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FLYING SAFETY

UNITED STATES AIR FORCE

In This Issue

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- Looking Over the T-29D

FLYING SAFETY

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Department of the Air Force
The Inspector General USAF
Major General Victor E. Bertrandias,
Deputy Inspector General

★ ★ ★

Brigadier General Richard J. O'Keefe
Director
Directorate of Flight Safety Research
Norton Air Force Base, California

★ ★ ★

Colonel Daniel M. Lewis
Supervisor of Flight Safety Publications

★ ★ ★

Photographs used in the Mountain Wave story were taken by the U. S. Navy, Mr. R. Symons and Mr. K. E. Oevgard.

A Raydist Station recording an account of a glider flight. Story is on page 21.

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ARTC CONFERENCE

TOP staff officers and representatives of all divisions of Air Training Command met recently with the Deputy Inspector General and key personnel in the Directorate of Flight Safety Research to evaluate flight safety problems. In his welcoming address, Maj. Gen. V. E. Bertrandias, Deputy Inspector General, emphasized the ever-increasing difficulties of adapting human capabilities to technical advancement. He stated that although the accident rate has been reduced from 29 per 100,000 flying hours in 1952 to 24 per 100,000 hours for the first nine months of 1953—the lowest rate in Air Force history—no opportunity should be missed to improve the trend. General Bertrandias stressed that it is within the human factors, in maintenance or in the air, that lives and defense dollars can be saved.

A detailed breakdown of USAF accidents by aircraft type, command, flying situations and other criteria was explained by Brig. Gen. R. J. O'Keefe, Director of Flight Safety Research. He elaborated on the loss to the Air Force in terms of crews and dollars and pointed out the specific problem areas that offer the greatest opportunity for safety effort. Among them were takeoffs and landings, transition training and variations in configuration in relation to flight characteristics.

Maj. Gen. G. O. Barcus, Vice Commander of ATRC, keynoted the conference when he stated that the ultimate USAF goal is to eliminate every possible accident in order to continue to reduce the cost of training without loss of efficiency.

Norton Air Force Base was chosen for the three-day conference because the Directorate of Flight Safety Research, Office of The Inspector General, USAF, has prime responsibility for aircraft accident investigation and is the repository for all aircraft accident records.

The major purpose of this symposium was to:

1. Familiarize ATRC representatives with the facilities and assistance available through the Office of The Inspector General at Norton AFB.
2. Further the general knowledge of individual Flight Safety officers assigned to the Air Training Command.
3. Standardize Flight Safety officers' procedures in the conduct of their duties.
4. Present specific flight safety problems and, in panel discussions, recommend corrective action.
5. Discuss with the aircraft manufacturers the characteristics of their equipment in terms of the ARTC safety program.

Particularly interesting to the conferees were the discussions conducted by test pilots of the aircraft industry. The design and manufacture of aircraft and the training of people to fly them are the most fundamental areas for study in the entire field of flight safety development. It is therefore imperative that test results, flying techniques and training methods be reviewed mutually and the results pointed toward complete accident prevention.

Lockheed, North American and Republic were represented by Tony LaVier, Joe Lynch, and Jack Bade and Carl Bellinger, respectively.

Tony LaVier briefly traced the history of jet aircraft and expressed his appreciation of the difficulties encountered in transition from reciprocal to jet flight. Highlights of his talk included Lockheed's pioneering in jet flight production. In the ensuing discussion he provided experienced advice on spin characteristics in various configurations, fuel control, maintenance requirements and recommended approach patterns.

Speaking of the F-86D and F-86F, Joe Lynch of North American described design and construction developments necessary for high speed stability. He made specific reference to low altitude flying characteristics and re-emphasized the general tendency of inexperienced pilots to overcontrol all jet aircraft.

All industry test pilots emphasized the attention which must be given to proper landing approach patterns.

The Republic representatives, Jack Bade and Carl Bellinger, spoke in detail of the F-84F and F-84G, pinpointing specific handling characteristics, theoretical and proven capabilities, and idiosyncracies. Pitch tendency, aileron reaction, stall warnings and flight limitations, "artificial" feel of boost systems . . . the personality as well as the characteristics of aircraft were introduced by these test pilots who live with them under every conceivable circumstance.

Following the background talks the members, in panel groups, studied the specific problem areas and from their recommendations will come changes in the use of check lists, revised programs of transition training, greater utilization of training schedules, increased use of safety education material and changes in flying doctrine, particularly as it concerns spin recovery and landing approach techniques. *All pointed to your greater safety.* ●

"Get-HOME-itis!"

This malady can cause much distress. Fortunately there's an antidote, composed of little more than common sense.

JANUARY is traditionally the time of the year to take stock. You add up your assets and sigh with satisfaction. Then you count up your liabilities and determine how to turn them into assets. Before you take stock around your rose-covered cottage, you might read this piece on attitudes. An attitude is a little difficult to put your finger on. But it can be an important asset on your list — or a grave liability.

There's a song the husky-voiced gals still sing once in a while in the cabarets. You've heard it wafted over the smoky air, to the accompaniment of a real blue piano. The first line goes, "For every man there's a woman."

At first thought the application to flight safety might appear a little remote. Well, a quick survey of your friends, neighbors and comrades in arms will bring to light a fact you very likely have noticed already — for every man there *is* a woman. A wife, a mother, or a girl whose phone number comes to mind without consulting the directory. And if you're an Air Force pilot, the lady in question can have a good deal to do with our favorite subject, flight safety.

A lot of things go into determining safety in flight. The design of the airplane and equipment. The skills of the myriad of people who have a hand in getting the plane into the air. Your own proficiency as a pilot. All of these factors are rigidly controlled by the Air Force. But there is one factor the Air Force can't control — your attitude toward a particular flight. That's where the ladies come in.

Feminine relatives sometimes cause pilots to suffer from a malady known as "get-home-itis." You've never seen it in the statistical reports, but it causes airplane accidents. The pilot worried with it will do a lot of crazy things he wouldn't ordinarily do. Like flying the worst route home if it happens to be the shortest one. Like taking off for home when he's bushed and should have RON'd. Like attempting a landing at the home base when the visibility is so bad he can't see the runway anyplace but in his mind's eye.

All of these things are the result of "get-home-itis." "Get home for dinner." "Get home on time because we're playing bridge." "Get home early because we have to see the third grade play at school tonight."

Right here we should get one thing straight. Although the lady at your house may have started the "get-home-itis" attitude, the fault lies with you. You are the one who has formed her attitude toward your job. You are aware that flying today is a highly demanding profession, that it sometimes requires every bit of skill and concentration at your command, and that it is unforgiving of carelessness and mistakes. But does your wife realize that? In very plain words, does she know that your attitude toward a flight may mean the difference between a long career and a mighty short one?

At the risk of belaboring the point, we're going to tell you a little story. We told it once before in FLYING SAFETY, about six years ago. It isn't a true story, yet we think that similar things have actually happened. It goes like this.

Once upon a time there was a B-25 pilot. Lawrence Bates, Capt. USAF. He was weathered in at a base in Tennessee. And he wanted to get out.

Captain Bates stood in the door of operations and watched the flakes settling on the eight-inch layer of snow already spread over the ground by two days of intermittent snow and sleet. His gaze went from the sky to the flight line where his B-25 was parked. Snow was accumulating on the wings although the crew chief had just finished brushing them off.

Larry crushed his half-smoked cigarette and stamped back into the weather office to continue his vigil at the teletype machines. For two days now his face had been a mirror for the sequence reports.

Only one plane had been cleared eastward since the Captain had been grounded at this Tennessee field. It had quickly returned to the base, covered with ice, the pilot vociferously grateful for having his feet back on the ground. But Larry badgered him with questions about the attempted flight. Any forward visibility? Windshield ice up? De-icers do any good? What was the temperature up there?

Finally the pilot told him, "Look Captain, if you're thinking of clearing through this stuff you're nuts. This is the worst weather I've ever flown in, and I've flown in some rough stuff."

But so had Captain Bates. He had flown many a trip from India to China and back, and no one could deny the weather over the Himalayas could get pretty lousy.

Just then an ETA came in on a C-54 coming in from Langley Field, Larry's home base. He listened over the squawk box to the pilot's reports over various stations along the route. "Heavy icing over Richmond. Extreme turbulence over the mountains. Snow and ice over Tri-City. De-icers only partially effective."

Larry sat and muttered. "Why did this have to happen to me? Janice told me to be sure and get home for the colonel's party tonight. What will I tell her? She'll never believe I was grounded because of weather. She knows I'm considered a very good instrument pilot." He recalled the painful ordeal he went through last time he was a day late getting home. This time it would be worse.

When the C-54 landed and the pilot walked into operations, Larry was waiting for him. The pilot's reports were not quite as bad as he had expected. He could make it home! He had de-icing equipment and there was no reason why the operations officer shouldn't clear him.

The operations officer, who had heard Larry's tale of woe too many times already, looked dubiously at the clearance. "Do you really feel that you can make it?"

The Captain assured him that the B-25 could get to Langley easily, no sweat. So the operations officer signed the clearance. With his copilot and crew-chief in tow, Larry raced out to the airplane.

After receiving several advisory messages from Flight Service, he was cleared for takeoff. At 600 feet they were in the clouds. Ice began to build up almost immediately. The Captain let it build up on the wings. When he thought it no longer safe to wait, he started the boots pulsating. The ice cracked and flew off. He smiled to himself and let it build up again.

