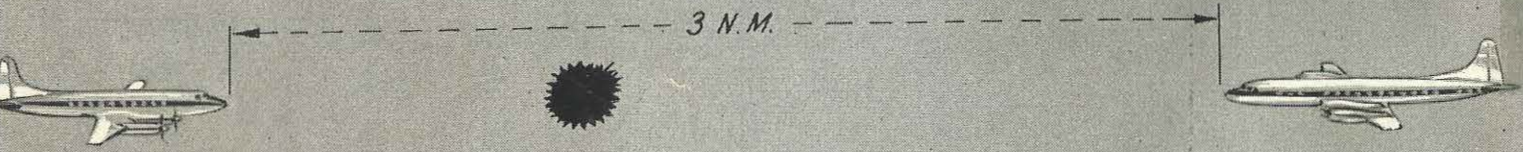
BEWARE

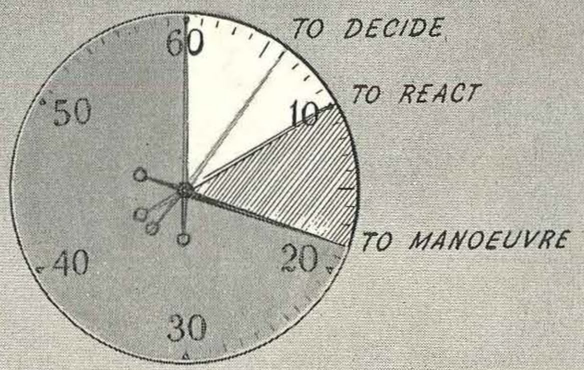
There're others besides

YOU UP THERE

in this V.F.R. situation



YOU HAVE LESS THAN 10 SECS TO ACT!



COMMONWEALTH OF AUSTRALIA

Aviation Safety DIGEST

Progress! . . . . .
Does your knowledge meet the challenges of today?

No 19, SEPTEMBER 1959

Gliding Safety

We have decided that the Aviation Safety Digest should be made available as a medium for conveying safety information to those people who battle with the elements without means of propulsion. We therefore welcome them to the ranks of our readers.

This decision has been reached because of several developments, not the least prominent of them being the occasional voice heard through the publication, "Australian Gliding" — a plea for some information on the lessons learnt from glider accidents and other events relating to flying safety. We believe that this Digest of ours could fulfil this need and, beginning with this issue, it is being made available in limited numbers to each of the gliding clubs.

Perhaps it is not well known to the rank and file members of the gliding movement that the Department carries the responsibility for investigating all aircraft accidents and incidents and that to enable the Director-General to discharge that responsibility he has under his control a team of specialists whose prime job it is to investigate all accidents and incidents to establish facts that may lead to greater safety in flying. It may be an even lesser known fact that this responsibility extends into the field of glider operations.

In this issue we report on two glider accidents which we hope will be of particular interest to you, our new reader. We do not expect to be able to offer you the same volume of material on gliding as we have been able to present on powered flying, but feel confident that, with your help, far more material of direct interest could appear in these pages. All it needs is a more general acceptance that the need to know implies the need to tell. If you keep us notified we will do our best to pass on to your friends the knowledge gained. In this way you will not only fulfil your statutory obligation to report accidents and incidents, but you will also render the gliding movement a service which it seems to lack at the present time. Until then, we trust that many of the lessons emanating from powered aircraft activities will be equally applicable to your operations.

Finally, we wish to express our regret that the scale of distribution of this Digest cannot be more liberal. Funds available for the production of this publication are strictly limited, so please bear with the decision to provide each club with three copies only. Be assured that your interest and ours are alike and that your needs will be kept in mind if and when we are in a position to improve the hand-out. You can help by keeping the copies on the move.

Aviation Safety Digest

No. 19 September, 1959

Prepared in
the Division of
Air Safety Investigation.

CONTENTS Page

WOODEN AIRCRAFT — THE VITAL NEED FOR INSPECTION

Are you one of those wooden aircraft owners who regard structural inspection of your aircraft as an unnecessary expense?

Optimism is a fine quality, but it won't help you if the structure of your aircraft has lost its strength. Many inspections of wooden aircraft have revealed alarming deterioration which could very easily have led to catastrophic failure in the air.

It is well known that various kinds of rot affect the wood itself, but perhaps the most difficult problem with wooden aircraft is the effect of age and weather conditions on the glued joints, especially where joints are made between plywood and solid wood. The conditions giving rise to this are generally fairly well established but some effects are more obscure and unpredictable.

Recently two wooden aircraft, constructed consecutively, were examined in detail to determine their condition. One had operated for six years in humid sub-tropical conditions, from rough strips, and had been parked mostly in the open. The other had operated in a more temperate climate and had been regularly hangared and protected from the weather. Contrary to expectations, the latter aircraft was found to have suffered serious separation of web from the centre section spar boom, whereas the former was in excellent structural condition. This shows how very difficult it is to establish the structural strength of wooden aircraft by theoretical assessment.

It has often been suggested that a life should be placed on wooden structures; if such a course were adopted it would mean early retirement of some very sound aircraft so as to ensure that any which had deteriorated were retired before they suffered a dangerous reduction of strength. The only reasonable alternative to placing a life on these aircraft is to have them inspected thoroughly in areas where failures are known to be likely. These inspections must, however, be very thorough and, of necessity, involve almost complete dismantling of the aircraft. A.N.O. 105.1.0.2.17 sets out this inspection requirement in detail.

So that our airworthiness officers and the industry might be alerted to the types of failures likely to occur in the various types of aircraft and to ensure a consistent approach to the problem throughout Australia, this Department arranged for courses of lectures and demonstrations on timber and adhesives during 1958 and 1959. These were attended by Department of Civil Aviation surveyors and representatives of the aviation industry.

Australia is not alone in its concern with this type of structure. The Air Registration Board in Great Britain has, as the result of three catastrophic mid-air failures within 12 months, reached the same conclusion and now requires wooden aircraft structures to be fully opened before each renewal of Certificate of Airworthiness.

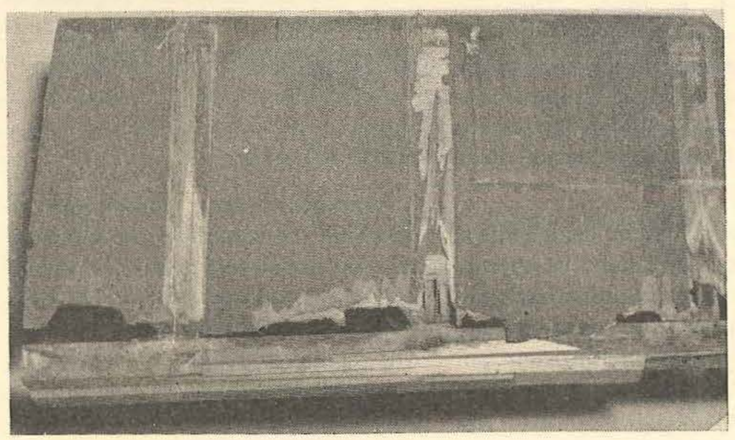
Surveys made so far in this country have shown that the inspections required by the Air Navigation Order are the minimum required to ensure safety and that a more fundamental approach to the problem is necessary.

NEW POLICY

Inspections have established to date that the aircraft most seriously affected were those whose construction consisted of a plywood shell wing with box type spars: aircraft with spars of solid type construction have not shown anywhere near the same deterioration. It has therefore been decided that aircraft with wooden box type spars and/or stressed ply shell covering may continue to operate in the role in which they are currently engaged, but no more will be imported and none will be permitted to change from their present operational role except within the private category. In more detail this policy is as follows:—

- No more import permits will be issued for aircraft of this type.
- No additional aircraft of this type will be accepted on airline, charter or aerial work licences.
- Aircraft of this type currently used in accordance with an airline, charter or aerial work licence shall be specified by registration letters on that licence. Such aircraft may not be transferred to another licence.
- Any aircraft of this type currently registered or which has been registered in Australia may be used in private operations.
- Before any aircraft of this type is brought back on to the register it must be inspected in accordance with A.N.O. 105.1.0.2.17.
- Design and construction of this type of aircraft will not be approved.

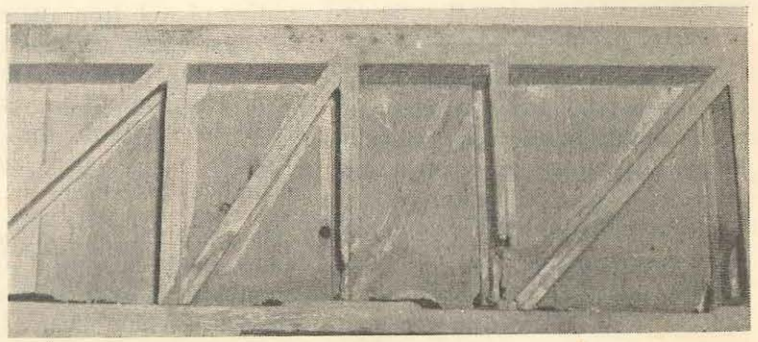
Deterioration in rear spar Anson aircraft. Note glue line failures and decay of web, stiffeners and spar rail.



THIS POLICY WILL NOT APPLY TO ULTRA-LIGHT AIRCRAFT ISSUED WITH A RESTRICTED CATEGORY CERTIFICATE OF AIRWORTHINESS.

The period between renewals of Certificates of Airworthiness has recently been extended to three years, with the result that the time between inspections under A.N.O. 105.1.0.2.17 is also extended. Serious consideration was given at the time to requiring a more frequent inspection, but this was decided against. However, from our knowledge of what can happen to this type of aircraft, private owners of all types of wooden aircraft are strongly advised to have their aircraft thoroughly inspected for deterioration at least once during the currency of the Certificate of Airworthiness. This is not just an idle warning. The examples of deterioration pictured here which have been found after quite short periods of operation show that a more frequent inspection than each three years is a very sensible insurance. In the light of our research into this problem we are convinced that the only alternative to prohibition of the operation of these aircraft is to insist on extensive regular inspections.

Interior structure of Avro Anson wing showing severe deterioration. Note complete separation of structural members, opening of splice in lower spar rail and lifting of plywood skin from spar rail.



To all operators of wooden aircraft and to private operators in particular, we say — Look very closely at the examples shown here and consider what it could mean to you if the same condition existed in your aircraft. Be assured that irrespective of how good the aircraft looks externally and how well you have taken care of it, this condition could very well exist inside. Have your aircraft thoroughly inspected at least once between C. of A. inspections. THIS ARTICLE PRIMARILY CONCERNS YOUR AIRCRAFT BUT IT WOULD BE WELL TO REMEMBER THAT IT JUST AS DIRECTLY CONCERNS YOUR LIFE — CAN YOU AFFORD TO RISK EITHER?

Guess and Live — If You're Lucky

A Viscount, en route from Sydney to Coolangatta via Casino at flight level 250, reported over Point Lookout at 1403 hours. Point Lookout is the last reporting point before Casino, where the normal route turns towards the coast. At the time the Point Lookout position was passed, the captain was on watch and the first officer, occupying the right hand seat, was having his lunch.

A.T.C. acknowledged the Point Lookout position and added "to facilitate descent suggest track coastal. Advise." This suggestion was accepted and the aircraft was instructed to report when over the coast. The captain then handed over to the first officer and proceeded to the cabin. The first officer turned the aircraft towards the coast and, on arriving there, commenced to descend. At 1418 hours he advised A.T.C. that the aircraft was over the coast at flight level 200 descending. A.T.C. promptly instructed the aircraft to limit the descent to flight level 150. At this stage the first officer realised that he had descended without permission and advised the captain on his return to the cockpit.

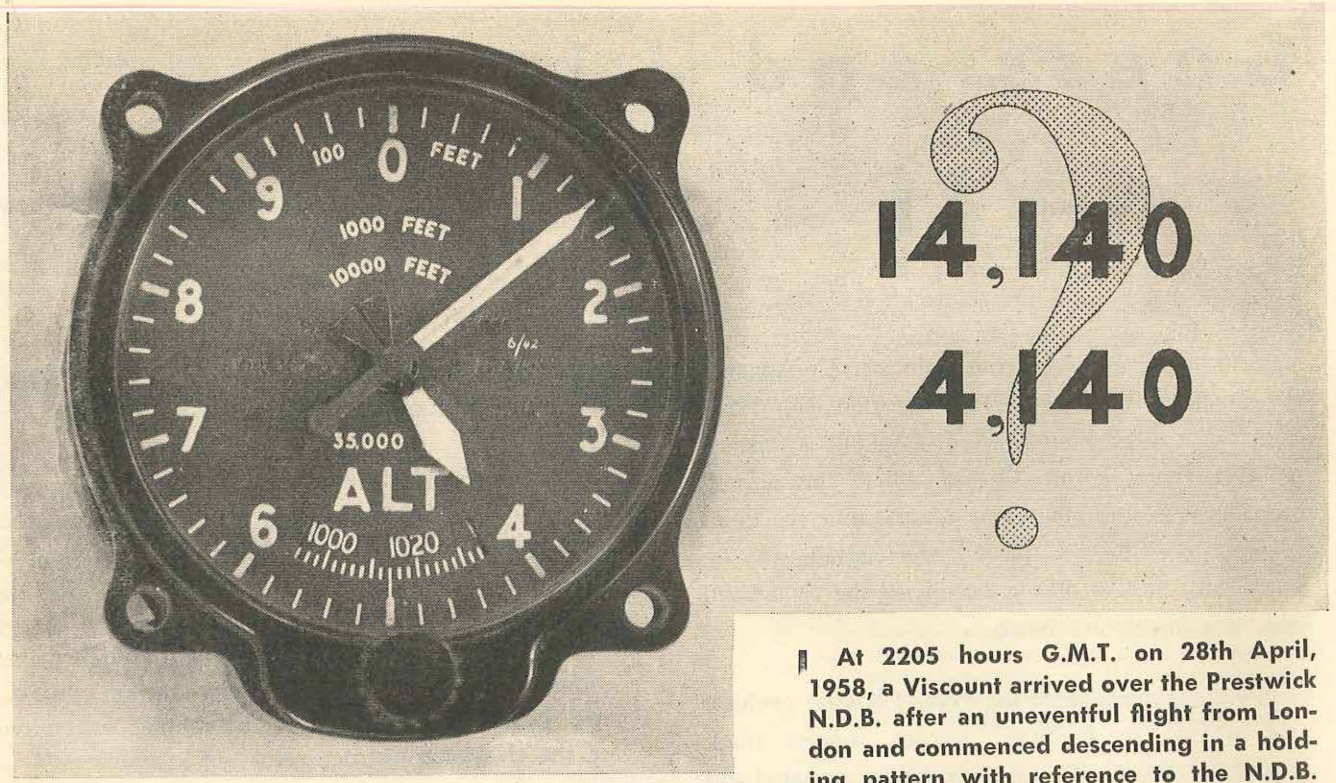
During the descent to flight level 200, the aircraft passed through the flight level of another aircraft on a reciprocal heading with substantially less than the minimum safe separation.

