followers engaged. The fulcrum position equated to a gauged EPR reading of 2.51. Empirical test of the installed system in another TA4K in flight showed that at 3,500 feet and 300 - 360 KIAS (ie cruise range) and at cruise power the gauge registered between 1.5 and 1.7. Following slam acceleration to military power at those speeds it settled between 2.48 and 2.5. In the crash, had electrical power been maintained to the transducer as the engine ran down for any reason, a correspondingly lower equivalent fulcrum position could have been found. But on the above figures the electrical power had been cut when the engine was at or very near full military RPM - that is, on impact at ground zero or earlier if trees short of it had penetrated the wiring. Not only that, the 2.51 figure also

/shows

shows that at the time the fulcrum froze the tail section of the engine was attached and intact, for the fulcrum position would have reacted to any abnormal release of pressure through rupture in that area. Serviceability of the EPR system is normally good, and the reading is taken as part of runway checks on takeoff. Failure to reach the predicted reading is a no-go item. Therefore the Court had a compelling indication of two things - the engine had been delivering close to full power at primary impact, and at that time the engine exhaust system was intact. Further evidence of normal power delivery can be drawn from the metallurgical examination at DSE of the section of exhaust, indicating that the temperature inside the tailpipe had not been abnormally high. The front cockpit EGT gauge reading was frozen at 440°C; this reading, as will be explained later, is thought to be unreliable.

A2K

29. Engine Analysis at No 1 RD. The strip examination of the engine at No 1 RD provided corroboration that the engine had been under power, and high power at that, on impact. No abnormalities of function were found. There was no sign of lubrication system seal failure. There was no sign of pre-impact engine fire. The FIRE glareshield warning light filaments taken from the rear cockpit had not been energised at the moment of impact (from the DSE report).

A2A

A2J

30. Summary - Engine. The above deductions reduced the requirements to look for cause of the accident in engine failure, to examine in detail some engine accessories, and to submit a fuel sample to detailed analysis. The badly damaged parts of the fuel control unit were nevertheless forwarded to No 1 RD. The FUEL BOOST ladder caption filaments had failed cold. They showed nothing inconsistent with normal function. No fluid filters in the engine or accessories showed evidence of pre-impact clogging. Only one anomaly remains - the DSE analysis showing that the OIL LOW light filaments in the instrument panel push switch were energised at the time they failed. This will be discussed later.

A2J

Aircraft Attitude

31. Again for the sake of clarity in what will follow it is necessary to pause in this factual recital to draw further conclusions as to aircraft attitude and behaviour through the initial swathe.

32. Pitch. The angle of attack vane was not recovered. Although the front cockpit indicator appeared to have frozen at 24 units angle of attack, of itself it was not thought to be a reliable indication. Any passing twig could have deflected the vane, and impact forces could have changed the reading after the electrical power was cut. However, with the entry into the trees it seemed likely that scrape marks on external vertical surfaces would show angle of attack. The most obvious and

/complete

complete vertical surfaces - the fin and rudder - were clear of such marks. But that was in itself far from an unimportant indication because at a high angle of attack those surfaces would be shielded by the wings. The same would be true for tailplane undersurfaces which, in this case, were free from punctures from below. Much of the fuselage above the wings would also be shielded and, in this accident, marks on fuselage surfaces forward of the wings had been obliterated by fire. Options tend in general to be further limited when aircraft squash heavily into impact, for the lower fuselage side walls bulge outward and become 'underside' panels; care must be taken in interpretation of scoring lest the assumed plane of reference be wrong. Then, with extensive breakup, small elements of outer skin are difficult both to identify and to orient correctly relative to the longitudinal datum. It is also necessary to be sure that any given fragment even if positively identified and oriented carries marks which were implanted while the panel was still part of the airframe. Anything marked after breakup is useless for the purpose. But one panel was found in the case in hand which satisfied all criteria. It had come from the intake bulge above the wing on the right-hand side. Outward bulging into the horizontal plane would be unlikely. It would most probably have been scored by the tree which struck close inboard on the right early in the sequence. The scoring of interest continued through tears in the fragment itself and at the edges of the section the scoring had been peened over as it broke from the aircraft; the scoring had thus occurred before separation. The section could be oriented easily and showed blanking by the wing in its lower quarter. The marks corresponded to a 20° angle of attack. Other panel segments from each side of the fuselage but less clearly identifiable and less amenable to positive orientation all tended to confirm an angle of attack of 20° or so. Added to the slight climb deduced earlier, we now have an aircraft with its nose pointed about 25° skyward.

A7p30

A7p31,32

33. Roll and Yaw. Markings of this kind showing roll could not be expected. But, despite the destruction of the aircraft underside, it was hoped to find something which might indicate yaw or lack of it. The elevator and tailplane, being blanked by the wing, were clean except for a doubtful indication of slightly yawed flight to the right on the left tailplane undersurface. But there was no way of knowing when that mark had been implanted. Part of the large servicing door under the fuselage at the wing trailing edge showed slight right yaw marks. But the underside of one of the drop tanks indicated yaw the other way - although the tanks are not rigidly aligned to the centreline when mounted. Gashes and scoring in aileron and flap undersurfaces were generally aligned to the longitudinal axis. Further, it is not difficult to envisage the aircraft snaking through the swathe in reaction to tip strikes. All in all the Court could find nothing indicating grossly yawed flight, nor could it conclusively assign any preferential weight one way or the other to the weak indications of lesser yaw.

/Empennage

Empennage

A2F,G

34. Elevator and Tailplane. The tailplane trim screw jack extension yielded a good result showing tailplane trim at one degree nose up - normal for the 300-knot regime. The elevator power pack was bench tested as 'serviceable'. The possibility of a repeat of the internal seal leaks which had led on an earlier occasion to cross-coupling effects in other planes through the pilot loop was carefully checked, but rejected. One external witness mark on the elevator corresponded to a position past full down, but this was attributed to tail-first or tumbling entry into secondary impact after hydraulic lines had been ruptured and the elevator was freed to flap. Full down elevator is anyway incompatible with high angle of attack and is discarded as a reliable indication at primary impact. Another mark implanted at some stage in the breakup sequence recorded an elevator position of nine degrees up relative to tailplane datum. The elevator bungee was distorted in a way which strongly suggested a 24° up elevator position, and damage to the control column interconnecting rod suggested an input from the cockpit of full aft stick. The relative merits of these indications will be argued later. All elevator and tailplane hinges and attachments had evidently failed in impact overload.

A2F,pG

A2H

35. Fin and Rudder. As with the tailplane and elevator, the fin and rudder were found complete and with no sign of pre-impact failure of any kind. The rudder power pack tested 'serviceable' on the bench. Rudder trim had been set marginally to the right. There were no clear or coherent witness marks to tell of the rudder position at primary impact, although the curling of the trailing edge showed that the entry to secondary impact had been tail first and had broken the rudder off to the right.

Wings

36. A few sizeable chunks of upper wing surfaces were found but the lower surfaces of the wings proper had been shredded. Nothing was to be gained by attempting 'reconstruction' of contiguous fragments. As to wing attachments, most of the slats, flaps, ailerons and spoilers were recovered and examined. All fragments found were within the wreckage trail; in particular nothing had fallen off short of first entry into the trees.

A7p33,34

A2E

37. Ailerons. All hinges and actuating rod fractures found in the aileron system were consistent with impact overload. The aileron power pack was not recovered. It mounts in the belly of the fuselage, the area which manifestly took the brunt of the impact into the bank. The power pack is a brittle casting and it would have shattered along with the rest of the underside.

/The bungee

The bungee also is missing. But lengths of the rods which carry the power pack output spanwise into the wings along the leading edges were found. Breaks and bends in these rods, when matched with parts of heavy wing structure through which they pass, gave rod positions consistently on each side equivalent to about half aileron deflections to roll right. The left aileron was still connected to a section of outer push-pull rod. The aileron trim tab setting was slightly right wing down. With the bungee missing the associated aileron bias mechanism could not be examined. As to the ailerons themselves, given a working system and a 20° angle of attack, with half right aileron deflection the left aileron would be presented to the airflow at an angle of 30° and the right at an angle of 10°. The left aileron tip crumpling had a clear bias upwards and the underside carried puncture marks while the upper surface was clean. That tip had also cut into the first tree trunk just below the deposit of red navigation light fragments from the wingtip proper. The right aileron tip crumpling was more concertina-fashion inwards, and both upper and lower surfaces carried puncture marks. The aileron tips were found on the bank; there was no possibility that, as with some other surfaces, the damage had been done down trail after primary impact. The only indication either of left aileron application or command came from marks at the base of the control column; the indication is discarded because it was most probably caused during final breakup and has no bearing on earlier control position.

A2E, pA,B
A7p33,34

38. Slats. Although the Court must admit to difficulty in conceiving of a slat failure mode which would actually cause this accident, for reasons of reputed weakness in the system particular attention was paid to the slats. RNZAF SMI/SKY/69 requiring the replacement of slat bolts had been embodied in NZ 6253 in February 1981. Enough of all six attachment points was recovered to establish that bolt failure in this case had been of the overload type; in the bolts that were recovered no element of fatigue cracking was evident. Distinctions between impact or aeroelastic failure of the slats could not be made. All slat fragments that were found were in the wreckage trail, although some elements were missing. But for one mark, the impact strikes had been from above along the leading edge - ie compatible with slats on the wing and deployed. The three slat rails recovered had been bent in a way indicating impact with solid objects and consistently in a position showing full or near-full extension at the time of those collisions.

A2I

A2IpA

39. Flaps. All indications were that the flaps had been positively retracted. Even if down hydraulic power had been applied, the blowback system would not have allowed flap extension at the probable speed of the aircraft.

A2I

/40.

A2I

40. Spoilers. All physical indications were that the spoilers had been properly faired; furthermore the SPOILER EXT ladder light filaments had failed cold.

Hydraulics and Control Runs

41. Hydraulics and Manual Disconnect. Hydraulic systems piping had been smashed. The Court could not attempt to reconstruct the system for examination. One of the two hydraulic pumps was recovered but without key to whether it was from the utility or the flight control system. The pump was stripped and examined and was found to be in good condition. DSE analysis of hydraulic oil samples showed contamination but the examination technique used could not distinguish between solid particles and suspended water. Post-crash rainwater contamination did occur and crash-induced debris was also present. What can be said is that the Court found no evidence of metallic debris in system filters, nor of filter blocking by other contaminants. The filaments in both the UTILITY HYD and CONTROL HYD ladder lights had failed cold. The elevator mechanism was found in the 'manual disconnect' mode but, being cable-operated, that could just as well have been a result of post-crash airframe breakup as of pilot selection in the air. Cockpit damage and burning precluded the possibility of deduction from the associated control handles in either cockpit.

A2L

A2J

42. Control Cable Runs. In the TA4 the control cable runs forward of the power packs are, in a sense, designed to fail safe. The elevator system is duplicated; a single cable failure would not cause difficulty. In the rudder system if cable failure occurred the rudder would centralise under the influence of the bungee, provided pedal pressure on the 'good' cable side was relaxed. Rudder control would then be available through the bungee bias trim system, although that facility would be lost in emergency generator. If aileron control failure occurred anywhere forward of the junction where the cables from the rear stick join the outer cable ring, cable tension would be maintained and the ailerons would either neutralise or maintain the given deflection until the stick was moved back toward the centre, depending upon which side the break had occurred and which way the stick was deflected at the time of failure. If the break occurred aft of the junction, cable tension would be lost. The ailerons would react accordingly and momentarily until the bungee overcame cable tension to reduce the deflection. By test on a static aircraft it was established that the bungee would overcome cable tension in that way. In either case aileron control would be available, in normal generator modes, through the bungee bias trim system and the follow-up tab. In detail:

A2E,F,H

a. Elevator Control Runs. Forward of the aft bellcrank assembly all but one of the elevator cable ends were found and checked. Most cables were intact, some were broken and two short lengths were not recovered. There was

A2F

/no

no sign in what was available of pre-crash elevator cable failure, and anyway the dual system leads the Court to discard the possibility of critical failure in the air. From power pack to elevator the entire mechanism was recovered and showed only the expected impact overload failures.

b. Rudder Control Runs. Similar degrees of cable damage were found in the rudder system. But in this case only about 40% of the cable end fittings were recovered for examination, and one entire length of cable was not recovered. Downstream of the power pack only impact damage was evident.

A2H

c. Aileron Control Runs. The entire cable system was accounted for and inspected except for some short lengths, one of them containing a turn buckle. The condition of the push-pull rods has been described elsewhere. At the port aileron the connections at aileron horn and at both ends of the bell crank were intact, although the rods themselves had been severed.

A2E

The above remarks must be seen in the light that some cables of all control runs had snapped during post-impact disintegration. While it would be illogical to conclude unequivocally from that that the airframe breakup was the sole cause of cable breaks, there is no doubt whatsoever that it was a sufficient cause. As to control run jamming, not all of the pulleys and quadrants were found and many that were found were damaged or broken. There was nothing to indicate prior jamming by foreign object or otherwise. And to place that in proper perspective, as well, it must be understood that the general disintegration was so complete that there was little possibility of being able to differentiate between markings caused by breakup and those that might have been caused by foreign article. Neither was there any great expectation of being able to find a foreign object amongst the debris unless it was large in dimension or in incongruity.

Cover

Miscellany

43. Speed Brakes. The left speed brake board was found with surrounding structure and ram attached. It was retracted. The right-hand board was found separated from the airframe within the trail. The ram was also found, separated at both ends but in the retracted position. The SPD BRK OPEN ladder caption filaments had failed cold.

A2I

A2J

/44.

44. AFCS. Nothing could be adduced from the cockpit controls as to Automatic Flight Control System selections. It would, however, have been most unusual for the pilot to have been flying at low level either in full AFCS or the control stick steering mode.

45. STAB AUG. On the other hand, flight with the stability augmentation system engaged would be normal, but again it was not possible to conclude from the wreckage what the pilot's selection had been.

