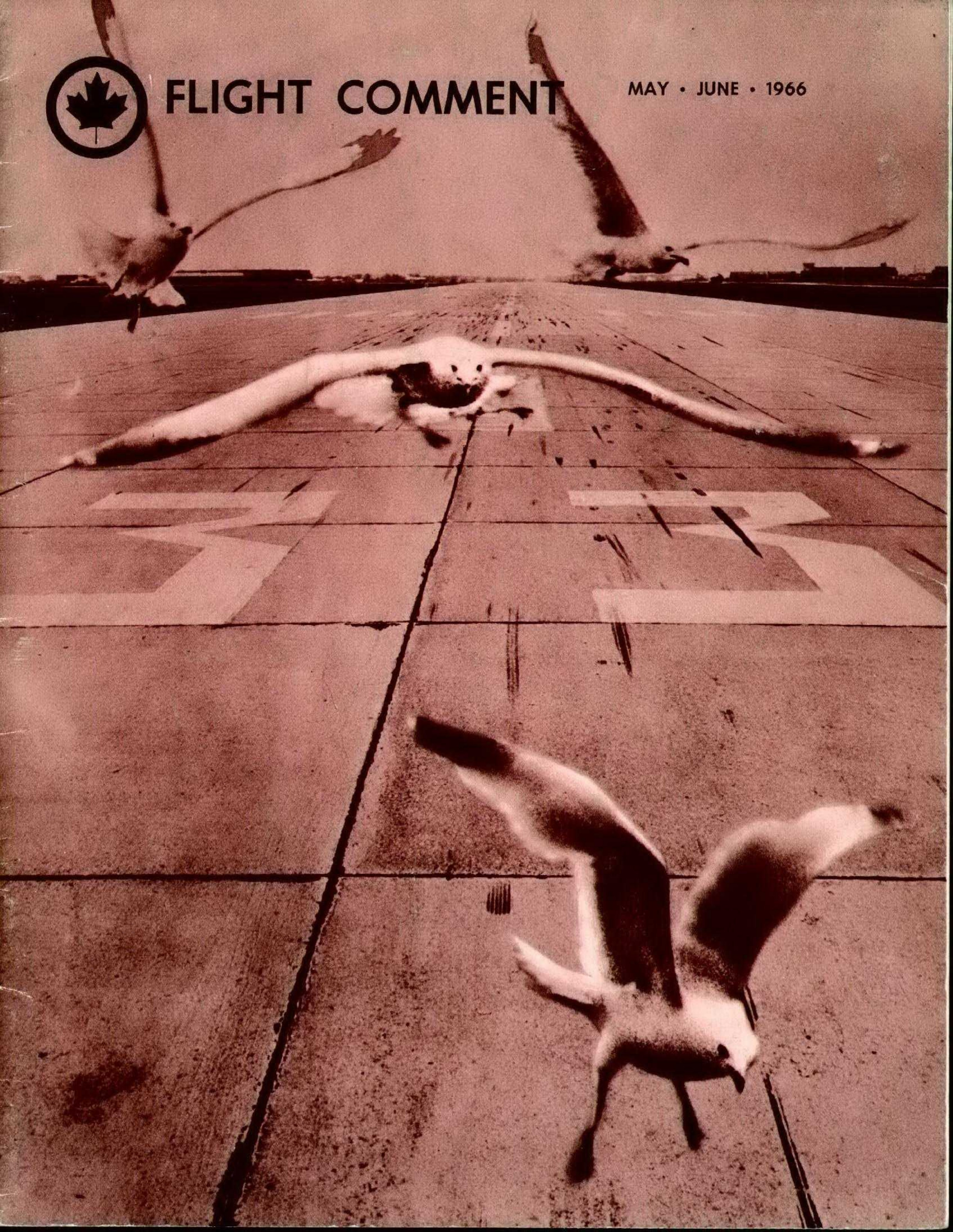
# FLIGHT COMMENT

MAY • JUNE • 1966



# Comments

On a number of recent emergency ejections, RCAF aircrew have been wearing the cotton orange-coloured summer coveralls. These suits have been badly torn during the escape sequence. The most recent concerned F/O DS Scott who ejected from a CF104 aircraft at approximately 400 knots, on 9 Aug. During the ejection the entire leg of the suit was lost.

During ejection trials in 1964 at Holloman AFB, we observed that the orange-coloured lightweight cotton flying coverall did not stand up well during medium speed ejections. On high-speed runs this suit practically disintegrated. On the other hand, both the old and new style RCAF summer coveralls were not affected by high-speed ejections. The new lightweight suit survived high wind blast. In fact, it was capable of withstanding, with barely a scuff mark, a ground impact during an unsuccessful dummy recovery.

Whenever RCAF coveralls are available, the orange-coloured coveralls are not to be worn because of this proven unsuitability.

Those who have received a Good Show will receive a scroll containing an account of the story which appeared in Flight Comment. We are in the process of preparing these; of course, there have been quite a few over the past decade – about 150. The scrolls will be mailed shortly.

"Editorial Assistant" is a euphemism for Flight Comment's one-girl office staff. Five years ago Miss Rachel Mayhew arrived fresh from school, and was plunged into the secretarial hurly-burly. Having married LAC R Hales (earlier, of this directorate) the inevitable transfer ended her half-decade stay at DFS. Rachel's contribution to the accident prevention side of DFS was a "good show" from start to finish.

We're in the throes of a cleanup (please, no comments) which will entail discarding a modest accumulation of old Flight Comments dating back to 1950. By September, this year they'll have to be destroyed; any member of the armed forces interested in these may write. We'll mail them on a first-come-first-served basis.


DIRECTORATE OF FLIGHT SAFETY CANADIAN FORCES HEADQUARTERS

G/C AB SEARLE
DIRECTOR OF FLIGHT SAFETY

S/L MD BROADFOOT
FLIGHT SAFETY

W/C JT MULLEN
ACCIDENT INVESTIGATION





Editor—F/L JT Richards

Assistant Editor—Mrs DJ Kines

Editorial Assistant—Miss Donna Deavy

Art and Layout—CFHQ Graphic Arts

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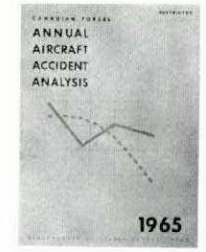



## THE FACTS ARE IN

The numbers game for 1965 has been played and the news is not good. More fatalities and more accidents with an alarmingly high increase in costs of aircraft destroyed and damaged reverses the happy trend which DFS has been pleased to record for the past ten years. Our flight safety program needs serious re-examination.

This small space is hardly sufficient to permit a detailed critique - we recommend the Annual Aircraft Accident Analysis to all our readers to get the whole picture. Some of you also may have had an opportunity to attend the annual briefing by the DFS team (we know we missed a few in '65). But a brief resumé reveals deterioration in all the popular cause factors:

- pilot carelessness, negligence, errors in judgement with further, abundant proof that light aircraft and helicopters are the deadliest of the species
- poor techniques, inadequate supervision or briefing resulting in confusion and mistakes
- ineptitude, carelessness or lack of skill of tradesmen or technicians who left out split pins in critical areas or left them in undesirable places to cause Foreign Object Damage
- environmental factors - including birds (scratch one CF104D), telephone wires for the death-defying nap-of-the-earth flyers, snow and ice for non ski-equipped ground-loopers
- engine failure and undercarriage collapses headed up a large list of materiel failures whose number continues to move upwards
- finally, and unhappily for DFS/AIB, an increased percentage of undetermined accidents with no lessons learned.

One further point; there were a number of sporadic or unrelated causes over a wider range of aircraft than in previous years.

Will we benefit from all these mistakes? We should, because there is now no reason for anyone connected with Canadian military aviation to be complacent. We exhort all commanders, with the assistance of their flight safety officers, to study the 1965 record and revamp your flight safety program. Finally, we say again as we did six months ago on this page that true professionalism is being alert all the time.

GROUP CAPTAIN AB SEARLE
DIRECTOR OF FLIGHT SAFETY

# Operation Bird Track

William W H Gunn
Canadian Wild Life Service

A CF104 is on a low-altitude sweep across the countryside - suddenly the engine turbine disintegrates in a burst of shattering metal. Thrust is lost almost instantly. The pilot is left with no alternative - he must eject while there is still time.

What caused the engine to fail? Sometimes the cause is mechanical such as a bearing failure but on two occasions we know it was the result of a bird entering the engine intake. Birds are also the suspected culprits in two or three other similar accidents. A bird ingestion is not always catastrophic, but each 104 lost means more than a million dollars' worth of hardware down the drain, a pilot's life is placed in jeopardy, and other persons and property endangered by the falling aircraft. This is too dangerous and expensive to have happen very often. Yet it is the job of these aircraft to fly at altitudes where bird traffic is sometimes heavy and the hazard of a strike is high.

Since it is unlikely that any practical modifications in design can be developed at this stage of the game to make the 104 (or any other current type of aircraft) more "birdproof", the solution seems to lie in reducing the probability of mid-air collisions between birds and aircraft.

What can be done? Nowadays, there's no easy answer. When planes flew at lower speeds, birds had a good chance of avoiding them and if not - well, propellers made good "chopper-uppers". However, modern jets approach quietly and at such high speeds that by the time birds realize they are in danger they have little or no opportunity to get out of the way.

If we can no longer count on birds avoiding aircraft, can we manage to have aircraft avoid birds? At today's speeds, a pilot would obviously require a warning well in advance of an impending collision with a bird or flock of birds if he is to take effective avoiding action. The pilot's problem is about as difficult as the bird's - by the time he sees the hazard (if he does at all), it is probably too late.

If we could track birds by radar just as we track aircraft, we could then control aircraft flight paths to reduce the likelihood of a birdstrike. Another crackpot idea? Let's look at the possibilities a little more closely. Birds, like other animals must follow logical patterns of activity in order to survive; certainly, bird flight is an important part of this activity. If we could recognize and understand the significance of their flight patterns to the extent that we knew where and when they were likely to occur, we might be able to work out ways of avoiding the worst of the bird traffic. This should bring a reduction in the number of bird strikes to an acceptable minimum - for, let's face it, we can never eliminate them entirely.

With this concept in mind, research work has been going on in Canada for nearly three years to see if information provided by radar about bird flights can be useful in reducing the number of strikes. Even in the early days of radar it was recognized that birds in flight do produce echoes on some types of radar displays.

As this was classified information for a while it was not widely known until some years after the end of World War II. Then, about the mid-1950s scientists in Switzerland, Britain, and the United States began watching and photographing radar displays to learn more about the daily and seasonal movements of birds over relatively large areas - much larger than had previously been possible by visual observations. Radar recording proved to be a fascinating and valuable new technique for observing bird migrations.

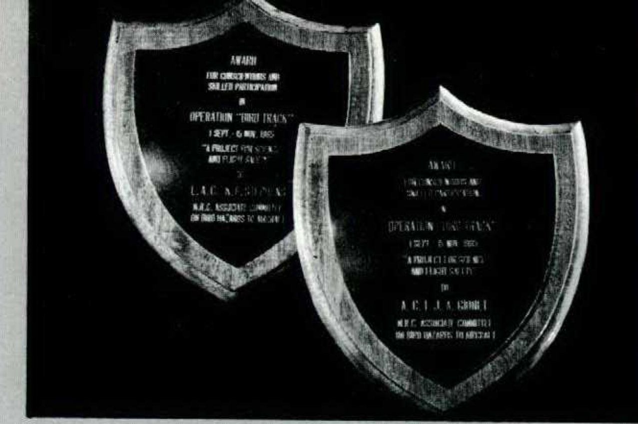
Meanwhile, the birdstrike problem was becoming of increasing concern to the commercial airlines in Canada, and the RCAF. In 1962 the National Research Council was asked to form a committee to investigate the growing problem and to make recommendations on how to reduce the hazard. The Associate Committee on Bird Hazards to Aircraft, as it became known, was formed in 1962. Today, its members include representatives from the RCAF, Air Canada, Canadian Pacific Airlines, Rolls-Royce of Canada, Canadian Airline Pilots' Association, Department of Transport, Canadian Wildlife Service, and the National Research Council itself.

The committee's first approach was to tackle the problem of birdstrikes that happen on or near the ground at airports. Devices for scaring birds were developed and tested and, of more importance in the long run, ways were found to make airports less attractive to birds. This involves removing the attractions that bring them there in the first place, such as food or shelter. This campaign at the airports has been effective, and that is another story in itself.

To tackle the problem of strikes that occur away from the airport, ie, in flight, radar was an obvious avenue of research. First, we had to find out if birds were visible as echoes on Canadian radars. Some tentative efforts at radar photography were made at Toronto in the fall of 1963. An automatic motion-picture camera trained on a plan position indicator (PPI) radar display, took one frame of film each radar sweep through 360°. As each sweep lasts about 10 seconds, each frame (or picture), therefore represents that amount of time. When the film is run through a projector at, say, the normal speed of 24 frames per second, there is a very rapid speed-up in the movement of the echoes. The 1963 film proved that bird echoes did indeed show up clearly on the DOT's 23 cm radar system; the speed-up made the normally slow-moving bird echoes very much easier to follow and study. Evidence emerged to support the theory that migrating birds tend to fly the barometric pressure patterns associated with air mass movements. Birds seem able to select the weather (and particularly the wind direction) that will help rather then hinder their flight in the desired direction.



***Among the several military and DOT specialists employed in OPERATION BIRD TRACK, LAC Stephens and AC1 Gionet were selected for their competence. The awards were given by the NRC Associate Committee on Bird Hazards to Aircraft. These two airmen are seen receiving the awards from their commanding officers.***



W/C Garland, OC CEPE detachment, Gold Lake presents plaque to LAC KF Stephens.