The first officer's explanation is as follows, "I recall that during lunch a message was passed to us concerning our progress to Coolangatta. The captain was at this stage working the radio and he acknowledged the message and told me that we have been asked to move over to the coast and call on the coast. I recall hearing (on the cockpit speaker) the words 'to facilitate descent' and connected that with an indication that it was clear on the coast and that we would be clear for a VFR descent into Coolangatta."

The way in which the first officer's misconception arose is not hard to appreciate. He knew that it was not unusual for aircraft on this route to be cleared for descent via the coast. Being occupied with his lunch during the transmission concerning the diversion — and thus not giving it his full attention — the word "descent" was seized upon, out of context, and became an operative word in his conception of the clearance instructions.

Everyone is prone to this sort of mistake; "getting the bull by the tail" is a difficulty probably as old as human communication. The problem with this sort of error is that the person involved is confident that he has understood the message correctly. The only way to avoid errors of this nature is to maintain a constant awareness that they can and do happen very easily, and to be alert to situations and circumstances which can lead to such mistakes. This means that from the time you arrive at the airport and at least until you walk down the gangway after completing your flight you must be mentally alert to the traps and hazards awaiting the relaxed mind.

Assumptions are guesses! Actions based on anything less than a full and meticulous appraisal of a situation can have disastrous consequences. This last phrase has become somewhat hackneyed and perhaps it doesn't have much impact on the mind, but can you imagine the results of two aircraft meeting head-on at a closing speed of about 600 knots? That is the picture we have in mind when we use the phrase. By the way, watch out on the drive home!



ALTIMETER ERROR

At 2205 hours G.M.T. on 28th April, 1958, a Viscount arrived over the Prestwick N.D.B. after an uneventful flight from London and commenced descending in a holding pattern with reference to the N.D.B. Some three minutes later the aircraft struck the ground near the N.D.B. masts, approximately three miles northeast of Prestwick Airport. The aircraft was substantially damaged by impact and ensuing fire. Three of the crew of five were seriously injured and the other two received minor injuries. No passengers were being carried.

(Summary based on the report of M.T.C.A., United Kingdom.)

THE FLIGHT

The aircraft departed London for Prestwick at 2042 hours, cruising at 18,500 feet with an E.T.A. of 2205 hours. At approximately 2150 hours Scottish Airways cleared the aircraft to descend to 8,000 feet, and this descent was commenced at 2153 hours. One minute later the Prestwick weather was passed to the aircraft as ⅛th cloud at 200 feet, ⅝ths at 300 feet and ⅞ths at 800 feet. This put the cloud base just below the minimum. The captain then advised that he would carry out an I.L.S. approach and if not clear at the minima would divert to Renfrew.

At 2157 hours the captain reported at 13,000 feet, descending with an E.T.A. at the Prestwick N.D.B. of 2204 hours, and was cleared to 4,000 feet. The captain then transferred to Prestwick Approach and in his initial call at 2158 hours reported at 11,000 feet descending. Approximately five minutes later the G.C.A. controller, who was going to position the aircraft for the I.L.S. approach, contacted the aircraft and was advised by the captain that the aircraft was at 14,500 feet descending. The G.C.A. controller thereupon advised the aircraft that "you are too high for me at the moment. I'll take you from the holding pattern when you reach the beacon." Immediately the aircraft reported at 14,500 feet, the approach controller noticed the discrepancy between this height and the previously reported height of 11,000 feet, and asked the G.C.A. controller to query the height. Before the G.C.A. controller could do so, however, the aircraft reported over the Prestwick N.D.B. at 12,500 feet at 2205 hours. This was received about 90 seconds after the 14,500 feet report and

effectively dispelled from the controller's mind any momentary doubts as to the aircraft's altitude.

After arrival over the N.D.B. at 2205 hours, the aircraft began a holding pattern to lose height. At 2207 hours, the captain reported, "just left 11,000 feet." The aircraft crashed at approximately 2208 hours.

ANALYSIS

As the descent was commenced the captain set the Airport QFE on his altimeter and the Zone QNH was retained on the first officer's altimeter. When contacted by the G.C.A. controller between 2203 and 2204 hours, the captain reported his height by reference to the first officer's altimeter. Calculations based on time and rate of descent show that when the captain read the altimeter at this time the aircraft was at 4,500 feet and not at 14,500 feet as reported. From this it is evident that the captain failed to notice the position of the ten-thousand-foot pointer as he looked across at the first officer's altimeter. He subsequently perpetuated this initial error when reading his own altimeter at 2,500 feet and 1,000 feet when he gave his altitude as 12,500 feet and 11,000 feet respectively.

The captain had calculated the time for commencement of the descent on the basis of a rate of 1,500 feet per minute and with the deliberate intention of not being too high on arrival at the Prestwick N.D.B. He began the descent at the time planned and the descent was made as intended without interruption. Despite these facts, he accepted his height without any misgivings as 12,500 feet when he reached the N.D.B. some 12 minutes later.

The presentation afforded by pressure altimeters having three pointers is not always conducive to rapid and accurate reading, especially in regard to the ten-thousand-foot pointer which can be overlooked or obscured, particularly at night. The possibility of ambiguous presentation with consequent wrong reading has been well known and there is a constant endeavour to produce something better.

Although he was not manually flying the aircraft because the autopilot was engaged, the captain was controlling the descent and monitoring his instruments. On top of this he was doing all the R/T (the exchanges on which occupied about 4½ minutes of the 12 minutes between the start of the descent and Prestwick N.D.B.), writing down the weather reports, studying the approach and overshoot procedures, briefing the first officer on the possibility of an overshoot, attending to descent and initial approach drills and checking the altimeters. There seems little doubt that in so doing he overloaded himself to an extent that made possible the mental loss of the descent sequence.

The captain stated that he did not use the monitored approach system (see Note at end of article) because he had never met the first officer before and because the first officer had not been to Prestwick since the war. He also gave it as his opinion that use of the system would most probably have increased his work load because he would have had additional duties of reading check lists and tuning beacons.

Although the captain was within his rights in making this decision, nevertheless, it would appear probable that had he used the monitored approach system and followed the standard drills and procedures, or had he substituted some other procedure which made full use of his first officer, the altimeter reading error, if made at all, may have been quickly noticed. In the two-pilot crew it is essential that the two pilots work as a team with each knowing what the other is doing and each cross-checking the other so far as is possible.

During the descent the first officer seems to have spent much of the available time trying to tune the Prestwick I.L.S. Locator Beacon. As the main Prestwick N.D.B. had already been tuned satisfactorily on the other ADF set; as G.C.A. was available to monitor their I.L.S. approach; as the Decca Flight Log was working satisfactorily; and as the I.L.S. Locator Beacon was only a short range locator, this continued effort was unnecessary and was undoubtedly detrimental to his vital duties of monitoring the instruments and R/T conversations.

OPINION

The accident was caused by the captain flying the aircraft into the ground during the descent into Prestwick after misreading the altimeter by 10,000 feet. Whilst a somewhat ambiguous presentation of height on the pressure altimeter may have initiated this misreading, a lack of co-operation between the captain and first officer and a lack of alertness on the part of the first officer were the main contributory factors.

COMMENT

LET'S FACE IT. Exposure to altimeter reading errors has increased significantly in recent years due to the larger number of aircraft using increasingly higher operating altitudes, the higher rates of climb and descent possible by these aircraft and the generally faster operating speeds.

There is no immediate prospect of the perfect altimeter, one which will eliminate reading errors, being available in commercial quantities for some time; therefore we must learn to live safely with the present equipment. Various modifications made to the three pointer altimeter have reduced, but not entirely eliminated, the possibility of misreading errors; furthermore, by far the greater number of altimeters in service are of the unmodified three pointer type.

As we in the Department see the position the only immediate solution capable of eliminating dangers arising from altimeter misreading lies in the development of crew drills specifically aimed at:—

(a) Providing a better distribution of crew duties in the cockpit, thereby reducing both fatigue and the probability of altimeter misreading errors; and

(b) Providing adequate cross checking of altimeter readings.

The operator's monitored approach system mentioned in the foregoing article seems to recognise the need for improved co-ordination of flight crew effort. This system appears to have possibilities for the prevention of these errors provided it is introduced as a mandatory requirement throughout a particular company; however, before adopting such a system considerable research in the human engineering aspects of cockpit workload would be required. Research takes time — in the meantime we suggest that you attack the problem individually by paying careful attention to the crew drills which have been introduced by your Company in an attempt to guard against altimeter reading errors.

Remember! If you are not convinced that it could happen to YOU, the proof you seek may be presented too late. GUARD AGAINST IT NOW!!!

The monitored approach system had been adopted as a standard procedure by the operator "in the interests of safety and efficiency." It was felt that the problem of errors in the control cabin which were due to a lack of effective checking and cross-checking of all vital actions, together with unsuitable distribution of duties between the two pilots, could best be solved by the monitored approach system, using the first officer to fly on instruments from the start of the descent until the captain was ready to take over to land. In this system the first officer would be free to concentrate on flying the aircraft accurately, whilst the captain monitored and directed his flying, communicated with A.T.C. and was free to control every situation as it arose. By such means the work load would be more evenly distributed between the two pilots, who must, in consequence, be more efficient individually and as a team, and the strain and fatigue on the captain would be reduced.

It was recognised that the system demanded a high degree of confidence from the captain in the skill and capability of his first officer, together with a high degree of understanding and co-operation between captain and first officer to avoid possible mistakes and also that rigid adherence to correct procedures would be of paramount importance. Having a standard procedure was stressed as being particularly valuable in helping the captain and first officer work as a team even though they may never have previously flown together.

If you fly complicated airplanes on complicated missions, trying to remember all the complicated procedures in an emergency, you are a potential victim.

Pilot Saturation

(Reproduced from "Flying Safety," March, 1959.)

A term which is much bandied about is pilot saturation. Although it appears completely self-explanatory, some consideration should be given to the components which go into such a condition. The human is capable of mentally attending to only one thing at a time. Although in practice an individual may seem to be doing a number of things concurrently, in actual fact the attending to the stimulus or the performing of the response is a sequential type of activity in which attention shifts very rapidly from one to the other so that the illusion of multiple activities at the same time is created. There are many things which change the rapidity with which an individual can alter his attention as well as the speed with which a given activity may be performed. Some of the more common of these are illness, fatigue, toxic contamination, emotional disturbances and ageing.

Even under optimum circumstances, however, there is a limit. When this limit is exceeded, the result is a general breakdown of the entire system. In flying aircraft the pilot must attend to many things, and during some periods of flight, and during practically all emergencies, these must be attended in a very short period of time. If at any time the number of things to be attended to and acted upon exceeds the limitations of the human machine, the breakdown which follows may well develop into an accident. Much of the responsibility for the overloading of the pilots must be laid at the feet of designers of equipment and in the hands of those who have defined the procedures which must be executed. From the standpoint of the individual pilot, however, it is small consolation to know that the predicament in which he finds himself may, to a great extent, not be of his own making. The clear fact remains that he is the individual involved, and if there is an accident he is the one who experiences it, and should injury result it is he who suffers. It becomes expedient, therefore, that each individual recognise the overloading potential and take actions which are within his ability to preclude its occurrence.

There are several methods by which a pilot may prevent becoming supersaturated with the requirements of flight, or in other words, overwhelmed. The first of these is learning the aircraft. This is nothing other than training, retraining and re-retraining until the handling of the aircraft becomes almost automatic. This is the overlearning process. It can be done by flying, by simulators or even by reading appropriate T.O.'s. The value of such training is that when emergencies happen the pilot does not have to be simultaneously thinking about how to handle the emergency and how to handle the aircraft. The latter has become more or less automatic by diligent training.

Another method of avoiding pilot saturation is knowing emergency procedures. This is also training, but specialised training. Because emergencies seldom occur, many people do not bother to know exactly what should be done in every type of emergency. Those who do not bother to learn are all too frequently killed because if an emergency occurs they either do not have time to analyse the situation and take corrective action before a crash occurs or they take the wrong type of corrective action and compound the emergency with the result that an accident becomes inevitable. On the other hand, those who know their emergency procedures well, can instantly respond to the demands of the occasion and take the correct type of remedial action before an accident occurs.

There is a third method of avoiding pilot saturation and this also is in the form of training. This is instrument proficiency. There is no other type of flying which is as demanding of vigilance and technique as instrument flight, yet accidents continue to occur under instrument flight rules because the pilot loses control of the aircraft. These are usually the cases wherein instrument proficiency has been minimal, and when the chips are down the pilot suddenly finds himself supersaturated with the requirements of flight. He cannot attend all things which must be attended and suddenly he is in a spin or a stall and all effective control of the aircraft is lost. This can only be effectively prevented by instrument proficiency. Those who cannot become proficient should not fly. If they do, sooner or later they will turn up missing during an attempted cross-country on some dark or stormy night.