46. Landing Gear. From the pattern of damage to the landing gear legs it was clear that all three had been retracted at impact.

47. Ram Air Turbine. The RAT was not recovered, however impact marks on the RAT doors, support mechanism and retaining panel indicate the RAT was not deployed.

48. Warning and Caution Lights. Aside from the others mentioned elsewhere in this text, the only warning and caution lights recovered, identified and analysed were the OBST and BRAKE (ie park brake) glareshield lights. The filaments had failed cold. All four of the glareshield lights analysed were from the rear cockpit. All six of the ladder lights analysed were from the front cockpit. The OIL LOW light was from the front cockpit. The front glareshield lights and the rear ladder light strip had been destroyed by impact and fire, or were not found.

A2J

The Instruments

A7p26,27

49. As expected, the indications from analysis at No 1 RD of the badly damaged instruments and related items contained many contradictions. But there was consistent indication of the heaviest blow having come from low on the right. There was indication of high loading in the normal axis. There was strong indication of massive longitudinal impact forces. There was some indication of nose-up attitude. The face of the front airspeed indicator/machmeter had an impact mark thought to have been implanted by the underside of the needle, recording a speed of 328 knots. The needle itself was not found. The other indicator had had the face and needle obliterated by fire. The air data sensor yielded a speed of 250 mph. As No 1 RD points out, however, that reading is meaningless without knowledge of the time of power cut off or the time-order in which that happened relative to separation of the airspeed capsule. An alternative reason for treating the reading with caution is the likelihood that the pitot head was ripped away by very early contact with tree branches.

A2B

/50.

A28 50. The Court believes that Warrant Officer R.D. Hingley of No 1 RD who signed the analysis of the displacement gyro package should be congratulated. The Court read with considerable interest his conclusion of nose up, left banked primary strike against a near vertical surface, major impact from the lower right, a tumbling action thereafter, and final stoppage at a secondary impact. The unit mounts in the after fuselage. The Court then established to its satisfaction that this sequence had indeed been derived solely from the technical evidence and that the examiner had not known of the circumstances at the crash scene. The Court with all its additional knowledge could not have described the probable behaviour of the after fuselage section more succinctly.

The Escape System

A2M 51. General. Most of the cartridges associated with the escape system had been fired, some by the fire but many by action of the firing pins operated by gas or spring pull-percussion devices. System gas deposits were found in some of the tubing recovered and in some of the mechanical devices which are gas-operated. Of the explosive devices not recovered it is known from downstream gas deposits that at least one of them (the front inertia reel gas generator initiator) had operated, and therefore it is reasonable to conclude that at least some of the 4 items not accounted for also had fired.

A2M 52. Anomalies. In a normal ejection sequence the devices fire sequentially in an orderly fashion, and there are some items which are inhibited or delayed until other actions are complete. The pattern in this sequence was disorderly; in fact it was not a pattern at all. Some cartridges which ought not to have fired did. For instance, the canopy external jettison cartridges had operated, one clearly from impact breakup and consequent pull percussion, and the other from fire. A number which ought to have fired did not. They are listed below:

a. Neither of the two ROCATS nor their respective ballistic initiators (the ROCAT-initiator combinations are each treated as a single unit in the ledger chart at Appendix 2M). Gas had not reached the initiator input nozzles in either case; the upstream tubing was not recovered. But the left-hand cartridge in the paddle assembly behind the front seat, normally inhibited until the canopy has gone, had fired. Gas from it had apparently reached the rear seat dual boost cartridges which supply gas to the ROCAT initiator; the caps had been struck and the boosters fired but they had been damaged by fire also. The same paddle cartridge supplies gas to the front seat boosters through a manifold and delay initiators. Neither delay

/initiator

initiator had been fired; gas had not reached them and the assemblies had been broken by impact. Therefore, it would seem, system gas was interrupted in the rear seat circuit after the local boosters had fired, and in the front seat circuit either at or before the manifold mounting the delays and front seat boosters.

b. Neither the canopy ram separator nor the ram hydraulic shutoff valve had operated or received gas. Piping to the ram separator runs through the canopy framing and had been demolished by fire. However, the tubing to the hydraulic valve was found. It had broken in two places and gas had passed through the first break but not the second. Thus the interrupt point in that circuit could be identified in the line from the canopy thruster cartridges (which had operated).

c. The right-hand pull-percussion device ('coke bottle') normally operated by line as the canopy clears had not operated. The firing pin had been forcibly sheared. The left-hand coke bottle had, however, operated normally by percussion. Until either one of these two devices operate, neither seat can leave the aircraft in a normal ejection.

53. Man-Seat Separators. In the man-seat separation systems, an initiator is normally fired by gas from the seat dual booster - the latter is the same item that boosts gas to the respective ROCAT initiator. In this case the rear one had been subjected to heat - it was in the burned-out cockpit - but the cap had also been struck by the pin. Gas from the seat booster had reached the initiator as advertised. The downstream delay cartridge had also been subjected to heat but, as with the initiator, the pin had also operated. The manifold of the separation rocket had not received gas, however, and the rocket had not fired although it had been subjected to heat. In the front seat system, it will be recalled, the seat dual booster had not received gas and had not fired. It is not surprising then that none of the separation initiator, the delay cartridge, nor the rocket had received gas. Neither had they been subjected to heat; they were all unfired and in relatively good condition.

54. Mechanical Devices. At the rear of the canopy are two gas-operated piston thrusters designed to unlock the canopy and the hinge to permit it to depart. One was found extended and the other retracted, although both cartridges had fired. One thruster will unlock the canopy but it was necessary to

A2M

/investigate

investigate the other in this case. It was found, by inspection after disassembly, that there were gas deposits in the annular chamber at the end of the cylinder which matched with the two outlet ports on the piston shaft. They could only have got there if the piston had reached full travel. Thus, the thruster had operated as it should but had been slammed home again by some external impact. The front seat inertia reel system had been retracted only half way; the rear one had been retracted fully. The retraction system is also gas operated through a piston and rack-and-pinion. The front cartridge was not found, but gas from it had entered the cylinder and operated the piston as far as is had gone. The rear cartridge had operated by pin and cap, but had also been subjected to heat. The part-retraction of the front reel will be discussed later.

55. Parachute Initiators. The rear seat parachute release actuator and the ballistic spreader had both operated in place in the fire. The front parachute release actuator and ballistic spreader were untouched by fire and had operated by normal percussion action.

56. Front Seat. The front seat harness had failed at the lap strap retaining pins. The shoulder harness had disengaged from the pin. The left lower strap lug of the torso harness had pulled clear of the quick-release box as the retaining plunger withdrew slightly. The hole in the lug was distorted oval and there was marked scoring where the lug had pulled free from the plunger. The anti-G pin which normally restrains the plunger had been bent, allowing the plunger to lift. All of this testifies to the violence of deceleration at impact.

A7p35,36

A7p37

The Pilot

57. Factual evidence relating to the pilot offered at this stage is limited to medical evidence of a technical nature bearing upon the behaviour of the aircraft as it entered the trees, struck the ground and disintegrated. Other matters concerning the pilot's medical and mental condition will be discussed later.

W27
A2M

58. The aircraft was one of two modified for airmix breathing. From autopsy, there was nothing in the trachea or lungs indicating inhalation of smoke. Toxicological analysis which might indicate intake of other fumes or, for that matter, of any drug or anything else which might have affected performance, was not possible. But subjectively from other evidence neither was there cause to expect effects from such things, nor from hypoxia or hyperventilation.

W27

/59. From X-ray

W27
A7p38

59. From X-ray analysis the bone breaks in the left arm and hand were consistent with the hand having been on the throttle or possibly the glareshield. They were inconsistent with the notion of hand on the seat pan ejection handle. The front throttle lever showed that classical form of damage which indicates hand on throttle at impact. The rear throttle lever had no such damage.

W27
A7p40

60. Again from the X-rays, indications were strong of the right leg having been extended almost fully at impact. (Note: in the Palmerston North Hospital Radiologist's report, the heading at paragraph 6 should read 'Left Leg'.) Consistently, the left leg appeared to have been positioned bent at the knee and slightly abducted - that is, thigh splayed outward. Both front cockpit rudder pedals had been shattered; both rear cockpit pedals were whole.

W27
A7p39

61. Little of a similarly weighty nature could be drawn from the X-rays of the right hand and arm. However, the injuries there were not inconsistent with the notion of hand on the control column, and it was largely the curious character of some fractures in the fingers which gave concern. Neither those fractures nor any others, however, suggested hand on the seat pan handle. The front stick grip and attachments had been stripped from the control column; the rear stick grip had not.

W27

62. Both shoulders and abdomen showed lacerations caused by harness straps.

DEDUCTIONS FROM THE ABOVE FACTS

63. Before entering upon a description of the accident under Section 25 as required by NZAP 201, it is as well to break format and extend this section to draw deductions from the material so far recorded. This will significantly aid later analysis of evidence relating directly to cause. But before proceeding it is necessary to dispose of two anomalies outstanding from the above. They are the illumination of the OIL LOW lights at impact and the two differing indications of up-elevator.

OIL LOW Light

64. The OIL LOW light could not of itself have caused this accident. Neither do the direct implications if the light were showing a genuine alert appear to be strong enough of themselves to cause it. There is anyway evidence to show that the oil level was not unduly low. Replenishment records do not show abnormal consumption. The seals in the engine were sound. The burning of oil from the ruptured tank where the engine came to rest shows that a considerable quantity was in the tank. And, if the alert had been on for a time, one

/would

would expect that the pilot would have climbed and nursed the aircraft to Base. Instead, he apparently asked for, and got, full power, which would be a curious thing to do if he thought oil starvation was likely. The OIL (pressure low) glareshield light is mounted in the front cockpit only and was not recovered. The front cockpit oil pressure gauge trapped reading of 35 psi was judged by 1 RD to be unreliable.

65. The interest of the Court centres rather on one other reason why the light might have been on. The OIL LOW system includes two sensors in the tank, one at the 80% level and one at 20%. The light bulbs are mounted in a spring loaded push switch on the instrument panel. When the push switch is operated the bulbs (four) will illuminate if the oil level is below 80%. If the level falls below 20% the lights come on anyway. The system is not designed to prevent the warning if the 20% probe is uncovered by itself for any other reason - the NATOPS manual records a note that the light can come on 'momentarily during periods of take off acceleration.....' (page 1-21). Reference then to abort decision presumably means that the effect is not limited to deck catapult launchings. Acceleration forces thus would seem to have an effect on the operation of the 20% circuit. Although Skyhawk pilots generally report few occasions when the light has come on in the air, even inverted, it might in the case in hand be an indication of unusual accelerations at some time before actual impact.

66. There were no other indications of such accelerations, so the Court had to seek to explain how these bulbs could have illuminated because of the impact when others had not. The problem was compounded because the IFF glareshield filaments had also been energised at impact but had failed in a manner which clearly suggested that their illumination was impact-caused but that deceleration had distorted the filaments before they had reached full incandescent temperature. The proposition would thus have to explain how, having been subjected to the same forces at the same time, and having been energised by the impact itself, one set of filaments could fail differently from another. The bulbs are interchangeable, light to light.

A2J

67. The possibility of longitudinal deceleration having depressed the push switch is discarded - the springs are relatively heavy compared with the weight of the bulb housing. Even then the light would come on only if the level was between 20% and 80%; normal level is above 80%. However, within the circuitry there are a number of relays. They are mounted under the cockpit floor. Although they are of the 'anti-G' type, the extreme impact forces in this accident and concentrated in that area of the fuselage could easily have tripped them. To

/be sure

be sure, the same forces could just as easily have tripped similar relays in the same area within other warning light circuits, including the IFF light circuit. But then again, the time for a filament to reach full incandescence is measured in milliseconds. It is also known that not all of the relays tripped, else most of the warning lights would have been illuminated. It is reasonable therefore to conclude that one of the OIL LOW relays could have been tripped just long enough before impact to allow the filaments to reach full incandescence before impact deformation, whilst the IFF circuit was energised just enough of a split second later to have failed to reach full temperature before deformation, and whilst the relays in other similar circuits did not trip at all before breakup. In the absence of any other indications of abnormal behaviour by the aircraft in flight before impact,

the Court inclines to the view that the OIL LOW lights came on during impact and as a result of it, and that their illumination therefore had nothing to do with the cause of the accident.

The Elevator

68. At the time of writing the Court awaits a reply to some questions put to McDonnell-Douglas in the United States. It is hoped that the answers will reveal something of probable aircraft behaviour and in particular, attitude and elevator position - which could also by extrapolation say something about slat deployment.

A2F 69. There was an external witness mark suggesting about 9° up-elevator. But both the elevator bungee and the stick interconnecting tube witnesses suggested full or near-full up-elevator. The 9° external mark could have happened at any stage, including the stages after breakup at ground zero and after the hydraulic lines to the power pack had been breached leaving the elevator free to flap.

A2F 70. The bungee, it would seem, separated from its mountings in a sideways wrenching motion, at a time when the elevators were almost fully up. That separation would have occurred as the tailplane was wrenched from the right on the higher ground on that side, and trees taken out close to the bank, by which stage shielding by the wings would be less assured - witness the fuselage tail number fragment in the short tree stump close to the bank. The interconnecting rod between the two control columns lies close to the belly of the aircraft and as the latter deformed under the impact it would be one of the early items to suffer. It too seemed to be a reliable indicator of elevator position at ground zero or, perhaps, earlier in the swathe. It is also pertinent to consider the action of the elevator bobweights which are part of the

artificial

artificial 'feel' system. They are two. The main one acts on the front stick, and it is heavy (spent uranium?). The lighter one is aft near the tail. As the stick moves back they are cocked to provide a stick-centring force under normal-axis acceleration. At full aft stick the front weight arm reaches a rearward cocked position almost centred in the horizontal reference line. The impact here had both a vertical and a horizontal component. The weight would have started down initially, and would have been gathered more and more by the longitudinal deceleration as it did so. Its travel would be very quick and forceful. The rear one would tend to resist under longitudinal deceleration; it cocks forward. Design limits could well have been exceeded, but the front one would certainly start the sticks forward abruptly. Thus, the bend in the tube would most likely have occurred before the weight took the sticks forward at ground zero. The rapidity of movement of the weights, if it did not break the linkages, could easily have exceeded also the response capability of the elevators if they were still under hydraulic power; the elevator itself need not have snapped down in sympathy.