AC1 JA Goinet of CJATC, Rivers, Man, receives plaque from G/C RTP Davidson.

This technique was most promising, and resulted in a series of three extensive photographic radar "watches" called Operation Bird track. The first of these took place in the fall migration period of 1964. Radar displays were photographed by the motion-picture technique at 11 radar sites in Canada, (seven RCAF installations and four at DOT airports) selected to provide coverage of the duck migrations over the prairie region, and also the flow of geese southward out of James Bay. Both of these mass migrations create a high birdstrike hazard.

The 1964 films were examined in detail by Dr M T Myres, of the University of Alberta, and by the author. They contained numerous dramatic examples of large-scale bird migrations at times when aircraft were also using the same space; in fact, the cameras caught on film a radar view of several bird-aircraft collisions as they actually happened. On the film, it was possible to trace the paths of the aircraft and the bird(s), and to see where they collided.

The recommendation for even bigger and better photo coverage in 1965 was accepted by both the RCAF and DOT and, thanks to the facilities they provided, it was possible to carry out further "watches" during the spring and fall migrations of 1965 that were quite unprecedented in scope. Filming was done concurrently at as many as 18 radar sites in Canada (9 RCAF and 9 DOT) and also at Metz, France, the region where the Air Division is operating. For extended periods in the spring and fall, about 150,000 square miles of Canada were being monitored for bird movements.

All in all, Operation Bird-track became quite an undertaking. The RCAF ran two special training courses for photographers on the requirements of the operation. These men kept the cameras going and developed the film at the 9 RCAF sites in Canada and the one in France. Similarly, the DOT crews worked to change film and kept the cameras functioning at their airports. To quote one set of figures, the RCAF teams working last fall began on 1 Sep and continued to Nov 15; during this period they took, and processed, about 500,000 frames - more than 15 miles of film. The DOT figures were similar for this period. The spring watch produced a comparable output.

The operation was not without its problems - to put it mildly! Cameras and timers failed under continuous use and had to be nursed along with frequent maintenance or replacements, but the overall result was certainly a great success.

It takes time and patience to study 60 miles of film, frame by frame, and we were unable to develop the skill to do it quickly enough to keep up with the inflow of film last year. Moreover, there was a need to devise a uniform method of extracting the bird-movement information from the film, and to compare it with the concurrent weather data. Much of the film has had a preliminary viewing; in addition to revealing quite a number of surprising things, the film continues to substantiate the idea that there is a close link between migratory flights and weather conditions. This is particularly important to the study. If we can work out the details of this correlation, then we should be able to forecast the probable intensity and direction of bird movements on the basis of the weather forecast itself. This "bird forecast" could then become part and parcel of the information now used in the scheduling of flying operations.

The next step, then, was to run a test to see if this incoming information about bird flights could be put to practical use. Accordingly, a test project is now running at the CF104 Operational Training Unit at RCAF Stn Cold Lake. At this moment, a motion-picture camera is photographing a radar display at Cold Lake, in the course of making a continuous film record of bird flights within 50 miles of the base. It has been operating since the end of the fall filming project on 15 Nov 65, and will continue until a good year-round picture of bird flight activities is obtained for the region. (Cold Lake was one of the stations participating in Operation Bird track). This will include information about flight activities of large birds such as white pelicans and sandhill cranes that nest near the bombing ranges.

A number of specialists are contributing to this pilot project: photographers, radar technicians, radar controllers, meteorologists, film analysts, computer engineers, and flight safety personnel. Each reel of film is scanned by a team reading the intensity and direction of bird flights, the size of echoes, and indications of extent of precipitation. All this is coded and then added to similarly coded information about weather conditions prevailing in the region during the period of the film. Particular attention is paid to wind direction and velocity at several altitudes, to temperature variations, and the amount of cloud.

The accumulated information is ultimately recorded on punch cards - one card for each flight or movement of birds. The card then takes its place with many others for subsequent analysis to look for correlations existing between the types of bird flight recorded and the weather conditions that existed at the time. We hope that careful analysis will enable us to acquire the ability to forecast - given weather factors and seasons - the degree and type of migration or other flight movement. Much of the planning and detail of the coding procedure has been developed by Mr Walter Fryers, chief meteorologist at Cold Lake.

In addition to the development of this forecasting capability, which will inevitably take some time to reach reliable operational status, the test project at Cold Lake will also provide, when needed, *current* information on the extent, intensity, direction, altitude(s), and types of bird movements. This phase of the project employs polaroid film in a still camera. On request, or at predetermined intervals, a time exposure of about 8 to 12 minutes is taken of a radar display and developed immediately. Birds echoes that may be rather indistinct dots on the display appear as lines; these lines are created by the movement of the echo across the screen during the period of the time exposure. They are easy to see and identify as flights of birds and give an accurate picture of the intensity of bird movement as it was occurring within the previous few moments. With additional information supplied from a height-finding radar about the altitudes of bird echoes, an up-to-date report of the intensity, height, and type of bird migration in progress can thus be supplied to the flight operations centre. If necessary, flying programs can be modified to avoid areas or altitudes where the birdstrike hazard seems too high to warrant the risk.

This, in brief, is where we stand today on Operation Bird track. The two types of information sources now being developed at Cold Lake will undoubtedly require frequent changes and adjustment to work out the "bugs" inherent in any new procedure. If either or both of them prove their worth under operational conditions at Cold Lake, there is every likelihood they will also be tried elsewhere by the RCAF - perhaps most importantly with the Air Division in Europe, where a small network of reporting stations is not beyond present capabilities of NATO forces.

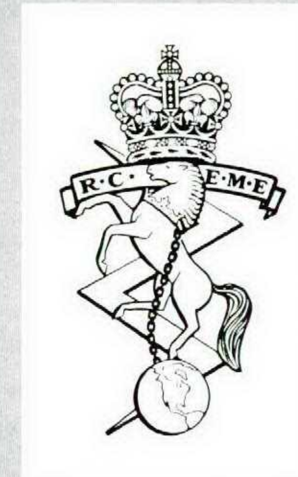
As for potential benefits to the operations of commercial aircraft in Canada, it seems likely that most multi-engined aircraft can and will withstand in-flight birdstrikes with small birds. The kind of information that would most benefit them would likely be specific information about the flight plans of flocks of large birds such as migrating geese and swans.

Tracking these flights is not beyond our present capabilities and may well prove worth the effort to put it into effect. Until aircraft are "bird-proofed" to a much greater extent than they are today, this information is needed to reduce the odds of a disastrous collision that we risk today by flying blind through the traditional migration routes of these powerful birds.

Dr W H Gunn, freelance biologist, is a PhD graduate in zoology from the University of Toronto. His thesis subject was "Reverse Migration of Birds at Pelle Point, Ont." It was based on information gathered from more than 100 migration "watches" over a 12 year period. He has co-authored scientific papers and is widely recognized for his studies on bird migration and weather.
Since Dr Gunn became a member of the NRC's Associate Committee on Bird Hazards to Aircraft, he has been applying his early studies of bird migration habits, employing the technique of photographing radar displays to research and follow bird movements. In 1954 Dr Gunn began his now-famous series of recordings of nature sounds and now has one of the largest record libraries of bird, insect and mammal sounds, most of which he recorded himself during long hours of patient watching and waiting in Canada's forests and meadows. These were extensively used in the CBC's international award-winning nature and science programs which Dr Gunn helped to create.



# GOOD SHOW




In the past ten years there has been one accident and one incident attributable to faulty maintenance in Canadian Army aviation. This represents an accident rate of .10 or one accident per 100,000 flying hours; this is a very low rate by anybody's standards.

The Royal Canadian Electrical and Mechanical Engineers (RCEME) assumed responsibility for aviation maintenance from the RCAF in 1961, so the ten-year record so well upheld by RCEME was in fact started by RCAF personnel. This commendable record has been achieved while working often under the most adverse conditions in the field. RCEME technicians are maintaining increasingly sophisticated aircraft, culminating during the past year and a half, in successful field maintenance of the CH113A helicopter. This excellent record reflects the conscientious, thorough, by-the-book maintenance of the men and the supervisors.

Well done, RCEME – KEEP IT UP!

## LSGT EM PERROW

A CH113 was leaking oil from the vicinity of the aft transmission. The quantity lost in a flight was not excessive and the helicopter was still considered serviceable. These aircraft occasionally leak oil at poor shaft seals or loose couplings, but these all appeared sound on this machine. However, when the leak was discovered by LSgt Perrow it had been known to exist for 40 airframe hours and could have caused an accident.

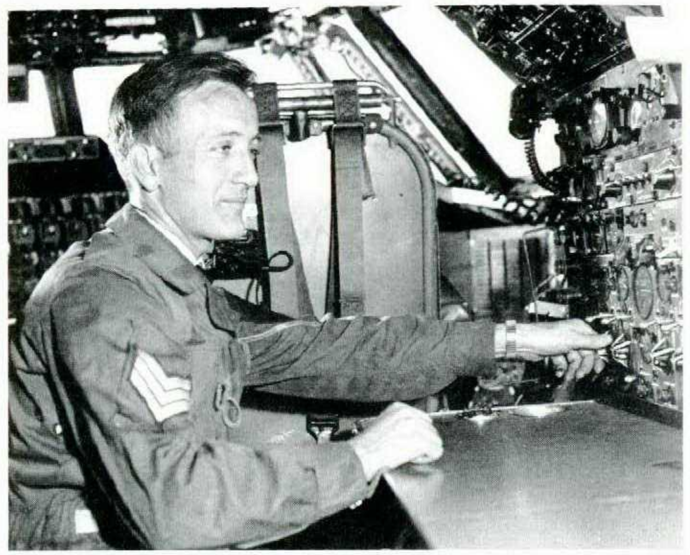
To find the leak he ensured all lines were secure, cleaned the area and applied a dye penetrant developer. During the next flight a large area of the developer washed off. In this area, on very close examination, a fine pencil line could be seen on the transmission casing. The paint was scraped away and the area coated once more in dye penetrant developer. This time the line showed up as a crack in the casing extending across one of the webs. The crack was very hard to find, and in an area where none could logically be expected. It could have broken in flight and seized the aft transmission.

LSgt Perrow's alertness, technical competence and perseverance in finding this unserviceability was a commendable contribution to flight safety.

# GOOD SHOW

## LAC WM McINNES

During a periodic inspection on an Argus LAC McInnes, an AF Tech, detected a small crack in the nose oleo casting. This crack was very difficult to detect with the naked eye; had it remained unnoticed it could have caused an accident. As the machinery of aviation becomes more complex the safe operation of our aircraft depends increasingly upon the competence of technicians like LAC McInnes.



## SGT JH PLOQUIN

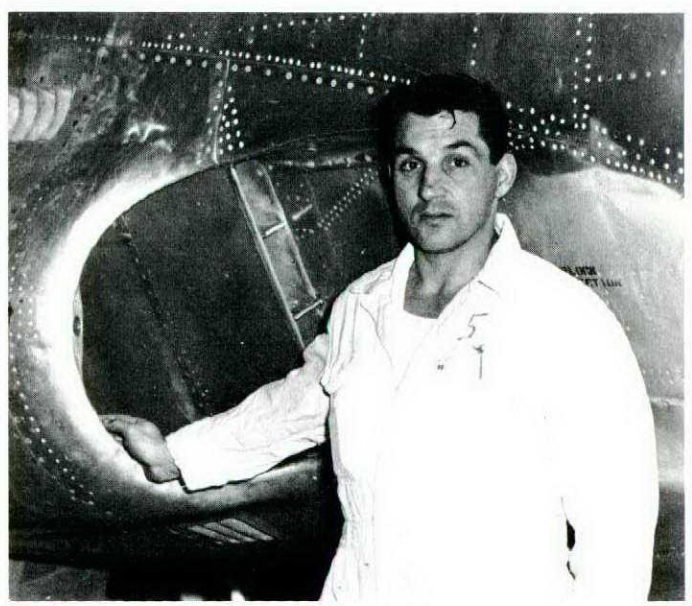
Sgt JH Ploquin, flight engineer, was performing the pre-flight checks on a Yukon aircraft on the second leg of an overseas flight, when he found that one of the rudder control torque tubes in the starboard wheel well did not rotate freely. Investigating further, he checked the rotation from the port wheel well and found the same binding restriction. An airframe tech from the maintenance detachment was asked to assist in a check for freedom of movement from the cockpit. At first a binding of the rudder controls occurred, then the restriction disappeared. A search revealed a broken control torque tube in the rear baggage compartment. On the previous trip, a piece of freight in the compartment had shifted, pushing a panel upwards severing the rudder torque tube.

Sgt Ploquin is to be commended for his alertness and thoroughness in conducting pre-flight inspections. Discovery of this damage undoubtedly prevented a serious accident.

## LAC JH GOUTHRO

LAC Gouthro of Stn Chatham was detailed to carry out an airframe primary inspection on a T33. During his visual check of the interior of the standard intake duct, LAC Gouthro detected a shiny spot on the metal approximately four feet from the duct opening. Closer inspection with a flashlight revealed a crack in the metal approximately four and one-half inches long. He immediately reported the condition and made an entry in the L14.

Due to the location and the fineness of the crack it was very difficult to detect. Had it not been for LAC Gouthro's vigilance and thoroughness it would easily have been missed or mistaken for a join in the metal skin – a classic example of applied accident prevention.