This time, however, it collected much faster, almost as soon as the boots were turned off. Soon he could no longer see through the windshield, and airspeed started decreasing. He checked the pitot heater quickly. It was on. He turned on the prop de-icers and the airspeed started building up. The copilot, unimpressed, glanced around at the crew chief.

Over the foothills, turbulence set in. Icing conditions were getting worse, and the de-icing boots would no longer clear the wings. Although the Captain was now pulling 40 inches manifold pressure and using 2300 rpm, the airspeed was decreasing steadily.

As the airspeed went down to 150 mph, the copilot took up all the slack in his chute harness. Turbulence made it almost impossible to keep the plane upright. The gyro instruments had spilled twice. Airspeed was down to 130, then 120, 110, full power and rpm's. A quick picture of Janice, dressed and waiting, flashed through the Captain's mind as the told the crew, "Prepare to bail out."

That was all the crew chief needed. He dumped the hatch and out he went. The altimeter read 5500 feet as the copilot left the plane. Almost as soon as his parachute opened, his feet touched the ground.

A few hours later, a rescue party found the B-25 lying in a snow-covered meadow, Captain Bates still in the cockpit. Fortunately the B-25 struck on a gentle upslope and although the plane was almost completely demolished, the pilot survived.

If this were a true story, it would have gone down on the statistical reports as "Cause Factor: Weather." But the real cause was that attitude we were talking about — "get-home-itis."

The Captain's wife would never have believed the crash was the result of anything but ice and snow. Why should she? She was interested in her husband's career. She saw that he ate the right foods, had a comfortable home, got enough rest. Probably she assumed a lot of the household duties she would have expected her husband to take care of, had he worked at a more conventional occupation. She didn't think it was too much to expect him to be home in time for just one special occasion. But it was.

We don't think "get-home-itis" has reached epidemic proportions. And we think Air Force wives are pretty intelligent gals who know the importance of your job. But if the "get-home-itis" attitude prevails around your house, fold this issue of FLYING SAFETY open to these pages and put it on the coffee table.

Remember, you may not be as lucky as our fictitious Captain Bates.

Don't make one flight for home your last flight — for anywhere. ●

IT was one of those beautiful moonlit nights and I was sitting at 19,000 feet well on top of a strato-cu deck headed for Paris. There wasn't much to do except the endless chore of airmen the world over, which is to wait for the clock to go around. When the wind is with you, destination CAVU, lots of gasoline in the tanks and the needle pointing straight ahead, there isn't much to do or think about and you can daydream as you stare into that great vastness of the sky. Of course, you daydream like a dog does in front of the fire, knowing you'll come out of it when some strange noise or suspicion enters your peaceful world. As a fellow once said: "Flying is made up of hours of boredom broken by occasional moments of stark terror."

Well, I was in the long hours and sort of daydreaming; the subject I kept focusing on was the exciting moments in the past 24 years of flying airplanes of various sorts to various places. How many chills and thrills had I experienced? Well, not too many, really. There was the time I had about two hours solo, couldn't get out of a spin and rotated a Fleet from 4000 feet down to about 900, where straight luck got me out. And there was the time I was in a cross-country air race, flying about 50 feet over Texas, and passed another airplane way off to one side. I put a pair of binoculars to my eyes to read this guy's race number, didn't pay enough attention and flew right into the ground. The ground—praise the Lord!—was level and I zoomed away from it without a dent.

There was also the time I got stuck on top of some clouds before I knew how to fly instruments and had a hard, dry lump in my throat for quite a while before I was lucky enough to find a hole and get down through it.

But those were all stupid things, I reasoned to myself. How about the close ones that weren't your fault? How about engines quitting and things like that?

Well of course, I had a few in single-engine airplanes way back when, but you expected them in those days and weren't disappointed as you generally had a field ready most of the time. Besides, airplanes landed slowly then and any old patch of ground was good enough.

The first narrow escape I had in an airplane was in a DC-2 right over an airport. I had a few in DC-3s too, but I feathered and got home—worried, of course, but okay. Paddled along about 600 miles in a B-17 on three, but it went like the book and there was no sweat. There was one incident last summer, right on takeoff in a Connie, at Rome, when number four digested a piston. We were well past unstick speed when it happened, so we went through the act as it is set up in the manual, circled the field and landed.

There was that fire warning at 18,000 feet indicating a cargo compartment fire. We got depressurized, made a fast descent and went on oxygen in the routine manner. It turned out to be a false alarm.

And I daydreamed about the thrills in weather, which, after all, is still about the biggest problem to face. The incident which stands out most, however, is the time—long after I'd been an airline pilot—that I

an airline pilot looks at SAFETY

Reprinted from COMBAT CREW Magazine
Hq Strategic Air Command, Offutt AFB, Nebr.
Oct. 1953

By Captain Robert N. Buck
Trans World Airlines

borrowed a little ship for a flight from New York to Scranton, Pa., to see my mother on Mother's Day. I wanted to get there in the worst way and kept poking into weather that good sense should have told me to keep out of. I wound up doing about 40 minutes on the primary flight group in rough air. Brother, that wasn't in the fun department.

There were also a few times I wished I'd had more gasoline when the destination went zero zero, so I've been real fussy about gasoline ever since.

And, there were a few thrills in thunderstorms. But I've learned and am convinced that if you slow her down, maintain attitude and airspeed, and to hell with altitude, you'll finally stumble out the other side in one piece. All the serious trouble I've seen around thunderstorms has been from hitting them too fast. Naturally you try to stay out of thunderstorms as much as possible.

And through this daydreaming I began wondering what one thing I could pick out that was the greatest danger. Was it engine failure? Ice? Thunderstorms? Or what? And it dawned on me, rather abruptly, that the greatest danger had always been myself. That most all the tangible thrills I'd had were brought on by goofing off in one form or another. Of the other type troubles—engine failures, etc., proper knowledge of the right thing to do turned them into almost routine incidents.

Why Goof Off?

So, it seems that if I goof off, there may be trouble, and if I don't, there isn't. Then why goof off? None of us have ever done it on purpose. Then why do we goof off at all? The answer that crops up is complacency. If we are smug and complacent, we are on the verge of trouble.

There are various types of complacency, and different places in which it shows up. A simple kind is when we tune the radio compass to a station, are just about on the frequency and the needle points ahead briskly. We say, "That's it!", but never bother to identify it. The other end of the scale is when we don't thoroughly learn emergency procedures. We think we know them, or the basic information, and feel that when an emergency occurs, we can out-think it. Well, of course, we can't out-think a quick happening. We can move faster than we can think, and in a fast moving emergency we may move too fast and do the wrong thing. On the other hand, if we know the book by heart, we still may move too fast but we'll probably do the right thing instinctively.

We can get complacent in the air from fatigue, and must guard against it. If we are tired or need oxygen, we may get complacent about identifying the station we tuned in or just take too many things for granted.

The other type of complacency, such as not bothering to know procedures well enough, is difficult to comprehend. We all have some of it to a certain degree, and it's a battle to keep it under control.

The first sign of complacency came after my solo, and I went through the first cocky stage thinking, "I'm a pretty hot pilot." Then, of course, something scared me and I quit being so red hot. In that same feeling, or something like it, comes advanced complacency.

Personally, when I get to feeling a little smug about how I know all the answers, a red flare goes up saying: "Take care, brother, you're about to trip over something!"

And so this session of daydreaming seems to bring out that the greatest danger is myself in a complacent mood. And speaking of complacency — "Engineer, how much gasoline have we left? Navigator, where are we? What's our ETA and can both of you prove it?" ●

A veteran of 17 years with Trans World Airlines, Capt. Robert S. Buck first soloed in a homemade glider in 1929. The following year he switched to power airplanes, and from 1930-37 tried his hand at racing, instructing and barnstorming. He became a TWA captain in 1940. During the war he flew for ATC, piloted a B-17 on a global precipitation static research project and poked into thunderstorms in a P-61. Since 1947 he has again been flying as captain on TWA international routes.

Capt. Buck believes that the greatest danger to a pilot is complacency.

the BIG PAYOFF!

Jet crews are gaining knowledge, experience and confidence in escape procedures through an indoctrination course featuring the mobile ejection trainer

**Captain Joseph P Davies, Jr., Medical Research Division
Directorate of Flight Safety Research**

IN the interest of greater safety through knowledge, the original ejection trainer, located at Williams Air Force Base, was utilized as a basic pattern for a completely mobile ejection seat training unit. This new model has a simulated cockpit in place of the original open-air boom bucket and the old 102-foot rocket launching tower has evolved into a 21-foot collapsible track which can be airlifted.

In short order several copies of the new mobile ejection seat trainer had travelling fever. And the jet pilots in FEAF, Alaska and Europe were soon joining the graduate club in mounting numbers.

The author had the privilege of giving ejection seat indoctrination to pilots in the FEAF area, where training was conducted in turn at Johnson Air Force Base in Japan, Kadena Air Base on Okinawa and K-2 in Korea.

One major purpose guided the mobile ejection seat training program: Impart knowledge and experience to the crewmember which would insure his successful escape from an airborne jet aircraft.

To accomplish this purpose, the indoctrination course included both a lecture period and a practice ejection. The lectures to FEAF personnel included the latest information on seat ejection and emphasized the review of actual emergency ejections and specific difficulties encountered.