71. The Court therefore accepts that the near full-up elevator markings reflect elevator position within the entry swathe.

Deductions Concerning the Engine

72. The Court believes that the engine was delivering full or near full power at primary impact. This deduction rests principally on the evidence from the EPR transducer, the engine strip report, and the witness marking within the CSD, given the sequence of primary and secondary impact. On the contrary side, trapped readings extracted from oil pressure and EGT gauges were lower than would be expected at full power. With respect to the oil pressure gauge, the reading was trapped by reason of heat fusing which could have happened at any stage after the explosion and fire from ground zero. The EGT reading was trapped by impact damage which could have been imparted at either primary or secondary impact. Both readings are regarded as unreliable on the twin grounds of uncertainty as to the point in the sequence at which they were trapped, and the high probability that they were affected by the violence of the impact and fit in to the highly scrambled pattern shown by the instruments in general.

A2B

73. The Court also accepts that the power was being delivered at the command of the pilot. Evidence of left hand on throttle at impact is strong.

W27
A7 p38

/74. Finally

74. Finally, the Court accepts that the engine was operating normally in all respects. Nothing in the strip reports suggests otherwise, no evidence of pre-impact engine fire could be adduced (and the FIRE warning light was not illuminated at impact), and the operation of the OIL LOW caution can be explained as above.

Deductions Concerning Aircraft Attitude and Flight Path

75. The Court accepts that the aircraft entered the trees on a flight path recovering upwards and that in the entry swathe it carved a path climbing some 4° to 5° above the horizontal.

76. The Court also accepts the weight of evidence showing a very high angle of attack - the necessary condition to produce the catapulting effect off the bank, the lack of penetration into it, the total destruction of the underside of the aircraft, the scrape marks on the fuselage side panels, the lack of punctures on the underside of the tailplane and elevator because of shielding by the wings, the evidence of slat extension at impact, and the consistent, if vague, indications of nose-up attitude resulting from instrument analysis.

77. The scars on the standing trees suggest a right-rolling entry through the swathe. The Court accepts that this was so, and in doing that also accepts that the wings were substantially in place right up to the impact against the bank. About the normal axis there was no sign of gross yaw.

Deductions Concerning Flying Controls

78. Integrity. All of the flying controls including the slats were evidently attached to the airframe in their proper fashion at the time of entry into the trees. The pre-crash integrity of the cable runs could not be established with absolute certainty because of the breakages unquestionably caused by the impact itself, but on the other hand there was no evidence to suggest pre-crash failure anywhere. Similarly there was nothing to suggest failure of hydromechanical components or either of the twin systems, although the aileron power package was not recovered. There were many breaks in the aileron push-pull rods downstream of the power pack but once again these were so consistent in type and so widespread that they could all be attributed to impact.

/79.

79. Control Deflections. The Court accepts the evidence from the bungee and the control column interconnect rod that at impact the elevator deflection was near full up. Certainly an up-deflection was necessary to achieve the attitude deduced above. It follows therefore that the pilot's right hand was on the control column because had he let it go it would have snapped forward. The injuries to the right hand and arm are not inconsistent with that deduction. Nothing could be similarly deduced in respect of lateral stick deflection. However, the Court accepts the evidence from the deformation of the ailerons, when keyed to the entry at high angle of attack, that the left aileron was deflected down and the right deflected up. It follows therefore that at entry the ailerons were behaving synchronously - there had been no dislocation of control runs from power pack to surfaces. It follows further that the bending and the breaks in the push-pull tubes truly show a synchronised aileron position at the time the deformation occurred. That could have been as the severed trees cut into the wing leading edges, or at impact against the bank. The Court believes that the damage probably contained components from both events. Therefore the ailerons were deflected by about half travel to roll to the right at entry into the trees, the deflection was commanded from the stick, and that command remained applied up to impact against the bank. Nothing could be deduced as to rudder position from witness marking, but the medical evidence that the pilot's right leg was extended and his left withdrawn at the time of major impact is accepted. Had there been an earlier control cable or other system break in either the rudder or the aileron systems (certain modes of failure could cause momentary unexpexted deflections in aileron) leading to control problems, evidence of an attempt to use trim might be expected. There was none. Partial power control disconnect is discounted; the system was modified some years ago and the US Navy reports that in their experience partial disconnects have occurred only during takeoff, never in flight.

A20

Deductions Concerning the Escape System

A2M

80. The pattern of actuation of the explosive devices in the escape system led the Court to believe that it was looking at a disorganised sequence initiated at the seat or seats and at least one of the two external canopy jettison cartridges each and severally, and that other devices exploded from the effects of the fire. It accepts also from the evidence of positive control applications and from the medical evidence that the pilot had had neither hand on either ejection seat handle at the moment of impact.

/81. Some

81. Some of the disorganisation not only can be but should be explained in the interests of maintaining faith in the system. It is believed that the sequence was impact-initiated, and that almost simultaneously the aircraft broke up and ruptured or severed the plumbing, interrupting the flow of gas through the system. The interruption seems to have occurred in several places; between the rear seat dual booster and the ROCAT, between the left hand front paddle initiator and the front seat delay cartridges ahead of the front seat dual boosters, and between the canopy thrusters and the ram separator and hydraulic shutoff valve. Positive evidence of this kind of effect was seen in the traces of gas being stopped between the two breaks in the tubing leading to the hydraulic shutoff valve, and elsewhere where gas had left a device but there was no trace of it in the inlet ports of the next device downstream. It has been estimated that the interval between initiation and plumbing rupture was in the order of nine milliseconds. That, of course, places the seat initiation squarely in the major impact at ground zero and nowhere else.

82. In the canopy system the seat/canopy interlock was removed when the left-hand lanyard-operated initiator (coke bottle) worked. The left-hand canopy sill was still in place in the cockpit wreckage. The latches had been withdrawn; the thrusters had done their work. But on the right the canopy hinge had been broken, the coke bottle had had the firing pin sheared and had not operated, and the canopy sill was found torn from the airframe near the canopy frame and the aft canopy fairing, with the six locking lugs extended and the cam rod distorted and jammed. It would seem that the left-hand side of the system worked, but the right-hand side did not. It is likely that the right-hand side of the fuselage was demolished by the large tree which had stood close in to the bank. The right-hand rear sill area had been badly damaged and it most probably was done by that tree. The coke bottle pin had been sheared. The thruster could have thrust at a non-existent bell crank on that side and failed to unlatch the canopy. Then the canopy would have been free to lift only on the left side, and in doing so would have operated the left coke bottle, broken free of the ram and pulled the ram cartridge plumbing with it, and broken the locked right-hand sill away from the cockpit. Thus, as with the seat, the initiation was at ground zero. Indeed the absolutely shattered condition of the perspex, its distribution, and the heat patterns on it also require it to have been attached at ground zero. So, for that matter, does the position of the canopy frame in the trail. If it had been jettisoned in the air and taken the right-hand sill with it, even disregarding the burning and the perspex, it would not have ended up there, but well short.

A6

A2MpC

/83. The

83. The injuries to the pilot were massive and multiple. If it needs emphasis, the failure of the seat harness provide further evidence of force of impact. The Court is satisfied that the pilot was strapped firmly into his seat and that the seat was in the aircraft when it hit the bank at ground zero. But the front seat left the aircraft and the rear seat did not. The pilot had to have taken the front seat with him under his body weight. The following sequence seems likely. The impact broke the seat harness anchors at the back of the seat pan, and, still attached by the shoulder harness which imprinted the evidence in his shoulders, the pilot tore the seat free. As it happened the body weight prevented full retraction of the inertia reel. The seat began to break up - it was found in several parts well down trail past the pilot. As it broke up, the top harness pin withdrew and man-seat separation was complete, having bypassed the normal system. Though this takes time to tell, the action would have been almost instantaneous. The lanyard would then have operated the pack opening initiator and, as the parachute deployed, the ballistic spreader operated. Being protected by the pack the parachute was not burned in the cockpit and was clear of fire by the time it deployed.

A2MpA,B

84. Thus it is possible to explain how each device in the system operated or was prevented from operating. There could well be slightly different scenarios capable of being drawn from the same facts, but the Court is satisfied on three counts:

a. The pilot made no attempt to eject immediately within the swathe.

b. Had there been an attempt to eject earlier the system would have worked; of the failures which were seen, too many were directly attributable to crash damage to come to any conclusion other than that they were all so caused. Knowing which components operated here, prior airborne total system failure would have required an impossible coincidence of individual failures.

c. There is, therefore, absolutely no cause to doubt the effectiveness of the system in getting a pilot into a parachute quickly; with what further effect it may do so is not the concern of this Court.

Deduction Concerning the Pilot

85. The Court is satisfied that the pilot was applying positive control pressures at impact, thus requiring him to have been conscious or, excepting the possibility of muscular spasm, at least not incapacitated to the point of being unable to try to control his aircraft.

/Deductions Concerning

Deductions Concerning Fire

86. The Court has already declined to accept a theory of prior engine fire, or of airborne explosion of any kind. So far as cockpit fire is concerned, the following points are made:

a. The pilot had not been overcome by smoke to the point of incapacitation.

b. Had there been a serious cockpit fire earlier the pilot could reasonably have expected to climb and call on the radio, or simply to eject, or any combination thereof.

c. Bearing in mind the manifestly fierce nature of the event which caused the burning, and with airmix breathing, one would have expected evidence at autopsy showing carbon in the trachea and lungs.

W27

d. Had there been a fierce fire, some sign of it on the helmet (which was found separately and which must have left the head early or have been burned) would be expected.

W27

e. Similarly, the seat and torso harness straps, having already been weakened by heat, would have parted relatively easily without breaking the retaining pins or pulling the QRB lug free.

W27
A7p36

f. In the same way the torso harness, having been carried clear of the seat by the pilot as he broke free, would not have endured the parachute opening shock and halted the body to land in the same tree as the parachute itself; rather it would be expected that the harness would fail and the chute drift to earth without the pilot.

87. On the contrary, the Court believes that the pilot had stopped breathing before the fire reached the proportion of holocaust, that he had not done so before impact, that the seat straps had been sound at impact, that the torso and parachute harness, risers and lower rigging lines had been burned after the body had come to rest in the tree, and that from this it can be concluded that the cockpit and fuselage fire occurred at ground impact and because of it. Further, the body had not fallen into an enveloping fireball.

Section 25. Conclusions of the Court

DESCRIPTION OF THE ACCIDENT AND ATTENDANT CIRCUMSTANCES

General

W1
W5
W1,3
ABC

1. Skyhawk NZ 6253 was flown by Flt Lt J.N. DICK as leader of the two-aircraft formation "Gold". His wingman was Fg Off G.A. TODD, a recent graduate from conversion training, in TA4K NZ 6254. Flt Lt DICK had that morning been assigned to fly as Gold 1 in place of the unit commander who had other commitments. The formation was to position and hold in the Ohakea Inland Low Flying Area (ILFA) at low level, seeking to ambush a four-aircraft formation Skyhawk "Red" led by Flt Lt R.G. READ while it was en route also at low level to carry out a dummy attack on a road bridge across a stream in the headwaters of the Ngaruroro River within the ILFA. If this intercept failed a second attempt would be made while still at low level as Red sought egress to the north and later, at high level, the two formations would practise 2 v 4 Air Combat Manoeuvring (ACM).

2. Although ACM was not itself a factor in this accident, it is important to the indirect terms of reference to understand that there are significant differences between the rules applying to Air Combat Training (ACT) conducted at high level and at low level. Some of them concern training safety, others tactical matters. At low level freedom to manoeuvre in the vertical is proscribed not only for safety reasons but also because the aircraft, if forced to use the vertical plane, run the tactical risk of exposure to anti-aircraft artillery weapons or of acquisition by opposing aircraft en route. Unlike the high level case where ACT will frequently degenerate into the classical dogfight, at low level air-to-air operational engagements will tend to be flat and each side, being unable to use the vertical to gain energy in manoeuvre, will try to maintain a relatively high airspeed in anticipation so that it might be assured of sufficient manoeuvre options if engaged. The intruder elements will normally adopt the tactic known as "progression", meaning that, where possible, a section of the formation will be detached to turn the intercept threat whilst the remainder progress to the target. Thus the intruder avoids subversion of his primary aim. On the safety front the low level intercept in training does not gravitate to dogfighting. The training aim is merely to make the intercept and to judge success one way or the other on whether the intruder sights the interceptor before the latter brings his attack to bear. This is normally signified by the intruder making a timely and single defensive turn toward the incoming threat. The aircraft then disengage and continue the flight.

3. Also on the safety front there are some obvious training requirements for each of the intruder and interceptor elements to brief together. This briefing is aimed at general formation discipline matters and achieving a common understanding of the intentions. There is a fine line between briefing sufficiently in this regard and briefing to the extent that tactical detail is revealed either way to give one side or the other an unwonted advantage.

/Briefing

Briefing

W3 W1 W1 W3 WS WS W3,12 W1,2,3,4, S W1 W1 W3. ASB W1 W1S W1 W1S

4. Combined Briefing. After some preliminary planning by Red formation, the main mission briefing was called by the Red leader at 0930 hours on 25 March 1981. The two Gold formation pilots attended initially to hear the rules of engagement and any direction on safety matters over the entire mission. The Gold pilots then left this common briefing for their own detailed formation brief, and the Red pilots continued similarly with their tactical brief. Red would use the progression tactic at low level. Both the Gold and Red leaders were categorised "Op 4" - that is, were qualified to lead four-aircraft formations. Although it is normal squadron practice to have the authorising officer present at briefings conducted by junior leaders, in this case no supervisors were available. With the unit commander's knowledge the briefings were conducted by the two formation leaders themselves without actual supervision. In this regard the unit commander had prudently briefed his operational flight leaders at the beginning of the week, emphasising the accentuated professional responsibilities devolving on them for the short period the unit was pressed for command supervisors.