## F/L EA MILLS

On a routine training flight in a Tutor, F/L EA Mills flamed out the engine to demonstrate the relight procedure. Although rpm was 12% on the first two attempts, the aircraft would not relight. A ground start was made to 15% but again no ignition. F/L Mills flew the pattern for a forced landing and had the student continue relight attempts. A deadstick landing was made. Investigation revealed that an airstart was impossible due to an error by the contractor during production. Several other aircraft were found defective.

The skill and judgement demonstrated by F/L Mills prevented a potentially serious accident and saved an expensive jet trainer.

## F/L AJ ANDERSON and F/O JAG HEON

F/L Anderson and F/O Heon were returning in their CF101 to Comox from a night training mission. Weather was reported to be 500 ft broken, 3 miles visibility in heavy rain and fog. The recovery was uneventful until the undercarriage was lowered during the prelanding cockpit check. When the landing gear was selected down, a loud bang was heard in the nosegear area. The nosegear indicated unsafe and an emergency was declared. All corrective attempts failed; the nosegear remained unsafe in both the retracted and extended position.

F/L Anderson flew two low approaches over the field to obtain a visual check of the gear, but darkness prevented ground observers from determining its position. With fuel running low the pilot elected to land on the next approach, and to attempt an approach-end barrier engagement. A successful engagement resulted from a flawless approach and landing.

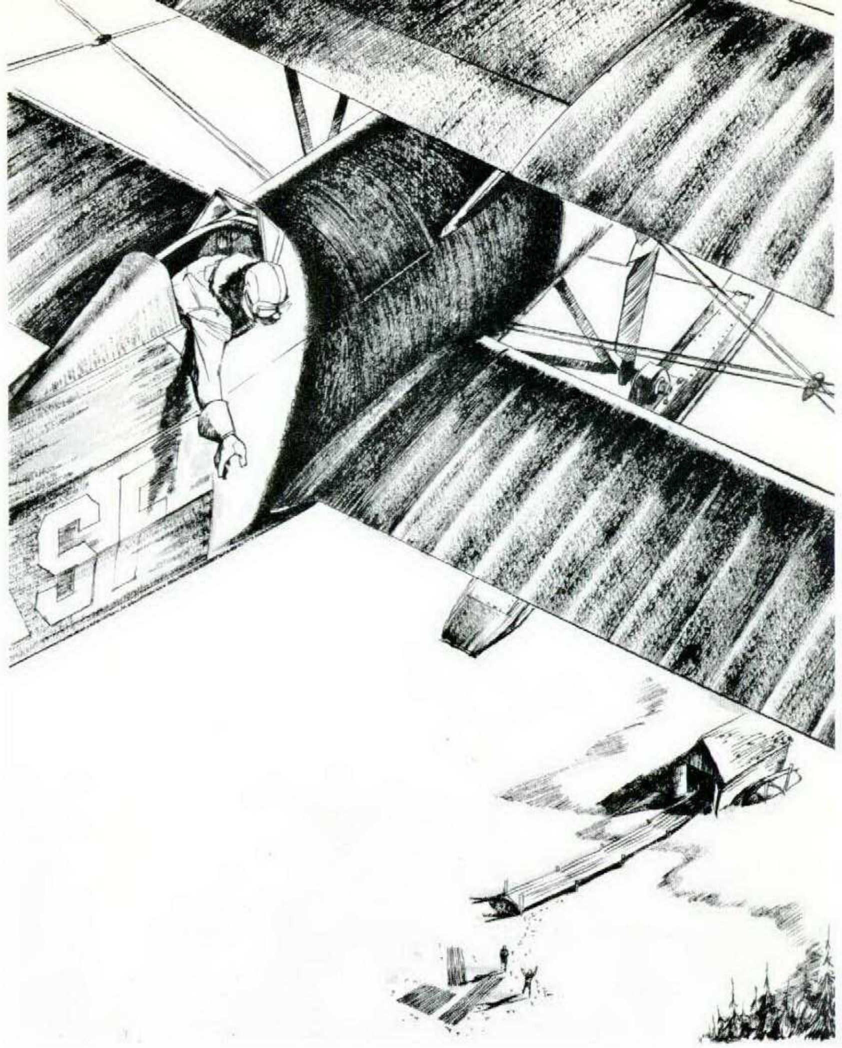
The nosegear downlock mechanism had failed and in all probability a normal landing would have caused extensive damage to the aircraft and possible injury to the crew.

This crew's calm analysis of the emergency, and the pilot's good judgement under adverse conditions prevented a potentially serious and costly accident.


## LT SK DEWAR

After a touch-and-go circuit at Shearwater, while turning downwind at 800 feet, Lt Dewar, the instructor, cut the starboard engine of the Tracker to simulate a failure. The student correctly went to full power on the port. There was a very loud bang from the port engine. Lt Dewar took control, reduced power on both to idle and levelled the wings. He added power on the starboard engine and tried unsuccessfully to feather the port propeller which continued to windmill. In this configuration the aircraft was very difficult to fly. Meanwhile, Lt Dewar had been turning towards the airfield and landed safely with the port still windmilling.

Quick thinking and good airmanship prevented possible serious injuries to the crew and saved an aircraft – a commendable demonstration of alertness and competence in response to a serious in-flight emergency.



# A FORECASTER LOOKS BACK . . .

DB Kennedy

Most of our readers will be familiar, at least in a general way, with the growth of weather services to aviation during the past twenty-five years. From very modest pre-war beginnings, these services increased rapidly in Canada during World War II, and have continued to grow steadily since then. The collection and processing of weather data, the preparation of the forecast and finally its dissemination to the users have become a highly complex operation. It now involves the widespread use of electronic equipment for sounding the atmosphere, processing the data and communicating the information from the observer, to the forecaster and to the user of the weather service.

In view of the rapid growth in weather service in the past 25 years, it is difficult to realize that the Toronto Meteorological Observatory, which played the main role in the early days of weather service, celebrated its hundredth anniversary on September 1, 1939. Weather observations at two-hour intervals were commenced at Toronto early in 1840 by British Army personnel. In 1853, operation of the Toronto Observatory became the responsibility of what was then the Province of Canada. Shortly after Confederation the Toronto Observatory became the headquarters of the Meteorological Service of Canada.

For the fifty years following the commencement of the Canadian weather service in 1875, the main emphasis was on a storm-warning service to shipping. Weather charts, based at first on reports from only seven stations in Eastern Canada and fifteen in the United States, were used in preparing the storm warnings. These were transmitted by telegraph and displayed by means of signals at ports on the Great Lakes and on the Atlantic Coast. The forecasting service from Toronto served only eastern Canada at first; later the coverage was gradually extended westward and in 1898 a second forecasting centre was opened at Victoria. Up to the mid-thirties, when the growth of aviation required the development of an aviation weather service, these two offices, at Toronto and at Victoria, issued all the forecasts for Canada.

With the advent of aviation came new demands for weather service. Warnings of the storms that might endanger shipping did not cover even the limited requirements of the aviator of the early twenties. Information on upper air conditions, that could be used in forecasting in-flight conditions for aviation, was almost completely lacking. The first station to measure upper winds (using hydrogen-filled balloons), was established in Toronto in 1920. Upper wind forecasts, based on a few such reports were first prepared in connection with the visit of the R-100 dirigible to Canada in 1930. However, very few stations in North America were making regular measurements with balloons at this time and any forecasting of upper winds was confined to special operations.

By 1924 the use of weather services in RCAF operations had reached a point where it was necessary to establish a weather observing station and commence pilot training in meteorology at Camp Borden. A few years later plans were made to have weather maps prepared for use in RCAF flying and ground training programs. Arrangements were made with the Royal Canadian Corps of Signals to transmit by radio from Toronto to Camp Borden the weather reports from stations in North America that were required for preparation of weather maps. The NCO who had been responsible for the weather observing program at Camp Borden was given some instruction in the preparation of weather maps at the Toronto Forecast Office. In those days, before frontal analysis was introduced, this consisted mainly of plotting the latest weather reports and then drawing the isobars. Some elementary training was given at Camp Borden to enable flying personnel to appreciate weather hazards and to use the limited amount of weather information available to them.

An idea of how little weather information was available to the aviator in the late twenties can be gained from the services arranged for a series of weekly airmail flights between Ottawa and Moncton in 1929. Three RCAF weather observers were sent ahead and remained near railroad stations en route. Their observations, sent by telegraph, were used in planning and carrying out the flights. In-flight "weather reports" were signalled to aircraft en route by laying out black boards in a prearranged pattern on snow-covered lakes. No special flight forecasts were issued; the only indication of future weather developments was contained in the forecast issued twice daily in Toronto for general public use and, of course, the visual reports spelled out on lakes en route. Forecasts of ceilings and visibilities for aviation use did not appear until the mid-thirties.

In fact, the experimental airmail flights in 1929, and other similar operations of that period, made little use of weather forecasts. Weather briefings, as we know them, were unheard of then. If the pilot was fortunate he had a copy of the latest public forecast which hinted vaguely at hazardous conditions in its reference to "scattered thundershowers", or "moderate gales" or simply "stormy". He received no specific information on current flying conditions – visibility and cloud height were not reported or forecast. A report of the sky condition (clear, partly cloudy or cloudy) 6 or 12 hours ago might be the latest information on landing conditions at his destination.

The establishment of a Canadian airmail service in 1930 further emphasized the need for a special forecasting service to meet the needs of aviation. A new system, based on locating and tracing the movement and development of "air masses" and "fronts" had been developed in Norway in the twenties. Canadian meteorologists trained in these new methods began to study their application to North American conditions.

The introduction of the new methods into the Canadian forecasting program took place gradually over a period of several years.

The commencement of experimental trans-Atlantic flights in 1936 brought about the establishment of a special aviation weather service in Canada which could provide weather observations and forecasts from mid-Atlantic to Montreal. To provide this service, forecast centres were established at St Hubert and at Botwood. After the days of the flying boats, the latter office was moved to the new airport at Gander.

Forecasting for the early trans-Atlantic flights contained a large measure of guesswork. Ships reporting surface weather were the only source of information over the North Atlantic. Weather ships, with their equipment for measuring wind and other upper air conditions, did not come into operation until World War II. In-flight reports, the source of much valuable information nowadays, were almost entirely lacking. Even the forecasting of terminal landing conditions at places such as Botwood and Foynes was based on very limited knowledge of weather conditions over or near the land areas. For trans-Atlantic flights organized briefings were necessary and the provision of weather documentation to the crew was a vital part of the pre-flight service almost from the beginning. This documentation included the latest weather reports for terminals (destination and alternates), a complete forecast, usually in phase with the flight plan, and a simple weather map.

In 1937 the decision to organize Trans-Canada Air Lines marked the beginning of a very rapid expansion of aviation weather service in Canada. Previously the provision of weather observations and forecasts for aviation had been arranged to meet the requirements of special operations such as airmail or trans-Atlantic experimental flights. Continuous coverage, 24 hours per day, if required at all, lasted for only a day or two. With the advent of scheduled commercial aviation, weather observing and forecasting became a 24-hour operation. It has continued to be so ever since.

When the author of this article joined the Canadian Meteorological Service in 1937 after completing training as a meteorologist at the University of Toronto, forecast offices were being established at Winnipeg and Vancouver to meet the special needs of the new airline which was then commencing training flights between those two cities. At that time there were fewer than ten meteorologists in Canada trained in the new techniques of air mass and frontal analysis, and none of these had much more than a year's experience in forecasting for aviation. Little attention was given to forecasting in the training courses of that period; this was particularly true of the forecasting of upper winds, ceilings, visibilities, cloud tops, icing conditions or turbulence. The newly trained meteorologist usually required several months as an apprentice before he could handle a forecasting shift on his own. With the acute shortage of meteorologists that existed at the time (two forecasters covered most of the 24-hour period in Winnipeg early in 1938) the new arrival often found himself pressed into service before he felt he was ready for the job.

Forecasting for aviation, in 1938, was primitive by present-day standards, due partly to the scarcity of weather reports, and partly to inexperience in forecasting conditions aloft. The problem was complicated by the special demands of the commercial aircraft of that period, arising from their limited range and their inability to fly above much of the weather. Forecasting for flights over the Rockies, for example, was much more demanding than now, because most flights were made in the neighbourhood of the 10,000-foot level.

Weather forecasting is essentially the analysis of the weather reports for a large area for a given time to locate clues which indicate future lines of development or change. The network of Canadian reporting stations in the thirties was very sparse by today's standards. Although hourly reports and "specials" were received from main airfields and radio range stations on the main airway, off-airways reports were few and far between. Many northern stations reported only two or three times a day. Some twenty stations, most of them on the airway, provided reports of measured upper winds, when clouds and weather permitted. The only measurements of upper air temperature and pressure were made at Toronto, and later at Edmonton and in Newfoundland, once a day, using specially instrumented light aircraft. A sounding to 15,000 feet was exceptional. Cancelled flights due to weather or mechanical problems occurred mainly on the days when upper air data was most desired.

Forecasting during the early days of commercial flying, in fact until the beginning of World War II, was based to a large extent on study of surface weather reports. With so little upper air data available, the preparation of upper air charts, even for the 850 millibar level, was out of the question. The information obtained by each airplane ascent was plotted on a chart and used in determining the degree of instability and the likelihood of thunderstorms or turbulence. This was supplemented by the use of plotted upper wind reports for the areas where observations could be taken.

One of the best sources of information on in-flight weather has always been "pilot reports". In the early days of forecasting for aviation this information was invaluable. Unfortunately these reports were too few and often too much delayed to be of direct value in forecasting. TCA crews were extremely helpful, however, and almost invariably visited the Met office after a flight for a debriefing. Information obtained in this way concerning cloud tops, winds, icing and turbulence was particularly helpful in forecasting for flights across the Rockies or the North Atlantic.