The practice ejection, which climaxed the course was designed to accomplish two things: First, it acted as a review of ejection procedures in a simulated cockpit. Second, it gave each student the actual physical sensation of an ejection, excluding of course, the effects of windblast and tumbling.

It is significant that while many pilots did not like the idea of getting a large slam applied in 15/100ths of a second, most thought there was little or nothing to it after experiencing the practice ejection.

The indoctrination program emphasized the major factors incident to successful ejection. Of course the first requisite is to know thoroughly one exact ejection procedure for one's particular aircraft. However, there are two rules which, if followed closely, greatly enhance the chances for successful ejection from any aircraft.

In order of importance, they are:

Eject While Sufficient Altitude is Still Available—

Studies on file in the Directorate of Flight Safety Research show conclusively that below 2000 feet, and particularly below 1000 feet, the chances for successful ejection from jet aircraft decrease very rapidly. Actually the chances for safe ejection between 1000 and 2000 feet are fairly good, but only *if the aircraft is near a level attitude.* However, a pilot who remains with an aircraft in a 600 mph steep angle dive will contact the ground from an indicated 10,000 feet in less than ten seconds. When the factors of ground elevation, altimeter lag, reaction time, and possible delays caused by "G" forces and other difficulties are considered, the advisability of leaving the aircraft at a reasonable altitude is obvious.

Separate From The Seat As Soon As Possible After Ejecting—

Men who have had experience on the ejection seat trainer will verify the fact that there is a small time delay between the time of firing and the recovery of your full capabilities. Even with a reminder just prior to ejection, many men have ridden the seat back down the track to a stop without unfastening the safety belt.

Couple this with the following facts:

★ Most men who free fall do not experience the usual sensation of falling, and therefore the time element in separating from the seat does not assume sufficient importance.

★ Sometimes it is not easy to unfasten the safety belt (due to wind and tumbling, etc.).

★ There is an almost *innate urge* to pull the ripcord first.

★ There is a great advantage in separating from the seat during the horizontal portion of the ejection trajectory in order to prevent possible injury caused by the seat falling into you or your parachute.

From the above it can be determined that immediate separation from the seat is important and that particularly at lower altitudes and *higher downward speeds* the procedure must be like clockwork. Consideration of these factors led to the development of the automatic lap belt release. Also, present SOP states that the safety belt will be unfastened prior to ejection below 2000 feet if proper body position in the seat can be maintained.

Another vital factor in many emergencies is the problem of fear. Fear is a possibility in any emergency. However, even when fear is present, difficulties can and must be evaluated so that positive remedial action may be taken.

The stories of panic are many. Recently a man's "D" ring was hooked over his parachute harness in such a manner that the conventional method of pulling the "D" ring did not work. Had he recognized the source of his trouble, unhooked the "D" ring and then pulled, his bailout would have been successful.

In contrast here is part of the story of a pilot who ejected near K-2, Korea, during August 1953.

After ejection, his helmet was twisted around on his head so that he couldn't see and had difficulty getting his safety belt unfastened. Although he thought he pushed the seat away with his feet, when he pulled the "D" ring, nothing happened. Then he pushed the seat away again and the parachute opened. All this was done by feel because of the twisted position of his helmet. Finally he got the helmet off and saw that the 'chute was twisted and also had several rips in it. Furthermore, the seat was caught in the shroud lines, spinning in the breeze and causing his canopy to get progressively smaller. Searching for a knife to cut the shroud lines and release the seat, he found two of his knives gone, and one unavailable. It was the fourth and last knife which saved the day. Just prior to landing he finally got the seat loose. In landing, his head hit a rock, but no injury resulted since he had kept his helmet between his knees and put it back on at the last moment!

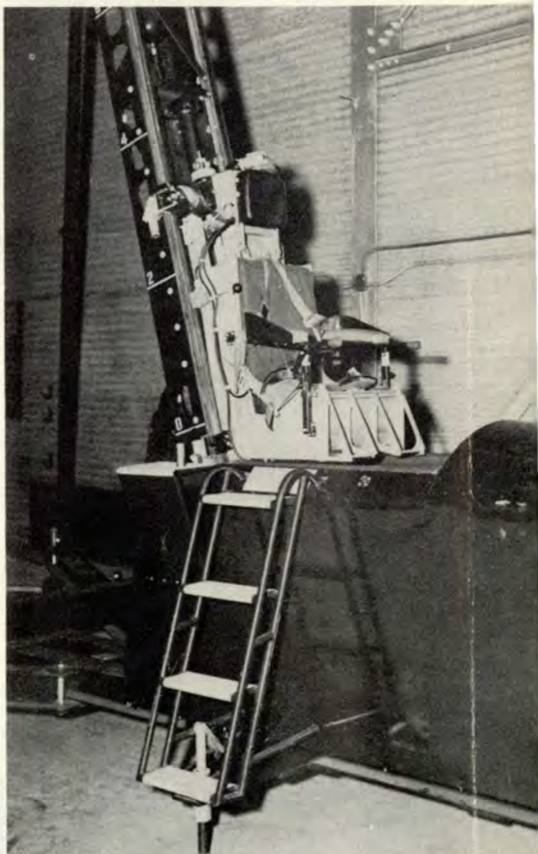
Incidentally, this officer attended the mobile ejection seat training course the day prior to his emergency.

Ejection seat indoctrination is but one phase of survival and emergency escape training.

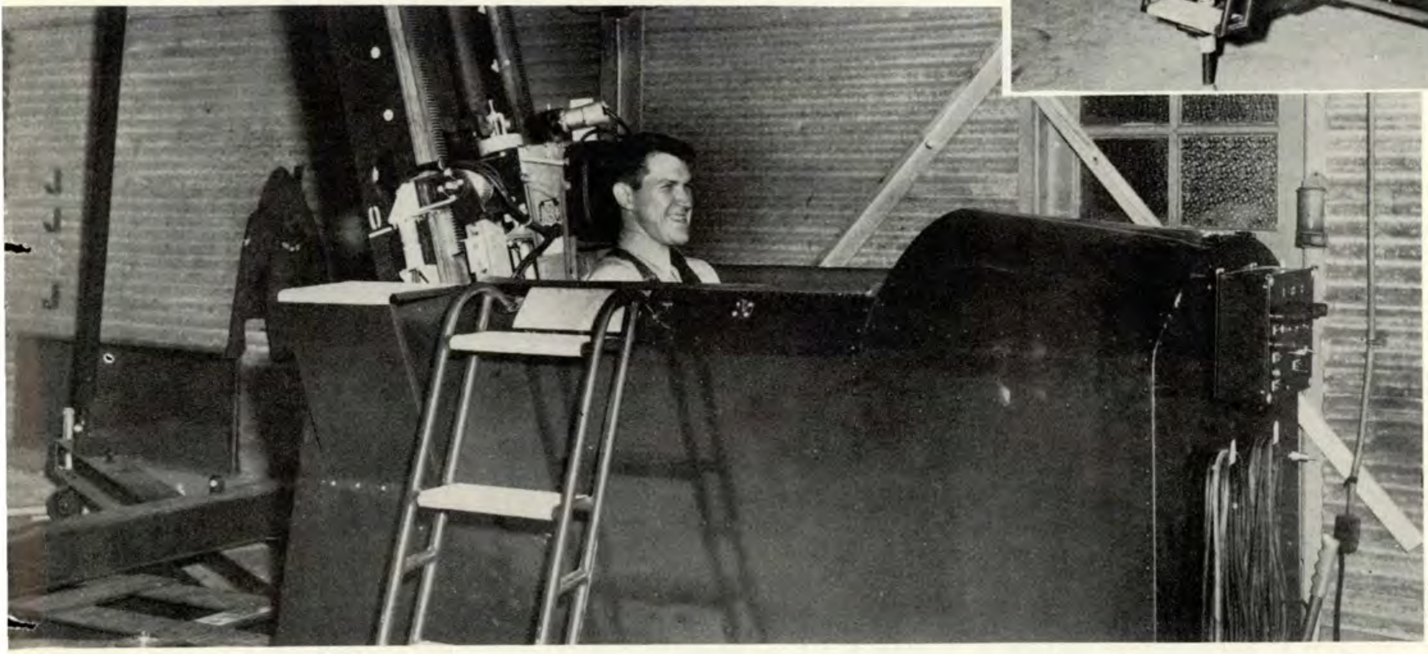
Following is the account of an emergency escape from an F-80C which indicates complete and thorough training of the pilot by his organization.

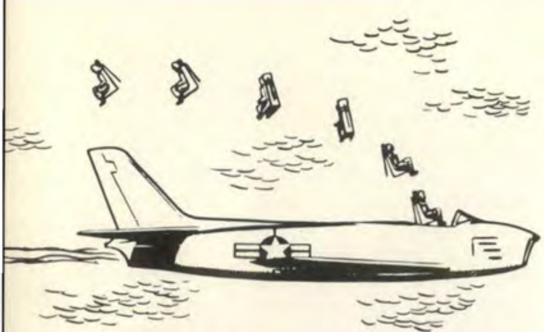
"I leaned forward, fired the canopy and placed my feet in the stirrups. As I leaned back I raised the armrests, and when my head touched the headrest I pulled the trigger. The entire operation seemed quite easy, automatic, and was accomplished very rapidly in a smooth uninterrupted motion. I would estimate that it took less than three seconds from my decision to eject until I cleared the aircraft. I had the feeling that I had done everything before. After clearing the aircraft I couldn't orient my position relative to the horizontal trajectory, but this didn't affect my releasing the seat and pulling the ripcord almost immediately.