5. Weather and General Unit Briefing. So far as weather briefing was concerned, the Red leader in his combined brief regurgitated the information which the Base Meteorological Officer had given at the standard early morning general squadron briefing. Flt Lt DICK had been present at that earlier briefing and had been master of ceremonies in the "Emergency of the Day" study. Throughout both this and the formation briefing sequences his behaviour seemed to be absolutely normal; the passing comment by his No 2 that he seemed to be a little quieter than usual is, in the face of judgements made by others, attributed to the retrospective perceptions of a very young man.

6. Gold Briefing. Gold's briefing was wholly oral. Whatever its content, the No 2 had understood what was required of him. The Court could not establish whether the caution as to aircraft weight had been mentioned by the Red leader in Gold's presence, but in any case it was less important to Gold because it was related to diving attacks and Gold would have burned off fuel by the time. The aim after entering the ILFA was to proceed to a point in the ranges and split, Gold 1 to the west of the divide and Gold 2 to the east, to hold in valleys with the hope of catching Red skylined over ridges. There was no expectation that the two would be able to communicate with each other while holding, nor with Ohakea, and there was no arrangement for scheduled mutual checks; they did not expect to be waiting for more than 15 minutes. Flt Lt DICK presented his flight plan to Operations at 0945. Fg Off TODD estimated that the briefing had finished at 0950, but as will be revealed he seems to have a somewhat erratic sense of time.

7. The Flight Plan. The basic route to be used was a standard low level training route designated "Raumai 23". The local procedure is that on such standard VFR routes flight plan filing is accomplished by submitting a "flight detail" nominating the route. Flt Lt DICK had, however, prepared a common flight plan form for both formations. This form did not include an intended diversion by Gold to the south to overfly Base road runners near Otaki. Flt Lt DICK had not signed the

/form

form and, with his permission, the duty Operations Officer signed it for him when he presented it in person at about 0945. Subsequently, the 75 Squadron Duty Pilot submitted a flight detail for Red formation on route Raumai 23, whereupon the Operations Officer cancelled the Red element of the plan filed by Flt Lt DICK but left the Gold element extant.

W15
W16

8. Authorisation. Both formation sorties were authorised by the unit commander when the duty pilot brought the authorisation book to him in his office. He confirmed the route and task, but was not advised of the intended diversion by Gold to the south. The point was not called in evidence, but the Court established to its satisfaction that the duty pilot was not himself aware of the intended diversion. The deleted signature by Red 3 in the authorising officer column of the page is inconsequential; an error of placement which has no bearing on the accident nor on unit procedures.

W5

A3A

9. Summary of Preparations for Flight. The morning general briefing was held at 0800. Flt Lt DICK was told that he would lead Gold in place of the scheduled pilot. During the general briefing he showed that he had prepared himself well to lead the discussion of the "Emergency of the Day" - which was to do with a hot gas leak. He prepared for flight and attended the combined briefing with Red at 0930 and then continued with his own tactical briefing with his No 2. He would have prepared the joint flight plan before those briefings, because he had it ready to file at approximately 0945. He had, however, forgotten to sign it. He would have known of the standard flight plan "flight detail" filing system, and would have prepared this written plan presumably because he knew that neither of the two formations would actually fly the prescribed standard "Raumai 23" route, but would indulge in other activities along it and abandon it entirely for high-level ACM before its end. That surely signifies methodical attention to detail of importance. The signing omission is inconsequential. He had not, however, included the Gold diversion to the south, presumably because he thought it had no significance. And it did not, of itself; it is only his failure to notify the authorising officer which might be criticised. Gold formation pilots then went to their aircraft and took off at 1028. He was an experienced pilot. There is in this tale no sign of undue temporal pressure, even though he aimed to take off earlier than Red to allow for the overflight to the south. Steady and determined progress through the preparatory phases, yes. He was keen to get going, but disorganised rushing about, no.

W5

W3Q1

The Flight: First Stage

10. Gold. Gold formation took off at 1028 and proceeded south at 1,000 feet agl. The leader had advised Air Traffic by radio of the diversion from filed flight plan. The overflight of the runners was conducted primly and properly in the vicinity of Otaki with no evident violations of order or principle. The Court received a number of letters and relayed telephone messages from civilian observers in the region in the aftermath, but in view of their lay contents ("the second one was having trouble keeping up" and "in one of the aircraft the engine was missing" and a pejorative note of "hedge-hopping Skyhawks") and the time and distance factors, none of these informants was called. The pair turned north, routing east of Palmerston North and of the

W1
A3E

W1, W23

W1

/ranges

W3 ranges, maintaining 360 knots. Flt Lt DICK called Red to determine progress; Red formation was still taxying at Ohakea. The aircraft clock in the Gold 2 aircraft had been judged unreliable by Fg Off TODD, and he was unable to give the Court much in the way of relevant timings either directly or by translation from fuel usage. He was busy. However, the ATC A3E transcripts place Gold by radar six miles south south-east of the Manawatu Gorge at 1043. Fg off TODD was able to point out in evidence the intended location of the pairs split point in the ILFA but at first was unable to confirm on a map that that was the point actually used. By flying him in a Strikemaster over the route, the Court established that the split point was at a ridge line some three nautical miles north east of the crash site. Projecting from the 1043 position to that point at 360 knots established the split time at 1052. Fg Off TODD went to his valley as briefed on the east of the divide. Flt Lt DICK's aircraft had turned across in front of him and W1 underneath from the right, in a steep left hand turn. Fg Off TODD had last seen his leader as the latter turned south into a valley leading to the Colenso basin. Fg Off TODD was adamant that nothing in Flt Lt DICK's voice, his comments on radio, nor his leadership of the flight to that point indicated any irresponsibility or signalled any deterioration of alertness or performance. Indeed, Flt Lt DICK had indicated high satisfaction with his choice of tactical holding area in relation to the mission which then claimed his attention. Fg Off TODD was also quite sure that Flt Lt DICK had had his dark helmet visor lowered.

W3 11. Red. Red formation took off at 1054 and proceeded north at 360 knots. The formation diverged to the west of the planned track on entering the ILFA because the leader felt that the cloud base lay too close to the main divide on track. No member of Red formation saw either of the Gold aircraft en route to the bridge target. By projecting the Red formation forward at 360 knots from takeoff at Ohakea and backward from the attack on the bridge target, the Court established that the four would have passed within two miles to the west of the crash site at 1104 hours. Three members of the Red group saw a bush fire on that W2, W4, W6 leg but could not place it accurately in evidence; the leader had also seen smoke somewhere but had taken no further note of it. The three were insistent that it came from a heavily bushed area, about a mile or so on their right. Timing could not be established accurately, but all said it was on the leg terminating in the bridge attack, and one thought it was about ten minutes after takeoff. Two of the pilots remarked upon the peculiarity that the origin of the fire was a straight line; one had the line orientated at right angles to track, and the other described the line as having small pockets of denser smoke distributed along it. Estimates of smoke density varied, but all were sure that it was not of a "kerosene-based" colour. Two of them had seen the F111 crash at Ohakea and that served as the basis of comparison.

12. The Fire. Most obviously the Court was interested in this sighting if only because it might have a bearing on crash timing. It was calculated that Gold 1 could nothave reached the site much before 1055, and now there was a possible sighting of the post-crash fire at 1104 approximately. The Red pilots were questioned in detail and each item of material value which they could recall appears in the recorded evidence. None of the pilots had noted a second smoke source on that leg. But it is known that after the wreckage had been located and during the "rescue"

/attempt

attempt 1½ hours later another fire was in being some ten miles to the north west. This was reported to the Court by the General Duties Member who had been on-scene airborne commander in a Strikemaster for a period. This second fire was located in an open area without bush and had normal scrub fire characteristics in shape and size. The Court was also conscious of the traps of retrospective set in the minds of the Red formation pilots, and of the possible effects of channelled discussion amongst them. Of the three, only Fg Off GORE had been involved in the overhead on site after the wreckage had been located. Theother two were independent of that influence. Circumstantially the Court was led, on balance, to conclude that the Red formation pilots had more than probably seen the smoke marking the wreckage of NZ 6253 at about 1104 but had not recognised what it was they were looking at. Obviously they would have reacted differently had they seen an "aircraft crash" type smoke pall. That they did not see such a thing suggested either that the conclusion was false or that the smoke pall had had time to dissipate. Yet it had had something less than ten minutes to do so. This seemed to demand explanation. On the basis of the sequence of crash and explosion developed in the previous section at paragraph 25 it seems possible that there had been no particularly dark pall or, if there was, it had been short-lived for lack of liquid fuel to feed it. Thus it seemed that the crash had occurred between about 1055 and 1104. Moreover, it seemed that the crash need not have been particularly early in that time gate if the initial pall had dissipated quickly.

W1 W2 W3

13. The Weather. It will have been noted above that Gold flew to the split point north east of the crash site initially on the east of the ranges and then up their spine, while Red elected to step slightly to the west of the main range because the cloud on the hills dictated prudence. However, Gold 2 reported a general high overcast which lowered to 6,000 feet later, but with no cloud on the hills nor in the valleys. Red leader, on the other hand, diverged left because of cloud on the peaks a little farther to the south. Both reported visibility beneath the cloud as good, although the overcast was total and thick. Part of Red leader's rationale in moving left was to give himself tactical air room; he did not wish to become squeezed between hills and cloud in the event of ambush. Thus the apparent confliction between the two groups as to weather conditions can be explained. Gold saw the weather from the east of the range, finding it possible and practicable to fly safely to the split point, while Red saw it not only from a different physical perspective but also from a different tactical perspective. Additionally, Red 4, also an experienced four-craft leader, believed the lowest cloud base to be 5,500 feet - that is, clear of the hill tops which rise to marginally over 5,000 feet in the area but with most of the high ground around 4,000 feet. The Court believes that the weather, or more specifically the cloud, was standing clear of the ground by sufficient margin for safe operations, that there was no low stratiform or mist in the valleys, and that visibility was generally good (20-30 Km). There was no turbulence and only light wind.

W1

W2

The Flight - Stage Two

W1

14. Gold 2 held in his valley for a time, until he became convinced that he had missed the action. He then set out after Red, on his own, assuming that Gold 1 had already gone. He

/called

called his leader with no response, which reinforced his basic assumption. He found the Red aircraft on their southbound leg 15 miles west of Napier and on the evidence of Red 1, intercepted W3026 them at 1130. Successfully. He queried the whereabouts of Gold 1, but nobody had seen him. Concern then began to develop, gathering momentum to alarm as various efforts to raise Gold 1 by radio failed. Red 1 and 4 and Gold 2 returned to the holding area, and found the wreckage.

W1 15. Gold 2 had estimated his holding period at about 15 minutes, having already discarded the aircraft clock as a reliable timepiece. However, by projecting back from the intercept time on Red, it was evident that Gold 2 had not left his holding pattern until about 1120. Thus, his holding period amounted to double his estimate. This is not unreasonable; Fg Off TODD is inexperienced and would have been caught between the opposing disasters of holding too long and failing the mission, and of making a fool of himself by crying wolf too soon. He would have been busy in his fighting machine and time would pass him by. He would not depart from brief until he was quite sure that the plan had gone awry. He would not act hastily or on suspicion. It is probable that a more experienced pilot would have acted sooner, either to establish the tactical situation or to check upon his leader. But it must also be said that a greater degree of curiosity would not have prevented this accident, for its result had long been fatefully settled.

The Flight of Gold One

16. An attempt will now be made to reconstruct the movements of Gold 1 from the split to the crash. The Court found that the best way of presenting this was by using colour slides; thus could the sweep of terrain and the logic of the route be best conveyed. The slides are numbered and keyed to the text below. The President and General Duties Member explored the region in a Strikemaster a number of times, and each time were driven to the conclusions portrayed. Unfortunately, weather conditions similar to those on the day did not recur during the period, so some license is taken in the interpretation of some of the slides.

Slide 1 On the slide (NZMS 1, 1:63, 360) the heights between 3,400 feet and 5,000 feet have been colour-highlighted in bands of 300 feet. We see the route of Gold up the Makaroro Valley on the right, towards the split point. The loop to the left is the reconstructed route of Gold 1, which will now be explained. The two dotted lines are, on the right, the planned track by Red and, on the left, the actual track.

Slide 2 The aircraft approach the split point flying north up the Makaroro Valley. The crash site is in the 8 o'clock at about four miles, over the main ridge which runs parallel to the aircraft on the left. Gold 1 calls the split and turns to the left under and across his No 2. The No 2 proceeds ahead and to the right to his holding area.

Slide 3 Gold 1 is turning left at the split. He continues the turn short of the bald spur ahead, and will pass down a valley to the left.

Slide 4 He is now heading west and will turn left again to the south over the low ridge ahead of the aircraft in this slide.

/Slide 5

Slide 5 — Now heading south up a well-defined valley offering good tactical cover, it was about here that Gold 2 saw his leader for the last time. The intruders are expected ahead and from the left, skylined as they cross the divide from the Makaroro. The Strikemaster is flying here a little higher than Gold 1 would have been.

Slide 6 — Midway down the valley a saddle marks the divide into the Colenso Basin. Breasting the saddle, the country opens up.

Slide 7 — Lake Colenso is in the centre foreground. Note that at least from this height, it is possible to see over the hills to the Rangitikei Plains. In fact, on a good day one could see almost as far as Ohakea, at about 11 o'clock, 50 miles. Recall at this stage that Red's actual track would be from dead ahead.

Slide 8 — Breaking the flight sequence, the view is taken from slightly west of the position that the last one was taken from, this time looking east. The last slide showed the Colenso Basin looking south west as the aircraft crossed into the Colenso over the low ridge in centre slide. The crash site is on the ridge behind the low saddle, and can be identified from the helicopter pad which is at the near end of the scar on that spur.