Although technicians handled the plotting of the weather maps in the early days of aviation forecasting, at the same time keeping an eye on the weather to know when a "special" report was needed, it was commonplace for the meteorologist to plot his own weather map or take the observations. In fact, some forecasters preferred to plot their own maps, studying the data as they plotted it. When the map was plotted, isobars could be drawn and the fronts located in a relatively short time.

The only "progs" took the form of estimated future positions of fronts and pressure features (highs, lows, troughs or ridges) that might affect the weather in the next 6 to 8 hours over the routes for which the forecast office was responsible. Upper air analysis, and "prog" charts showing the forecaster's estimate of the situation 12 or 24 hours ahead, became part of the forecasting routine later, during the war, when upper air reports, obtained from radiosonde ascents, became relatively common.

With his latest surface weather map analyzed and the movement and development of the fronts and pressure features estimated, the forecaster set about making his forecast. During the first year or so of this service to aviation, flights were so infrequent that each received a forecast tailor-made to its requirements. This practice persisted for a longer time in the North Atlantic service than for the domestic flights because of the longer duration of the flights and the irregular manner in which information concerning the North Atlantic weather reached the forecaster.

This was the extent of weather service to all of aviation in Canada at the outbreak of war in 1939. None of the meteorologists engaged in forecasting, fewer than 20 in all, was assigned directly to serve the RCAF. Is it any wonder that early in the war, forecasters at RCAF bases were receiving credit for accurately forecasting times of sunrise and sunset! There is no record of any forecaster having graciously accepted this compliment to his skill, although at times he must have been tempted to do so. Good forecasts, and compliments for them, were hard to come by in 1939!

DB Kennedy, Head of the Meteorology and Oceanography Section at CFHQ, began his career in meteorology in 1937. After a few months at DOT Met Branch HQ in Toronto, he was assigned to the newly-established forecast office at Winnipeg, where he remained until the outbreak of World War II.

Mr Kennedy has been engaged in the organization of meteorological support for the Canadian Armed Forces since early in World War II. During the initial years he pioneered the instruction in meteorology for wartime aircrew training, and authored "A Pilot's Course In Weather" which was the standard meteorological training manual for civil and military aircrew in Canada from 1945 to 1952. In 1946 he was awarded the MBE in recognition of his wartime services.

Shortly after the war, Mr Kennedy became Meteorological Adviser at AFHQ. In 1951 he was appointed DOT Liaison Meteorologist and Meteorological Adviser to the Chairman Chiefs of Staff. In 1965, with integration, he was seconded to DND and assumed the duties of his present position.

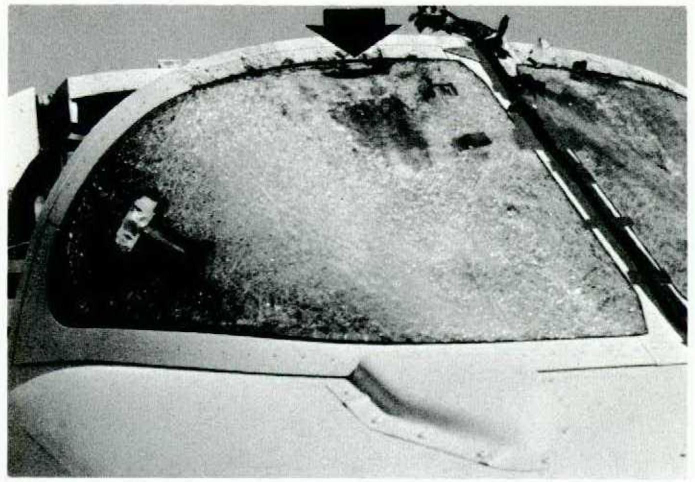


# Bird-Proofing the Tutor

The Sept-Oct 65 issue of Flight Comment contained an article ("Railroad with the Rocket Engine") on the Tutor escape system trials at Holloman AFB, New Mexico. The trials included two runs to test the capability of the Tutor windshield to withstand bird strikes. The results, particularly with a 4-lb bird were less than encouraging in that the glass inner layer of the windshield showered splinters into the cockpit capable of injuring the occupants. On impact at 200 kts, the 4-lb bird formed a pocket and moved up the windshield, shearing the vinyl at the metal insert at the top of the panel; at this point bird remains penetrated the windshield.

After this experience, it was back to the drawing board for a windshield with more strength and no splintering. The optical qualities of the new windshield had to be maintained, and to hold down costs the windshield had to be compatible with the supporting structure on the aircraft. The proposed design aims at these requirements, ie, it will have the strength to withstand a 4-lb impact up to 200 kts and not splinter.

The re-designed windshield will have the same outer and inner glass, and the same vinyl layer between



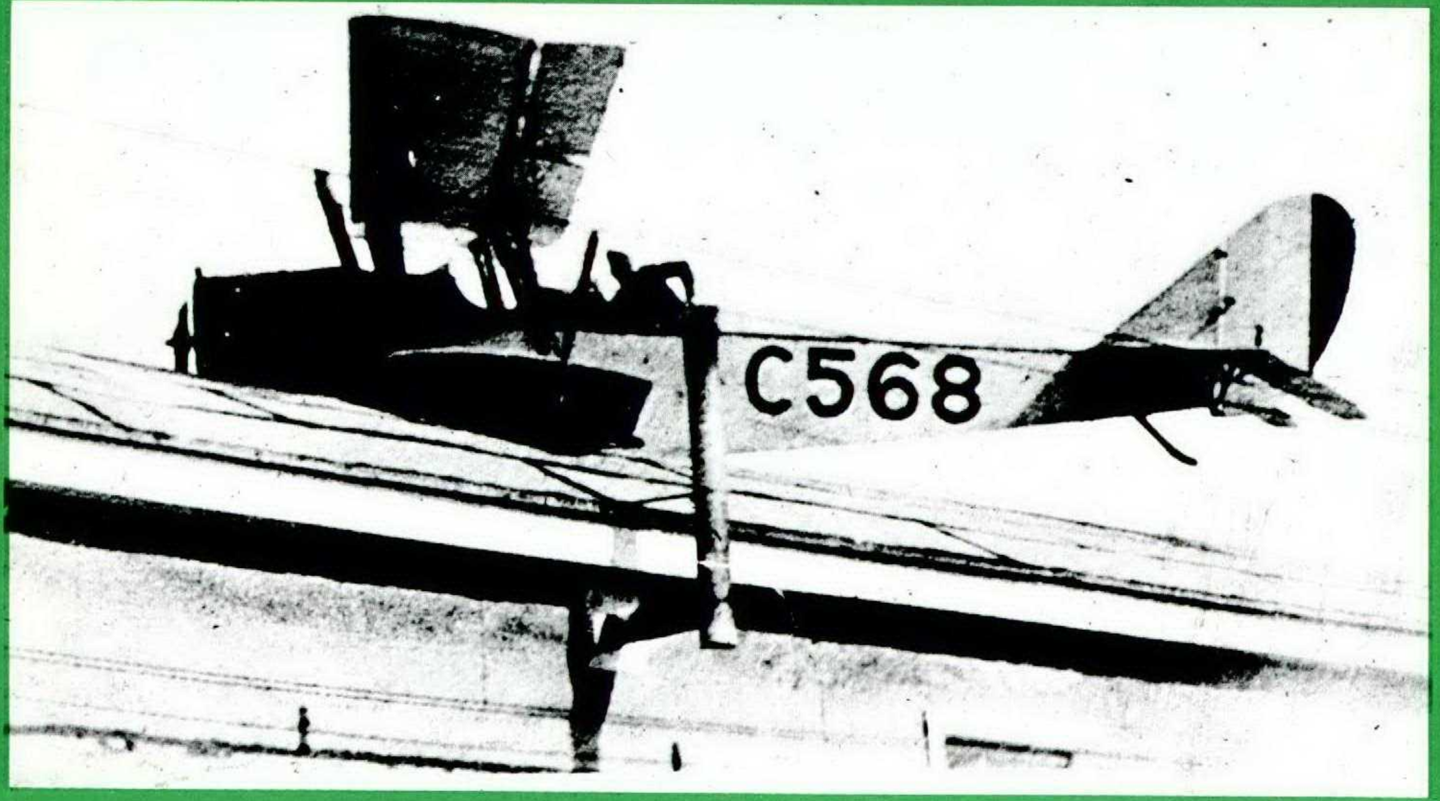
Tutor windscreen after 4-lb bird strike at 200 kts - the arrow shows point of penetration.

the glass panels. Increased strength will come from an additional inner layer of .110-.140 inch (about 1/8") semi-tempered glass bonded by a .120 inch layer of vinyl. In addition, the metal inserts in the outer vinyl layer have been changed to provide more resistance to the type of shear failure which occurred on the sled trials.

This prototype windshield has been ordered and will be tested on the rocket sled during the trials scheduled for the fall of 1966.

## "Flash-Back"

After that, the CO hit the roof.

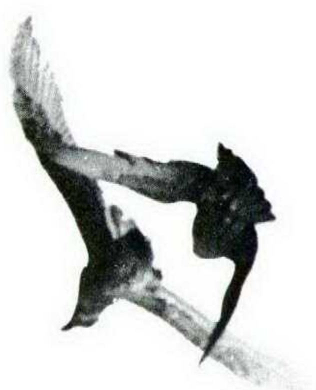


# WHY NOT FALCONS ?

**How about "Falconer, Group 3"? Service personnel are being used in other countries to fly these playthings of aristocrats, but on recent trials in Canada, Falcons didn't work out too well, even in the hands of expert civilians. . .**

Ryan Bros Photos
Victoria, BC

Falcon with victim



Splash – one gull

Victoria had just the right ingredients for falcon flight trials – lots of resident airport gulls, and a couple of resident falconers. During the tests other anti-bird measures were withheld to give the talonted (?) falcons a fair trial. From Nov 1963 to March 1965, trained peregrine falcons and the larger gyrfalcons flew in defence of the landing field.

The falconers, Mr Frank L Beebe and his assistant Mr B Davies, had a go at the gulls, using the assault technique. A falcon would be released to attack the gulls who would promptly disperse. The slower (or the braver) ones sometimes didn't make it but the attrition rate was insufficient to either eliminate or deter the gulls over an extended period. The return of the falcon to his container served as the "all clear" for the gulls to return.

At times, when heavy rains would surface an enticing earthworm crop, several falcon scrambles a day were needed to clear the air. The peregrines would not readily pounce on low-flying gulls over the wet black runways – attributable to the falcon's reluctance to swoop close to what appears as a water-filled ditch.

Another well-known falconer, Mr Galicz, suggested another technique of deploying his birds, and was offered the gull-infested RCN Naval Air Station at Shearwater, near Halifax. Exploiting the gull's understandable abhorrence of falcons, he used a "show-of-strength" technique. On release, the falcons would circle their owner; the mere presence of these birds, Mr Galicz claimed, would scatter the gulls, and scatter they did. Since the falcon used in this manner was a non-combatant, there was no risk of injury to the defence forces.

Both methods were effective in de-gulling airports but drawbacks to the basic concept became apparent. Falcons are rare – falconers are rarer still. Too, the accommodation, and the continuous training and conditioning of falcons is an unwieldy business to support at an airfield, to say nothing of the possible embarrassment of a falcon-strike on an aircraft. This training and exercising of the birds must be more or less continuous throughout the year; the project can't be shelved until needed. Bird strikes often occur at night – a period when falcons don't fly. Not all bird intruders bring out the aggressive spirit in falcons; size, obviously is a factor. An ocean gull can look slightly enormous to a peregrine.

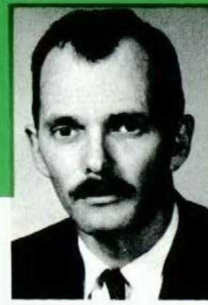
The trial over, the National Research Council's Associate Committee on Bird Hazards to Aircraft concluded that other means of bird dispersion offer more promise. Shotgun cracker shells, flares, tape-recorded bird alarm and distress calls, acetylene exploders, traps, and searchlights can be managed by service staffs. Most promising of all, but not without its problems is the alteration of the airport environment (ecology) to turn it into a barren wasteland for the bird population where little food is available, and no self-respecting bird would wish to reside.

Falcon and T-bird compare tails

# Keep the LID* on!

* Load - Inflation - Deflection

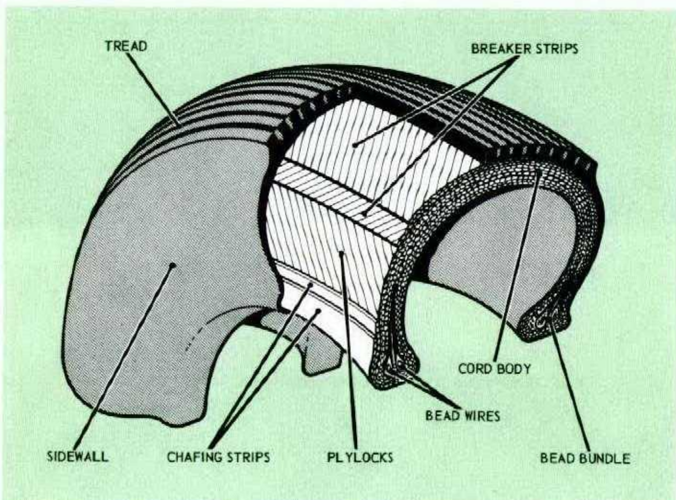
Paul D McLean



Paul D McLean is chief chemist at the RCAF Materiel Laboratory, Rockcliffe. This article is based on his extensive research in aircraft tire characteristics, capacities and design. Mr McLean came to his present position in 1951 after graduating from Acadia University, Wolfville, NS, with a Master of Science degree. For three years during the war he was a flight engineer on Lancasters.