"I attribute the success and ease with which I ejected and survived in the water afterwards in great part to the extensive and excellent survival training carried on in my squadron. All members of the squadron have recently been through an ejection seat tower ride and associated lectures. Also, within the last month we witnessed a demonstration of water survival at the beach which included actual use of dinghies, 'Mae Wests,' marker dye, flares, etc., and three

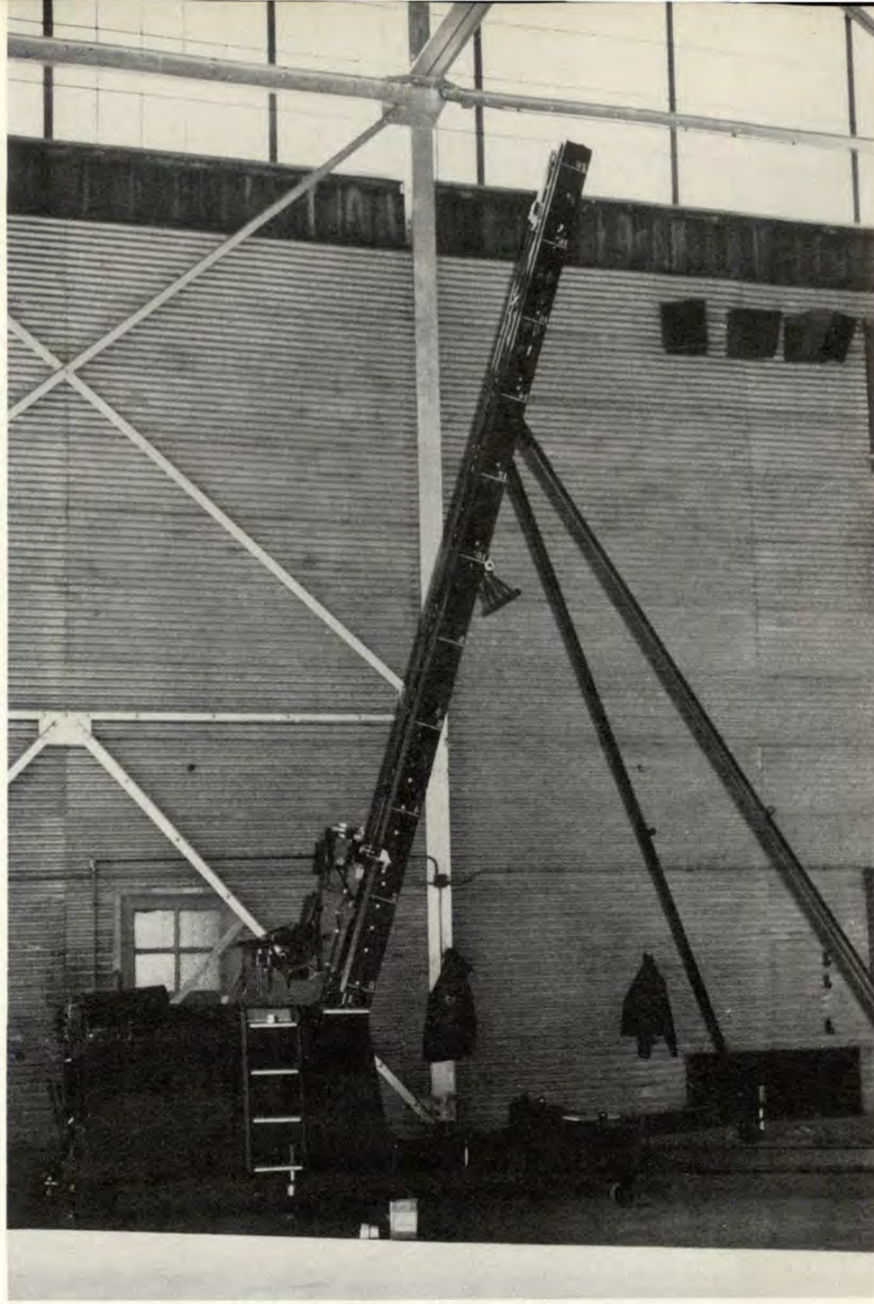


Bottom, seat in firing position. **Right, seat in safetied, loading position.**





The first rule for safe ejection is to know the procedure for your aircraft.



The trainer accomplishes two things: It enables a student to review procedures and to feel the actual physical sensation of an ejection.

actual jumps into the water just off shore from a C-47 by experienced parachutists to show the different ways of getting out of the harness and when to inflate the B-5 life preserver.

"The week of my accident, training was taking place at the base swimming pool. All rated personnel had to jump off the high board, get out of their parachute harness in the water, inflate their Mae West and climb into an overturned dinghy. The pool was also used to check out the new Mark IV exposure suits being issued to the squadron. I felt the fact that I was at home in the water and had a lot of swimming experience aided me after landing in the water. The squadron is now conducting a class in swimming for the less experienced swimmers. I have mentioned the above training because it was a great help to me when it came time to use it, and similar training might aid members of another squadron."

Remember, too, no bailout, ejection or conventional, is complete until you have landed safely. So be sure you are up on the latest techniques, particularly those pertaining to water landings. Make the necessary preparations prior to water contact and don't get out of your parachute until you touch the water.

Another pilot who completed the FEAF ejection seat training course at K-2 states, "The indoctrination program helped me tremendously in making a successful ejection without injury. I unfastened my chest strap while still in the air and released my leg straps successfully after hitting the water. Once while descending, I judged myself to be only a few feet from the water. I dropped my helmet more properly to judge my altitude and *it disappeared before striking the water*, again emphasizing the fact that it is impossible to judge your height above water!"

Training in survival and emergency escape does pay off — in a "big way." Shares are cheap; the dividends are enormous. So how about getting hold of some stock in the mutual fund? ●

WELL DONE!

Captain Charles H. Proctor

Captain Kermit E. Spears

By making nine "saves" over a period of two years, Captains Proctor and Spears have prevented a loss to the USAF of over two million dollars in drone aircraft and equipment. Proctor and Spears recovered these shot-up, damaged or malfunctioning drones on the Salt Flats area in New Mexico.

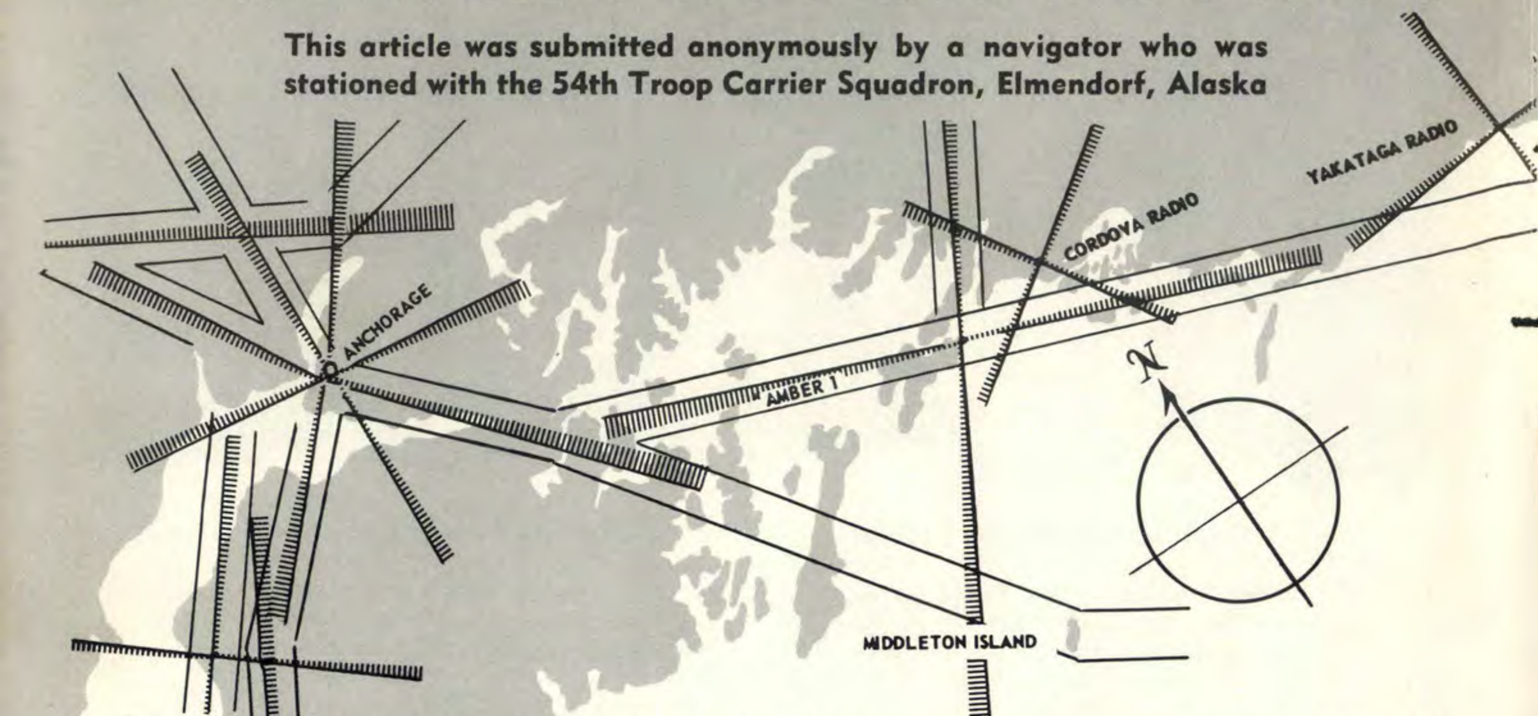
They elected to utilize the Salt Flats area for the recovery to preclude endangering lives and property in the vicinity of Holloman AFB, home station of the drone unit. Especially noteworthy is the fact that all recoveries were accomplished by remote control from a director B-17 flying formation with the nullo (unmanned) drones.