However, the best method of all for preventing pilot saturation is pre-planning. This is the simple expedient of determining what is to be done insofar as possible before the flight takes place. This not only applies to routes, weather and alternates and to the pre-flight inspection of the aircraft, it also applies to the thoughts given to potential emergencies, to survival equipment and to such things as a more logical choice of altitudes. There are many dead pilots who would be alive today if they had chosen a 13,000 foot flight altitude instead of 11,000 feet. They did not think they were going to get off course and strike a 12,000 foot mountain, but a little prethought would have told them that they might get off course, and there were 12,000 foot mountains, and the smart thing to do was to fly at 13,000 feet.

The moral of the story is that pilot saturation can be controlled. In this and succeeding issues some of the human limitations which relate to pilot saturation as well as various factors associated with all phases of flight from the pre-flight planning to the post-flight writeups will be discussed with a view toward showing areas of greatest accident potential and hence the areas in which pilot oversaturation can be most profitably avoided.*

**As information comes to hand, this will be published in the Aviation Safety Digest.*

Ambassador Accident during Flapless Take-off

During a flapless take-off on Runway 35 at Canberra Airport an Ambassador aircraft sank on to the runway with the undercarriage retracted just after becoming airborne following simulated failure of the starboard engine at the take-off safety speed. The aircraft skidded to a halt on the runway 6,100 feet from the commencement of the take-off. The aircraft sustained extensive damage to the fuselage and propellers but there were no injuries to persons.

NATURE OF THE OPERATION

At the time of the accident, the aircraft was engaged on flights to determine whether it could clear the terrain surrounding Canberra Airport by the prescribed margin following engine failure on take-off at a weight nominated by the operator. The operator desired to use Canberra Airport as an alternative airport for Ambassador aircraft on regular public transport services from Sydney to Cooma. The flights were being conducted by the operator with officers of the Department of Civil Aviation observing.

CIRCUMSTANCES

The aircraft was being flown by the company's Ambassador Check and Training Captain with a company first officer and the test flights were commenced at approximately 1035 hours Eastern Standard Time. After two abortive tests on Runway 30, a take-off was carried out on Runway 35 without flap* at an all-up-weight some 3,000 lb. below the desired operating weight of 49,000 lb. On this take-off the aircraft cleared the terrain by what has been described as a "not unreasonable margin."

*The best climb gradient is obtained without flap.

It was then decided to repeat the test at an all-up-weight of 49,000 lb., and at 1315 hours the aircraft was taxied to Runway 35 to carry out the test. In addition to the crew two Department of Civil Aviation officers were on board. The weather at this time was fine, visibility 25 miles, wind 310°/13 knots, temperature 30.5°C. and QNH 1014 mbs. Under these conditions the density altitude was 4,700 feet and the wind gave a 10 knot headwind and a nine knot crosswind component from the left for the take-off.

After an engine run-up and pre-take-off check, the throttles were opened to 30 inches of boost and the brakes released. The throttles were then advanced to give take-off power. During the take-off it was noted that the engine instruments indicated take-off power and all engine pressures and temperatures were normal.

At about 95 knots the nosewheel was eased off the runway and at the take-off safety speed, 114 knots, the starboard throttle (critical engine) was retarded and set at 14 inches of boost in order to simulate the drag effect of the propeller when feathered. At about this time the aircraft became unstuck and a second or two later the captain, who was having no difficulty in keeping the aircraft straight, called for the undercarriage to be raised. The first officer immediately selected the undercarriage up, at which time the airspeed was observed to be 116 to 118 knots. Just after the undercarriage was selected up the underside of the fuselage contacted the runway and the aircraft skidded to a stop almost on the centreline, some 700 feet short of the upwind end.

INVESTIGATION

Runway 35, which has a sealed gravel surface, is 6,800 feet in length, 150 feet wide and is 1,872 feet above mean sea level.

The first point of contact with the runway occurred 4,237 feet from the commencement end of the runway and was made by the tail bumper wheel. This was shown by white paint along this mark for a distance of 59 feet.* There were no signs of the aircraft having contacted the runway from the end of this mark for a distance of 309 feet where abrasive marks made by the fuselage commenced and continued unbroken until the point at which the aircraft came to rest.

*The tail bumper wheel tyre is painted in order to indicate if the tyre has been in contact with the runway, in which case an inspection of the tailwheel strut attachments and rear pressure bulkhead is required.

One hundred and ninety-five feet from the commencement of the fuselage mark, cuts made by the propellers in the runway appeared on each side of the fuselage mark. It has been calculated from the distance between the port propeller marks and the r.p.m. of that engine that the groundspeed was 101 knots at the time the propellers first contacted the runway.

The underside of the fuselage from the nosewheel doors to the rear door was extensively damaged. The airframe and components were otherwise undamaged and no significant defects or evidence of malfunctioning were found. The tips of the blades on both propellers had sustained some damage but there was no evidence of any pre-crash defects. Similarly, no defects or evidence of malfunctioning were found in the engines, which were undamaged.

The all-up-weight on the take-off was 48,972 lb., which was 6,028 lb. less than the maximum permissible specified in the certificate of airworthiness. The load was correctly distributed.

ANALYSIS

Neither the crew nor the observers were able to account for the aircraft failing to fly away but they all agreed that the starboard engine was throttled back at or just above 114 knots, that the aircraft became airborne at 115 or 116 knots and contacted the runway at 117 to 118 knots. Their observations are supported by the evidence of the propeller marks which, in terms of airspeed, indicate that the aircraft contacted the ground at 116 to 118 knots.

Their testimonies also indicate that some two seconds elapsed from when the starboard throttle was retarded until the aircraft became airborne and that the aircraft was in the air for approximately three seconds, i.e., at least one second before the undercarriage was selected up and for one second afterwards. From the end of the tail bumper mark to the fuselage impact mark was 309 feet, which, at the relevant airspeed, represents approximately 1½ seconds. This, in conjunction with the occupants' evidence concerning the time the aircraft was in the air, indicates that the aircraft became airborne shortly before the tail bumper contacted the runway and when the aircraft was about 4,000 feet from the threshold. The distance required to become airborne is consistent with the flight manual figures.

From the available data, the fuselage angle to maintain V_2 in the flapless configuration is about 9 degrees, whereas the maximum angle that can be achieved at unstick is about 6½ degrees.* This means that there is a distinct possibility of bumping the tail bumper just after unsticking as the nose is raised, as it must be if the speed is to be kept at V_2. This possibility is noted in the Flight Manual. A heavy bump would undoubtedly result in a downward pitching of the nose with a consequent reduction in angle of attack.

The occupants did not feel the tail bumper contact the runway or notice any significant downward pitching of the nose. The nature of the tail bumper mark shows that the bumper was pressed very firmly on to the runway and, from the length of the mark, the contact time was ¼ second. There is every reason to believe that the nature of the contact mark was sufficient to cause downward pitching of the nose. Information from overseas indicates that the tail bumper can contact the runway without even experienced pilots on the type being aware of it. It is more difficult to explain why the occupants failed to notice the downward pitching. It can only be concluded that it occurred so close to the fuselage impact that it was not recognised as occurring separately.

*With the undercarriage legs fully extended, as they would be at V_2, and the mainwheels and the tail bumper just touching the runway, the angle between the fuselage datum and the runway is 6½ degrees. This is known as the fuselage angle limitation.

On each of the previous take-offs the captain made the initial climb at a speed higher than V_2, the recommended speed to give the desired gradient. From this it seems that he was concerned with the possibility of the tail bumper contacting the ground and was content to maintain the angle of attack at which the aircraft became unstuck until the aircraft was well clear of the runway. As the aircraft continued to accelerate above V_2 on the last take-off it is apparent that this same technique was being adopted. The effect of this technique was clearly demonstrated on the previous flapless take-off wherein the gradient was such that the first officer did not consider sufficient height had been achieved to raise the undercarriage until the aircraft had travelled a considerable distance from the point of unstick, at which time the speed was approximately 120 knots, 7 knots above V_2. The adoption of a shallow gradient in order to avoid damage from tail bumper contact is understandable; however, if a performance penalty was to be avoided the risk of tail bumper contact had to be accepted.

At the time, all the occupants considered that the aircraft was sufficiently established in the air for the undercarriage to be retracted. It appears that this opinion was based on the aircraft being airborne at V_2. However, before the climb path is stabilised after unstick, it is possible for an aircraft to wander from the desired gradient because of turbulence and the aircraft's handling qualities at that stage coupled with piloting skill. Because of this, the various flight technique authorities stipulate that an aircraft should be "safely airborne" before the undercarriage is retracted. Even so, there is reason to believe that it is not uncommon for some pilots to retract the undercarriage as soon as the aircraft is "airborne at V_2," or simply V_2. In an aircraft with ample ground clearance there is no great risk in following this practice because the clearance will normally take care of any descent below the desired gradient during the initial climb. However, it is critical in aircraft with little ground clearance and there is a possibility, particularly in a single engine flapless take-off, of nosedown pitching resulting from the tail bumper contact with the ground. Consequently, apart from being merely airborne, such an aircraft must be at a height to preclude inadvertent contact with the ground, for any reason, when undercarriage retraction is started.

The operator introduced Ambassador aircraft into this country early in October, 1957, and the captain involved in this accident was endorsed and trained as the Ambassador Check and Training Captain. At that time it was not envisaged that the aircraft would be operated in the flapless configuration and this operation was not made a requirement for the type endorsement, nor was any information on such take-offs included in the company's operations manual. During his conversion to the Ambassador the Captain carried out one flapless take-off, the only one made by him prior to the day of the accident.

Although the captain was a sound and competent pilot it is considered that tests involving single engine flapless take-offs were beyond his capabilities at the time because he lacked the knowledge and specific experience required to appreciate all the factors involved in carrying out such a manoeuvre in the Ambassador. This lack of knowledge and experience resulted in a premature retraction of the undercarriage.

GLIDER PRESENTS NEW HAZARD for CAR OWNER

During local flying activities at the Caversham airstrip, Western Australia, in October of last year, a Grunau Baby glider collided with an unoccupied motor vehicle parked on the side of the duty runway whilst the pilot was attempting to land. Both the glider and the motor vehicle were substantially damaged, but the pilot escaped with only minor injuries.

The pilot has described the accident as follows —

"At the time I was engaged on my first practice flight for the day and after reaching an approximate height of 600 feet when the auto tow line was released by my cockpit control, I made an immediate gradual turn to the left and then flew downwind parallel to the airstrip. My indicated height was then about 200 feet and I decided to turn left in towards the strip to complete a box circuit prior to landing. At the commencement of the turn I was at a position approximately 300 yards south of the strip. During the turn the aircraft commenced to skid and I realised that a steeper bank was required and rather than overcorrect in close proximity to the ground I elected to allow the aircraft to continue to skid and float over to the northern side of the strip into the low scrub border where I consider that a reasonably safe landing could have been made. During my initial turn towards the strip I encountered a gust of rising air which temporarily upset the angle of bank. Due to my concentrated efforts to bring the aircraft in for a landing alongside the strip as there was then no possibility of making a landing on the actual strip, I failed to see a car parked almost on the northern edge of the strip until too late to take any avoiding action."

The nose of the glider struck the side of the vehicle at an estimated speed of 45 knots and then dropped to the ground still resting against the vehicle.

An examination of the wrecked glider failed to reveal any defect or condition which might have contributed to the accident. The vehicle was parked in a position which could be regarded as reasonably safe, having regard to the operations being conducted on the duty runway.

The gliding experience of the pilot at the time of this accident amounted to 8 hours involving 105 flights, and he had satisfied the requirements for A, B and C gliding certificates. The pilot had commenced his gliding experience two years prior to the accident, but had received very little formal instruction and his knowledge had been gained largely through his practical experience of flying.

There were a number of eyewitnesses to the accident and to the flight which preceded it. They are in general agreement that the glider could have been safely landed from its position opposite the threshold of the duty runway. They all report, however, that the attempted turn into wind was made with very little bank. The pilot's account indicates that he realised the aircraft was skidding but apparently he was reluctant to put the wing down for a normally banked turn because of the proximity of the ground. When the pilot realised that he would be unable to align the aircraft on the intended landing path he stopped the turn and decided to land where the aircraft was heading. This sudden change of plan and perhaps a little apprehension as to the safety of the landing resulted in the pilot failing to observe the presence of the vehicle.

Although there was nothing unusual or difficult in the situation presented to the pilot he apparently lost confidence when he found the aircraft skidding and overshooting the intended landing path. Although his practical experience of gliding was quite substantial his basic training in the principles of flight appears to have been inadequate for a pilot of his experience.

Flying a Tethered Glider

In September of last year a Kranich glider was being used by club members in local flying exercises at the Radium Hill aerodrome in South Australia. Launching was conducted by winch into a 15-knot southerly wind. On the flight which culminated in this accident the tow proceeded normally until a height of some 350 feet had been reached.

At this point a defect occurred in the cable spreading device at the winch and the operator stopped the towing action. Noticing the cessation of tow the pilot lowered the nose to a normal altitude but, before he released the cable, the dive brakes spontaneously extended and were immediately reset in the closed position by the pilot. He then glided straight ahead for a short distance and made a left turn downwind. The winch operator and his assistant noticed that the cable had not been released but they had no means of quickly releasing or cutting the cable at the winch end. They paid out the slack but finally the weight and drag of the cable on the ground pulled the glider down from a height of approximately 100 feet. The pilot realised at a late stage that he had overlooked the release action and completed it, but this was done too late to prevent the glider striking the ground at a steep angle.

An examination of the glider revealed that the release was operating normally and the fact that the dive brakes could extend spontaneously was confirmed. It was also noticed that a nose hook was being used which did not incorporate any automatic override device.