Undercarriages enable an aircraft to move about the airport but their most vital contribution is providing the pilot with effective means for safe takeoff and landing. They serve no useful purpose while airborne; in fact, their weight penalty of approximately 5% is constant and severe. Until a better device for "air-ground" transition is available, undercarriage design makes demands of the pilot and technicians "to use and maintain aircraft tires properly".

Aircraft tires are made of rubber, rubber-coated fabric, and steel wire, put together, with surprising ingenuity to get the most strength from the least weight and size.



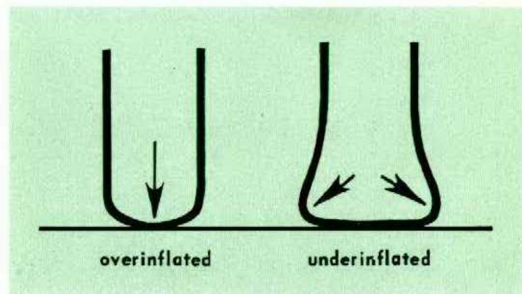

A typical tire construction

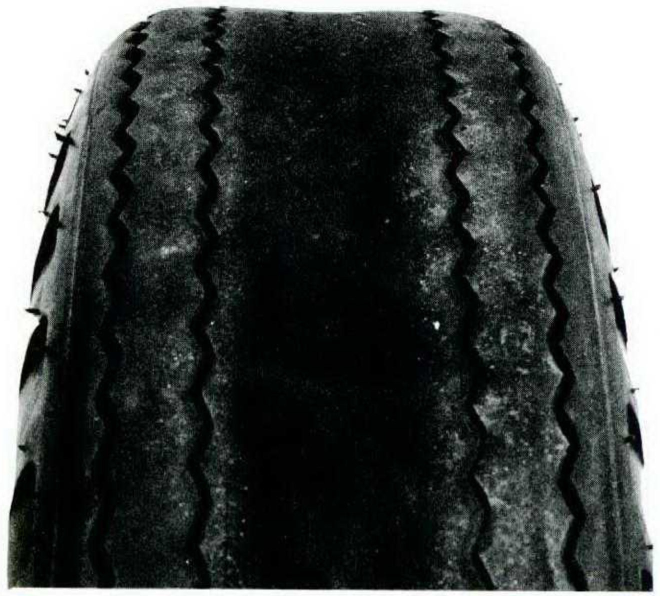
An aircraft tire is described by size, type, ply rating, rated pressure, rated load and other measurable physical characteristics. They are built to withstand violent changes in rotation and load, often under extreme temperature ranges and centrifugal forces as high as 7000 G!

Traditionally, a main wheel tire is selected at the aircraft design stage so that the static weight on the tire is 80% of its rated load. This allows for increases in load during development and provides a safety factor. Of course, another tire design must be selected when the static load approaches the rated load of the tire.

The static weight on the Cosmo main tire, for example, will usually be between 10,000 and 13,000 lbs. This means the loads are 67% to 87% of the rated load of the tire - a good match for the aircraft role and weights. (EO 05-150A/8).

It is imperative to use correct inflation pressures for these varying loads. What are the criteria for these pressures? The pressure should be enough to cause the tire under load to deflect between 28-35%. This deflection is a percentage of the distance from the wheel flange to the tire crown with no load on the tire. If the tire pressure produces a deflection of less than 28%, the tire will wear on the crown. When the tire pressure permits a deflection of more than 35%, shoulder wear is common and there is danger of a blowout when the sidewalls overheat - like running on a semi-flat tire.

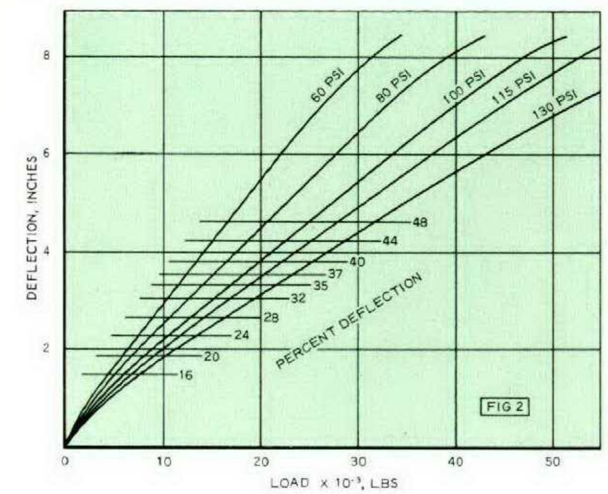


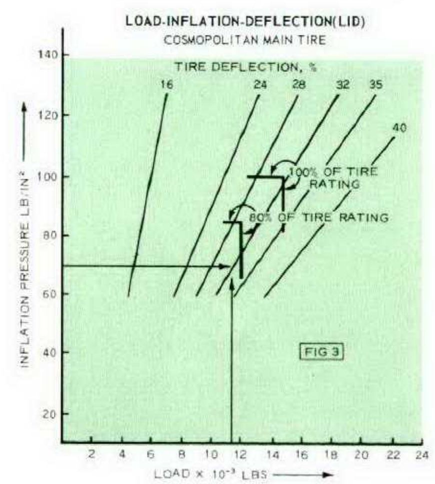



Crown worn from overinflation

## "LID" Curves

The handiest place to find the pressure suitable for a given load is the Load-Inflation-Deflection (LID) curves for that tire. The curves describe a tire's capacity and aid in tire selection. When incorporated with aircraft load characteristics they take on more importance; they constitute an operational guide. These curves are obtained by loading the tire at any one pressure, from zero pounds upward until the tire bottoms. Deflection measurements are plotted for convenient intervals of increasing load. The measurements obtained at various inflation pressures and loads produce a family of curves (Fig 2). By a bit of arithmetic Fig 2 is converted to Fig 3; these are the LID curves for the main tire of the Cosmo.




If the load on the main tire is 11,300 lbs. (see EO ), Fig 3 shows that the tire pressure must be 70 pounds per square inch ($lb/in^2$) in order to keep the deflection at 32%. Above 70 $lb/in^2$ the crown of the tire wears and the cushion effect (energy absorption) is less. Conversely, pressures below 70 $lb/in^2$ will cause the outside ribs to wear and the sidewalls to heat.

A single tire pressure can often be selected to match most loads. Figure 3 shows that the deflection is a little over 28% for an inflation of 80 $lb/in^2$ at 11,000 lb load and a little over 32% deflection for a 13,500 lb load. This is why 80 $lb/in^2$ was selected as the normal operational main tire pressure.

### Temperature Extremes

An aircraft tire is exposed to a wide temperature range of 120°F to -65°F; this has a marked effect on tire pressure. Experimental work at the RCAF Materiel Laboratory confirms that the pressure drop in a tire with a drop in temperature can be described by the Ideal Gas Laws:

$$P_2 = \frac{T_2}{T_1} \times P_1$$

$P_2$ – pressure at low temperature, $lb/in^2$
$P_1$ – pressure at hangar temperature, $lb/in^2$
$T_2$ – low temperature in degrees "Rankine" (458 - F°)
$T_1$ – hangar temperature in degrees "Rankine" (458 + F°)

Example: If the outside temperature is 40 below and the inside temperature 68°F:

$$P_2 = \frac{(458 - 40°F) \times 70}{458 + 68°F}$$
$$= 56\ lb/in^2 \text{ inflation at } -40°F$$

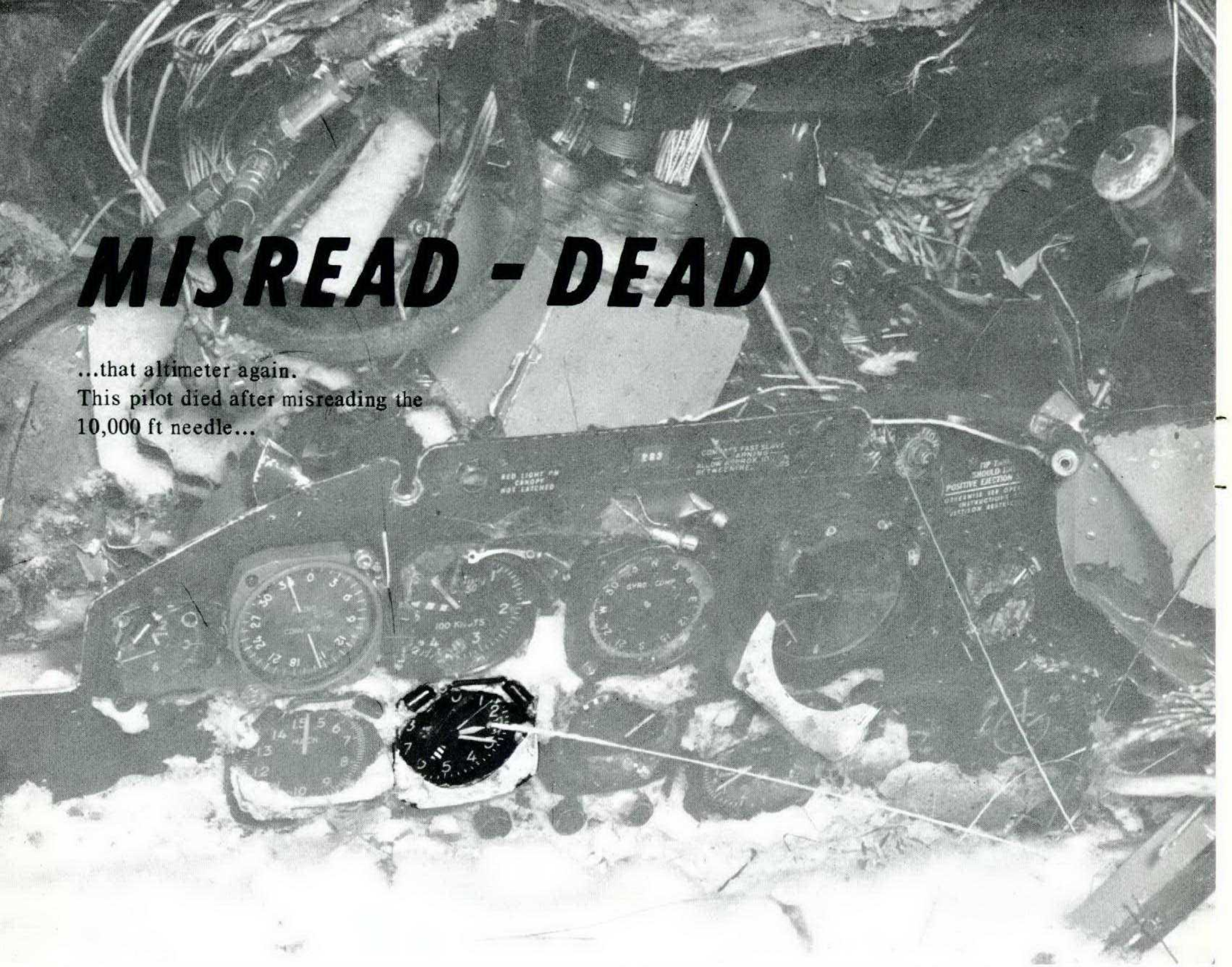
At this pressure a tire loaded to 11,300 lbs will deflect over 35% which can cause early tire failure. Calculations show that the pressure must be 88 $lb/in^2$ to maintain 32% deflection at -40°F if the initial pressure was 70 $lb/in^2$, and 100 $lb/in^2$ if the initial pressure was 80 $lb/in^2$. (See EO 110-5-2A).

We have used the LID curves for the Cosmo main tire but the principle applies to all tires; the data is available for comparison with each aircraft weight and balance.

The increasing demands made by aircraft designers for tougher yet lighter tires means pushing performance closer to the strength limits of the materials. This in turn requires both technician and pilot to know the facts - only in this way are we going to get the most out of our tires.

# MISREAD - DEAD

**...that altimeter again.**
**This pilot died after misreading the 10,000 ft needle...**



(The altimeter in the photo was not "frozen" on impact. Actually, the instrument mechanism was extensively damaged and in this case, the reading is meaningless.)

*The detailed reconstruction of a fatal crash it might be argued, is best confined to a document entitled "Proceedings of a Board of Inquiry into an Aircraft Accident". This one - in which a young instructor was killed - carries a grim warning on an unforgiving instrument: your altimeter. It's worth the telling if it will save a life; too many have been lost already.*

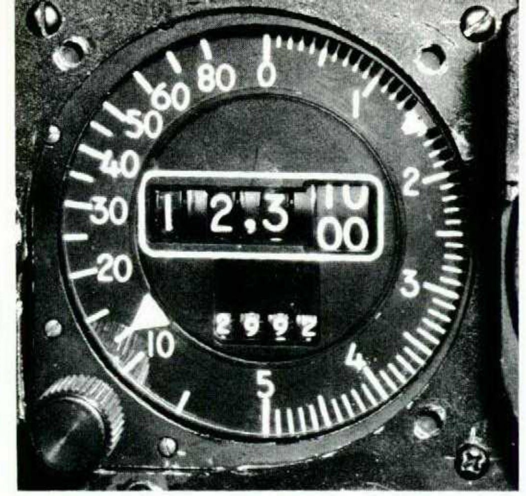
There was to be nothing unusual about this flight - a qualified flying instructor had volunteered to carry a medical officer from Stn Gimli to Moose Jaw. The trip would also give him the chance to visit relatives; he planned to return later in the day. The total airborne time - about two hours. The flight to Moose Jaw that Sunday was uneventful except for a minor undercarriage unserviceability which was quickly rectified.