Slide 9 — This view shows the Colenso Basin looking east, up the Mangatera Valley. The crash site is immediately to the left of the large slip in the centre. Recalling that Gold 1 crossed into the basin from the left, he then had a number of choices of valley up which to fly in order to catch Red as they came up, according to his expectation, from the right and crossed the ridge on the skyline. The original formation split point is on the skyline, to the left, just off-slide.

Slide 10 — Any one of these valleys would have done. This is typical, but the Court believes it is not the one that he would have used, for it would have shortened his holding orbit. He could have used this one, but the Court believes that he would have elected to go a little further south (right on the slide).

Slide 11 — This looks up the head of the valley shown on the previous slide. Had Gold 1 gone further south, he would have crossed the ridge on the right-hand side here, and been able to maintain tactical cover whilst looking for Red on their expected track. Alternatively, if he chose to use this valley, he could turn either side of the peak on the left (Remutupo).

Slide 12 — Here the Strikemaster turns short of that peak. Note again that the saddle on the far side would still afford cover from the eastern side of the main ridge.

Slide 13 — Over the ridge, and a short valley opens up. If Gold 1 had crossed around the other side of Remutupo, he would have flown along this valley from bottom right. Note the saddle just showing at top left. That leads into the valley of the crash.

Slide 14 — The saddle now shows clearly. The expected threat is on the right and behind. We are looking north.

/Slide 15

Slide 15 — Through the saddle. Note the ridge on the left, with the valley opening up to the west behind it. Perfect masking from the threat on that side, and also by the main ridge on the right.

Slide 16 — Around the corner, and a ridge with a pronounced bluff begins to appear. We are close to the ridge on the left.

Slide 17 — Further around, and the crash scar can just be seen below the bluff.

Slide 18 — Again, a little further around. Note how close is the ridge on the left. The crash scar can clearly be seen. But the Court found a problem here. The slide appears to show the Strikemaster on the crash scar line, but it is not. From this profile the Court had the utmost difficulty in determining how Gold 1 could have flown into the line of the crash without first hitting the ridge on the left. That was the reason for the extended search along that particular ridge for evidence of pre-impact strike, but there was none. The Court experimented, but it was clear that in the distances and at the speeds involved, the aircraft could not have aligned with the scar from the position shown in this slide, or after crossing the left-hand ridge anywhere lower down. And the wider the pass around the ridge the worse the difficulty of alignment. But this also discredited any theory of coming around the first ridge low, having the crash ridge unmask late, and running into it.

Slide 19 — This view looks down the crash valley from the east, overhead the main divide, to gain a perspective. The scar is on the spur in the centre of the frame. The ridge which had given positioning problems is nearer to the camera on the left. The Court experimented with an approach from the north - ie the right - but this resulted in a startled abort; the aircraft could not turn tightly enough from the north turning right into the valley to align with the crash scar. Neither is it likely that Gold 1 descended into the valley directly from the east, as here. To do so would have involved crossing the main divide and, remembering that he thought Red would approach from that side, being skylined to them himself.

Slide 20 — Further, although it would be possible to get on to the crash scar line from the east, it would still involve a jink to the left as seen here, and the spur on the left would still be in the way.

Slide 21 — It must therefore have been that Gold 1 came around the corner from the south, positioned higher up.

Slide 22 — He crossed the left-hand ridge higher, and the impact ridge unmasked earlier. Here the Strikemaster is aligned with the crash scar. This profile is certainly a feasible one, and for the reasons outlined above, the Court believes it to be the most probable.

/But note

But note another effect here. The Court is well aware that photographs can be made to tell lies. And it is also aware that these slides were taken under different light conditions from those existing on the day of the crash. It would be improper to draw too much from this slide, but note how the cloud shadow has masked the crash ridge against the background of the higher ridge behind it.

Slide 23

A7p5

Note here a similar effect. This slide is not in sequence, but in this case both the crash ridge in the foreground and the one behind it are similarly lighted, particularly lower down. They meld. Note too the bluff on the right. It is clear, but there is a false line running down from it which could be mistaken for the end of the spur running into the valley floor. Remember too that the ridge forming the backdrop is the one which Gold 1 would have crossed heading right to left on first entry south into the Colenso Basin. He could well have intended to turn right around the crash spur and repeat a holding pattern.

Slide 24

Or, just possibly, he might have seen Red as he headed south on a previous pass into the Colenso as he crossed the lower ridge heading south. Red was not on the planned track, but to the west of it. It could be that Gold 1 had seen them in transit off-track, and had positioned himself to burst out of the valley upon them; this would, however, place the crash time very close to the time Red passed it. Perhaps too close. That is possible, but it is more likely that Gold 1 was merely intending to turn right from the valley, northward to begin another sweep. He would have arrived, on the Court's calculations, in the crash zone on the first orbit after the split at about 1055. He knew that Red had been taxying at Ohakea at about 1045. He knew their intended route, for he had had it on the flight plan he had submitted. He therefore knew roughly at what time to expect them. Using the derived holding pattern, he could have completed three, just possibly four, orbits in the waiting time to 1104 when Red passed the site to the east. But it is also possible that he crashed on the first pass at 1055, not yet being thoroughly familiar with the terrain from earlier passes. However, the Court does believe that the route as depicted in this sequence is a highly logical one and indeed one which allows very few variations, having regard to the lie of the land and the aims of the mission.

A Reconstruction of the Crash Sequence

17. The following is the Court's reconstruction of the most probable crash sequence based on the evidence. Skyhawk TA4K NZ6253 scythed into large trees approximately 100 feet below the crest of a minor ridge in a steep and heavily forested mountain valley some 500 feet above the valley floor, and clear of a steep buttress above and to the right. The time was not before 1055M and not later than 1104M on 25 March 1981. Weather was overcast at 5,500 to 6,000 feet and above, but clear beneath with light winds and no turbulence. The aircraft was erect, and was intact. It had two 300-gallon drop tanks on stations 2 and 4 and no other external stores. Each drop tank was about half full on impact. The engine was delivering full power or close to it, at pilot command. The pilot - and others - habitually flew at speeds between 300 and 360 knots for the kind of mission in hand, and evidence in this case pointed to a speed at main impact in excess of 328 knots.

W3Q3
W5Q2

18. The aircraft entered the trees with high kinetic energy on a flight path rising some 4° to 5° above the horizontal on a heading of 295° magnetic approximately. Angle of attack was high. The slats were deployed and still attached. Within the swathe before the point of ground impact, wingtip marks on the trees showed that the angle of bank had been about 13° left and that the aircraft had rolled right to reach about 1° right bank in a distance of about 10 metres. Rigorous mathematical treatment was not possible, but the witness markings on trees yielded an approximate rate of roll in the order of 300 degrees per second based nominally on a maximum forward speed of 360 knots. That rate of roll is within the capability of the aircraft. The pilot's left hand was on the throttle. His feet were on the rudder pedals with the right leg extended and the left withdrawn. His right hand was on the control column, applying near full-up elevator and approximately half right aileron. Passages in the TA4F/TA4J NATOPS Flight Manual (which is in use for the TA4K in the RNZAF), at pages 4-6 and 4-6A, relate the behaviour of the aircraft in conditions of high loading, high rates of roll, rolling pullouts, and the tendency toward cross-coupling and pitchup in certain of those combinations. All of the evidence very much suggests a deeply stalled aircraft with the pilot trying to pick up a dropped left wing whilst pulling hard to avoid the ground, and a fast, squashing impact into the trees, possibly associated with high angle of attack pitchup. It also suggests that the application of elevator to avoid the ground had been late, for, had that proportion of control been applied for any length of time or had the aircraft been rolling at that rate for any reason for any length of time, cross-coupling effects would have been more developed and physical evidence of earlier structural overload would be seen.

19. The pilot made no attempt to eject as the aircraft struck the trees. Neither had he done so earlier, for the system would have worked; the Court is confident of that. The wings severed trees early and were themselves damaged but not to destruction. The integral and drop tanks ruptured and sprayed fuel. Deeper into the swathe the aileron tips were shorn off in

/strikes

strikes on tree trunks. The aircraft then took heavy body blows on other trees close to a steep bank, but particularly on the right-hand side. It then struck the oblique face of an earth-covered rock bank, taking the weight of impact on the right-hand side and the underside generally and, in its high nose-up attitude, the fuselage ricochetted off the bank upwards and slightly to the left. Simultaneously the sprayed fuel ignited and, with the remainder of the fuel bursting from the impact breakup, created a violent explosion which completed the destruction of the aircraft. The remnants of fuselage and the engine, on fire now, cut egress skyward at about 20° through the forest canopy and lofted up to 200 metres above the trees before secondary impact, shedding burning components as it went. The after fuselage and empennage tumbled. Final breakup of remaining sections occurred at secondary impact through the trees to the ground. The main components of the wreckage burned for a short while but sympathetic bush fire did not take hold.

20. The pilot was thrown from the aircraft at the main primary impact point. He was killed instantly, momentarily before the explosion, but his body was burned in it. His seat harness failed at the lower attachment points and his torso harness at the lower left locking lug in the quick release box, testifying to the energy of the impact. He and his seat left the aircraft in the same vertical trajectory but on a line slightly to the left of the main wreckage. As he and the seat left, the seat back broke and detached, the pan fell away and distributed its contents widely, and the parachute actuating lanyard began the parachute opening sequence. The parachute, in its pack, had been protected from the effects of the fire. The parachute was extracted and as the ballistic spreader line reached its travel the spreader operated. Thus the pilot was stopped short, by half, from carrying on through the full distance of the throw imparted to the remainder of the cockpit and the separated ejection seat.

21. The escape system was initiated by impact effects at least at the seat initiator cartridges and at least at one of the two independent external canopy jettison initiators each and severally. Almost simultaneously the sequence was interrupted as the cockpit area was breached and the escape system plumbing was ruptured or severed. System gas did not reach either of the rocket catapult initiators nor the canopy ram top cartridge. However, all mechanical devices associated with the system did work where the cartridges had fired; retraction of the front seat inertia reel system had been stopped at half travel by the weight of the pilot as he was thrown forward, and the left-hand canopy thruster had been retracted forcibly after extending fully under system gas pressure. The right hand canopy locks probably remained engaged because of early damage to that side, and the canopy lifted off in impact from the left, taking the right hand sill with it.

Statutory Findings

22. Before moving on to analyse the causes, the provisions of NZAP 201 Chapter 5 Annex D require findings to be recorded at this point on the following:

/a.

a. Authorisation. The authorisation was proper, except that the pilot ought to have made sure that the authorising officer was aware of his premeditated diversion to the south. The Court is, however, satisfied that this had no bearing on the accident and that the omission does not reflect on unit procedures; it was a minor thing containing no element of subterfuge whatsoever.

b. Briefings. It was the briefer not the briefed who crashed, and then as a singleton. The crash occurred during a waiting period preparatory to the substance of the mission. A few days before the crash the unit commander had briefed his junior leaders, including Flt Lt DICK, on their responsibilities of leadership in particular. In that regard the Court noted a very pleasing understanding of purpose and limitations by all participants in the mission. The weather briefing forecast the conditions accurately, as it happened. The only conceivable question might concern the enforced break with normal procedure whereby the authorising officer was unable to attend the operational briefings. It is possible that an experienced supervisor might have been able to detect in Flt Lt DICK any sign of emotional problem or tiredness, had one existed. From other evidence this proposition is rejected; Flt Lt DICK had been in the spotlight at the general morning briefing in the presence of his squadron commander and had subsequently been observed more intimately by his peers and juniors. None detected anything of the sort. Counting the earlier supervisory briefing, the Court finds that all four briefings involved were sufficient and adequate.

c. Competence. The pilot of NZ 6253 was competent to undertake this flight.

d. Serviceability of Aircraft. Finding in this regard will be brought out later.

e. Weather. The weather was suitable for the mission in hand. The Court will, however, have comment on a factor not included in weather briefings - that is, lighting conditions.

DIAGNOSIS OF THE CAUSE OR CAUSES

Introduction

23. As nearly as the Court can get to it, the tale at paragraphs 17 to 21 above tells what happened in those few seconds. But why? What caused the aircraft to hit the trees at a point so deep in that small valley? Here the Court was confronted with the ultimate in logical discord where, with the postulation on reasonable evidence of a substantially serviceable aircraft in the hands of a competent, healthy, trusted and experienced pilot, flying in a familiar regime well outside the possibility of inadvertent slow-speed aerodynamic departure, in adequate weather conditions for the mission, the aircraft had hit a hill. Neither was this an Erebus where, apparently, it is accepted that through managerial and new-wave software technological mistakes a serviceable aircraft and a competent crew were pointed at a hill and in obedience went ahead and hit it.

W5

24. Clearly, the Court had to be sure that there was not some other factor at work, one which had not yet been revealed. It would have to be one which had seriously affected either the aeroplane or the pilot's ability to control it, and had done so in a way or with an abruptness which prevented or did not prompt an escape attempt, but yet had left the pilot able to maintain positive control pressures to the end. It seemed that the trouble, if there was any, had to be such that the pilot tried to fly through it and was still trying at the time the aircraft struck. Unless that were so the Court would have to conclude that he had committed a singularly profound error of judgement or of skill, or had been grossly in breach of flying discipline.

Review

25. Again, the investigational technique would have to be one of elimination and examination of the residue. A chart of possibilities was drawn up and traced through element by element. From what has gone before, and apart from the more esoteric possibilities, the following can be eliminated from it.

A2Q

26. Supervision. No supervisory factor was involved directly in the causal chain.

/27. Control

27. Control. By 'control' is meant anything which might have affected the aircraft controls or the pilot's ability to effect control. The question is what drove the aircraft into the hill, so that it is not a simple failure which is involved.