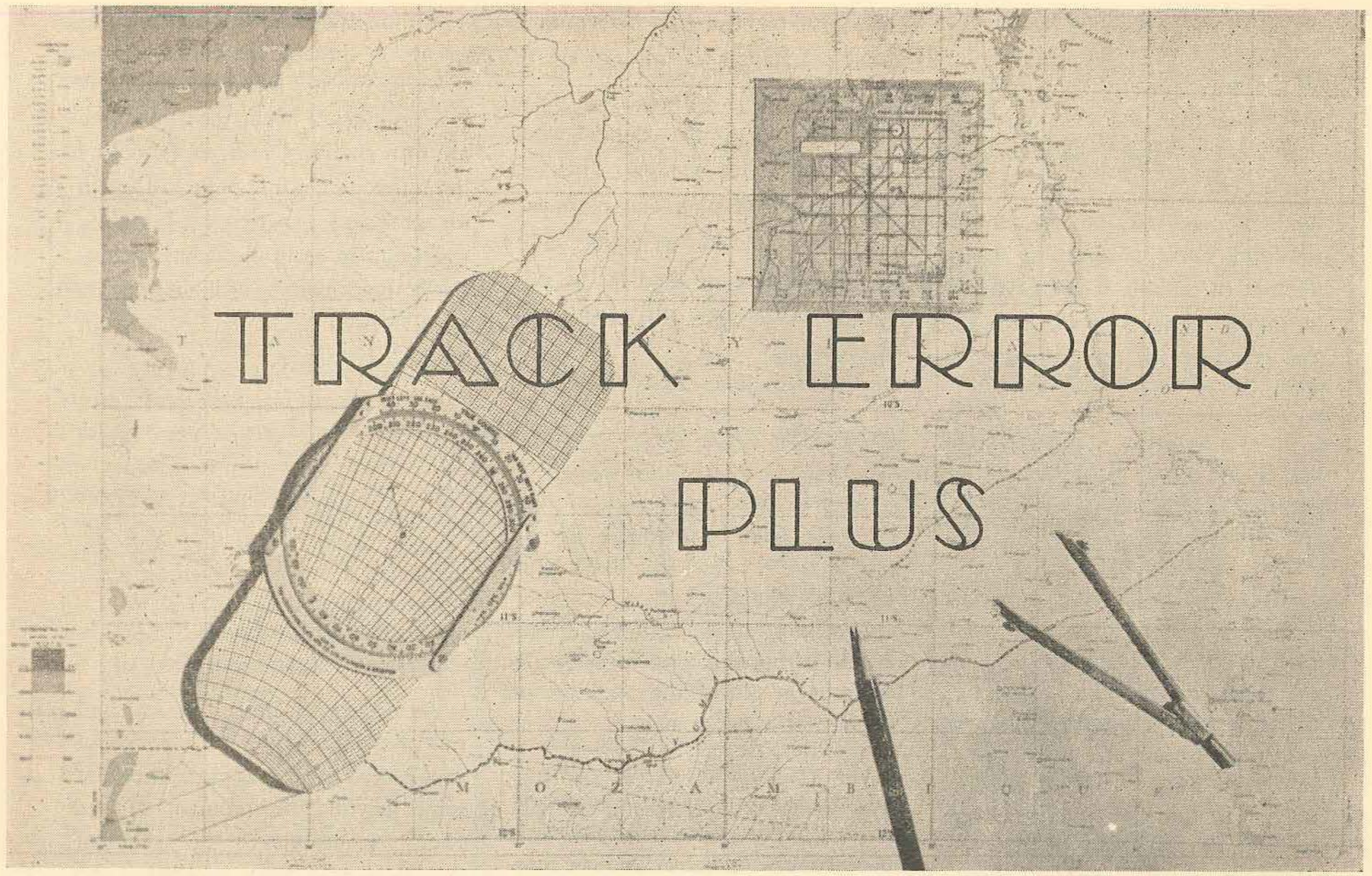
At the time of the accident this pilot had a total gliding experience of some 17½ hours involving 84 launches. This included over 10 hours on the Kranich, involving 16 launches, but 9 of these hours were obtained on an aero-tow delivery flight. The pilot possessed a "C" certificate for glider flying in addition to a private licence for powered aircraft.

It is probable that at the time the launch was abandoned the glider had sufficient height to complete a circuit and landing. It is also evident that there was still sufficient room for the glider to be landed straight ahead. The pilot on this occasion, however, flew straight ahead for a short while, thus involving a loss of height before commencing to make a circuit.

As occurs so often, this accident was the culmination of a series of unexpected events, some within and some beyond the control of the pilot. Nevertheless, the accident may well have been avoided if the winch gear had remained serviceable, if it had been equipped with an emergency release device, if the tow hook had incorporated an automatic override device or if the pilot had retained his full concentration and had been decisive in the emergency. It could even be said that the accident would not have occurred if the dive brake mechanism had not been defective and thus had not distracted the pilot's attention.

The obvious lesson is that attention to detail is all important in glider operations — as it is in power operations. In isolation none of these factors should have resulted in an accident, but in combination they over-taxed the resources of the pilot with the result that he was seriously injured and the glider extensively damaged.

TRACK ERROR PLUS



Some 27 minutes after departing Sydney for Canberra a DC.4 passed over Nowra aerodrome which is in the Nowra Danger Area and approximately 28 miles east of the flight plan track.

THE CIRCUMSTANCES

The aircraft departed Sydney for Canberra at 1523 hours E.S.T., cleared via the 220°M diversion. This route is direct to Marulan, 77 miles, and then 218°M to Canberra, a distance of 52 miles (see sketch). The E.T.A. for Marulan was 1554 hours and at Canberra 1612 hours. The crew reported that on departure from Sydney both ADF compasses were tuned to the Sydney N.D.B. and track was maintained by back-tracking on this station; a course of 228°M being established. The climb was made through "broken contact," and on reaching the assigned cruising flight level, 80, the aircraft was above 8/8ths cloud and flying in and out of cloud tops.

The take-off was made by the first officer and he hand-flew the aircraft throughout the flight from the right-hand seat. The captain has stated that he monitored the first officer's flying until the top of the climb and then became occupied with other duties. According to the testimony of the crew the position of the aircraft was established visually as being approximately on track just before cruising level was reached. Also that shortly after reaching cruising level, moderate to severe turbulence was encountered necessitating a reduction in airspeed and what was described as "slight" course deviations to avoid the worst areas of turbulence.

The first officer said that after settling into the cruise, he tuned the A.D.F. compass to the Marulan N.D.B., but was unable to get a reliable bearing until 1550 hours, some 27 minutes after departure, when Marulan was shown to be about 20 degrees to starboard. Three minutes later the needle swung around to quite readily indicate passage of station and, at the same time, the Sydney D.M.E. indicated 77 miles which is the distance to Marulan. An abeam Marulan position estimating Canberra at 1610 hours was passed by the first officer to Sydney A.T.C. at 1554 hours.

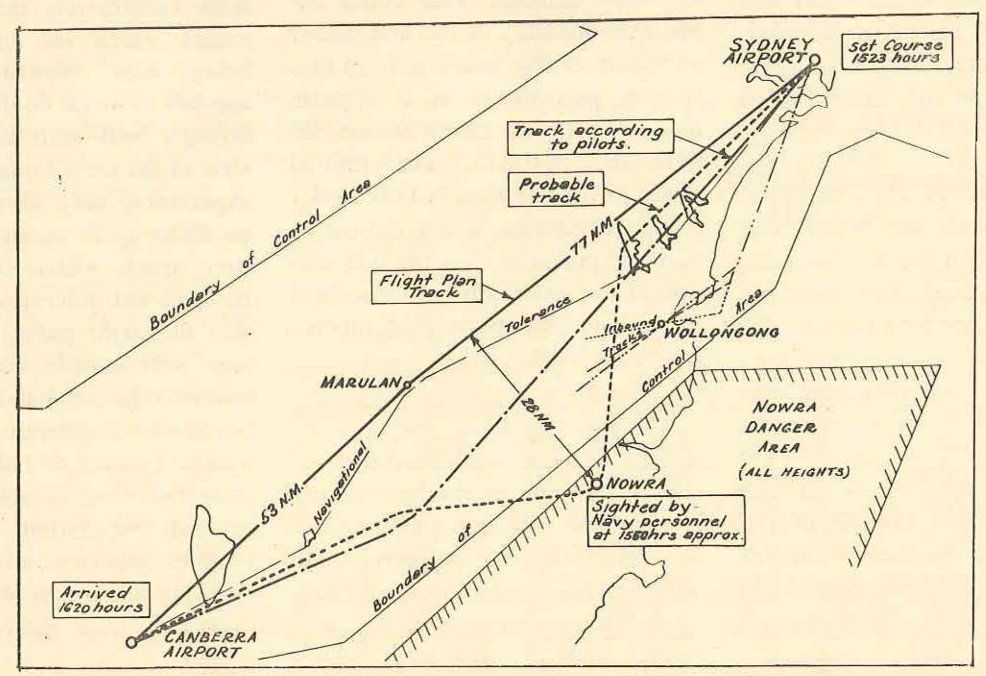
Just after passing the abeam Marulan position, A.T.C. queried the position of the aircraft. This was because the R.A.N. aerodrome, Nowra, reported that a Douglas four engine aircraft, either a DC.4 or DC.6, had been sighted overhead at approximately 1550 hours on a southerly heading at a height estimated to be about 7,000 feet. Nowra aerodrome is 71 miles from Sydney and approximately 30 miles east of Marulan.

According to the captain he recommenced to monitor the first officer's flying at the time of the A.T.C. query and noticed that the aircraft was "1½ dots in the yellow sector of the Canberra V.A.R." He advised Canberra A.T.C. accordingly. At the same time he checked the D.M.E. distances from Sydney and Canberra and reports that they were 80 and 51 miles respectively which would place the aircraft a few miles past Marulan and within 12 miles of track. A reliable bearing on the Canberra N.D.B. was obtained at about this time and the aircraft was turned on to a heading of 255°M for that place. As this turn was made the V.A.R. ON/OFF flags were observed to be flickering and for this reason the V.A.R. was considered unreliable. A few minutes later visual contact was established at approximately 40 miles D.M.E. from Canberra and at about 1600 hours a position abeam Lake Bathurst was passed to Canberra A.T.C. The aircraft was cleared for a V.F.R. descent and landed at Canberra at 1620 hours.

ANALYSIS

The crew admit that the aircraft was a considerable distance off track, probably some 15 miles when abeam Marulan, but consider that it could not have been over Nowra. An examination of other aircraft movements over southern New South Wales at the material time, however, established beyond all reasonable doubt that the aircraft sighted over Nowra by a number of R.A.N. officers could only have been this aircraft. Nowra aerodrome is within the Nowra (D202) Danger Area and aircraft are prohibited from flying through this area without prior approval of Nowra Tower. On this occasion the aircraft entered this area without the knowledge of the crew or Nowra Tower and whilst naval flying was in progress within the area.

The weather forecast for the flight gave 4/8ths cumulus cloud, base 4,000 to 5,000 feet and tops 8,000 to 12,000 feet, 2/8ths to 4/8ths large cumulus and cumulo nimbus, base 5,000 to 6,000 feet and tops 20,000 to 30,000 feet, intermittent moderate to severe turbulence, the average wind up to 8,000 feet 280°/30 knots and wind at 8,000 feet, the selected cruising level, 290°/45 knots. At the time



the forecast was issued a cold front was situated between Sydney and Marulan and this front passed through Sydney Airport as the aircraft was taxying for take-off. The Sydney Area Meteorological Officer reports that an "aftercast" of the weather over the route during the time of the flight shows that the weather was substantially as forecast, except that the wind below 5,000 feet was from the south at 10 to 20 knots.

Although the passage of the front immediately prior to take-off suggested to the crew that the forecast winds would be incorrect, no attempt was made to obtain revised forecast winds. Having discarded the flight plan courses the track on departure from Sydney was maintained by "back-tracking" on the Sydney N.D.B. In essence, the testimony of the crew is that a course of 228°M was established during the climb to maintain the desired track of 222°M and that this course was flown on the cruise until approximately 1600 hours at which time it was altered as a result of a N.D.B. bearing from Canberra. On this basis the aircraft could only have been over Nowra if the wind had been some 85 knots, or approximately twice the forecast strength, which, in view of the "aftercast," is inconceivable.

The radio navigation aids applicable to this route are N.D.B.'s at Sydney, Marulan and Canberra, D.M.E.'s at Sydney, Canberra and Yass, and the north-east leg of the Canberra V.A.R. Except under normal atmospheric conditions the range of the Sydney and Marulan N.D.B.'s at 8,000 feet overlap by a considerable amount as do the Marulan and Canberra N.D.B.'s. The range of the Sydney, Canberra and Yass D.M.E.'s also overlap for a considerable area. The north-east leg of the Canberra V.A.R. extends towards Marulan although its range is only about 40 miles at 8,000 feet. These aids were operating normally at the material time. The V.A.R. unreliability reported by the captain was found to be due to a defect in the aircraft's equipment. The unserviceability of the aircraft's V.A.R. equipment in no way contributed to this incident as the V.A.R. was not used on departure from Sydney and the unserviceability was detected just after the Canberra V.A.R. channel was selected.

As the aircraft was over Nowra at approximately 1550 hours it is apparent that the "reliable" bearing on Marulan obtained by the first officer at 1550 hours and the "passage of station" at 1553 hours were false. As previously mentioned, there was some thunderstorm activity over the route and the crew report that whilst reception of the Sydney and Canberra N.D.B.'s was quite good, considerable interference was experienced on the radio compass when tuned to the Marulan N.D.B. The Marulan N.D.B. is a relatively weak station and under adverse atmospheric conditions the effective range would be considerably reduced. This could explain the inability of the first officer to obtain reliable bearings from that station, particularly as it appears the aircraft was never within 25 miles of Marulan. The limited range of the Marulan N.D.B. under certain conditions is not critical as accurate positions over the mid section of the route can be determined by use of the Sydney, Canberra and Yass D.M.E.'s.