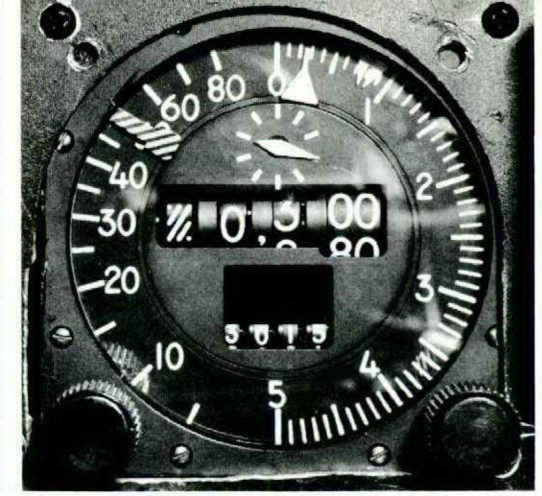
The weather for the return flight wasn't encouraging; while above limits, still, the best available alternate appeared to be Minot, North Dakota. Conditions were unsettled; in fact, they were forecast to deteriorate below limits at destination a few hours after his return.

The pilot reported after climb-out that he was level at 29,000 feet. The timing on the tapes of this transmission confirms that he had reached this altitude. (Reconstruction of the entire trip was possible from the invaluable recordings of the two stations and Winnipeg Centre.) Later, after requesting clearance from Winnipeg Centre for an enroute descent to 6000 to burn off fuel, he was cleared and handed over to Gimli terminal control.

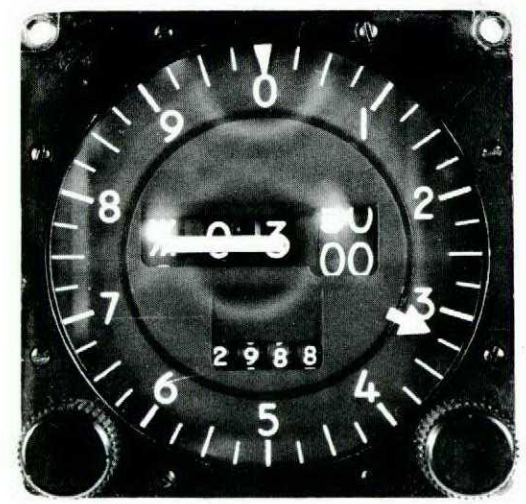
From here on, the accident investigators by carefully calibrating the tapes from the Gimli control agencies, were able to reconstruct with some certainty the remainder of his flight, during which he made the fatal error.

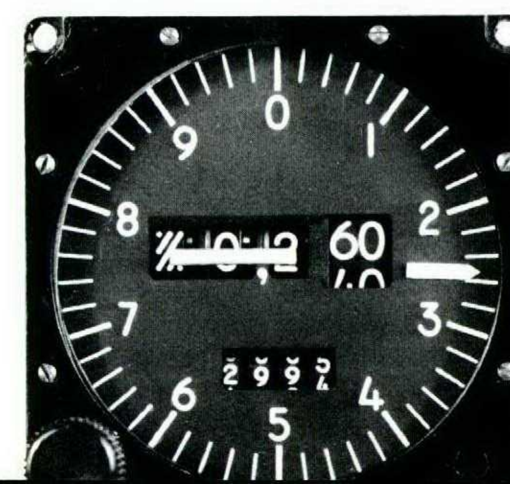






Some proposed altitude presentations





Two minutes after leaving 29000, Gimli terminal advised him to conserve fuel due to the weather at home base. The pilot acknowledged this and later advised that he was level at 20000 feet. This transmission, however, occurred *four minutes* after vacating flight level 290. Assuming a standard enroute descent of 350 kts, 80% rpm, speed brakes in, and a vertical speed of 4000-5000 feet a minute he could easily have been close to 10000 feet when he advised at 20000. Cloud tops in the area only supported the pilot's illusion that he was at 20000 feet; they were approximately 10000 feet lower than forecast.

The pilot was then cleared to descend further and struck the ground at high speed.

Had the final descent been initiated from 20000 feet an unusually steep descent manoeuver would have been necessary to attain the very high vertical speed required to reach the surface in the time elapsed (1 min and 50 sec), and the 12 nautical miles known to have been traversed. However, accident investigators were able to establish that the aircraft struck the ground in a flight path and speed similar to enroute descent. The low cloud gave the pilot little or no chance to correct his error; it was dark and the area snow-covered and featureless.

Why had he made such an error? He was a qualified flying instructor and a competent pilot. Yet, he joins the list of those who, over the years, have failed to interpret the information on the standard altimeter.

To learn something from the tragic loss of this young pilot, two features of this case are worth noting. First, the events leading up to his misreading the altimeter, and second the real cause of the accident. The pilot was flying on his day off and was returning home. It was night. The weather at the base was reported to be 300 feet and 6 miles in very light drizzle and fog. The pilot knew that weather conditions in the area were getting worse. Another distraction arose; the GCA search radar was reported unserviceable. And more distractions? During the four minutes from the time the pilot reported vacating flight level 290 and confirming his levelling off at 20000, there were twenty-three transmissions and replies, during which weather reports for Winnipeg, Gimli and Rivers were received - and probably transcribed. His oversight now becomes understandable.

But these circumstances do not mitigate the depressing reality - the much-misread altimeter. We're getting a new one - at last - and it will be similar to an instrument developed by industry in 1955. Following a study in the late fifties on the feasibility of employing digit counter read-out for altitude information, the altimeter program went dormant until 1961, at which time IAM was asked to develop an instrument presentation aimed at instant read-out with no ambiguity. Since 1963 the program has been under constant study, discussion and development.

Our recent decision to acquire a new altimeter parallels a similar decision in the United States military. The menace might be considered to be at an end - but only for the 10000-foot ambiguity. Altimeters are notoriously prone to misreading and mis-setting; an alert pilot is still the indispensable other-half of any height measuring device.

The "old" altimeter will be around for some time and lest anyone question its lethal potential here is a small part of the tragic record:

- ***In 1961 a T33 struck the ground during a night letdown at Saskatoon; the pilot misread his altimeter by 1000 feet.***
- ***In 1963 a CF104 crashed during a night letdown killing the pilot; the most probable causes included misreading of the altimeter.***
- ***In 1965 a CF100 struck the water during a bad-weather letdown and both aircrew were killed; misreading of the altimeter is the suspected cause.***

Numerous cases have been reported both by the RCAF and USAF, of GCA being unable to pick up aircraft on the elevation scope as the pilot was flying either 1000 feet or 10000 feet too high - to say nothing of the chilling certainty of continuing recurrences in good weather or in a harmless simulator.

# *Aftermath of a Pitch-down*

...my big problem during the descent was the fact that I was unable to see....

***This pilot describes the wildest ride of his life, and the effects of a high-speed bailout - including temporary blindness.***

"...we rolled out behind the target at approximately 2½ miles. My navigator made contact with the target... we heard GCI call 'skip it if no contact or tally-ho by two miles.' As I was going through 20° of turn, the aircraft suddenly nosed over and the control column moved forward. The nose dropped so fast we were both hanging in the straps. My first thought was that the pusher had engaged but we heard no horn, I then relaxed on the control column and let the aircraft do what it wanted. The nose kept on dropping so I tried the paddle switch to disengage the PCS. This did no good as the stick was still held full forward. The nose continued to drop. The aircraft then pitched up negatively, airspeed indicators swung to zero then back to and stabilized at approximately 100 kts momentarily at which time I pulled the drag chute. Airspeed when nose initially dropped was 260 knots, drag chute stayed for - I would estimate - 5 seconds. I attempted to move control column forward just prior to aircraft pitching up. However, control column was already full forward, "G" pulled was initially negative; when aircraft pitched positive "G" was encountered. In the next few seconds I felt alternately positive and negative "G". During this time the aircraft did three snap rolls I believe, and the aircraft rolled to the right each time. During these gyrations the control column remained fully forward. Going through 15,000 ft I told my navigator to get out. The aircraft was in a slow roll, which I was able to stop just as I was telling him this. I tried once more to bring the control column back then I told my navigator to get out. Shortly after, I saw the canopy go and felt the wind blast. Just before the canopy went I was looking at the artificial horizon which indicated 45° to 50° nose down - wings level. With peripheral vision I saw the airspeed indicator which I believe was approximately 260-270 kts.

I waited a short while after the canopy had gone to make sure that my navigator had gone before I ejected. After squeezing the trigger I remember the seat leaving the aircraft - flying through the air and then the chute opening. It must have been during this time that I lost my helmet - (visor down chin strap done up). After I had settled in the chute I noticed that the helmet was gone and that I was unable to see. I tried to clear my eyes, deployed my seat pack and prepared myself for the landing. I thought of a water landing and tried to release the quick release box. I was unable to do this for some reason. During the ejection I had the wind knocked out of me and it took a little while to catch my breath. My big problem during the descent was the fact that I was unable to see. I was able to tell that I was getting close to the ground by the sound of the wind in the trees. So I was more or less prepared for the landing. The next thing I knew was the survival kit hit the ground then I hit a tree. My feet hit the ground momentarily and then I found myself hanging in the parachute about three feet off the ground."



# On the Dials

RCAF U P

## Airway Navigation

When airway navigation is being discussed two questions frequently arise:

- What track should be used on the flight log for an airway?
- On a TACAN airway, why are the centreline radials between two stations apparently mis-matched?

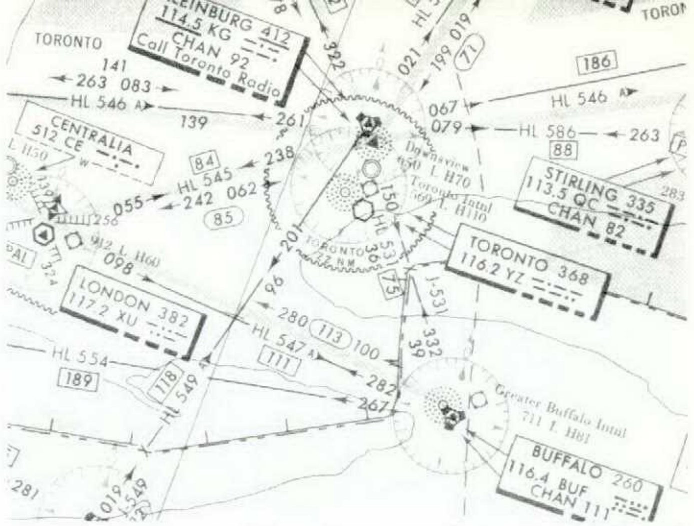
For an answer to the first question let's look first at what information is available on the FLIPS. If the airway segment in question is between two non-directional beacons, the track between them is shown on the FLIP. No problem – use the published figure. If, however, the airway segment is formed by two radio-range legs, the FLIPS show the inbound magnetic bearing of the range legs. A problem – now there are three choices:

- average the published bearings to find a track
- use the inbound bearing
- use the outbound bearing

All three choices will provide an adequate solution for practical navigation purposes. But a standard method is desirable and so one was selected, at least for examination purposes, both in training schools and on ticket exams.

The outbound bearing was selected because the heading on the log card is used only as an indication of the drift to expect when tracking on an airway. Also, it is the heading to fly after passing a station during the log work, PX, and cockpit checks which are normally done before turning your attention to tracking down the airway. The same reasoning applies to a segment of a TACAN or VOR airway which on the FLIPS is two radials – one from each station. This solution is not the best, perhaps, but seems as good as either of the other choices. So, on ticket exams the track to use on the log card is the outbound leg or radial from the station.

The second question usually arises from a discussion on what track should be set on the track indicator to fly the centreline of a VOR or TACAN airway. Definitions are important here. First, TACAN and VOR airways are identical in their use of radials. Second,




you will note we said setting a track on the *track* indicator. In the RCAF the term "track" is used in place of the term "course", so a course indicator is now a track indicator, and so on.

To get back to the original subject let's take a look at why the straight line between two TACANs is represented by mis-matching radials.

A TACAN site transmits 360 radials or tracks. Each radial emanates in a straight line and as the transmission is line of sight its usable range depends on the height of the receiver. The radials are calibrated to magnetic north at the transmitter site and extend in straight lines from the transmitter. The bearing displayed in the aircraft is therefore a radial (or a straight line) from the TACAN site.

An aircraft at some distance from the TACAN site could be in an area of a different magnetic variation yet receives bearing information relating to the TACAN site. If you could receive the next station when overhead a TACAN site, it would be possible to fly that radial all the way. Normally, you would change to the station ahead about half-way along; the track setting must, of course, be changed as the straight line between two TACAN sites is represented by a different radial from each. Because the aircraft equipment shows a selected radial, a different track setting is required when changing from one station to another if a straight line is to be flown.

In closing, it is worth mentioning, because the radials are dependent on the variation at the site; if you are tracking on a radial in an area having significantly different variation from that at the TACAN site, the difference between heading and track includes the drift angle and the difference in variation.