This technique in making the recoveries was developed by necessity as each situation arose, since training in landing drone aircraft is not received by remote control pilots. The way these pilots handled each emergency reflects favorably on their skill and practice in all phases of drone operation.

To Captains Proctor and Spears for their fine work in preventing loss of lives and property and in saving needed defense dollars, Well Done.

Foul Wind at Fairweather

This article was submitted anonymously by a navigator who was stationed with the 54th Troop Carrier Squadron, Elmendorf, Alaska



IN 1949 one of our C-54s was reported missing. It was found at the 9000-foot level of Mt. Crillon in Fairweather Mountains between Sitka and Yakutat, Alaska. The accident was attributed to navigational error, probably induced by inaccurate or split beam legs.

In 1950 a Canadian Pacific C-54 was reported missing and to date has not been found.

A few days later a General Airways C-46 was reported missing and was found approximately two miles east of our C-54.

After the accident in 1949 navigators were assigned to the 54th Troop Carrier and an intensive proficiency program was inaugurated. At the time of the two 1950 accidents probable tragedy was averted on nine separate flights and a new theory was developed. The navigational aids were found to be as accurate as those any place in the world. However, who could believe that an aircraft could move from an area where the known wind is 15 knots and within a matter of seconds at the same altitude encounter winds of 135 knots with no visible effects, no turbulence, just a smooth slide toward the Fairweather Mountains? But it was there.

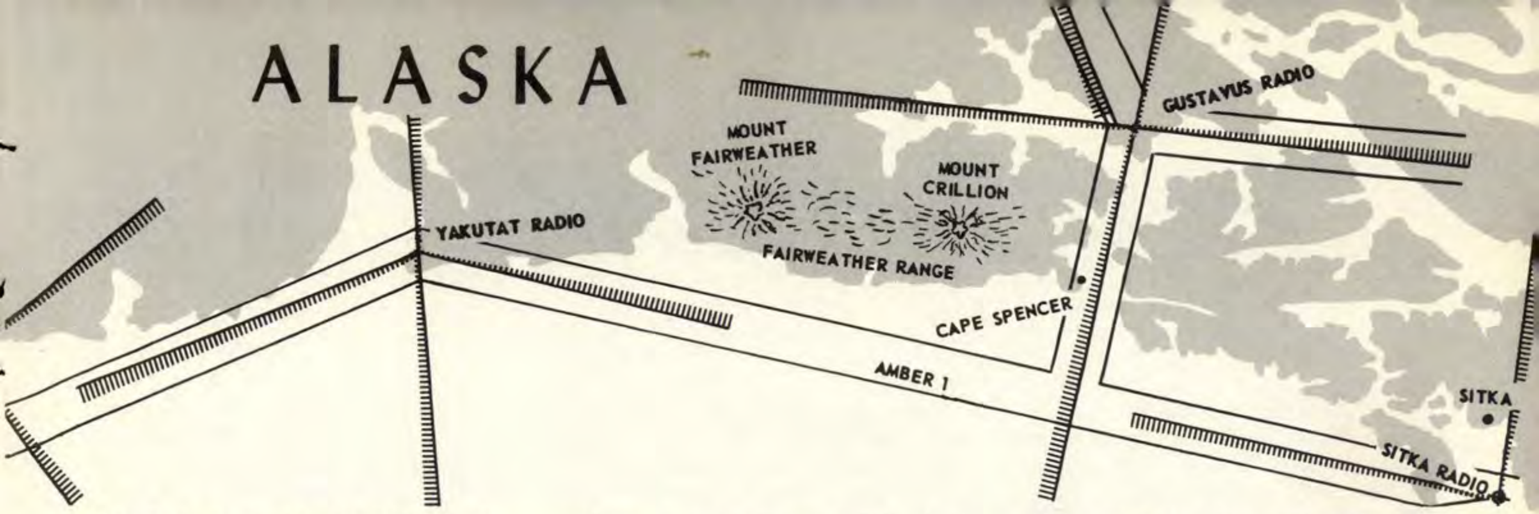
The first two incidents, two days prior to the disappearance of the Canadian Pacific C-54, were experienced by the squadron navigator who was directing an aircraft from Tacoma, Washington, to Elmendorf AFB, Alaska and by myself. I was 30 minutes ahead of the other aircraft en route from San Antonio to Elmendorf. Both flights were beautiful and uneventful until approximately 100 miles south of Middleton Island. Our maximum wind velocity encountered to that point was 15 knots, and groundspeed had settled down to where a good ETA on Middleton was practically a certainty. From a distance of about 120 miles the beacon at Middleton could be seen through breaks in the clouds and was dead ahead. Naturally, I sat back prepared to ride my ETA to Middleton.

Then it happened! The weather closed in, but still I saw no problems. Middleton was dead ahead and we had a good groundspeed — had it made. The intensive program of proficiency we had gone through, however, resulted in an automatic desire to stay busy, so five minutes after entering the weather I took a fix and found that I was five miles farther to the right than I had anticipated. I took a verifying fix within a minute and found that I was seven miles to the right. I called for a 15-degree correction to the left, which was questioned by the pilot, since he too had seen Middleton dead ahead. While the pilot was making the correction, I continued taking fixes and determined that the correction required, because of our rapid movement to the right, was approximately 45 degrees. I instructed the pilot and continued taking fixes until we reached not only Middleton Island but also Elmendorf, our destination. I found the "strong wind" corridor to be approximately 70 — 80 miles in width, and shortly before passing Middleton, we were back to our original 15 knots wind.

Upon arrival at Elmendorf, the squadron navigator and I compared logs, verified the unusual circumstances and determined that we must have been caught by the lower reaches of the jet stream which is know to exist in this area but which was believed to be at higher altitudes.

The next morning we had a navigators' "bull session." We informed the others of our experience and warned them to be especially watchful in that area.

The following week a navigator returning from Tacoma experienced winds in excess of 100 knots from a westerly direction in a 50-mile corridor between Sitka and Yakutat. On



this flight he could see Middleton Island and ascertained that a right drift of two to three miles per minute was a fact, and that a heading change of 40-degrees was necessary to arrive at Middleton.

A few days later another navigator experienced a similar wind in the same approximate corridor. Then followed a couple of weeks of normal flying, and again it happened. This time I was flying with a student on a route check to and from Tacoma. On the trip down, which was uneventful, I showed him the area to watch and cautioned him to be extremely careful. It paid off. On our return trip, we encountered a wind from 210°/112 knots and again used our 40-degree correction. This was not our last encounter with our "pet" wind, but that comes later.

While flying with the squadron operations officer, still another navigator caught a similar wind and corrected 40 degrees to Middleton Island.

Approximately two months later a pilot, with no navigator aboard, was returning from Tacoma via the coastal route (Amber 1). He crossed directly over Sitka and proceeded toward Cape Spencer. A short time out of Sitka the beam leg was lost and a distant "N" signal was heard. He turned left 15 degrees, then an additional 10 degrees, but the beam was not encountered as he had anticipated. The beam was still not encountered as he approached the NE-SW leg of the Gustavus beam, so as a safety measure he turned left 90 degrees and flew until the beam leg was crossed. This took 17 minutes on the new heading and shows that the distance right of course after the two corrections was approximately 30 to 50 miles. (Cape Spencer was the last reported position for the Canadian Pacific C-54 which vanished.)

Then our theory — which was checking out so nicely — exploded. On a return trip from Tacoma a student navigator flying a route check with me encountered a wind of 130 knots, but this time from 064 degrees. Our jet stream theory was out. What now?

I gathered all the information I could get from the navigators who had experienced it and proceeded to the weather office. The weather office had heard a few of our tales about the winds and had done a bit of research on his own.

Through the cooperative efforts of the 54th and the weather office we found that in the vicinity of Yakutat and Yakataga there is a persistent low pressure area, which at times develops winds in excess of 100 knots that influence the route between Anchorage and Seattle. A review of the weather maps and sequences on each date when the wind was encountered showed a deepening of the low pressure condition in this area. Armed with information, we devised a new route that would take us farther out over the water, where we would miss the low pressure area and the accompanying strong wind. As a result, a new SOP has been established.

If existing weather necessitates the use of Military Airways en route from Tacoma to Elmendorf and radio aids are lost at any time after passing the Sitka beam leg, an automatic change of heading 45 degrees to the seaward is taken and maintained until reliable Loran coverage ensures completion of the mission. This is done so that if the strong wind is present, the course to Middleton Island will be made good. If not, a course will be established toward the Homer Range, where Loran can be used to advantage. If the reciprocal strong wind is encountered, a course approximating Kodiak will be made good, and Loran can again be used to advantage. But in any case the 45-degree correction will keep the aircraft out of the area of excessively high mountains.