The crew say a position, approximately on track, was obtained visually as the aircraft reached the top of the climb. Assuming the aircraft was on track, this position would have been reached at approximately 1540 hours at about 37 miles from Sydney and 35 miles from Nowra aerodrome. Under the conditions that existed it would have taken the aircraft at least 10 minutes to cover this distance to Nowra. It follows, therefore, that as the aircraft was seen over Nowra aerodrome at 1550 hours, it must have flown direct to Nowra aerodrome from a point on the flight plan track about 37 miles from Sydney. This constitutes a departure from track of some 45 degrees or approximately 28 miles in 37 miles.

The captain holds a first class airline transport pilot licence and at the time of the incident his aeronautical experience amounted to nearly 12,000 hours, most of which was gained as pilot-in-command of multi-engine aircraft. The first officer is the holder of a second class airline transport pilot licence and at the time of the incident had accumulated a total of over 6,000 hours' aeronautical experience, including some 1,260 hours as pilot-in-command of multi-engine aircraft. Both the captain and first officer were familiar with the route and radio navigation aids available.

It has not been possible to determine conclusively the sequence of events which led to the aircraft being over Nowra, but there appears to be no doubt that it arose through inadequate navigation. In view of the crew's qualifications and experience, they should have had no difficulty in maintaining the desired track within the prescribed navigational tolerances. The fact that the flight path of the aircraft was well outside these tolerances can only be attributed to an indifference to the requirements of Air Traffic Control or failure to appreciate the dangers arising from inaccurate navigation. Very likely, their attitude stemmed from the fact that this was a very short flight, the estimated time interval being 49 minutes.

TOWER OF BABBLE

(Extract from the U.S. Naval Aviation Safety Review, "Approach," May, 1958.)

The Beech was just turning on to final, gear down, flaps 30, props full forward, when the tower said, "Hold clear, nine."

"Hold clear? Guess he wants us to wave off," grumbled the pilot, "okay, dump the flaps," and he reached for the throttles. A moment later the air in the cockpit was blue with four-letter words as the pilot lunged for the flap lever and raised them from the 45 degree down position that the co-pilot had placed them in.

"What in $"%@=? did you lower the flaps for? I said to dump the flaps, don't you know that means to get rid of 'em?"

Before the nervously shaken co-pilot could reply the tower called to ask why they had taken a wave-off. In a few more explanatory transmissions it developed that the tower's "hold clear, nine" was intended for an R4Y holding off the runway — seems he was starting to inch up on to the runway. Yep, both the Beech and the R4Y were number nine.

The mythical tower of Babel had nothing on this situation, nor on many other similar situations that take place in naval aviation nearly every flying day. The confusion that exists in cockpits, in control towers, and on the line is astounding — and it's astounding that more accidents don't happen because of wrong or non-standard terminology and signals.

The confusion in the above case originated in the tower, but towers aren't the only source of conflicting words and instructions that can end in disaster. In fact, it's often no words rather than words that create a hazardous situation.

There are three underlying causes for the misinterpretations that arise out of situations like the one described above.

First is the English language, which is littered with pitfalls in its written and spoken forms. Even under ideal conditions "go" can sound like "no"; and "gear" sound like "clear," "prop" can be interpreted as "stop."

Second bugaboo is mathematical probability — says that if you say "nine" around a busy airfield often enough, there's bound to come a time when two nines will answer up.

And the third offender, the only correctible one, is people. Ever since "Hell's Angels" a great preponderance of the people who work in, on or around airplanes seem to talk the terse, grade-B movie "flying talk." It's a normal, human trait that you can't blame people for, to talk the "jargon of the trade."

But individuality makes us invent our own jargon, and some of it just doesn't get around to the right people until panic button time. Say now, there's one —Panic Button—bet you can find a lad who'll look all over the cockpit for one.

Well, what would YOU do if you had half flaps and your pilot told you to "Dump 'em?" The co-pilot in this story had heard the phrase before, but to him "dump" was synonymous with "down" and "lower." His pilot insisted that "dump" meant the same as "jettison," "get rid of," "do away with," "spill."

You can probably think of several pet phrases right now that are perfectly clear to your crew, but what about the young lad who just offered to be a "warm body" for you so you could run a Beech up to Norfolk or North Island for some parts? Never flew with you before, but this is daylight VFR and he's just sitting there to run the wobble pump . . . And then you make that backward motion over the throttles as you go to raise the wheels, so he'll ease off to 30" for you. Oh, you didn't think he'd pull them all the way back on you? Well, there's a pilot who now touches up the grey hair that was brought about by a lad who did just that.

One of our pet peeves turned into a near-accident not long ago — we grumble and growl when towers ask us to "expedite this" and "expedite that" because we like to expedite through the clear, blue air but we rebel at being rushed into a hasty ground check or takeoff.

So, when the tower asked a lined-up aircraft to "expedite clearing the runway," they weren't sure whether they were supposed to hurry up and take off or hurry up and taxi back off the duty runway. The tower operator knew what he wanted, but the resultant dangerous confusion arose because the pilot responded with his own perfectly logical interpretation of "clearing the runway."

And then there was the many-thousands-of-hours pilot who saw his student was going to fly right down into the runway so he said "break it" . . . pause . . . "break it" . . . BREAK IT — NEVER MIND, I'VE GOT IT . . .$"%$. Turned out the youngster was braking as hard as he could, even though he didn't understand why the instructor wanted the brakes on while still in the air . . . "break it" was flying talk that he'd heard used in a recruiting movie, but he hadn't yet reached the point of learning what to break. No one had told him.

In one P2V squadron they had to convince several radar operators to stop asking for permission to "fire up the radar" after one pilot heard only the two words, "fire and radar." This same squadron was the one in which a pilot was saying, " . . . in case you have to bale out . . . ", when a man put his headphones on heard only the last two words, and was halfway out the hatch before someone grabbed his collar. Seems he had a harness on but no chute.

While pilots are far more guilty of creating confusion babble than others, we've heard of a near classic by a tower operator who tells R4D's approaching the ramp to "go to button two." If you stop and ask him why you should switch to channel two at that point, he'll come up and tell you that he wants you to head for main gear turntable number two and what are you confused about, sir? We call them buttons here, see?

Then there was the FJ-3 making a mirror approach to a carrier. LSO was monitoring the approach and called a reassuring, "all the way down" to the pilot. Pilot interpreted this as "bring it down" and nosed over, dropped his right wing crossing the fantail and sheared the right main gear as he picked up No. 5 wire. LSO's must remember that their words, if not clearly understood in that critical stage of flight, can turn a good pass into a fantail-buster.

An F9F-8P ran off the end of the runway when he aborted his takeoff upon hearing an urgent, "Ten, hold it up." Tower wanted another aircraft, also No. 10, to stop taxi-ing. Scratch one main gear.

And the old handy thumbs-up-signal! Boy, that can sure get airplanes and people into predicaments in a hurry! Thumbs-up has come to mean just about everything except that you have no thumb. It's used to mean "up," "roger, I understand you," "yes, I hear them screaming at us," "all's well," "climb," "look up there," and "look, my thumb is bleeding." Unless you're accustomed to what thumbs-up means from a certain individual, you can't depend on it much anymore.

While it doesn't happen very often, a Safety Council recently pointed out the potential confusion that existed in their area when a squadron partly transitioned into new aircraft had several new and several old aircraft with the same side numbers. This not only created difficulty in communications, it also resulted in a "who's on third?" situation when a duty officer became anxious about No. 10 which was overdue, and was reassured by a helpful but uninformed POOW that "No. 10 is in the barn, sir." The other No. 10 was overdue.

While conducting some undercover research on the subject of misleading instructions and words we ran into a dilly without even looking for it. Taxiing along one recent moonless night we asked the co-pilot, "Do I turn left here?" and he immediately answered up with a laconic, "Right." With our thumb-prints still on his throat, he then amplified his meaning — that's right (oops, that's correct), he wanted us to turn left.

Human response to stimulus has an important relationship to commands, especially in moments of mental stress. Take the case of the student who was having trouble in the air — the chase pilot said, "pull up!" and the pilot immediately ejected. He insisted, later, that he had heard the words, "bail out," and the chase pilot insisted he didn't say them. What most likely happened here was that the student was ready to bail out, he was "primed" to hear the command just as you're primed to see the traffic light turn green after it changes from red to amber. And when he heard the terse phrase, same syllables, same tone of urgency, he heard what he was expecting to hear and out he went.

Pilots who are in a position to offer advice to someone in an emergency situation might keep this in mind and, where possible, offer their advice in a calm, reassuring sentence rather than a short, harsh command that might "trigger off" an undesired response. Think of what you do when the neighbour's not-very-friendly pooch snarls in your path — you don't say "nice dog" in a harsh tone, that would trigger him off. You speak calmly and soothingly, even if you call him a no-good-mangy cur, because he responds to voice tone stimuli better than to words. Try it.

How far can we go in eliminating Cockpit Confusion? Theoretically, we could eliminate it completely if everyone said just what he meant in plain, standard language.

But we're not automatons and we rebel sometimes at attempts to make us say a standard, canned phrase. Listen to some traffic turning base next time you're in the tower and you'll hear much originality . . . "gear down and in the green" . . . "down and locked" . . "gear check complete" . . . "gear down and apparently locked" (no gambler, he) . . . "three in the green, pressure up" . . . "turning base, rollers and draggers in place" (hepcat, this one) . . . and occasionally an unimaginative conformist who says, "turning base, gear down and locked."

Transferring actual control between pilots is another place where words and sign language break down frequently. Co-pilot puts his hands on the yoke momentarily, pilot says, "got it?" and the machine bumbles along on its own because the co-pilot thought the pilot said, "got it." Pretty hard to go wrong if you do it the old corny way — rock the wheel, raise both hands, and watch for the other fellow to pat his head. Would completely eliminate one standard phrase — "but I thought you had it."

Let's get off your back and the tower operators' and take a look at the plane captains out on the line. Many of them have never had "Taxi Sense" as required reading, and their signalling gyrations would delight even the most avid ballet enthusiast. Here again originality is the bug, for who wants to guide a zillion dollar flybird into the chocks with corny old-fashioned signals when a dash of flavour will lighten the hearts of weary pilots? So we get NAS Nijinskys who flail the air with dramatic waving of arms while weary pilots groan or, worse yet, follow their signals right into an open gas pit. Plane captains and taxi directors, unite! Taxi signals were made standard for a serious purpose and OpNav Inst 3710.7A directs that they be used as adopted.

No, we probably won't ever standardise terminology or hand signals to an ultimate degree. But we can add an extra dash of common sense to some of the jargon and mystical hand-wavings that take place in cockpits and on the line. Like briefing a co-pilot whom you haven't flown with, for example, and telling him that after takeoff you'll raise the wheels and he's to bring back the throttle to 30" when you turn them loose.

And like using standard, Navy-wide accepted terminology that leaves no doubt. IFR means Instrument Flight Rules, and if you started referring to Inflight Refuelling as IFR, someone's gonna be embarrassed! Same as TOT — what do you call it, take-off time, time over target, turbine outlet temperature? Does your squadron PIO get mistaken for pilot induced oscillation?

Whether you're a one-seater jet jockey or a Connie co-pilot, a tower controller or a substitute acting plane captain, a little common-sense in the use of English — both the Queen's English and body English—will go a long way toward eliminating that helpless feeling experienced by a senior pilot in an allied service who elected to take a waveoff and called for "takeoff-power." Yep, his flight engineer took off power — all of it.

CONFUSING CONSPICUITY

Extracted from Flight Safety Foundation Bulletin, 22nd April, 1957

Being seen (and obvious about it) is a desirable state day and night, but when wing illumination lights are used to accomplish this, confusion can prevail. A recent near-miss report emphasises the point.

"We were V.F.R. on course and had them in sight at least five minutes before passing. They had steady navigation lights and also their wing ice lights on. From the angle we approached, we could see the two white lights long before the green wing-tip light and were actually unable to tell which way they were going. At first we thought it might be two planes in close formation going away from us. Then we decided it was a plane approaching head-on with its landing lights on. When the green navigation light finally became visible and we could see which way the plane was going, we descended to 14,500 and passed below and ahead of it . . ."

Fatal Spin, Twin Engine Beechcraft

A Beechcraft Travel Air, Model 95, spun to the ground 25 miles northwest of Little Rock, Arkansas, on 22nd July, 1958, killing all four occupants.

(*Summary based on the report of the Civil Aeronautics Board, U.S.A.*)

(All times appearing in this report are Central Standard Times based on the 24-hour clock.)

THE FLIGHT

The aircraft took-off from Adams Field at approximately 1100 hours with four men on board: a C.A.A. General Operations Safety Inspector, a pilot who was to be flight checked for a twin engine type rating and two passengers. The check flight was to consist of various flight manoeuvres such as take-offs, landings, stalls, simulated engine out emergency procedure and single engine operation.

Shortly before 1200 hours the aircraft was observed to nose down and commence spinning until it finally struck the ground. Witness opinion as to the altitude from which the spin started varied considerably and cannot be fixed closer than between 800 to 2,000 feet.

INVESTIGATION

The Beechcraft Travel Air, Model 95, is a four-place aircraft, equipped with two 180 h.p. engines and full-feathering propellers. The aircraft was relatively new, had been properly maintained, and was in good operating condition in all respects.

The flight called the control tower for taxi-ing instructions at 1054 hours and was cleared to Runway 35. After reaching the run-up area both engines were run-up. The aircraft then took-off, flew the traffic pattern and landed. Immediately after, clearance for a second take-off was requested and granted and the aircraft then took-off and departed the Adams Field traffic pattern at approximately 1109 hours.