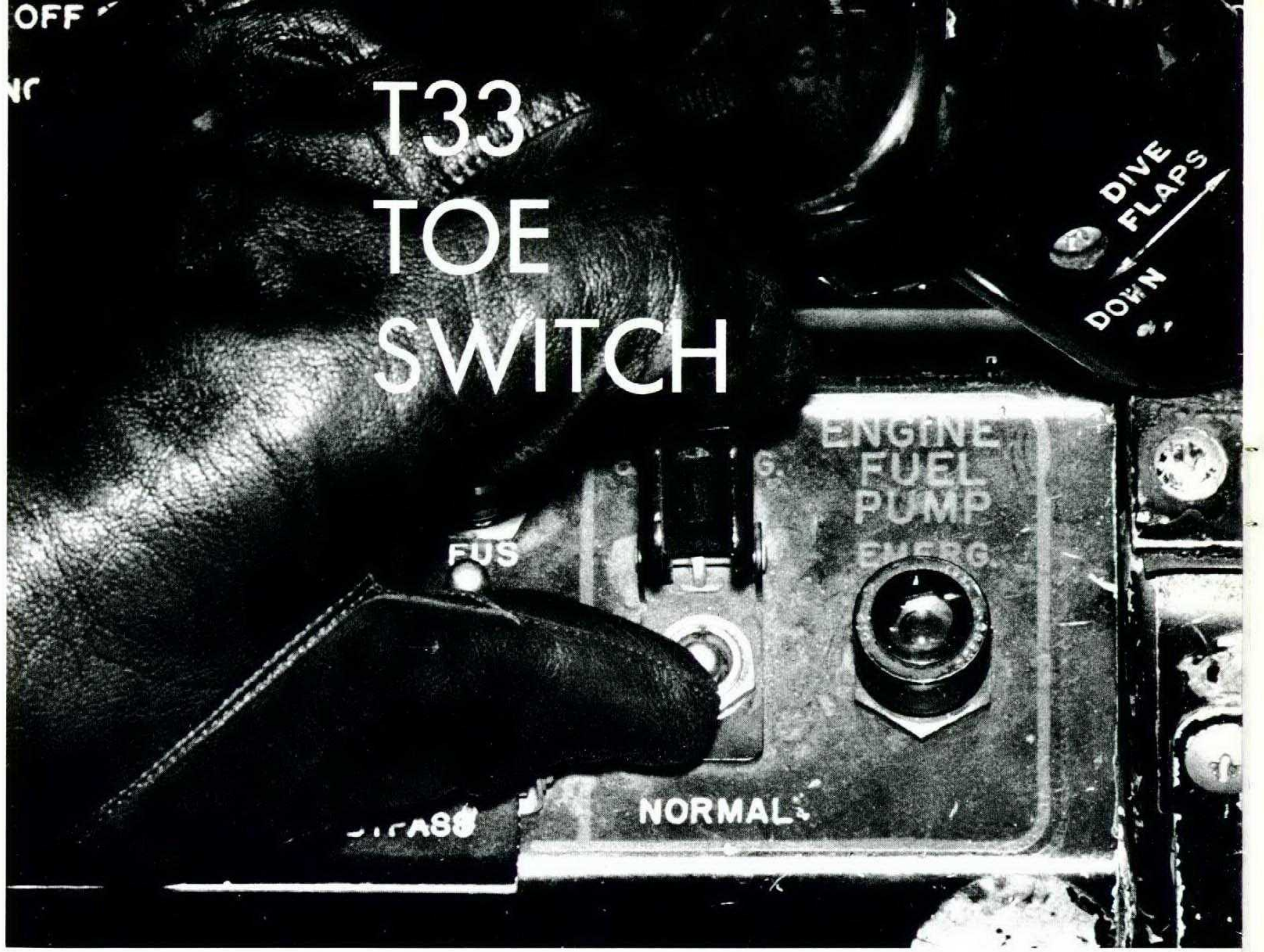
# A Bloodied Nuisance

Recently, a landlubber aboard a small fishing trawler off the English coast was surprised (and perhaps horrified) at a fisherman's solution to the pesky gull problem. The day's catch was being cut up and gutted, strewing the deck with a tempting meal. A member of the crew turned quickly from his work and after catching a gull, covered it with blood and entrails. It flew off followed by the others and alighted on the sea about 150 feet away to clean itself. After circling their bloodied brother for a while, the gulls left and did not return that day.

The fisherman explained that his family had used this technique for generations. Apparently, if a gull appears, moves or calls as though it is being threatened, the remainder scatter. Even stuffed gulls in odd postures have the same effect.

Looks like we'll have to add one more item to the "bird scarer's kit": herring blood and guts.

# T33 TOE SWITCH

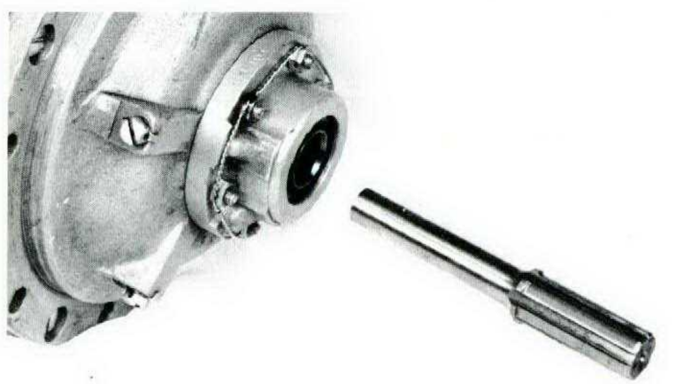



A pilot had just taken off in a T33, when only a few seconds after switching off the TOE switch, (TOE - takeoff and emergency) the engine flamed out. He dead-sticked the metal glider in, after a short sharp 180. The cause of this incident is shown in the photograph - a broken fuel pump shaft.

An isolated occurrence? It was, but the point of this story isn't something about materiel failure, but the discussions this incident prompted. You should have a full understanding of the takeoff and emergency fuel pump isolation function of the T33.

We're not knocking anyone on this because the confusion is understandable. The T33 fuel system is rather complex, and the description of the TOE function in the AOIs is most brief:

> An engine fuel pump isolating switch, commonly referred to as the Take-Off and Emergency (TOE) switch is marked NORMAL, TAKE-OFF and EMERGENCY. It is situated on the left side of each cockpit, see Figures 1-3 and 1-4. The switch is provided to ensure that at least 60% of the engine thrust (equivalent to 88% rpm) is available should any failure occur in the fuel system. This switch should be in the NORMAL position at all times except in the case of fuel system failure, or during take-off.



The fuel pump shaft sheared and the engine flamed out.

From this description little emerges in the reader's mind as to what actually happens when the TOE switch (or what is more properly called the isolating valve), is engaged.

The fuel flow in a T33 is governed by:

- the throttle valve
- acceleration control unit (ACU)
- barometric pressure control (BPC)
- isolating valve - (TOE)



The T33 fuel system is held in balance by a servo pressure system. In normal operation this servo system maintains the fuel delivery from the two pumps in equilibrium with the demands made upon them by the throttle and the requirements of atmospheric pressure changes with altitude and speed. What the TOE switch accomplishes is to isolate servo pressure control of the upper fuel pump. Except for low throttle settings, this places the upper pump to full stroke, ie, maximum output.

With the TOE switch on, and the fuel demand of the engine *greater* than the output of one pump at full stroke, the lower pump will deliver sufficient fuel to maintain the total output required by the engine. Bear in mind that the lower pump is subject to normal control by the BPC and ACU.

If the fuel demand is *less* than the output of the upper pump at full stroke the lower one is servoed to minimum stroke. The upper pump delivers pressure and although isolated can still respond (to a limited extent) to throttle movement. On selecting the TOE switch prior to takeoff, the engine receives the full output of the upper pump which delivers more fuel than the 65% throttle position would deliver with the servo system maintaining normal fuel flow. For this reason you get the surge.

Why the altitude restriction, then? With TOE selected on, the barometric pressure control, through the servo system, still controls the remaining pump, but the upper fuel pump at full stroke exceeds the engine fuel requirements at high altitudes. Thus, the BPC effect is overridden.

Let's go back to that T-bird which flamed out after takeoff. In actual fact, the lower fuel pump driveshaft broke. The pilot had returned the TOE switch to normal and *then* experienced the flameout. Selecting TOE switch on the relight attempt would have given him the upper pump at maximum output - enough for a relight and full throttle response to about 90% at sea level. Had the upper pump shaft broken, ie, the pump with the isolating valve, selecting TOE switch would have placed the lower pump at full stroke.

Of course, this is an over-simplified description of the fuel system in the T-bird. We suggest you refer to EO 10B-15B-2, Part 8. In this publication appears a detailed description of the system, its components, and their function.

Some of us are rather long-removed in time from our T-bird FTTU and there are those who have not been formally acquainted with the nuts and bolts of this fine aircraft. Our knowledge is understandably thin in spots.

The TOE switch, we find, is one of those areas which in a bull session, soon separates the "haves" from the "have-nots" in an understanding of the T33 fuel system - researching this article cast some light in a dark corner, too!

## A New Tropical Flying Suit

### Hot Weather Trials this Summer

Industry has recently developed a fire-resistant, synthetic fabric (Nomex) which will provide the wearer with a greater degree of protection against burns than previously. Nomex, a variant of nylon, when used in layers provides a significant increase in protection over previous materials. Before, racing car drivers had two choices of fire-resistant coveralls: treated cotton or fibreglass. Treated cotton was merely flame resistant but had almost no insulating ability. For example, at a 2500°F (typical of a gasoline fire) in a treated cotton coverall a man feels pain in less than a second and his skin blisters after 2½ seconds. With a double layer of Nomex it takes 7½ seconds to feel pain and 20 seconds to cause blistering. Similarly, fibreglass material, while flame resistant has little insulating value.

This advance in the state of the art coincides with the introduction (for user trials) of a new tropical flying coverall similar to the current lightweight flying coverall. About 100 of these lightweight, high air permeable, flame resistant flying suits of jungle green will be tested. They will be assessed in comparison with the current lightweight flying garment.

The suits will be tested on a tri-service basis at six hot-weather locations to include the African, Mediterranean, Caribbean and Canadian environments.

# Gen from Two-Ten

C45, NOSE-OVER The student, with less than 10 hours on type, had just landed whereupon the instructor took control to continue taxiing the aircraft down the runway to the cut-off. After initiating the turn off the runway the instructor returned control of the aircraft to the student. "For some reason unknown to me" states the instructor, "the student decided to discontinue the right turn and instead initiated a left turn".

At this point there seems to have been some doubt in both pilots' minds as to who had control. In any case, while trying to correct this turn an over-application of brake gave us this classic photograph.

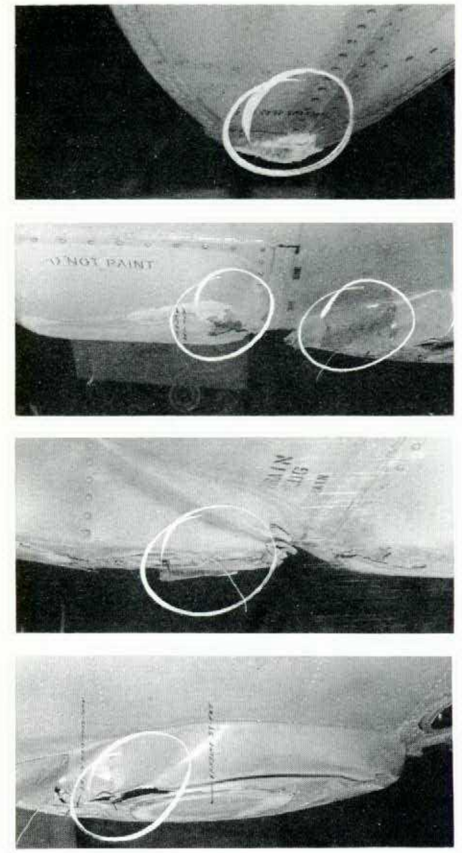


DAKOTA, TOWING AGAIN The Cosmo was being towed from the hangar. The tailplane swung, damaging a nearby Dak. The NCO i/c of the towing crew was moving an aircraft with insufficient help; this is where the story has that old familiar ring. Only two people were available, and despite this obvious deficiency – a minimum of five are required – he proceeded to move the Cosmo with the help of only *one* man on foot.

This NCO's response to his manpower shortage was commendable – but illegal, and an aircraft was unnecessarily damaged.

L19, WIRE STRIKE During an Army exercise in which the pilot was on a low-level patrol and search, the aircraft struck a cable suspended 70 feet above the ground between two hills. The poles suspending these wires were not visible and to complete the camouflage they were not marked on the map. The aircraft was flyable despite losing a 5-foot section of the port wing leading edge. Both the propeller and engine cowl sustained damage. The hazard derives from the proliferation of unmarked power lines being strung about the country, a problem which is of concern to several government and non-government flying agencies. What emerges also, from this occurrence was the lack of an adequate reconnaissance of the area which should have preceded the exercise.



SEA KING, FIVE POINT LANDING A tight pattern following an overshoot and "a great deal of traffic on tower" were enough to blot from memory the student's decision to leave the gear up until final approach. The commanding officer's remark that "the squadron commander's recommendation that the policy of leaving the undercarriage down in the circuit be strongly emphasized, should be an adequate safeguard to prevent further incidents of this nature".

Quite true.

# HOW FLEXIBLE IS A "FLEXIBLE" HOSE?

The request was routine enough: determine how a flexible oil feed line from an Eland Engine had failed. The Materiel Laboratory could handle this one handily; they've had practice - apparently too much practice.

A crack in the metal line beneath the outer wire braid was permitting a profuse loss of oil. The line failed from "cyclic overstress", or more simply, it had been bent too often. The line may have been damaged on installation making it susceptible to vibration damage, or it could have vibrated severely near a mounting point.