This SOP has been used to advantage. One of our C-54s lost all radio aids shortly after passing the Sitka beam leg and headed for Anchorage. Because of prior experience in this area by both pilot and navigator, the automatic 45-degree seaward correction was taken and Middleton Island was seen through a break in the clouds about five miles west of course. So the wind was there once more.

The 54th Navigator is not unaccustomed to winds in excess of 100 knots at 7000 to 9000 feet. These winds are quite prevalent in the Aleutians where the bulk of our flying is done. In most cases, dependent upon the pressure areas with which they are associated, their speeds rapidly increase, and their directions change from 100 to 180 degrees. These winds, however, have been reasonable and predictable. Therefore, it certainly jolted a few of us to find a completely alien wind of such magnitude, with no visible sign and no possibility of prediction. However, "our wind" was there — we found it — we recognized it — and I believe I can safely say that we exercised good judgment in overcoming it. Needless to say, we are cautious of it. We respect it, and we feel exceedingly lucky on trips where we don't find it. ●

Keep Current

NEWS AND VIEWS

Record Breaker

A Cessna XL-19B equipped with a high pressure demand type oxygen system and powered by a Boeing XT50-1 turbo-prop engine has flown to a new world's altitude record for light planes of 37,063 feet. This achievement has received official approval of the Federation Aeronautique Internationale, governing body for world aviation records. The former record for light planes was 30,203 feet.

Bill Thompson, chief engineering test pilot, took off in 90-plus degree heat for the record attempt. An hour and a half later and more than seven miles in the sky the outside temperature was minus 58 degrees Fahrenheit. Although windows and skylight were iced over, the new turbine still gave him a rate of climb better than 50 fpm! High tailpipe temperature caused Thompson to throttle back at 37,000 feet, experiencing an engine flameout immediately thereafter. He landed 45 minutes later with the new altitude figure recorded on a sealed barograph.

The "Flying Barber Pole" configuration on the F-86D makes for quick identification in photos and by "chase" pilots.

First light plane in the world to use turbo-prop power, the XL-19B differs from the standard Cessna "Bird Dog" Army observation plane only in its engine and accessories. It was pointed out that close to 125 pounds has been saved in engine weight, and although JP-4 military fuel was used for the record flight, the power plant will operate on anything from diesel fuel to high octane aviation gasoline.

The XL-19B development program is a joint project of the U. S. Army, U. S. Air Force, Cessna and Boeing.

A Helping Hand

Although all of us are supposed to be completely familiar with the contents of the Radio Facility Charts, 'taint necessarily so, as evidenced by some of the choice ones that are pulled from time to time. Of course we have to admit that the constant changes that take place in the facility business make it difficult to stay current. But, remember, those changes are for the most part in your favor and a few spare minutes devoted to scanning through the latest editions of the Radio Facility Charts may well pay dividends.

Here's one wrinkle that is worth noting and pasting away in your mental file. It isn't necessarily a new item but you may have overlooked it in the past, so here we go quoting direct from the latest edition of the Radio Facility Charts:

"The Air Defense Radar Network can furnish emergency assistance to aircraft lost or in distress in ADIZ's and extended adjacent areas on an around-the-clock basis. These emergency procedures are supplementary to information now contained in Supplementary Flight Information, United States.

"As radar is restricted to line-of-sight coverage, altitude should be increased if necessary and possible before initiating procedures. Procedures should be repeated every 20 minutes until instructions are received or interception is accomplished.

"a. *With two-way radio:* Request radar assistance from the Air Defense System through any CAA range station or call Radar Control on 121.5 mc or 243.0 mc using distress calls of 'Mayday' or 'Pan'.

"b. *With receiver only:* Tune to 121.5 mc or 243.0 mc. Fly a *right* hand triangular pattern with two minute legs and one half needle width turns of 120°. Complete at least two patterns before resuming course. If radar contact is established, instructions will be given on 121.5 mc or 243.0 mc.

"c. *With no receiver:* Fly a *left* hand triangular pattern as above. If radar contact is established, a rescue aircraft will be dispatched for intercept. Resumption of course will not compromise this system as the aircraft will continue to be tracked or 'distressed' from point of initial contact."

Duck Season

To duck or not to duck; that is the question.
Whether 'tis nobler in the mind not to duck
And suffer the slings and arrows of outrageous canopies,
Or to take arms against a sea of troubles
And by ducking, end them? To duck, to live,
And by doing so we end
The thousand Natural shocks
That heads are heir to.
'Tis a consummation devoutly to be wished
That pilots stoutly will adhere to
T.O.'s pertinent to their gear.

"Pilot jettisoned canopy from his F-86A at 6000 feet but did not eject. Paint matching that on his P-3 helmet was found on the leading edge of the canopy."

Your head is fair game to a dishing canopy. The victory is seldom in dispute. Many canopies take a swipe at your noggin when they go, although most recent jet aircraft canopies are designed to go their own way regardless of your head and body position. The emergency procedures section of your aircraft technical orders gives the word when it is necessary to lower your head and body prior to jettisoning the canopy.

Remember, when instructions say merely to lower your head, you should duck your entire upper body and head down as low as possible.

A safe policy is: When in doubt—DUCK!

DUCK when jettisoning canopies from the following aircraft:

F-51 (all models)
F-80 (all models)
F-82 (all models)
F-84B and C
F-86A, D, E and F

Though not specifically noted in the Technical Order, it is wise to duck when jettisoning canopies from all F-47's, F-89's and B-45's—and in any aircraft where motion of the fuselage may slam the canopy sideways.

Flying the Omni-Range in an AN-T-18 Link Trainer

An omni-range indoctrination device has been developed at Pepperrell Air Force Base in an effort to give local pilots a basic familiarization with the new type range instruments.

Using an AN-T-18 type Link Trainer, the ADF system was reversed, with the control dial installed on the pilot's instrument panel in the trainer. This serves as the course selector. The pilot dials his desired course and the Instrument Trainer Instructor gets the indications on his receiver dial at the desk.

To accomplish this reversal of the ADF instruments, the transmitter teletorque in the base unit was disconnected, and the instruments were switched in the desk and the trainer. Then the teletorques on these instruments were reversed, so that the teletorque in the trainer which is normally a receiver is now a transmitter. The desk teletorque is changed from a transmitter to a receiver.

The "To-From" indication was solved by installing two lights (similar to the "Z" marker light), beside the course selector in the trainer. These are connected to the 6 V transformer in the fuselage, then to a switch on the operator's desk through two blank collector rings at the trainer base.

No alteration was needed for the vertical needle doubles for this localizer-vertical needle. The ILS vertical needle doubles for this purpose.

The RMI (Radio Magnetic Indicator) has not been duplicated by this base training section as yet, so to find the magnetic bearing to the station, a pilot turns his selected course dial until the deviation needle centers, and the "To" light is on. When this occurs, his magnetic bearing to the station is indicated on the selected course dial.

As the pilot dials his selected

Alert shack-hanger speeds scrambles.

course, and changes his position on the map—by flying the trainer, the instructor at the desk follows on the SCS-51 dial and the "To-From" switches.

Prior to setting up this system, there was no opportunity at this base for pilots to get any practical experience with VOR. The Link Section can now, in a one-hour period, give a pilot a good idea of the operation plus some actual practice with a set. Basic familiarization is accomplished by having the trainer "in the straps."

This cuts down the time necessary to check pilots out in the omni procedure. Also, in the past, pilots tended to shun the AN-T-18 type trainer in favor of the later model C-8, while now they show a marked interest in the older trainer, resulting in an increase in utilization.

The project officer, Major Walter C. Cederlund, Base Plans and Training Officer, who has worked with the Link Training Section on this development, finds that, compared to lectures and literature, he now has a much more effective system of getting VOR across to the pilots.

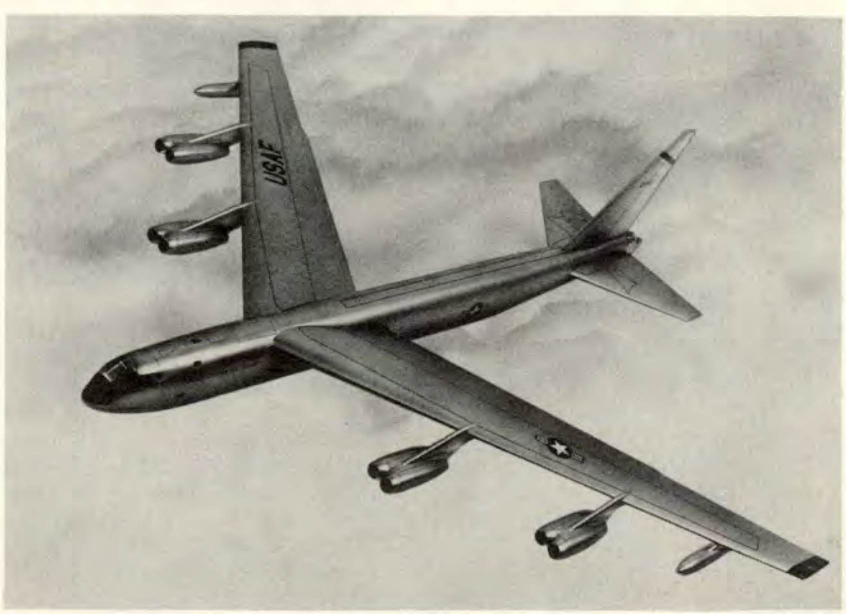
THE NEW B-52

Pictured opposite is a model of the new B-52A Stratofortress, now in production for the United States Air Force.