Shortly before 1200 hours several witnesses observed the aircraft some nine miles west of Mayflower, Arkansas. None had aeronautical experience and they gave varying versions as to the altitude and attitude of the aircraft. They agreed, however, that the aircraft nosed down and started spinning. Two witnesses observed the aircraft strike the ground and stated that it spun until ground contact.

The crash site was a cornfield on flat river-bed land, soft from recent rains. The aircraft had contacted the ground in a slightly nose-low attitude while descending nearly vertically. The aircraft initially struck the ground on a heading of 127 degrees magnetic and then, except for the empennage, pivoted counter-clockwise on the right engine to a heading of 108 degrees. The wreckage was not scattered, thus showing the predominant vertical motion at impact.

The flight control systems were generally intact and showed no evidence of malfunction or failure prior to impact.

The pilot held a valid airman certificate with commercial and single engine land ratings and a current medical certificate. He was relatively inexperienced in light twin-engine aircraft, the evidence indicating that his piloting time in such aircraft was 10 hours, of which 5 hours was in the Beech Model 95. His total experience in single-engine aircraft was 1,500 hours.

The C.A.A. inspector had logged 5,341 flying hours, but had done an unknown amount of other unlogged piloting. To qualify for giving "light twin" engine rating flight checks, he had completed the C.A.A. "light twin" checkout programme in September, 1956. During this course he flew the Piper Apache three hours, and the Cessna 310 two hours. On 13th November, 1956, he completed a second course entitled "aircraft characteristics and performance below 12,500 pounds." During this course he flew the Piper Apache seven hours, the Cessna 310 eight hours and the Beechcraft C-18 one hour. He had given 18 multi-engine flight checks since he had completed this course of which five were in the 60 days immediately preceding the accident. He had about 440 multi-engine flying hours, but no recorded time in this type of aircraft, the Beech Travel Air Model 95, which, having a maximum weight of 4,000 lb., is classed as a light twin.

Prior to take-off the inspector briefed the pilot on the forthcoming flight. The briefing included a discussion of a number of items in the operator's manual and in the aircraft flight manual. It included other factors such as the best rate-of-climb speed, the best angle-of-climb speed, and single-engine minimum control speed. There was testimony indicating that this briefing lasted for approximately one hour.

The gross weight of the aircraft at take-off was approximately 4,000 lb., or the maximum allowable gross take-off weight. The centre-of-gravity was located within the allowable limits, approximately 1.3 inches forward of the rearward limit.

The aircraft was equipped with a throw-over type of control wheel which permitted the aircraft to be flown from either the right or left front seats with operable pairs of rudder pedals available for both pilot and co-pilot. Examination of the broken throw-over wheel arm indicates that the wheel was positioned on the left side at impact.

ANALYSIS

The exact manoeuvre that was being attempted at the time the spin started cannot be determined from physical evidence, but it may logically be deduced. Normally this type of check flight for rating lasts from an hour to an hour-and-a-half. Manoeuvres to be demonstrated to the satisfaction of the inspector are a simulated single-engine climb-out following a missed approach, an engine failure on take-off, and an engine failure at minimum control speed. As the accident occurred after the check had been in progress for about an hour, and as these manoeuvres are normally done towards the end of the flight, it seems entirely possible that one of these was in process when the spin started.

It is most unlikely that a spin was started at low altitude intentionally as spins are not called for in either the testing for type certification of most twin-engine aircraft nor during check flights for type ratings. The Board is of the opinion that the spin occurred unintentionally.

Examination of the wreckage indicated that the aircraft struck the ground in a left spin. The flight controls were capable of normal operation, the aircraft was aerodynamically clean (flaps up, gear up, all openings closed), and no evidence of structural failure or deformation was found.

The spin-recovery characteristics of the aircraft are good, so that any conventional spin-recovery technique results in a rapid stopping of the spin. Stopping the spin does, however, leave the aircraft in nearly a vertical dive since the spin is a normal nose-well-down spin. Recovery from this dive with flaps up and the loading which existed would take from 1,000 to 1,500 feet of altitude.

If a spin or any other manoeuvre is entered which endangers the safety of the aircraft during a flight test, the C.A.A. inspector customarily takes over the controls and recovers from the manoeuve. The performance of this function is possible with the single throw-over control column. However, during the entry of a spin or its recovery, particularly at low altitude, the Board believes this function would be considerably more difficult.

When the aircraft contacted the ground it was in approximately a 20 degree nose-low attitude with the left wing down and was moving slightly forward and to the right, but primarily vertically downward. This indicates that a recovery had not been effected even though opposite rudder (right rudder deflection) control existed at impact. The nose-up attitude (relative to a normal spin) was in all probability caused by the pilot's last-second attempt to pull the nose up by up-elevator movement just before contacting the ground.

The Board is of the opinion that a stall and spin occurred at a low altitude during the demonstration of one of the engine-out minimum control speed manoeuvres. The Board was, however, unable to determine their reasons for entering the initial spin. Nevertheless, it believed that the following factors may have caused or contributed to the entry into the spin. The only experience that the C.A.A. inspector had in this particular make and model aircraft was during the flight ending in the accident. During this time, about one hour, it is reasonable to believe that the applicant pilot did most of the flying. It appears that the inspector was not familiar with the handling and stalling characteristics of the aircraft. During the performance of simulated engine-out manoeuvres at minimum control speed it is therefore possible that the aircraft reached a stall-spin airspeed condition before the inspector recognised it. In this condition, any mistaken handling of the power-plant or flight controls could lead to an unintentional spin.

Subsequent to the accident the Board had the Beech Aircraft Corporation conduct a test programme in which spins simulating the conditions of the accident, and spins under even more critical conditions, were demonstrated. Recoveries from these spins which included those with a windmilling inside engine and a feathered outside engine, and a windmilling inside engine with power being developed by the outside engine, were satisfactory. However, these spin tests did demonstrate that if the spin was entered at 1,000-1,200 feet altitude complete recovery was not possible.

PROBABLE CAUSE

The Board determined that the probable cause of the accident was the unintentional entry into a spin at too low an altitude to recover.

At 2319 hours on 6th April, 1958, a Viscount crashed and burned near Tri-City Airport, Freeland, Michigan. All 44 passengers and the three crew members were killed.

VISCOUNT STALL DURING FINAL APPROACH Tri-City Airport, Michigan

(*Summary based on the report of the Civil Aeronautics Board, U.S.A.*)

(All times appearing in this report are Central Standard Times based on the 24-hour clock.)

THE FLIGHT

The flight was scheduled between La Guardia Airport, New York, and Chicago, Illinois, with intermediate stops at Detroit, Flint and Tri-City Airport, Michigan.

The trip to Flint was routine and the aircraft landed at 2237 hours. At 2302 hours the aircraft departed Flint for Tri-City Airport and was to be flown in accordance with an I.F.R. clearance at a cruising altitude of 3,600 feet. At 2316 hours the flight advised Saginaw (Tri-City) radio that it was over the airport. A short time later ground witnesses observed the lights of the aircraft when it was on the downwind leg of the traffic pattern. The aircraft was seen to make a left turn on to base leg and at this time the landing lights of the aircraft were observed to come on. During this portion of the approach the aircraft was flying beneath the overcast, estimated to be 900 feet, and appeared to be descending. When turning on final the aircraft flew a short distance beyond the extended centreline of the runway and the turn was seen to steepen for realignment with the runway. Soon after this the aircraft was observed to level off and then to descend steeply and strike the ground. A large fire immediately erupted. Available emergency equipment was alerted and brought to the crash site.

INVESTIGATION

Investigation disclosed that the aircraft struck the ground in an open cornfield muddied from previous rain. The wreckage site was 2,322 feet from the approach end of Runway 5, almost directly in line with the runway. Line of sight from the main wreckage to the end of Runway 5 at its centreline was 45 degrees. The entire wreckage was confined in an area almost equal to the length and span of the aircraft. It was determined that the aircraft struck the ground on its nose and the leading edge of the right wing, with this wing sufficiently forward so that its leading edge was parallel to the ground. The angle of impact was approximately vertical.

The main wreckage, consisting of the major portions of the fuselage, empennage, and wings, was found lying in an inverted position. Most of the aircraft was consumed by the intense fire which followed ground impact. There was evidence that several minor explosions had occurred. These explosions were caused by the ignition of isolated pockets of fuel which were formed after the aircraft struck the ground.

It was apparent that the nose of the aircraft struck the ground with considerable force. The lower half of the nose section, including the nose wheel bay, was compressed by impact forces into a mass one-fourth of its original size and was buried in the ground.

Examination of the wreckage failed to reveal any evidence of the flight controls having malfunctioned prior to impact. It was determined also that the flaps were selected to the 40-degree "Down" position and that they were extended to this position. The nose gear and the main landing gear were determined to be in the "Down" position at the time of impact. Most of the instrument gauges, however, were so badly damaged it was impossible to obtain readings, and the gauges which

could be read were of little significance.

The nose gear Dowmic switch, a part of the stall warning (stick-shaker) circuitry, was found mounted in its normal position on the aft side of the nose strut with its wires still attached. The rubber boot that covers the wires over a distance of approximately four inches from the switch had been partially burned away. However, the rubber boot over the switch plunger was still in position and was undamaged.

Prior to checking the switch electrically, a number of actuations of the plunger were made but no audible operation of the switch was heard nor could contact of the points be felt. Subsequent inspection disclosed that although the operating plunger was in the withdrawn position the rocker or armature sub-assembly, which supports the movable switch contacts, was in the position it assumes when the operating plunger is depressed. This position permitted the switch contacts associated with the stall warning circuit to be in contact at all times regardless of plunger position. Initial electrical checks disclosed no continuity between these contacts; however, during subsequent checks by the examining group and tests conducted by the National Bureau of Standards continuity did exist between the closed contacts.

The switch contacts in question are normally open in flight and are closed upon landing by movement of the operating plunger, whereupon the stall warning system is rendered inoperative. Upon becoming airborne the plunger is withdrawn, permitting the rocker sub-assembly to be returned by spring force, thereby opening the contacts and arming the stall warning circuit.

It was found that the rocker would return to normal when the lower magnet was removed, but would remain in the depressed position when operated with the magnet reinstalled. A similar behaviour was noted with the two switch magnets interchanged. Upon restoring the magnets to their original positions, the switch operated properly and continued to do so. It was also determined that the sensing unit of the stall warning system was installed April, 1957, and was not calibrated prior to the accident.

In addition to the examination of the nose gear switch, the National Bureau of Standards conducted static and dynamic acceleration tests on four similar switches and the test results indicate the extreme improbability of the nose gear switch malfunction having been the result of crash impact.

All four engines and their respective propellers were forward of the wing spars in a straight line and were in about their normal positions relative to their respective attach points on the aircraft. Nos. 2, 3 and 4 engines were buried in the ground to a depth of about five feet.

Engine accessories were functionally tested or, if this was impossible because of damage to them, were disassembled and examined. All appeared to have been capable of normal operation prior to impact, and there was no condition revealed which would indicate maloperation prior to impact.

During the investigation a number of eyewitnesses, located on and around the airport, were interviewed. While they were not in complete agreement as to what they saw, in general it was as follows: None actually saw the contour of the aircraft in the darkness, but some did see its lights and heard the noise of the engines. They said that the aircraft was first seen on the downwind leg of the traffic pattern to Runway 5 and that this leg was flown close in at an altitude of 600 feet or higher above the ground. They further stated that as the aircraft turned on to base the landing lights came on and the aircraft continued on beyond an extended centreline of the runway where a steep left turn was made for realignment. A licensed commercial pilot and other witnesses testified that the aircraft was banked 50 to 60 degrees during this turn. The witnesses then described a roll out of the turn followed by a pitch-over and a nose-down steep descent to the ground. It was also thought by some that immediately after the roll out of the turn the aircraft nosed up slightly accompanied by a surge of power. The lights, which were seen in varying combinations, were the navigation, landing, and taxi-ing lights. The wing ice lights or cabin lights were not seen. Some witnesses said that after the aircraft struck the ground reflection from the fire lighted the scene and the tail of the aircraft could be seen momentarily in a somewhat upright position. The altitude of the aircraft immediately prior to the pitch-over was estimated to be between 400 and 600 feet.

At the time of the flight a low pressure centre was moving across southern Michigan and had just moved eastward between Detroit and Toledo. As the flight approached Tri-City, ceilings were between 900 and 1,100 feet with visibility reported as being three to four miles. There was light snow and a freezing drizzle. Surface winds were reported from the north-north-east 18 to 27 knots. Witnesses described the weather at the time of the accident as freezing drizzle and strong wind gusts. Some said that pronounced gusts occurred while the aircraft was in the landing pattern.

The captain was a veteran pilot who had been with the operator 17 years. He had approximately 1,700 flying hours on Viscount aircraft and a total of more than 16,000 hours on all aircraft. He was known to be a careful and conservative pilot.

ANALYSIS

From all available evidence the Board believes that the aircraft structure, its control surfaces, and power plants were in proper operating condition prior to the crash. Although the flight control linkages could not be examined in their entirety, because of damage caused by the intense fire, those portions examined showed no evidence of a control malfunction.

The Dowmic switch that arms the stall warning system when the aircraft is airborne was found to be malfunctioning after the crash. Examination of the switch and acceleration tests conducted on similar switches indicate strongly that the malfunction existed prior to the accident.

During the investigation it was determined that the aircraft while flying at an altitude between four and nine hundred feet above the ground pitched over and dived nose-down, striking the ground in or near a vertical position while on a north-easterly heading. There are a number of facts which point to this conclusion. The open flat terrain presented a clue, an undisturbed tree, 67 feet high, 148 feet behind the wreckage and in line with the flight path of the aircraft. While the fact that this tree was not damaged does not necessarily indicate a steep impact angle of the aircraft it does establish a minimum approach angle of 22 degrees.