A20

a. Primary Flight Controls. The aircraft type has dual hydraulic systems and a manual backup to them. The hydraulic systems converge at certain hydromechanical devices. Two of those devices were recovered and checked. But if there had been a problem, the manual disconnect should have been available. It is not prone to causing difficulty of itself through partial action. It, too, could be disabled, however, if the primary control cables parted, but then trim would still be available to give control. For that to be disabled there would have to be a parallel failure in the trim circuit itself or in the primary generator circuit. The emergency generator had not been deployed. Even if control cables parted, it would not be reasonable to expect it in more than one system and even then the systems are designed to seek the null generally. Thus, it would appear, for the aircraft actually to go out of control in normal circumstances there would have to be either a number of coincidental failures in a number of different systems or a major event causing simultaneous failure across those systems. The first conjunction is most unlikely, and the second was not evident in this accident. Neither, for that matter, is it considered likely that the aircraft had earlier gone out of control to the extent of violent uncontrollable manoeuvre which prevented an ejection attempt - the particular case would be rapid roll arising from aileron, cross-coupling from rudder, or stall - because the rate would have to be high. Dynamic inertial cross-coupling would be expected, or other induction of high angles of attack at speed, and the aircraft structure would surely fail. It did not in this case; even the weakest element, the slats, were still aboard at impact. All in all the Court believes that gross control malfunctions can be eliminated unless the pilot was already unwisely low, so low that he had mortgaged his options of regaining control in the time available.

b. Other Aerodynamic Controls. Noneof the other ancillary aerodynamic controls, including the slats, could have caused the aircraft to hit the ground. In any case they all appeared from the evidence to have been properly behaved.

/c. Structure.

c. Structure. Major structural problem is, on the evidence, eliminated. Neither was there evidence of minor problem either in main structure or in control surfaces and other attachments including landing gear.

d. Fire. The Court rejects any theory of engine or airframe fire in two ways. First, there was no evidence of such occurrence. Second, had there been a fire of either kind, the pilot would surely have climbed and tried to deal with it, or called for help, or ejected. Even at low level, although his actions might have been less deliberate, a zoom and ejection would be a reasonable expectation. Again, short of conflagration whilst airborne, or explosion in the air, neither of which the Court accepts as possibilities, a problem of fire causing the aircraft to run into the ground suggests options mortgaged to altitude.

W27

e. The Pilot. Hypoxia or hyperventilation is eliminated. The altitude taken in conjunction with the airmix system precludes the former. A panic-event, if one happened, could induce hyperventilation but we return again to the theme of many options being available to the pilot, other than just running into the ground. On the evidence, no sign of bird strike was found. No feathers, blood, flesh, claws or beaks in the swathe nor traces of them on windscreen, canopy frame, perspex fragments or helmet.

f. Survival Equipment. The possibility of incapacitation or control restriction by an inflated G suit, dinghy or life jacket was considered. An inflated G suit is not crippling and can be deflated (in the Skyhawk) by decoupling the connection. Both dinghy bottles had operated. The rear one was found in the ashes of the rear seat pan with the firing mechanism attached but with the diaphragm ruptured, presumably from heat. The front one had been thrown out of the RSSK 8 pack andhad operated, presumably consequentially. The dinghy was found in a compact heap of ashes, suggesting that it had not inflated. Lifejacket inflation is not crippling either; the bottle here had operated but it, too, had been subjected to post-crash fire. In any event, the pilot had not been prevented from applying controls at the time the aircraft crashed.

/28. Power Loss.

28. Power Loss. The engine was working. It was not on fire before impact. It was delivering full or near-full power at impact. Even if the evidence is wrong; had it failed or showed signs of doing so, the aircraft had energy to zoom and the pilot time to take his options, or he should have had. The engine did not fall out of its mounts or otherwise rupture the exhaust system in the air, for at the time electrical power was cut the EPR was equivalent to full power and RPM was still very high when rotating parts contacted casings. The fuel was good. The engine did not of itself cause this accident.

A2Q

29. Other. With reference to the chart, structural failure has already been discussed. By speed factor is meant either low-speed departure or high-speed flight outside aerodynamic envelope. The impact was not consistent with slow speed. Having regard to the nature of the task and the cloud, both limiting vertical manoeuvre, pure Q factor overload is not possible unless the pilot had grossly violated discipline. Anyway, the slats, in particular, were still with the aircraft at impact.

The Residue

30. With regard to the above technical matters the residue of possible cause is small to vanishing. Aside from esoteric types of system or aircraft failure, the only major factor not accounted for is control run jamming. Alternatively, the other factor which needs more attention concerns a combination of minor failure, distraction, timing, and altitude. These latter align with the last stem of the reference chart, and relate to the pilot.

31. Control Jamming. The Court will not be able to eliminate entirely the likelihood of control jamming. There is a case on record in the RNZAF (SOR OH 52/79) where a Skyhawk pilot in a TA4 had a frightening experience put down to foreign object jamming. A blanking cap had wedged near the aileron power pack, tripped the aileron power disconnect mechanism in isolation, and considerably restricted the application of left aileron. Unharmonised control forces resulted, which confused the pilot, and he had to use a combination of rudder and what little left aileron there was available to control the aircraft laterally. In informal discussion with the Court - not taken in evidence - the pilot said that he had been further confused in his attempt to control the aileron with trim, because, with the stick held hard against the left-hand artificial stop caused by the blanking cap, any attempt to apply assisting trim of course resulted in the tab behaving as a mini-aileron. Instead of providing a correcting aerodynamic moment it acted the other way. In his situation, pulling through from a half roll of the top which ended as a full roll, and building speed, that effect had not occurred to him. By juggling speed, limited aileron and rudder he recovered the aircraft, but with some remorse he also admitted in this conversation that not only had he not considered ejection

/even when

even when nominally out of control down the side of the pull-through, and losing height to regain a semblance of level flight at 1,000 feet, it had not even occurred to him to think of considering it. This episode gave the Court food for thought. For one thing it illustrated the psychological set which can apply and cause the mind to reject any conscious thought of considering ejection, even when it is confused but not, it is hoped, to the extent of forgetting what it is sitting on. But it illustrates another point. To cause control run jamming by an object which has been in the aircraft for some time, that object must be induced to work its way into a critical position. The jamming incident here involved previous aerobatic manoeuvres in the same flight. Thus the object was permitted to float about and lodge where it was not wanted. Jamming does occur, no doubt, on occasions where aircraft have not been subjected to negative G. But one assumes that the probabilities are lower the more sedate the flight. The one concerned in the accident should have been in that category. The Court could not from the wreckage conclude that jamming had not occurred, nor could it avow that there was no foreign object in the wreckage. But, though possible, control run jamming in this flight if it was being conducted responsibly is considered to be improbable. Restriction of either stick in the cockpit area is regarded likewise; FLT LT DICK was carrying no equipment other than normal, and the dispatch and preflight should have detected anything untoward in the vacant rear cockpit were anything there.

The Pilot's Background and Record

32. General Description of the Pilot. Flt Lt J.N. Dick was well-known in the Service to be a sociable, popular, intelligent, educated, clever, alert and able young man. It was not for nothing that his nickname was 'Fox', although without connotations of the kind of subliminal and dishonest cunning associated with that animal. He was a competent and confident public speaker. He was a gifted amateur movie film hobbyist. He was physically fit. He was psychologically stable. He was medically fit. At autopsy, although the body was not complete, no adverse inherent pathology factors emerged; his coronary arteries were healthy. The answer to the possibility of cerebral disease will never be known, but is statistically exceptionally remote. He was clean-living. Toxilogical examination was not possible at autopsy, but the Court accepts from subjective evidence given by friends that there is no cause to suspect anything in the way of drug abuse including overindulgence in alcohol. In regard to the evidence from friends, and in the informal interviews conducted with them, the Court wishes to make the point that from their demeanour and frankness it is believed that their evidence is to be trusted wholly. Not only that, it was painfully obvious to the Court that the closest friends had been hard hit and, because they were at a complete loss to explain how one whom they regarded so highly could have

W10
W27
W14Q1
W11, 14

/flown

flown into the ground, they were anxious to reveal anything that they knew. They too, it seemed to the Court, are young men of honesty and integrity. Had they been able to contribute anything to the puzzle, they would have done so.

W5

33. His Experience. Flt Lt Dick's log book shows a total flying time of 1151.4 hours up to the end of February 1981; during March up to the beginning of the flight in question he had completed a further 20.6 hours in the Skyhawk. Seven of the flights in that month had been in T models, three of the seven being in the last three days before the accident and in NZ 6253. Of the total flying, over 500 hours had been accumulated in the Skyhawk during the previous two years. He was a member of the aerobatic team formed for the 'AIR FORCE DAY 81' display. In recent weeks he had completed many low flying, weapons, formation and ACT sorties. He had been a qualified operational four-aircraft flight leader since mid-1980.

W5
A8

34. His Assessments. The annual summary entered in his log book in July 1980 accords Flt Lt Dick 'High Average' ratings in pure and role flying, 'average' in air weapons, and notes with approval his continuing enthusiasm for the role, his recent qualification upgrade, and his good work within the squadron on the ground and in the air. It was signed by Wg Cdr G.J.W. Goldsmith. Earlier entries signed by Wg Cdr J.S. Hosie accord the same order of flying ratings and the same tone of comment. In the RNZAF 5000 folder, the report on the dual check of 26 January 1981 conducted by Flt Lt C.C. Lee records a satisfactory test with minor critical comments. The pattern back through the folder is one of an individual who was expected to do well, and who was delivering the goods. Early remarks include reference to a cautiousness of approach and a methodical one. In July 1978 in a standardisation report in a Strikemaster, specific comment is made upon leadership ability and a steadfast refusal to allow pressure to affect his flying.

35. Summary. There is little to be said. There was absolutely nothing in this which the Court could find as a factor in the accident; quite the contrary.

W5

The Court did, however, consider the question of over-confidence or tendencies toward it. In informal investigation nothing emerged; no evidence has been called specifically on the point because it would prove nothing not already known. And there is ample indication of psychological and mature balance to make imbalance in that regard unlikely. The only possible factor which might be considered is the one concerned with the imbalance of experience versus seniority brought about by the accelerations in rank attracted by university graduates. But

/once again

once again, with the maturity shown by this officer, the significance of that factor has to be low. He was not pressed in conducting the mission; he was familiar with the requirements and had an experience and record more than commensurate with meeting them. He was also responsible and not given to horseplay except in its proper place. Because the cloud base on the day would not have allowed it and because he would not have risked the professional aim of the mission by exposure to the other formation, any idea of irresponsibility such as aerobatics to kill time is rejected by the Court.

Nature of Mission

WS

36. The mission was one familiar not only to Flt Lt Dick, but to all unit pilots. The Court does not proffer a parallel to the proverb that familiarity breeds contempt, for it was clear from evidence and interview that the pilots and their supervisors and commanders are highly conscious of safety needs when low flying. The Court would rather make a more general point.

WS

37. Within other Western Air Forces, tactics have changed and are continuing to change to force all aircraft likely to be involved in the battlefield, or in offensive penetration operations, downwards to operate at very low altitudes. Training has followed suit. As altitude has decreased and incidence of training flights increased, so has the accident rate risen somewhat. The RNZAF cannot be immune from this effect. As often happens in such matters the operational need and activity begins, a problem then emerges, and that problem is followed up by the scientists. Very often the studies result in realisation that what had looked a simple problem is not so simple nor so easily understood. So it is in this case. At times in the past, low flying practice was low flying practice, academic and fun. Today the emphasis is more often on low flying for a purpose, within a scenario involving an exercise adversary. It is not suggested that that has not been done in the past at all; but what has changed is that it is now the norm and it is done very much more often. The attention of the pilot is divided between flying the aircraft close to the ground safely and identifying a threat and hiding from it or dealing with it. The situation is stressful in itself, and any pre-existing stress must be a more significant handicap than before.

Stress

38. Pre-existing Stress. The Court leans heavily on the evidence of friends of Flt Lt Dick in this section. It has already been stated that on the morning of the accident, Flt Lt Dick seemed to all tobe perfectly alert and normal.

/He was

W1 He was not tired or yawning or disinterested. The Court did not wish unnecessarily to call the young ladies involved in his life. It would have had to do so to establish accurately what he had been doing over the last 24 hours.

W11 His male flat mate - Fg Off Lamb - was in Australia. But the Court is satisfied from what it adduced without calling them that Flt Lt Dick was rested and relaxed on the day. Attempts informally to investigate further ended with the same answer - normality. It turned out, however, that he had been suffering some mild emotional concern for a month or so, which he had discussed with his friends. That had, apparently, been resolved early in the morning of the day before the accident when Fg Off Lamb and the lady in question had telephoned him from Australia. It would appear that

W14 decisions had then been arrived at. Certainly Flt Lt Dick had decided to visit her in Australia, and one of his friends here thought it probable that a further decision of marriage was in the offing. Flt Lt Dick was, according to his friends, relieved by whatever the decision(s) had been. The Court therefore had to look at the obverse of stressful depression - euphoria and mind not on the job. The answer will never be known but it is known that statistical correlations have been made between accidents and personal events, euphoric and depressive. It will remain a possibility, but on the balance of other evidence relating to maturity and stability of outlook, a remote one. He was, after all, experiencing nothing more than a natural human condition which at one time or another smites most.

39. In-Flight Stress. There should have been no significant in-flight stress; the matter of extraordinary stress has been mentioned already. The only other form of stress would be that associated with the tactical aims in hand, and divided attention.

Divided Attention

40. This kind of mission by its nature calls for divided attention. The Americans have an apt phrase for what is under consideration - loss of 'situational awareness'.

A2P An excellent article from the USAF Aerospace magazine of January 1980 is copied at Appendix 2P . (The Court hastens to add that it had reached its conclusions in this matter before it found the article.) So far as the possibility of a cockpit alert causing distraction in this accident is concerned, none of the warning lights found appear to have been on in flight. They include the FIRE light and the OIL LOW light.