The model shows the new nose and crew compartment design, with side-by-side seats for the pilot and co-pilot. The two prototype B-52s now flying have a tandem cockpit arrangement.

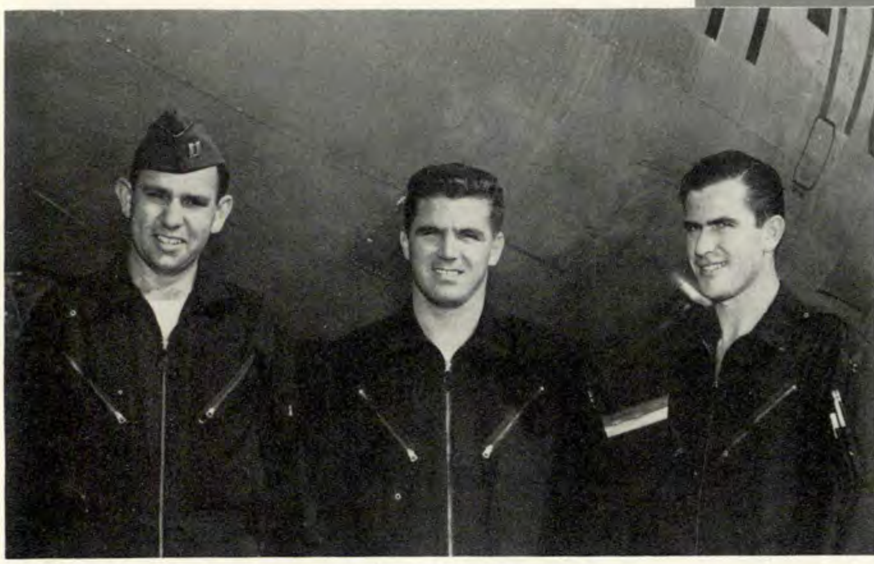
The production model will be powered by eight Pratt & Whitney J-57 turbojet engines which are mounted in four sharply raked-forward pods hung under the swept-back wing. Auxiliary fuel tanks are located under each wingtip.

The B-52s will be delivered to the USAF Strategic Air Command to form "more than seven" combat wings of heavy, long-range jet bombers, the Air Force has announced.



T-29B—A familiar profile . . .

T-29 FLYING CLASSROOM



L to R: Capt. Strain, Capt. Macruder and Mr. Snowder, test crew for the T-29D.

EVERY once in a while we get the feeling that the entire aviation world is completely mad — mad as a March hare about jet aircraft, that is. Straight wings, swept wings and deltas. Transonic and supersonic blowtorches replete with afterburners and supermen.

Well, just to be different we've decided to write about a conventional, two-engine airplane. It doesn't rumble, roar or belch obnoxious fumes. But it serves a mighty important purpose. We give you the T-29D.

Most of you are familiar with the Convair T-29. If you haven't flown it, at least you've seen it parked on an Air Force base somewhere. The line of astrodomes marching down the top of the fuselage sets the profile of this aircraft apart from all others.

But on the new T-29D which underwent acceptance flights at San Diego, California early this winter, the familiar astrodomes are gone. Parked on the flight line at Lindberg Field the first D looked like a commercial airliner with USAF markings. Which is understandable, since the T-29D is a military version of the Convair-Liner 340. Once you've stepped inside the plane, however, the illusion that this is a commercial transport ready for a fast run to Texas is dispelled.

Instead of deep carpeting, reclining seats and a blonde hostess, the cabin is filled with training equipment. Radar and electrical equipment racks flank the aisle forward, and a curtain incloses a training area amidship. There are facilities here for six students and two instructors.

The earlier series of T-29s were also military versions of commercial aircraft (the Convair-Liner 240), designed to train bombardiers, radar operators and navigators. The new D differs from the A and B series not only in the absence of astrodomes and the rearrangement of the interior but also in the power plants and the electrical system.

The D is powered by two Pratt & Whitney R-2800-99W engines. Engine exhaust augmentors are provided for engine cooling and to supply heated air for cabin air conditioning and wing and tail anti-icing. Increased inverter facilities in the regulated alternating current supply system accommodate the electronic training equipment.

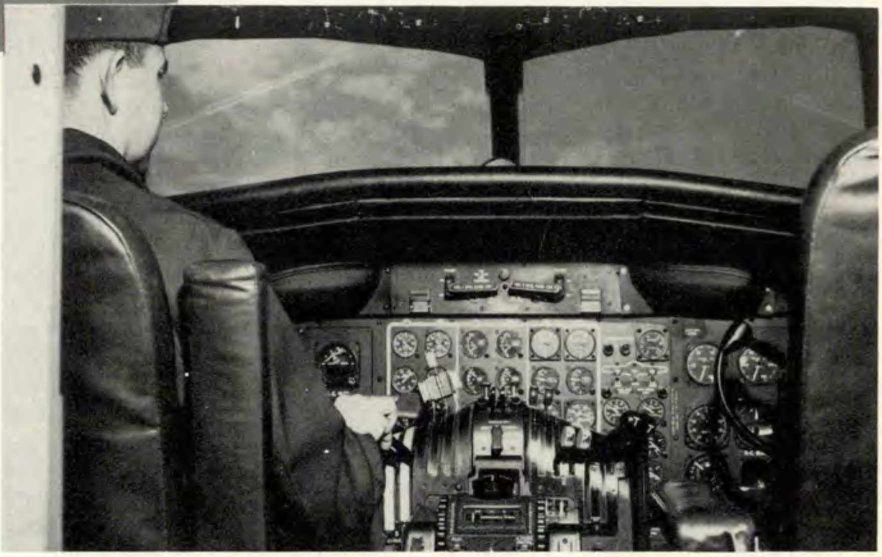
In all other systems, the T-29D is similar or identical to the B. There are two integral fuel tank areas outboard of the nacelles in each side of the wing. Total usable fuel is 1530 gallons. The two tanks on each side normally function as one tank and supply the engine on that side. A cross-feed system permits operation of either or both engines from the tanks in either side of the wing, although transfer of fuel from the tanks in one side to the tanks in the other side is prohibited.

The engine oil system was designed to Air Force requirements and is identical to that in the T-29B. A reserve oil tank with integral heating provisions, selector valve, combination pressure and scavenge pump and line scavenging timing device are installed below the floor on the right side near the aft end of the cabin. Either or both engine oil tanks can be replenished from the reserve tank in flight.

Like the T-29B, the D has three separate hydraulic systems. The main system is common to the commercial version of the aircraft and is of the semi-open center type with a normal operating pressure of 3000 psi. A manual bypass valve is opened during flight to allow fluid to circulate through the central portion of the system under low pressure. In this position pressure is trapped in the accumulator for operation of flaps and brakes. Normally, all compon-

Flying Safety Magazine checks up on the flight characteristics and safety angles of a new addition to our ever-growing Air Force.

... T-29D—Cleaner and faster.



The test crew from Edwards AFB claims the instrumentation of the cockpit is good.

ents are operated with the bypass valve in pressure position.

In the event of complete hydraulic failure, an emergency system using air pressure from a bottle releases the landing gear up latches and operates the main landing gear brakes.

The other two hydraulic systems are the alternator-generator system (which powers the hydraulic drive motors of the right generator and No. 2 alternator) and the cabin pressure hydraulic system. Pressure for both of these hydraulic systems is developed by pumps driven by the right engine.

Anti-icing, de-icing and defrosting systems are comparable to those on the commercial model. Wing and tail leading edges are anti-iced by heated air forced by ram pressure to enter heat exchanger muffs installed on the augmentor tubes. Windshields and direct-vision windows incorporate Nesa glass for electrothermal anti-icing. Prop de-icing is accomplished by A. C. powered heating elements in the leading edges of the propeller blades. A timing unit alternately routes operating current momentarily to one prop and then to the other.

Five thermocouple-type detection circuits protect the nacelle areas aft of the engine shrouds and forward of the main wheel well aft bulkheads, and the area of the reserve oil tank below the cabin floor. Fire warning lights are located above the engine instrument panel.

A one-shot extinguishing system is mounted in the left wing fillet. Controls in the cockpit enable the pilots to stop all flammable liquid flow to the fire area before discharging the fire extinguisher.

Armed with all these facts concerning the new airplane, we sought out the flight crew who were conducting the acceptance tests. They had set up temporary headquarters in a spare corner of one of Convair's office buildings, where they were busy "reducing data" gathered on the last flight. We found Captain William M. Macruder, pilot for the test flights, engrossed in a slide rule and stacks of notes. From the Flight Test Operations Laboratory at Edwards AFB, Captain Macruder is an engineering graduate of the University of California and has been in the flight test business as an engineer and a pilot for five years. He has taken part in the testing of the H-5 and H-19, and the C-124, C-125, F-86E and B-52.

Co-pilot for these tests was Captain Bailey "Skip" Strain, Flight Test Engineering Laboratory, Edwards AFB. Captain Strain has a master's degree in aeronautical engineering and prior to this assignment was with the Air Force's guided missile program.