In an effort to determine the cause of the sudden pitch over and steep descent, considerable study was given to the propellers and their related systems with particular significance placed on the possible movement of the blades below the flight fine pitch stops during the approach. It has been determined that such a malfunction of one propeller, whereby the inflight fine pitch stop was withdrawn, thus permitting the blades to move to a low pitch, would not initiate an abrupt manoeuvre such as occurred in this instance. Furthermore, the electro-hydraulic stop as well as inherent propeller operating characteristics provide safeguards which practically eliminate the chances of such an occurrence creating a hazardous situation. This conclusion confines the study to those portions of the propeller system that are common to all four propellers.

The circuitry, which permits withdrawal of the inflight fine pitch stops after the aircraft is on the ground, is so arranged that a double fault must exist to accomplish this function in flight. Furthermore, the existence of such a double fault would be indicated by warning lights in the cockpit and precautionary measures to counteract such a development would have been available to the crew. In addition, test circuitry to detect a single fault in either the positive or negative side of the circuit is provided. Consequently, it is considered that the propeller inflight fine pitch stop control circuitry provides protection against inflight withdrawal of the stops to such a degree that unwanted withdrawal did not occur in this instance.

The inherent propeller-engine operating characteristics are such that a considerable degree of protection against insurmountable drag during approach is provided. This is true in that the propeller is being governed in accordance with engine power and airspeed throughout the approach. High drag is developed only at low airspeeds, 108 knots or less, and with throttles completely retarded. The blade angle would remain above the inflight fine pitch stop with as little as 11,000 r.p.m., with power applied. It is believed, therefore, that the inherent operating characteristics of the propeller would preclude any high drag situation occurring during the final phase of a normal approach. This has been substantiated by both test flights and propeller wind tunnel tests.

Since it was evident that there was no malfunction or failure of the power-plants and aircraft structure prior to impact, attention was focused upon the operational phase of this accident.

There is no question of the crew's competence to fly Viscount aircraft. Both captain and first officer had considerable flying time in Viscounts and both were properly certified by the C.A.A. As stated before, the captain was known by those close to him and by the C.A.A. to be a careful and conservative pilot.

From the witnesses it was learned that the downwind leg of the traffic pattern was flown close in. It was also revealed that the aircraft, when on the base leg, flew beyond the extended centreline of the runway and that a steep left turn in the form of an "S" was made for re-alignment. Some of the witnesses said that they believed the aircraft regained a level attitude momentarily on final, and that this position was followed by a slightly nose high attitude and then a vertical dive to the ground.

With the probability ruled out that the propeller blades moved into the ground fine pitch position during flight, the possibility that the aircraft stalled was carefully considered. Many flight tests have been made of the stall characteristics of the aircraft in level flight and shallow turns; under these conditions normal recoveries have been easily made. Also, the inherent stall characteristics of the aircraft in these attitudes are not vicious and recovery is normally made with little loss of altitude. Therefore, it seems extremely unlikely that a stall occurred from a level flight attitude. However, if an unanticipated stall occurred during a steep turn at any altitude below 1,000 feet, a safe recovery might be impossible.

A study of the stall tests showed clearly that with the stall warning device functioning the pilot should receive warning of impending stall in sufficient time to execute corrective action. However, with this device inoperative, and with the aircraft in steep turning flight, the warning and the "g" break occur almost simultaneously.

While tests indicated that the aircraft could be controlled within safe limits under all conditions tested, it is also true that a fully developed stall was never permitted. Further, the pilots who flew throughout these stall tests have considerable experience in flight test operations and, since each individual test was carefully planned, there was never an element of surprise. Expecting the stall to occur, the pilots were able at all times to prevent the stall from reaching dangerous proportions. From previous tests made by the manufacturer it was learned that when a stall occurs during a steep turn the aircraft tends to roll to the outside of the turn, "over the top," and enter a spin in this manner.

The approved Flight Manual for the aircraft defines the stall as that condition of flight when the lift coefficient has reached its maximum value (C_{Lmax}). It further states that if the angle of attack is increased beyond this point a wing drop and a nose-down pitch cannot be prevented. Should an attempt be made to correct the roll in a power-on stall by use of ailerons alone and without simultaneous forward movement of the control column, the wing drop may be large (greater than 90 degrees), probably associated with a large change in heading and a considerable loss of height.

Because of the conditions described, it appears that the company's Viscount training programme lacked two important factors: the dissemination of necessary information to all pilots relative to the importance of the stall warning device with respect to adequate warning and the dangers confronted when it is inoperative, plus the stall characteristics of the aircraft with various flap settings in turns steeper than those normally made.

On the night of the accident, the low pressure centre moving eastward between Detroit, Michigan and Toledo, Ohio, brought colder air into southern Michigan and changed the precipitation from rain to snow and freezing drizzle. With it also came variable ceilings and visibilities. At the time the flight was flying between Detroit and Saginaw, weather conditions at altitudes up 5,000 feet were conducive to icing. This condition was further substantiated by the captain of a Constellation which landed at Saginaw 13 minutes before the accident, who said that he observed his aircraft accumulate about one inch or more of ice on the wings during the approach to Saginaw.

It is probable that the existing weather conditions contributed materially to this accident. The close-in approach, short radius of turn, and the steep bank may well be attributable to an attempt by the pilot to keep the lighted runway in sight because of the restricted visibility occasioned by snow showers and freezing drizzle. Since the investigation disclosed that the wing flaps were 40 degrees down it is believed that the pilot lowered the flaps to this position either just before or during the turn. This would suggest that the airspeed in the turn was 142 knots or less, the recommended never-exceed airspeed with flaps lowered beyond 20 degrees. With the type of approach described, combined with a possible accumulation of ice similar to that encountered by the Constellation, maximum gusts in excess of those being recorded (tending to cause the natural stall warning buffet to be unrecognisable), increased stalling speed in the steep turn close to the operating speed, and an inoperative stall warning device, a veteran pilot could suddenly find himself in a stall situation from which he could not recover.

PROBABLE CAUSE

The Board determined that the probable cause of this accident was a stall during a steep turn, resulting in an over-the-top entry to a spin at an altitude too low to effect recovery. Contributing factors were an inoperative stall warning device, gusty winds, and possible ice accretion on the airframe.

A PURPOSE WELL SERVED

Prior to start-up the pilot wound the elevator trim control forward, but when it was about half-way to the maximum position sponginess and resistance were noticed. Attempts to wind the elevator control further forward caused the rudder trim control to rotate. The elevator trim control was then wound back, but half-way to the maximum rearward position the same symptoms were encountered. Inspection revealed that a piece of rag had been wound around the elevator and rudder controls where they passed through an inspection hatch in the belly of the aircraft.

The aircraft had undergone a major inspection which had involved a dual inspection of the control system. This dual inspection was completed and certified as having been completed. Following this inspection it was necessary for an electrician to complete a small modification in the underfloor area below the control cable chain tensioning mechanism. This mechanism was covered in grease so, to protect his head, the electrician wrapped a rag around the chains. He then forgot to remove the rag on the completion of his work.

WOULD YOUR COCKPIT CHECK HAVE FOUND THIS FAULT?

Overloaded Lodestar Crashes in New Mexico

(Summary based on the report of the Civil Aeronautics Board, U.S.A.)

A Lockheed Lodestar crashed and burned 12 miles southwest of Grants, New Mexico, during darkness on the morning of 22nd March, 1958. All four occupants were killed.

THE FLIGHT

The aircraft was engaged on a private flight from Burbank, California, to Tulsa, Oklahoma. The flight had made routine position reports from its assigned altitude of 11,000 feet until passing over Winslow, Arizona. Shortly after the last routine report at 11,000 feet a higher altitude was requested of Air Traffic Control because of encountering icing conditions. The request was granted and the aircraft reported, five minutes later, being at 13,000 feet between cloud layers. The last report was over Zuni, New Mexico, estimating Grants at 0249, 19 minutes later. Ten minutes after this report a ground explosion at an elevation of 7,200 feet m.s.l. was observed by another flight and by ground witnesses. The wreckage of the aircraft was found in the area of the witnessed explosion.

INVESTIGATION

The weather forecasters at Burbank could not recall briefing a flight to Tulsa the evening of 21st March. At the time of departure steady rain was falling and the freezing level was 8,000 ft. On the planned route moderate to severe turbulence was forecast at 5,000 feet and above. An instrument flight plan was filed with Air Traffic Control specifying flight at 11,000 feet.

The flight departed with two pilots and two passengers aboard, at 2241 Pacific Standard Time, and position reports were made on schedule.

The flight progressed normally until 0157 when a report was made over Winslow, Arizona, at 11,000 feet, estimating Zuni, New Mexico, at 0226. At 0214 the flight gave Zuni radio this message: "N300E estimating Zuni at 28. At one thousand encountering light to moderate icing of all types. Request one three thousand, believe I will be on top at one three thousand." A clearance to 13,000 feet was issued by Albuquerque Air Traffic Control and delivered to the flight at 0215. At 0223 the flight reported: "N300E reached one three thousand at two zero, now between layers." At 0231 the flight reported: "N300E over Zuni at three zero, one three thousand, estimating Grants at four nine." This was the last known message from the aircraft.

The scene of the accident was in a small valley between two mountains at an elevation of approximately 7,200 feet. The major portion of the wreckage was in or adjacent to the initial impact crater. The crater was approximately 25 feet long (measured north to south), 12½ feet wide (measured east to west), and 3½ feet deep.

The fuselage, centre section, and empennage were completely destroyed by the severe impact and subsequent fire. The left and right wing panels outboard of their respective nacelles were found next to the impact crater in normal position relative to the remainder of the structure. Both wings were crushed chordwise. Wing flaps, still attached, were in the retracted position. The landing gear was also found in the retracted position.

Examination of the rudders, vertical fins, elevators, trim tabs, and horizontal stabilisers indicated that the empennage had been intact prior to ground impact. No evidence of malfunction of the empennage or controls therein was found. The control system forward of the empennage was so severely damaged by impact and fire that its condition prior to impact could not be determined. However, flight control cables were found to be properly attached to their respective terminals.

Examination of the two powerplants disclosed that the right propeller was in the feathered position at the time of impact.

Disassembly of the right engine revealed a failed master rod bearing and several broken connecting rods. Examination of the left engine indicated normal operation prior to impact.

Minimum take-off weight for this flight was computed as 20,757 lb. Accordingly, the aircraft was at least 2,152 lb. over the maximum certified weight at the time of take-off. Assuming a fuel burn-off, including climb, of 320 gallons, three hours after take-off the weight at the time of the crash was approximately 18,837 lb., or 232 lb. over maximum certificated weight.

On the night of 21st March along the route between Prescott, Arizona, and Grants, New Mexico, (a) the freezing level was approximately 10,000 feet, (b) winds at the 10,000 to 15,000 feet level were generally from 230 to 270 degrees at 30 to 40 knots, (c) ceilings after midnight and prior to 0300 were mostly 3,000 to 5,000 feet, lowering occasionally to 1,500 feet to 2,500 feet in light rain, (d) surface visibilities were 10 miles or better, (e) Grants, New Mexico, at the time of the accident was reporting clear skies and visibility 30 miles, with a cloud bank to the west, (f) Zuni, New Mexico, at this same time, reported a broken ceiling measured at 1,500 feet with an overcast above, based at 2,500 feet, and a visibility of 10 miles in very light rain, (g) radiosonde observations indicated a possible top to the lower cloud decks at 12,000 feet. Visibilities were greater east of Grants.

The pilot of an Air Force B-36 at 20,000 feet, 30 miles south of Albuquerque, reported seeing an explosion at 0240 on the surface between Zuni and Grants. An employee of the C.A.A. at the Grants communications station reported to Albuquerque Air Traffic Control Centre at 0240 he had observed what appeared to be a surface explosion south-west of the Grants station. This agrees with the observation of the Air Force witness and the actual location of the wreckage of the aircraft.

All times herein are mountain standard unless otherwise indicated, and are based on the 24-hour clock; all altitudes are mean sea level.

ANALYSIS

On that portion of the route through central Arizona and western New Mexico all evidence indicates that the flight would have encountered extensive cloudiness, numerous shower areas, and moderate icing in clouds, and precipitation above 10,000 feet.

Fifteen minutes before reaching Zuni, the flight had added two minutes to its Zuni estimate, advised that it was encountering moderate icing at 11,000 feet, and requested clearance to 13,000 feet. Clearance was granted and the flight subsequently reported (0223) at 13,000 feet between layers.

It was raining at Zuni when the flight passed overhead at 0230 and Grants was reporting a cloud bank to the west. These weather observations, combined with testimony of ground and air witnesses describing the ground explosion associated with the accident, indicate that the accident site was located at the eastern edge of the bad weather area.

On the basis of the foregoing, it is apparent that icing conditions had been encountered by the flight, necessitating a change of altitude. A climb of 2,000 feet carried the aircraft between cloud layers and the use of boot type de-icing equipment partially alleviated the icing difficulty. In view of continued passage through below freezing temperatures, residual ice not discharged by the boots was retained on the aircraft. Furthermore, passage through a precipitation area over Zuni immediately prior to the crash may have added some additional ice.

Such icing would have an adverse effect upon the single-engine performance capability of this heavily loaded aircraft which was near its usable ceiling.

When operating on single-engine at or near the single-engine ceiling, at maximum weight, a stall and loss of control can easily occur. This requires increased vigilance on the part of the pilot to maintain the proper aircraft attitude and airspeed. Had the aircraft departed Burbank at its permissible weight of 18,605 lb., the weight at the time of the accident, because of fuel consumed, would have been approximately 16,500 lb., or about 2,000 lb. less than it was. Consequently, stalling speed of the aircraft would have been lower at the time of the emergency.

It is pertinent to point out that the aircraft, when fuelled to the capacity of its four standard tanks and with a normal oil supply, would have exceeded its certificated allowable weight by 91 lb. without a flight crew or payload. The full use of the two additional 77-gallon baggage compartment tanks under the above conditions would add 924 lb. of fuel weight to the already existing overload. Although this aircraft had been operated in the past at weights in excess of the maximum certificated weight pursuant to a flight permit issued by the Administrator, no waiver of the certification weight limits was issued for the flight of 22nd and 23rd March, 1958, a flight on which passengers were carried.