But to get back to the point of the story. The lab report reads in part:

***It has been the experience of this laboratory that technicians working with flexible lines, both metal and teflon, treat them as though they were completely pliable... flexible hose lines are flexible only to a limited extent, and should never be made to exceed minimum bend radii as detailed in engineering orders.***


SABRE, HOT LANDING The student pilot was having difficulty with his circuit flying; his tendency was to come in too high and hot, so when his engine failed to respond on an overshoot he floated, using too much runway to prevent running into the boondocks.

Having already made one circuit and overshoot due to a tricky wind, and perhaps slightly confused by an impending runway change, the student approached the runway again too high and probably too hot on final. He touched approximately 2000 feet down the runway and elected to overshoot, (making it a touch-and-go) for another approach and landing.

At this point, a malfunctioning fuel control unit caused the engine to rumble and fail to accelerate. After several throttle movements failed to have any effect the student aborted the takeoff. The tires began to smoke and the left tire blew.

Investigation later showed the runway to have a downwind component contributing to the already harassed student's problems. Another Sabre written-off from service.

# *Comments*
## TO THE EDITOR

Dear Sir:

I think you'll find that most Air Div 104 pilots would disagree with your statement regarding "Canvas Bag Jams Throttle" on page 10 of the Feb issue. Hanging a bag of publications on the throttle is generally regarded as bad form, but carrying publications in the cockpit in a cloth bag is standard procedure. Safety Equipment furnishes the bags. We have not "been able to largely resolve air-crew requirements of this sort" as stated. Our new flying suits won't carry the necessary items (pockets are too small) and we all use the non-issue cloth publication bag.

An Air Division strike pilot carries the CF104 checklist, a letdown book, 2 FLIP maps, an Enroute Supplement, a 6½" CPM folder, a flashlight and a plasticized area map. These items are carried in the "little brown bag".

It's the same old story. RCAF flying clothing never seems to meet requirements. Maybe we could dye some of those orange flying suits blue...

F/L DV Tinson
422 Sqn 4 Wg

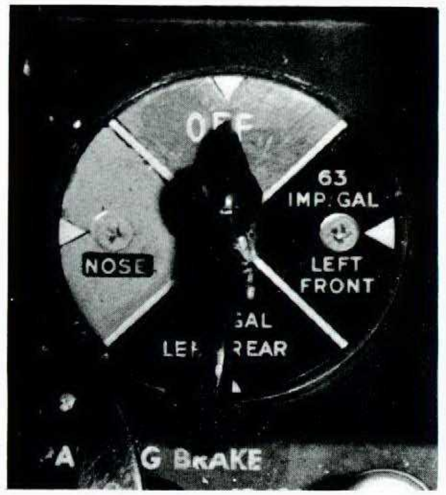
*"Our "Somewhere Over the Rainbow" (Mar - Apr 65) refers.*

Dear Sir:

In a recent issue (Jan-Feb) there is a small article captioned "Murphy's Muddle" accompanied by two photographs showing fuel selector placards of the Expeditor aircraft. The photos show correctly installed placards versus incorrectly installed placards. The article states in part, "The chap we're really annoyed with is the designer who built this part so that it could be assembled in the wrong position in the first place".

I would like to draw to your attention the fact that the designer of the aircraft did not actually create "Murphy's Muddle" in this instance, since each placard was originally imprinted with the words "right engine" or "left engine". These original placards were marked in US gallons, and if memory serves me correctly, special placards were designed and installed for Canadian use to read in Imperial gallons. Some Canadian placards did not have the words "right engine" or "left engine" imprinted thereon. In a situation such as this the designer is unable to control modifications to the original design.

MW Ney




*The original designer may well have incorporated the word "engine" on the American model placards, but a word will not prevent a Murphy.*

*You will note the mounting screws symmetrically located, permitting an inattentive technician to install the wrong placard. The designer could have simply positioned the screws off-centre at no cost to the manufacturer but of considerable saving, possibly, to the customer.*

Dear Sir:

Your Comments to the Editor column, (Jan – Feb), contained a query by Mr John G Kirkman, Edmonton, regarding the use of "yaw cords" on some jet aircraft.

Your explanation is correct in that yaw cords do provide an economical and accurate indication of yaw or slip and skid in an aircraft. However, I believe you will find the reason for installation of a yaw cord on the nose of F80, F84 and T33 aircraft was to provide the pilot with an indication of yaw during gunnery attacks. The yaw cord was visible when sighting the target through the gyro gunsight making the necessary rudder corrections possible without movement of the eyes to crosscheck cockpit instruments. One of the original "heads up" flying displays.

F/L NA Christie
TCHQ, Winnipeg

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*The Reynolds number we used in the reply to S/L Feake's letter was in error. It should have read $10^7$ power. Further, our reference to aspect ratio should have been thickness ratio.*

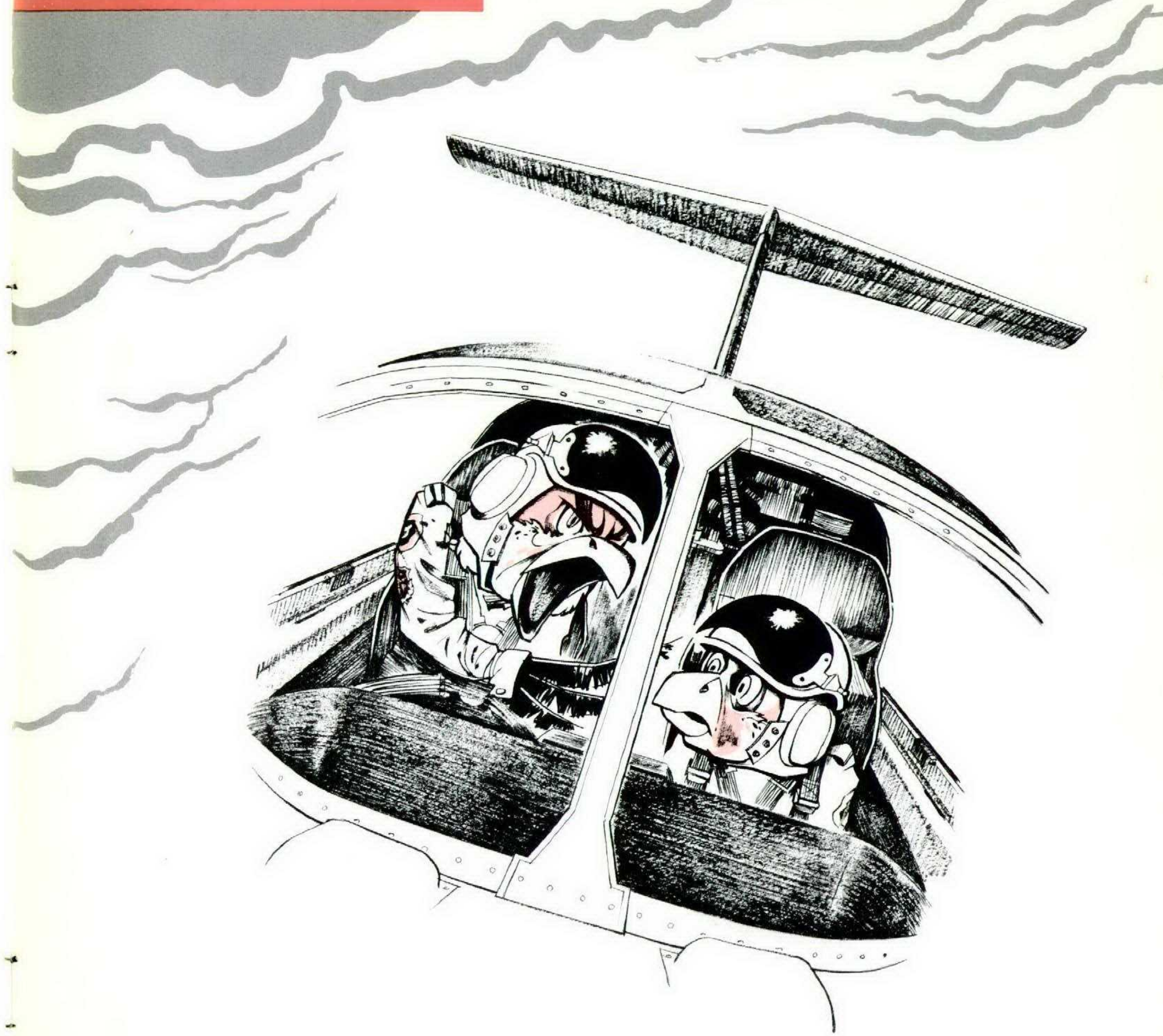
## One Bird - Two Strikes

A Tracker sustained a birdstrike in the engine area which had *apparently* caused no damage. Fifteen flying hours later oil began leaking from the starboard engine forcing the pilot to bring back the craft minus one powerplant. The external oil line to the propeller CSU was broken, although metallurgical tests revealed no cracks or defects, no evidence of fatigue, corrosion or plastic flow. Failure must have resulted from the bird impact.

Before returning the aircraft to service after a birdstrike a real going over is obviously a good idea. This might have been a bad one in a single-engine aircraft.



BIRD WATCHERS' CORNER

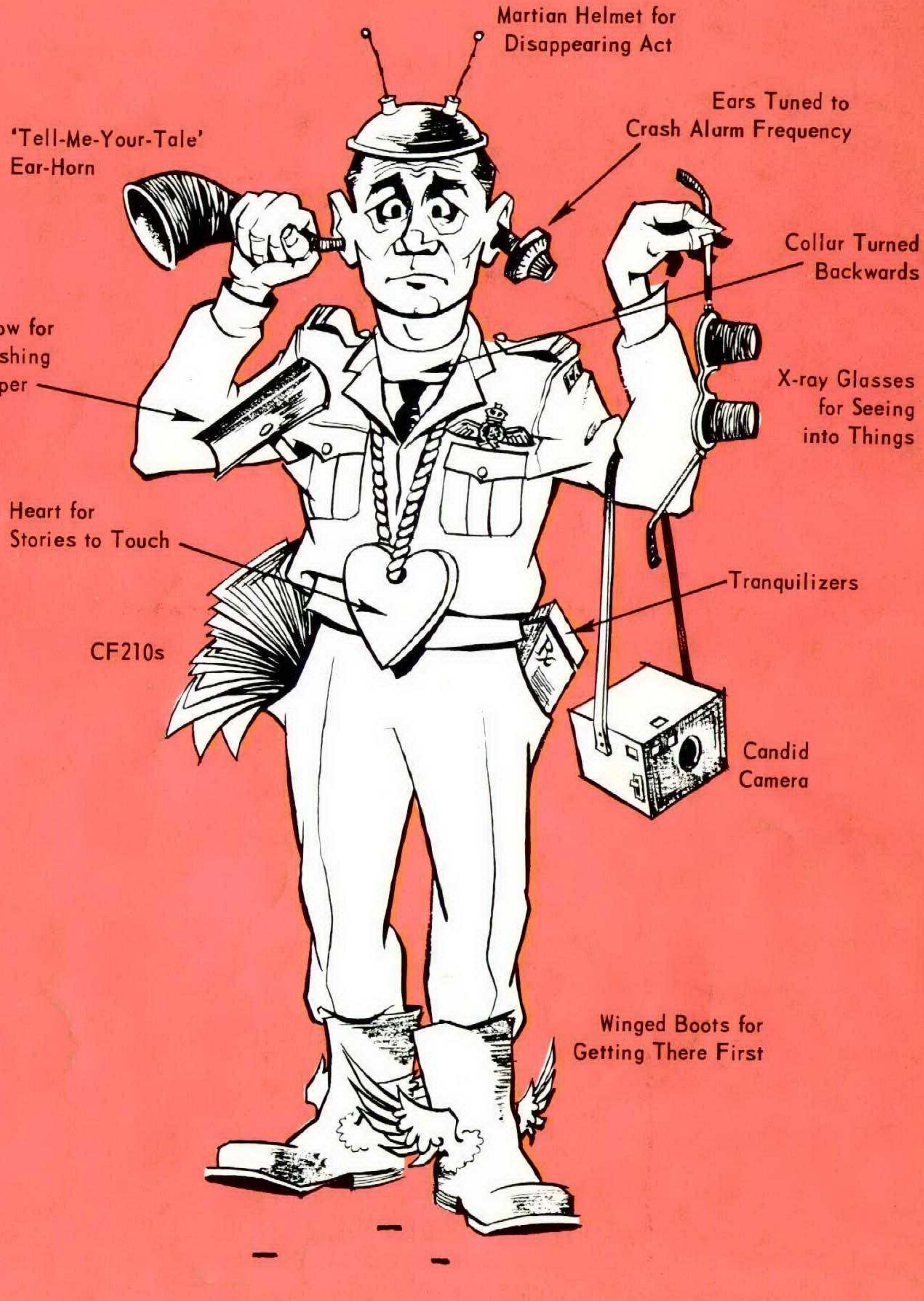


# CROSSCHECKERED PITCOCK

In nesting areas where chicks flit and fumble, aerodynum professorus is rightly cock-of-the-walk, with a heritage as colourful as his plumage. His characteristics are diverse in the extreme; a prime example is the Kingbird sub-species with plumage emblazened with crests, and a casual demeanor as unruffled as his feathers. Selected for their rapidity of movement among other talents, pitcocks can thrust, at near-Mach 1 speeds, their feathered fingers toward a control or switch to intercept a fledgling's faux pas. On a rare occasion, a pitcock has been known (when provoked, of course) to emit his distinctive distress call:

FORTHESAKEOFMYSOUL IHAVECONTROL

# YOUR FSO




Our thanks to F/L R Bullough, Stn Summerside