W27 41. To the above article may be added the results of research known to be under way in Britain. It seems to show that effects on the semi-circular canals are to be considered not only in conditions of no visual reference, but also in

/clear

clear conditions where their effects can override the stabilising power of visual perception. Mostly this does not matter but at low altitude even small misperceptions in pitch can matter very much - it takes only seconds to hit the ground from 50 feet at 360 knots with a four-degree nose-down angle. We are not concerned here with illusions leading to loss of control in cloud, but with much more subtle and very much smaller departures of pitch in clear air brought about by misperceptions of true horizon through speed and terrain, and through division of attention, and through changing axes of acceleration in the semi-circular canals as the head turns relative to the aircraft and its line of flight. The situation in the kind of mission under discussion in this accident is well set up for this kind of thing - 'burying the nose' as the USAF writer has it. With head turning, apprehensions about missing the 'enemy', the aircraft manoeuvring, a very high data reception rate required to avoid hitting the ground at speed, and, perhaps, with rapidly varying absolute heights above the precipitous territory and with varying horizon references, the ingredients were there in this accident. As they are for many other flights which do <u>not</u> end in accident.

Lighting Conditions

W305

42. The lighting conditions were adequate but not outstanding. Contrast was even. The pilot was flying with his dark visor lowered when last seen. The Court heard medical opinion that the use of a dark visor in the range of normal lighting conditions in daylight, though it must attenuate the total light received at the eye, does not affect contrast appreciation. The doctor believed that

W27

those conclusions had come from research measurements of light transmittance through tinted materials and knowledge of the working of the eye, and his conclusions could well be right. But as laymen and users of such equipment, the members of the Court would need to be convinced at least by evidence of experiments actually in the field, not in the laboratory, and involving the total system - that is, the light levels, the visors, the eye <u>and</u> what it discerns and registers in the brain, rather than by theoretical connections linking them all. The work could well have been done, but it would be worth checking.

FINDINGS

43. The findings of the Court are presented below under headings taken from the assigned Terms of Reference and in the same order. The comments below are strictly limited to those connected directly with the accident; in some cases further comment will be made as Observations by the Court.

The Cause of the Accident and Contributing Factors

44. Cause. In the circumstances enumerated often enough above, the Court can only arrive at a probable cause although it carries a conditional second cause with it. They are these:

Flight Lieutenant J.N. Dick flew Skyhawk TA4K NZ 6253 into a forested mountain ridge, 3,500 feet above mean sea level at 3940S, 17610E, at approximately 1100 hours NZST on 26 March 1981, at a speed in excess of 300 knots and while the aircraft was intact and capable of control, whilst engaged in a properly authorised and briefed low level operational training mission, in weather conditions adequate for the task in hand, but without having seen the ridge or, having seen it, without having appreciated that he was about to collide with it, until too late to avoid it.

First conditional cause: If the pilot had not seen the ridge at all until too late, that would be a function of contrast against the background and of the form of the ridge, deluding him into the belief that the ridge ended at a pronounced bluff higher up when in fact it did not.

Second conditional cause: If the pilot had seen the ridge but had failed to appreciate until too late that he would not clear it, that would be a function of diversion of attention from flight path relative to the ground accompanied by an undetected and slight lowering of the aircraft nose and, possibly, visual spatial delusion from stimulation of semi-circular canals as he turned his head, resulting in a subtle misapprehension of true horizon as he flew down the valley, causing him to adjust attitude downward marginally too far to effect recovery in time to clear the ridge blocking the exit.

If all of that adds up to a complicated way of expressing an error of judgement, so be it. The Court, however, believes that the cause of that error may be found in the above.

/45.

45. Contributing Factors. The following contributing factors, based upon the above as probable cause, are found:

a. The nature of the mission was such that the pilot was required, in an impending training adversary situation, at low level, to divide his attention between the oncoming operational exercise threat, and maintaining ground clearance whilst maintaining the high speed necessary to effect the engagement.

b. The pilot had his dark visor lowered in lighting conditions which, though generally within the satisfactory range, offered low degrees of contrast in the terrain in the area.

The Cause of Death

46. Flt Lt Dick died instantly of multiple injuries in his seat in the aircraft when the aircraft hit the ground.

The Extent of Damage to NZ 6253

47. The aircraft was totally destroyed.

Duty Status

W5 48. Flt Lt J.N. Dick was on duty on the day of the crash.

Damage to Property

A4 49. No private property was involved. The site is in the Ruahine State Forest. There was no permanent damage to the area from either the crash or the wreckage recovery operation.

The Purpose of the Flight and Authorisation/Briefing

50. The purpose of the flight was proper operational training at low altitude, and it was properly authorised (but for a minor legality having no bearing on the accident) and briefed.

/Supervisory

Supervisory Procedures in No 75 Squadron

51. Supervisory procedures in No 75 Squadron are perfectly sound. Supervisory capacity and depth, however, will be the subject of separate observation below.

Compliance with Relevant Orders and Instructions

52. There was no violation of existing orders or instructions either by omission or by commission which contributed to the cause of this accident.

Adequacy and Framing of Relevant Orders

53. Having found the possibility of dark visor usage as a contributing factor, the Court is bound to comment upon one order in the No 75 Squadron Standing Order book. At paragraph 2/601 it states that when flying below 5,000 feet at least one visor is to be in the down position. The Court was told that it was 'SOP' to use both visors when low flying. The No 75 Squadron Order should, it is believed, at least until it is shown that the dark visor is not a factor in affecting contrast vision, be amended to encourage pilots to think carefully about using the dark visor at low level in poor light, rather than slavishly using both. Other units might also be affected.

54. Some matters concerning orders in general will be mentioned under the Court's Observations.

SAR Response

W24,25,26

A2R

55. The speed of SAR response provided by the civilian helicopter and crew, and the police, from Taihape was beyond reproach. More than that, the Court has separately mentioned particular matters of credit to individuals arising from local actions.

56. But the question is thought rather to deal with internal RNZAF SAR matters. Since they did not affect the outcome of this accident, comment is reserved to the Observations section below.

/Allocation

Allocation of Responsibility Where Appropriate

57. Having found no attributable cause or causal factor anywhere else, in the circumstances of the accident and with only probable causes as listed above, allocation of responsibility is inappropriate.

RECOMMENDATIONS

58. Recommendations by the Court in respect of the accident are made below.

Relating to Low Flying Limits

59. Low Flying Limit. It will be noted that the low flying limit for operational low flying training has not been cited in connection with cause or cause factors. A recommendation will follow, but first some argument must be presented:

a. In this accident the aircraft hit a hillside in mountainous terrain but elevated 500 feet above a valley floor, and with an escape route to the left. If the probable cause findings above are wrong; if there was anything, pilot-induced or not, which caused the aircraft to go out of control it can be doubted that any higher low-flying limit might have saved him.

b. If the pilot had been deluded into believing the ridge ended at the higher bluff, a similar comment can be made.

c. If he had simply 'buried the nose' whilst under control, a case may be made for raising the low flying limit used in the RNZAF. That has been the solution in other Air Forces to this particular problem. But it has not stopped the accidents, although it might have reduced their incidence. The Court has not seen statistics to show a lowering of accident rates of this sort where that action has been taken.

d. It cannot be denied, however, that it is an obvious move to make. Perhaps too obvious. And, it is noted, where it has been made it has resulted not in raising the limit slightly, but in setting it at 150 feet (RAAF) and 250 feet (USAF), although it is understood that the latter allows 150 feet for some experienced pilots. It is a difficult question of balancing realistic tactical training against safety.

/e.

e. Safety is one yardstick; though not unrelated to it, another often used is cost. In peacetime that is measurable. In war it could be immeasurable. There is no doubt that aircraft will be required to fly defensively very low indeed in hostilities of any scale. Lower, it is suggested, than many Air Forces allow in training. Not low enough, and aircraft will be lost to enemy action. Too low in terms of experience, and aircraft will be lost in accident. Either way, highly expensive and effective weapons systems will not be brought to bear, and if that contributes to losing the battle the cost will be unmeasurable and immeasurable.

60. A Compromise. In the RNZAF, it is believed, there is a tendency still to regard the current 50 foot low flying limit as it used to be regarded in 'academic' operational low flying training - that is, as an aim. It is believed that sometimes pilots interpret the authorisation 'NB 50 ft AGL' as a target height, not a minimum height, whatever the authorising officer meant. The proper aim is, of course, to fly as low as the existing tactical scenario demands, and no lower, with an absolute lower limit of 50 ft AGL.

61. Recommendation as to Low Flying Limits. It is recommended that:

a. enquiries be made to determine whether the raising of low flying limits in tactical training overseas have had a positive effect on accident statistics concerning unexplainable 'fly-ins';

b. if they have, the RNZAF will be required seriously to consider taking its own pre-emptive move; and

c. in the meantime, the RNZAF mounts an internal publicity campaign, and causes the idea to permeate through all relevant training syllabi and establishments and to be incorporated into relevant Standing Orders, that the tactical training low flying limit is based upon the tactical need at the time, and the aim is to fly as low as is tactically necessary and no lower, but is never to fly at the authorised lower limit unless it is in fact tactically essential.

/Relating

Relating to Probable Cause and Cause Factors

62. Being a matter of illusion, it is probably difficult to train meaningfully to prevent the problems of spatial-awareness dysfunction affecting low flying operations. But that is no reason for not ensuring that the effects are well understood - at least as well as the more familiar 'leans' in cloud. It is known that the subject is discussed during Aviation Medicine courses for aircrew, but the Court suspects that although the aircrew might acknowledge their existence, they are inclined to do so with an air of reservation, even disbelief - "it can't happen to me". It is also known that a great deal of information is available from overseas, within such organisations as ASCC. What is at issue is dissemination of such information in lay terms, and its effectiveness. It is recommended that:

a. that which is known from overseas be gathered, collated, translated and taught with determination;

b. overseas Air Forces should be consulted as to airborne training methods used in alerting pilots to the causes and the dangers of 'burying the nose'; it is believed that the USAF in particular does some demonstration training in this regard;

c. the effects on contrast appreciation of using the dark visor in poorer light conditions whilst low flying should be thoroughly researched or, if the research is already available it should be brought forward; and,

d. in this respect the No 75 Squadron Standing Order Book should be altered to reflect the need, until proved otherwise, to consider such factors against the requirement for double visor protection from bird strike before electing to use both visors when low flying in poor light. Other units might also be affected by this.

Relating to Other Matters

A2R 63. Civilian SAR Response. Recommendation has been made elsewhere concerning recognition for services rendered by some individuals involved in response to this accident on the day.

64. Skyhawk Escape System. The Court is aware of the recognised shortcomings of the ESCAPAC system, but believes these not to be related to its raw potential to place a pilot in a parachute quickly. But inevitably doubts have arisen in the minds of many from the rumoured circumstances of this accident, aided by some unfortunate and uninformed Press comment and speculation. The Court most strongly recommends that wide and firm internal RNZAF publicity be given to the fact that the death of the pilot in this case is in no way attributable to any shortcoming of function or material failure in the escape system.

65. Aircraft Integrity. There was at the time of this accident an unfortunate conjunction with a wing cracking problem in the Skyhawk. Inevitably, again, the Press made a connection between the two events, raising speculation to which even members of the RNZAF are not immune. There is little doubt that the Skyhawk is aging and that cracking problems will occur in this aircraft as in others. There is also a certain amount of circumspection called for when an aircraft is mooted for retirement from the front line for other reasons, to protest its airworthiness without being further misunderstood. But the Court is quite convinced that the integrity of the main structure of this aircraft was in no way connected with the accident. It would recommend consideration of publicity to that effect.

OBSERVATIONS BY THE COURT

Introduction

66. The Court has a number of observations to make, from some of which will flow further recommendations. These are made in matters outside the immediate circumstances of the accident but which came to the attention of the Court and could, in other circumstances, have a bearing on the outcome of some future accident.

Supervision

67. The Court found no fault in the supervisory procedures at No 75 Squadron in respect of this accident. Supervisory depth is another matter, however. But, again in respect of this accident, the Court does not mean now to imply that there are shortcomings in the execution of those procedures. The point is more general, it applies to others as to No 75 Squadron, and it appears as a general air of breathlessness, of urgency, of insufficient time to consider.

68. Functional activity achievement in recent years has risen, within a relatively constant number of flying hours and people. We are accomplishing more with the same, it is believed. At the same time it is well known that average experience levels have dropped for a number of reasons. Manning at supervisory levels in most squadrons is spread thinly, and there are many physical shortages of the kind which had denied No 75 Squadron its second QFI for some time, and had taken its Training Flight Commander for staff training. With rising and diversifying activity rates, low inherent experience levels in squadrons, and shortages of supervisors, the stage can be set for insidiously rising incidents not necessarily in number so much as in form, and for accidents.

69. The Court is not so presumptuous as to proffer solution or make recommendation, but feels bound to remark that it would seem to be in the interests of the RNZAF to brake the rise in activity until capacity more evenly balances it. The breaking point has not yet been reached - it is probably better described as a bending point, and it is impossible to say where it lies - but it does, to the Court, seem to be timely to pause about now and take stock.

Orders Generally

70. Accidents cannot be legislated out of existence. But if orders are confusing or incomplete they can contribute to them. The Court in general observes that the RNZAF seems to be engaged in a round of rewrites of order books in a circular process which ensures that at any given time few of them at differing levels meld well one with the others.

71. A case in point emerged in this investigation, and it is suspected that it is only one of many. Although the pilots involved on the day, and the others in the unit, well understand the limitations connected with ACT at low level and elsewhere, No 75 Squadron does not at present have a written order covering them. No 14 Squadron does. The RNZAF Base Ohakea Standing Order Book does not. The RNZAF Operations Group Standing Order Book does not, but it used to. It was removed at the time of reorganisation a year ago, and was replaced by a direction to Base Commanders to raise such an order within certain guidelines. The necessity for that delegation might be argued, but that is not the point here. If Standing Orders fail to mesh properly, important matters can be missed and some can become contradictory. Credibility, interest and understanding suffer, not to mention good guidance.