The Civil Air Regulations prohibit the operation of a civil aircraft at a gross operating weight in excess of the maximum authorised by the certificating authority. This aircraft was overloaded when the engine failure occurred en route, which was followed by a stall and loss of control at the 13,000 feet altitude. There is no doubt that control was lost as evidenced by impact markings on the ground.

Ice accretion on the aircraft surfaces undoubtedly increased the weight of the already overloaded aircraft and adversely affected its flight characteristics. With icing conditions in existence and the wing de-icing boots in operation at the time of the engine failure, control of the aircraft would have been rendered even more critical.

The Board also believes that the sudden engine failure and the necessary immediate initiation of single-engine procedures distracted the pilot's attention from the flight instruments sufficiently to result in loss of control of the aircraft and the 5,800 feet terrain clearance was insufficient to permit recovery by instrument reference.

PROBABLE CAUSE

The Board determined that the probable cause of this accident was the loss of control of an overloaded aircraft following the failure of an engine at a cruising altitude which was critical for single-engine operation. The loss of control was aggravated by surface ice accretion.

Error in Engine Identification

An Australian four-engined aircraft with a three-pilot crew departed Sydney for Darwin at 1543 hours E.S.T. via the direct route and reached the selected cruising level of 16,500 feet at approximately 1610 hours. At about 1625 hours, when the aircraft was well settled into the cruise, the first officer vacated the right-hand pilot seat and retired to the crew bunk to commence a rest period. At the same time the captain, after appointing the second officer as pilot-on-watch, proceeded to the passenger cabin. The second officer took up his watch in the left-hand pilot seat and the engineer officer occupied the flight engineer position.

The captain returned to the flight deck after a period of 15 minutes and commenced to discuss the flight with the navigation officer. Five minutes later, at 1645, the aircraft yawed to the left and the engineer officer later stated that as this occurred he noticed the B.M.E.P. indicator reading for No. 1 engine fall back to 100 lb./sq. in., this representing a considerable loss of power. He immediately informed the pilot-on-watch that No. 1 engine had failed and was immediately instructed by him to shut down that engine, this he promptly did. As soon as he felt the yaw the captain moved towards the cockpit, but before he could resume his seat there was a distinct thud, and this was followed by severe vibration.

The engineer officer now advised the captain that the oil pressure indication for No. 2 engine had dropped to zero, whereupon the captain immediately ordered this engine to be shut down. This was done, and METO power was selected on Nos. 3 and 4 engines.

As No. 2 engine was shut down the captain and first officer resumed the left and right-hand pilot seats respectively. Just after this the captain received a report from a cabin attendant that No. 2 engine was on fire. The fire alarms had not operated and a subsequent visual inspection revealed that the "fire was out." The captain was now also notified that a cylinder was "hanging out of No. 2 engine" and that the window at seat G1 was badly cracked. It was inferred that the window damage had been caused by a portion of No. 2 engine or its cowling, and cabin depressurisation was commenced. Meanwhile the aircraft was turned on to the reciprocal course.

At this stage, Sydney Air Traffic Control was advised of the circumstances and that the aircraft was returning. Sydney A.T.C. at once initiated the distress phase of the emergency procedures. A little later the captain advised that he intended to proceed to Dubbo, some 94 miles away, this being the nearest suitable aerodrome.

With Nos. 1 and 2 propellers feathered, full right rudder trim and five degrees right wing down trim were required to hold the aircraft on course at 150 knots. At this speed the aircraft was descending at 450 feet per minute. The dumping of 10,000 lb. of fuel enabled flight to be stabilised at 7,500 feet at 150 knots with 2,200 b.h.p. on each of Nos. 3 and 4 engines. At this juncture the engineer officer mentioned to the captain that he may have feathered No. 1 propeller unnecessarily, even though he believed he had observed the B.M.E.P. indication for that engine as being well down.

The captain decided not to unfeather No. 1 propeller, however, since he was satisfied with the aircraft's performance and considered there would be some risk in unfeathering if the engine was in fact defective. Apart from these considerations, he believed also that the engineer officer was a "sound experienced engineer and not prone to make mistakes." The flight proceeded without further difficulty and a landing was made at Dubbo at 1740 hours.

DISCUSSION

Examination of No. 2 engine revealed that it had sustained severe structural damage to No. 2 cylinder and to the front-row master connecting rod. No defect or evidence of transient malfunction was found in No. 1 engine, and subsequent investigation has established beyond reasonable doubt that there was in fact neither a power loss in this engine nor a faulty indication of its B.M.E.P.

The B.M.E.P.'s of Nos. 1 and 2 engines are displayed on a common circular scale over which move concentric pointers of equal length and similar shape, labelled "1" and "2." Thus, if the torque indications from each of the two engines are the same, the pointer for No. 1 will be seen by the flight engineer as superimposed on the pointer for No. 2. In normal operations, however, even though equal power on all four engines is selected, the indicated B.M.E.P. for No. 2 engine is slightly higher than that of No. 1 since the latter drives a cabin blower, whereas the former does not.

It is probable that on this occasion there was initially a slight fall in No. 2's indicated B.M.E.P. as an early manifestation of the complete failure impending. This could have placed No. 2 pointer slightly below No. 1 on the common scale without the engineer officer becoming aware of the transposition. Later, the lower-indicating pointer was observed to fall back to a scale reading of 100 p.s.i. It is perhaps not surprising that the engineer, long accustomed to the normal relativity of the two physically similar pointers, when confronted with an emergency situation, should err in their identification. It is surprising, however, that confirmation of No. 1 engine's supposed failure was not sought by a recheck of the torquemeter indications during and after shut-down of No. 1.

The pilot-on-watch did not check to confirm which engine had lost power or the nature of the malfunctioning, and ordered the closing down of No. 1 engine solely on the advice of the engineer officer. The second officer holds a second class airline transport pilot licence with a second class endorsement for the type of aircraft involved. These qualifications permit him to act as co-pilot or as pilot-in-command under supervision and the requirements for these qualifications are that he must be competent in the application of all emergency procedures, including feathering and unfeathering of propellers. He must also be capable of carrying out asymmetric cruising flight with one engine inoperative (A.N.O.'s 40.1.5.9.1 and 40.1.0.6.3.3). The extent of the supervision required when a pilot with such qualifications is on duty as pilot-on-watch has not been defined but it is regular practice for second class airline transport pilot licence holders to be left in charge while the captain is absent from the cockpit.

COMMENT

The reaction to a given emergency of a person not specifically trained in dealing with it depends to a large degree on his personality or "temperament." At one extremity of the range of "temperamental" reaction is the reaction of the individual who "panics" — whose action is impulsive and may bear no logical relationship to control of the situation. At the other extremity is the reaction of the person so phlegmatic that he does not comprehend an emergency when it exists and thus completely fails to respond. Between these extremes, responses vary from the hasty impulsive action which, although intended to control the emergency, is based on an inadequate appraisal of it, through to the optimum response of the well-balanced and naturally-resourceful individual.

Knowledge that the emergency may occur and a theoretical appreciation of its effects and the means of controlling it, go a part of the way towards offsetting the undesirable influence of "temperament." In general, however, only thorough training properly equips a flight crew member to deal with an emergency in an orderly, confident and adequate manner.

Such training ideally combines detailed formal instruction in the technical aspects of emergencies with practical familiarity with their management. In both regards, comprehensive training under simulated emergency conditions is of the utmost value. Although it can be said that there is no substitute for reality, it does not follow that experience confined to real situations is the only means of becoming adequately prepared.

It has been clearly demonstrated that where pilots are given regular practice in the handling of emergencies under faithfully simulated conditions, there is not only a high order of transfer of ability from the simulated to the actual situation, but there is also a marked all-round increase in confidence.

In conclusion, the instrument display on which the foregoing narrative hinges deserves comment. As previously mentioned the torquemeters were of the combination type wherein torque pressures of two engines (usually paired Nos. 1 and 2, 3 and 4) are separately registered on a common circular dial by means of two similarly shaped concentric pointers; each of the pointers being labelled with a figure corresponding to the engine to which it relates.

It can be seen that in this form of presentation we have the situation whereby the "one" instrument offers the same kind of information from two distinctly separate power units but in a manner which does not readily permit positive identification of the source. Thus, there is inherent in the display the capacity for misinterpretation under circumstances of diminished vigilance, reduced viewing time or psychological stress.

The problem encountered here is fairly commonplace and relates to other situations in the field of instrumentation. The essence of the fix is to introduce devices or characteristic features which lead to an instantly recognisable relationship between the source and the information — in this case a particular engine and its particular torquemeter reading.

One way of achieving this would be to have a separate torquemeter for each engine and to locate them across the panel sensible to the location of the engine. Other considerations, of course, might make such an arrangement an impracticable proposition. However, until such time as we can have truly unequivocal instrument displays it should be borne in mind that any blame for misinterpretations such as that presently described cannot be regarded as resting on the flight crew member alone.

Nevertheless, let it not be thought that this removes from flight crews and operators the responsibility to learn the pitfalls, and knowing them, to consciously and continually guard against falling headlong into them.

THE UNACCOUNTABLE BLUE

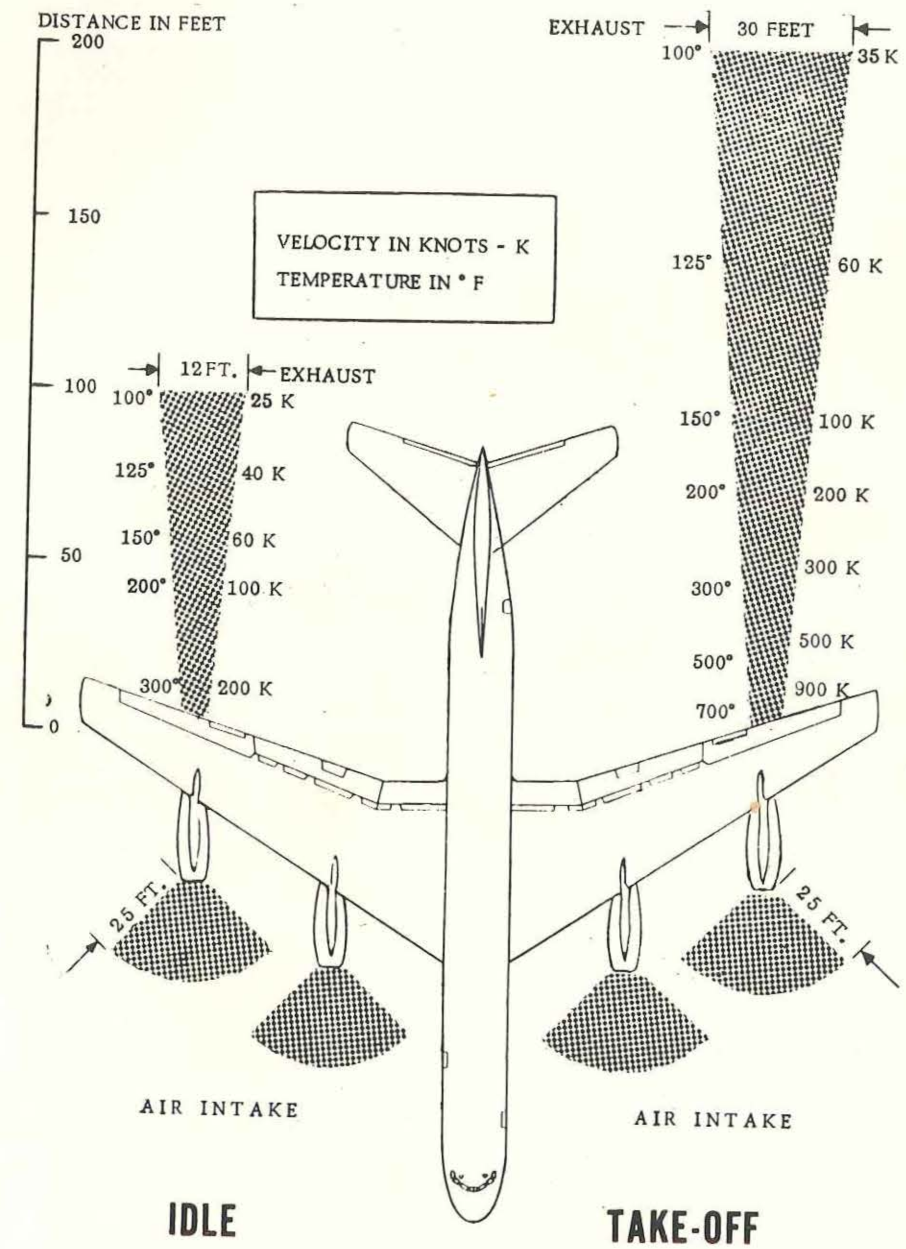
A four engine aircraft was cleared for a practice I.L.S. approach; it was night but the weather was fine and clear. During the approach the captain found that, with the Localiser needle centred, the aircraft was well to the left of the I.L.S. track. The approach was abandoned and after landing the captain queried the equipment.

The ground and airborne equipments were checked and found serviceable.

On departure later, the aircraft was flown along the I.L.S. track to the outer marker and the captain advised that the Localiser needle was indicating full scale blue deflection. After this the captain discovered that he had had the V.A.R. frequency selected instead of the I.L.S.

It does not require very much imagination to see that under other circumstances this could easily have been an accident. An error in channel selection is understandable but should not result in a hazardous situation. Before attempting to use any radio aid positive identification is vital for reasons which need no explanation. It seems to us that it might be a good safeguard if both pilots cross checked the identification as a routine procedure when using an aid.

JET BLAST and INTAKE DANGER AREAS



KEEP YOUR DISTANCE

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