72. There also seems to be some obscurity elsewhere. The RNZAF Base Ohakea Operations Flight has a booklet of "SOP's" issued under authority of the Flight Commander. That is good, in principle. In the matter of low flying, it echoes Base Standing Orders as, among other things, it states that Operations has "control" over activities in the low flying areas - although the SOP assigns control over the area and the Base order over the aircraft. It is doubted, however, that it is control that is meant, or possible. It would seem that the function would be better described as "co-ordination", for Base Operations does not have the facilities to exercise control in its full meaning. The Court also observes that the Operations SOP requires aircraft in the low flying areas to make 30-minute "ops normal" calls and/or calls on leaving the area. The Court could not find the 30-minute requirement expressed elsewhere, though it is eminently sensible. But surely it should be said with the authority of a Base Order, rather than in a sub-unit SOP which aircrew might never see.

73. Again, the Court can make no recommendation, but would observe that here might be another manifestation overall of the need to pause to get our house in order. Although it would mean yet another Manual and more labour in its preparation, a document standardizing form and format, required contents, coverage and style for Standing Order Books and SOPs could be very useful. For example, the RAAF system seems to be logical, standardized and easy to follow, at least in operational fields; perhaps a touch of exemplar plagiarism would not go astray. It is believed that NZAP 3184 goes nowhere near far enough in this regard. Our orders are not orderly. The principle works in technical fields; it should work in this one.

Flight Following

W15

74. The duty Operations Officer on the day of the accident did not comply with the above SOP in respect of insisting on 30-minute or vacating calls. It in no way affected the outcome of the accident, but his interpretation was that because Gold was on a flight plan, "control" became a responsibility of the ATC organisation. The Court encountered some confusion of

/thought

thought in this area, and it is more widespread than simply at Ohakea. It centres on perceptions of "control" and such ill-defined terms as "flight following". At Ohakea and in respect of the ILFA another ingredient is one of expectation that communications into the area do not work anyway. But neither can Ohakea "flight follow" an A4 aircraft on one of the low level routes in the South Island.

75. In fact, an A4 in that situation has no "flight follow" with it at all, if by the term is meant a watch, continuous or by scheduled call arrangement, on the safe progress of the flight as it is conducted. Nor does any other aircraft using ATC facilities in New Zealand on a VFR flight plan. The belief that it does is widespread, but the belief is wrong. Under current arrangements, apart from sensible and helpful actions taken by individuals within the ATC system, and apart from other indication of something having gone awry, as the Court understands it the earliest mandatory time at which a procedural SAR uncertainty phase must be called on an aircraft operating on a VFR flight plan is 30 minutes after ETA at destination. It is believed that the RNZAF should examine whether that meets its needs.

W16

76. The existence of a further trap emerged during the investigation with respect to formation operations. It may be assumed that mutual flight follow is provided by formation partners but, as here, if the operational intention is to split in a way denying electronic or visual contact, the mutual flight following effect can be nullified. If no other agency is aware of the situation, a large gap in cover opens up. This is particularly so if, as in the ILFA, lost communication with the outside world is accepted as the rule rather than the exception. People will be lulled into accepting lost communication as signifying no more than it says, and that can be a dangerous assumption. Regular scheduled checks should perhaps become "SOP" in training.

77. Recommendation The Court has recommendations concerning flight following:

a. The RNZAF should give serious consideration to persuading CAD authorities that something like the Australian system of nominating "SARWATCH" times and "NOCOM" times should be adopted in New Zealand for VFR traffic. The NOCOM procedure is one whereby a pilot who will be out of communications en route nominates a time at which he will next call, and, if he does not, an uncertainty procedure is invoked. Further, it is believed that there are merits in the Australian system of applying similar disciplines to en route calls for VFR traffic as apply to IFR traffic.

b. The current staff target on improving AGA communications in the Waiouru Training Area should be accorded high priority and, if it does not already do so, be extended to cover the ILFA as far as feasible.

/c.

c. The pitfalls of responsible agencies assuming that all formations are capable of mutual flight watch within themselves should be publicised, as should greater awareness of the need to consider lost communication as it may signify other things, and to make good contingency arrangements.

SAR Response

78. It has been stated elsewhere that the local SAR response was adequate. But the Court observes that there would be advantages in having organic helicopter SAR capability at Ohakea, although this has not been possible to date. It recommends that RNZAF SAR helicopter facilities be based at Ohakea as soon as practicable.

W13

79. In the SAR helicopter response from Auckland, two difficulties arose. Although the delay in takeoff so occasioned was not long, the callout came at a time when the refueller driver at Hobsonville was at lunch, with the keys. In other circumstances the delay could have been important; in this case the problem was solved somewhat drastically. It is recommended that RNZAF Base Auckland review its arrangements in this regard. The second difficulty concerned misleading information over the presence or otherwise of a qualified doctor aboard the aircraft. Again, in other circumstances this could have been important, for it led to a decision in this case not to deploy the doctor available at Ohakea because it was thought everywhere that one was on the aircraft, mostly on the basis of assumption. The only observation that can be made is upon the need for participants to understand the importance of accuracy in terminology. Slang terms for medical personnel like "The Doc" can confuse, and assumptions are out of place.

W18
W19
W13

W20
W21
A3F

Crash Kit

80. The Court observed that the civilian Accident Inspector had a number of very useful items for his task. For example, he had a very handy combination inclinometer instrument. The RNZAF does not seem to have such equipment; in 1981, a makeshift plumb bob and a navigation protractor are out of place. Necessary specialised equipment should be assembled and held centrally for use at site investigations. It would be impossible to cater for all contingencies, and wrong to develop something based only on this experience, but it is recommended that the matter be attended to.

"Treescape"

81. Had the pilot been alive, his position in the tree would have been precarious and remained so until the Iroquois arrived. The accident served to show that it is not just in South East Asia that "treescape" devices are needed; they can also be needed in New Zealand. It is recommended that this be attended to.

/Flight Data Recorders

Flight Data Recorders

82. This investigation has taken the entire attention of three senior officers for a period of several weeks, and has involved diversion from primary task of a number of other officers and men for varying periods. In terms of cost, the Court observes that capital expenditure on flight data recorders for RNZAF aircraft, if they are able to eliminate much of the painstaking reconstruction obligatory in this case, might be effective.

Accident Investigation Training

83. The RNZAF does not have and does not need a full-time Accidents Investigation Branch. The Court observes, however, that the RAAF which presumably does not have full-time specialists either, conducts an Investigation Management Course. The Court further observes that reports on the course from within the RAAF rate it as excellent value in the field. It is available to officers up to the rank of wing commander. From the experience now ended, the Court recommends most strongly that selected RNZAF officers should attend that course from time to time.

Signature of President: ..... WG CDR

Signatures of Members: ..... SQN LDR

..... SQN LDR

Date: 14 May 1981

SKYHAWK

FATAL CRASH

The crash of Skyhawk NZ 6253 on 25 March 1981 was the first fatal aircraft accident in the RNZAF since 1973. The accident occurred in rugged terrain, in the Ruahine Ranges, approximately 20 miles north-east of Taihape. The absence of eye-witnesses, the rugged terrain and the degree of disintegration required the most comprehensive accident investigation undertaken by the RNZAF in recent years, in an attempt to establish the cause of the accident.

The mission that morning was for two Skyhawks to intercept a formation of four Skyhawks, who were going to attempt a low-level attack on a bridge in the Inland Low Flying Area. The two formations were then going to carry out two v four Air Combat Manoeuvring. At 0930 the pilots of both formations had a combined briefing, where they discussed the rules of engagement and safety matters for the entire mission. At the end of the combined briefing the formation leaders carried out individual formation briefs. The mishap pilot, who was the leader of the pair, briefed his wingman orally on the conduct of the flight and in particular the tactics that they would use to intercept the four intruders.

The intention of the pair after entering the ILFA was to proceed to a point in the ranges and split, with the leader holding to the west of the divide and the wingman holding to the east, and hold in the valleys with the hope of catching the intruding formation as it skylined over the ridges. The plan was to hold for 15 minutes, and if no engagement occurred, proceed north in search of the intruders.

At 1028 the defending pair departed Ohakea for the ILFA and at 1052 they split as briefed. No further communications between the pair occurred. The wingman flew to his holding area to the east of the divide as briefed. After holding for about 15 minutes the wingman left the holding area and proceeded north in an attempt to intercept the intruding formation. He eventually intercepted the intruders 15 miles west of Napier at 1130. He queried the whereabouts of his leader, but nobody had seen him. Concern for his safety began to develop as various efforts to raise him by radio failed.

The wingman returned to the area that his leader had planned to hold in. Once there, he saw smoke rising from a spur. Closer investigation revealed a burnt out strip and a parachute in the trees.

Immediately following the reporting of the wreckage Ohakea Operations sought the assistance of civilian helicopter operator and the police. Within 15 minutes of being called out the helicopter was airborne with a crewman and the local policeman onboard. The pilot was briefed on the situation in the air and was guided to the crash site by a Strikemaster, which was orbiting overhead.

On arriving at the site the task confronting the pilot was formidable. The wreckage was still smoking and a parachute was deployed across a tall tree in the dense forest. With the chance of the pilot being alive a rescue attempt had to be made.

The dense bush prevented a landing, and as the helicopter was not winch equipped an alternative method had to be used. At a landing pad in a river-bed a number of rope straps were joined together and attached to the cargo hook. The crewman and policeman then stood in a loop and were underslung 80ft underneath the helicopter and flown to the crash site, where they were lowered to the ground beside the parachute. They established that the pilot was not alive.

Divided Attention

The type of mission being flown necessitates divided attention. The pilot must navigate, avoid terrain, look for the "enemy", and fly the aircraft: not a light work-load when flying at 50ft AGL. Studies overseas show that effects on the semi-circular canals must be considered in clear conditions where their effects can override the stablising power of visual perception. Mostly this does not matter but at low altitude even small misperceptions in pitch can matter very much - it takes only seconds to hit the ground from 50ft at 360 kts with a four-degree nose-down angle.

In this type of accident we are concerned with the subtle and very small departures of pitch in clear air brought about by misperceptions of true horizon though speed and terrain, through division of attention, and through changing axes of acceleration in the semi-circular canals as the head turns relative to the aircraft and its line of sight. The situation in this accident is well set up for this kind of thing.

Engine Failure

At the time of impact the engine was delivering full or near-full power. The engine did not fall out of its mounts or otherwise rupture the exhaust system in the air, for at the time electrical power was cut EPR was at the equivalent of full power, and RPM was high when the rotating parts contacted the casings.

Low Flying

Since the late '60s there has been an increasing tactical requirement to fly low level. Corresponding with this increased low level activity the USAF has found that there has been an increase in the percentage of fighter/attack aircraft accidents. Two types of accidents that predominate are collisons with ground or water in, as far as can be ascertained, perfectly good aircraft, and pilot-induced control losses. A measure of the concern about this type of accident is the number of articles on collisons with the ground, one of which is reprinted in this issue.

It would be easy to change the low flying orders and raise the minimum altitude, but this wouldn't achieve anything. It would be a backward step in valuable tactical training for our aircrew, and would probably induce pilots to "break the rules" to get the job done. Pilots of fast jets must be aware of all the traps that can occur at low level and if they begin to encounter any of them - climb. A climb out of dangerous situations is far better than ending up at the bottom of a smoking hole, even at the expense of being "bounced".

☆ ☆

Despite the exhaustive examination the Court was only able to derive a probable cause of the accident. The Court concluded that the Skyhawk impacted the ridge at a speed in excess of 300 kts, while the aircraft was intact and capable of control. It was possible that the pilot did not see the ridge or, having seen it, he did not appreciate that he was going to collide with it, until too late to avoid it. If the latter occurred it would have been from a diversion of attention from flight path relative to the ground, accompanied by an undetected and slight lowering of the aircraft nose.

Primary Flight Controls

The Court concluded that the possibility of a control malfunction was eliminated. For the Skyhawk to get out of control in normal circumstances there would have to be either a number of coincidental failures in a number of different systems or a major event causing simultaneous failure across those systems. In the Skyhawk the first option is highly unlikely and there was no evidence of the second occurring.

Aerodynamic Flight Controls

None of the other ancillary aerodynamic controls, including the slats, could have caused the aircraft to hit the ground. From the evidence they all appeared to be functioning correctly.

Fire

There was no evidence of a pre-crash engine or airframe fire. If this had occurred it is highly probable that the pilot could have zoom climbed and safely ejected.

Pilot Incapacitation

Hypoxia can be eliminated because of the altitude the aircraft was being operated. The possibility of a birdstrike around the canopy was also eliminated, as no sign of a birdstrike was found in the evidence.

Ejection

The parachute canopy that was deployed on the tree tops was initiated by the impact. In this accident the pilot made no attempt to eject. There is no doubt that the ejection seat would have worked 'as advertised' had an ejection been commanded.

Survival Equipment

The Court considered pilot incapacitation or control restriction by the uncommanded inflation of G suit, dinghy, or lifejacket. The inflation of the G suit is not crippling and can be easily deflated by disconnecting it. Both dinghy bottles had discharged, but the dinghys had not inflated. The inflation of the lifejacket, if it had occurred, would present no major problems in controlling the aircraft.

Control Jamming

The possibility of the controls being jammed by FOD could not be entirely eliminated. A recent instance of FOD jamming controls occurred in a Skyhawk during aerobatics. Considerable effort was required to control the aircraft on this occasion. With respect to this accident however, it is considered an unlikely possibility as the aircraft was assumed not to be involved in any negative G manoeuvres prior to the crash. The more sedate nature of this flight makes it less likely for a foreign object to move and thus jam or restrict a control run.

Lighting Conditions

The lighting conditions in the overcast conditions were adequate but not outstanding. When the pilot was last seen he had his dark visor down. Medical opinion says that the use of the dark visor in the range of normal light conditions of daylight does not affect contrast appreciation. Many pilots have found though, that contrast perception on an overcast day is quite difficult and a better appreciation of terrain clearance is gained by having the dark visor up.