The third member of the test crew was the flight engineer, Elden Snowder. A civilian from the Flight Test Engineering Laboratory at Edwards, he also is an aeronautical engineering graduate.

The crew were in agreement that the new trainer is a fine airplane from the pilot's point of view. "The T-29D climbs well. Short field landing and takeoff performance is good. You should be able to get into a 1500-foot strip with no trouble at all, and take off in 2000 feet at maximum weight (43,575 pounds). Single engine performance is excellent. The instrumentation of the cockpit is good. All of the controls are identifiable by feel. There's no shimmy in the nosewheel steering. The landing gear retracts fast — like a fighter. All the emergency procedures seem sound. This is definitely a two-man airplane, of course. The pilot would have a hard time reaching the landing gear handle from the left seat.

"Naturally, there are a few things we don't like. Elevator forces on takeoff and landing are pretty high.

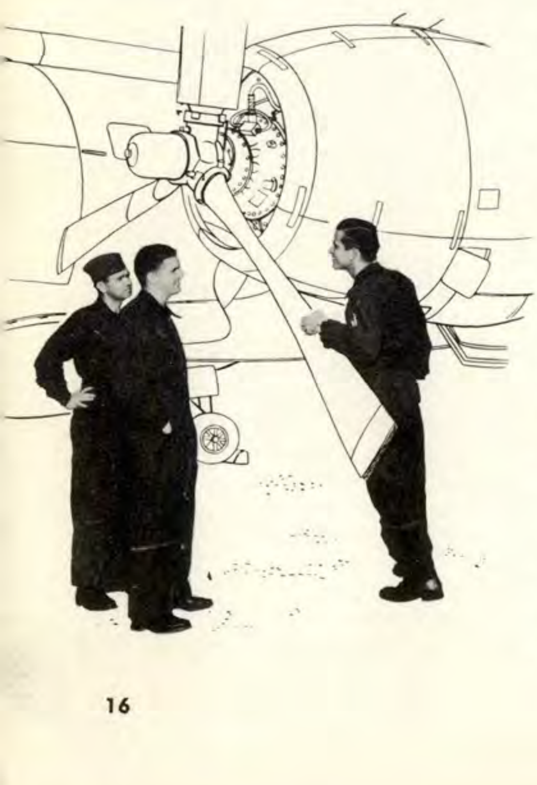
It takes a lot of trim on final approach to flare out. And in the air, aileron forces are high. The antiglare shield in the cockpit is high, and lack of visibility on climb-out and during go-around forces the pilot to resort to instruments."

We were primarily interested in what changes the test crew would recommend be made before the D's were delivered to the Air Training Command. Captain Macruder and Captain Strain pointed out that although there were a number of changes they were tentatively considering recommending, further flights would influence their final suggestions. "For instance," Captain Strain said, "there's a considerable power drain on the right engine — the aircraft's K system (electronic training equipment) and cabin pressurization are both driven by the right engine — which results in low manifold pressure and fuel pressure readings on that side. At present we think it would be a good idea to put some of that load on the left engine.

"Also, the flight instruments are on one generator, radio equipment on the other. If either generator should fail on an instrument approach, the pilots would be in trouble. We'll undoubtedly recommend changes there."

With regard to the propeller reversing system, both pilots felt it might be advisable to provide a detent on the throttles so that the props could not be put into reverse inadvertently. "At present it's possible to pull the throttles too far back and not be aware of the fact until the gear touches down." (The propeller reversing system on the T-29D does not actuate until the wheels touch.)

The walk-around-check is emphasized by the flight test crew.



For the sake of convenience, the crew intended to recommend relocation of the radio circuit breakers. Since they are now located in the passageway, a pilot must leave his seat to reach them. A bulkhead directly behind the pilot's position seemed a more satisfactory location.

Although they had not yet tested the automatic prop feathering device to any extent, the crewmembers were interested in discussing the item, which is a carry-over from the commercial version of the airplane. The automatic feathering system is intended to prevent manual feathering of the wrong propeller during emergencies. The system is operative any time the autofeather master switch on the pilot's pedestal is in the ON position. The switch is located in front of the pitch control levers and is covered by a red guard which must be raised to place the switch ON. Illumination of a green light near the switch gives indication that the switch is ON and the system is prepared to operate.

The system will operate whenever the BMEP drops to 70 or less and the throttle remains in the open position above 75 per cent power application. Throttle switches are controlled by cams attached to the throttle lever torque tubes. The cams are adjusted to actuate the switches at a throttle position corresponding to 45 inches manifold pressure at sea level. Each throttle switch, when supplied with power from the corresponding torque pressure switch, controls the power supply to the control coil of the corresponding feathering switch through a time delay unit. Autofeathering, therefore, can take place only when the throttle switches are closed (throttles advanced beyond the 45 inch manifold pressure position). The throttle switches are used to prevent a propeller from feathering when power is reduced by retarding the throttles.

The autofeathering control switch is turned OFF when the normal climb has been established after takeoff. The feathering switch must be reset each time the autofeathering system has been operated in order to allow the blocking relay to return to the normal position. The blocking relay prevents automatic feathering of the opposite prop when one propeller has been feathered automatically or manually (provided such manual feathering occurs while the autofeather circuit is armed).

A two-second time delay feature is incorporated in the feathering circuit to eliminate the possibility of the propeller feathering during temporary lags in engine power. The two-second delay is comprised of two equal time delay periods: (1) an inherent one-second delay in the torque oil pressure system, and (2) a one-second delay in the electrical circuit brought about by action of two thermal relays in parallel, each set for one second.

Two test switches, one for each propeller circuit, are used to insure proper operation of the automatic feathering system before takeoff. Manual feathering is accomplished in the conventional fashion.

The question in the minds of the flight test crew was whether this safety device was of sufficient value to warrant the additional maintenance time required to keep the system inspected and operative, and the risk of the device's failing in flight.

By the time acceptance tests are completed, the crew may have decided to recommend changes other than those mentioned here. Additional flights and study may also have convinced them that some of the changes they had contemplated recommending were not advisable after all.

If you are one of the pilots who will fly the first T-29Ds which were delivered to the Air Training Command early this year, or if you are a bombardier, radar operator or navigator training in the aircraft, you may find the big new trainer just as we've described it. Or you may find some changes have been made.

In any event you will be sure that the many experts in aeronautical engineering and electronics who have been associated with the development of the T-29D and the pilots who conducted these acceptance flights have made sure the airplane will accomplish your mission in the safest and most efficient manner possible. Albeit without those plush airline accommodations you expected the first time you saw the airplane. ●

Hot Potato— MATS STYLE

MATS Comes Up With a New Spark for Old Flying Safety Meetings.

LOOKING for new ideas to spark your Flying Safety program? All too often we hear the old cry, "What can I use for material in my Flying Safety meetings?"

Sometimes that does pose a very real problem, especially for the officer who is new to the game. This business of deriving maximum benefits from each scheduled meeting isn't easy, by a long shot. Ask any old hand — But it can be done!

MATS has come up with a new and very realistic approach to this problem. It's so good in fact we are passing it along to you. MATS calls this the "Pilot Judgment Quick Decision Exercise," and we feel it may be best explained by direct quotes from a recent copy of their pamphlet.

This pamphlet has been prepared for the discussion method of instruction which moves more slowly than does the lecture type. The discussion method has certain advantages.

First, it is personalized instruction.

Second, the group members are participants and do not merely listen. They must be on the alert for the moment the leader will call upon them. It is through the cooperation of the group members that an acceptable judgment (conclusion) is reached. During flight, teamwork is essential, and when the same people are led to a "meeting of the minds" by discussion, it is certain that better flying teams will result.

The group leader for this discussion should be the Squadron Commanding Officer, the Operations Officer or the Flight Safety Officer.

When the Commanding Officer conducts the meeting or actively participates in the meeting, he will have an excellent opportunity to analyze his pilots by their decisions. His presence will emphasize the importance attached to the program.

It will be the discussion leader's responsibility to confine the discourse to related facts and judgments. The success of this form of idea interchange will depend upon the leader, and, as compensation, his leadership will be improved.

Since the first fatal accident of Lt. Selfridge, 17 September 1908, while piloting his Wright Flying Machine, human error has been accounting for more than half of the Air Force accidents. Under the causes for human error, the largest and most costly single factor for the many accidents is the pilot's inability to make proper judgments (decisions). In our time of increased aircraft size and complexity, when *one* pilot is sometimes responsible for the safety of more than 100 lives, it becomes apparent that the transport pilot's judgment must be superior.

The information contained in the following exercise was extracted from the report of a C-54 accident which took place at a western Air Force Base; however, it could pertain to any type aircraft. The accident involves some of those judgment deficiencies which are common during Ground Controlled Approaches.

"The aircraft struck the telephone pole 2700 feet before reaching . . . the runway."

Study this exercise before presenting it in a meeting. Use only those questions and answers which will be of value in standardizing your particular operations. The use of the blackboard for a clearer presentation cannot be over-emphasized. Discuss the approximate position of the runway and range station, holding pattern, etc.

History of Flight

The instructor pilot and crew of ten, including three student pilots, departed from their home base at 1430 hours in a C-54. The purpose of the flight was training and the flight cleared to a nearby base where two hours of transition were completed.

While filing a return clearance, the pilots were briefed on the weather, which was measured 3500 overcast, 2000 feet scattered, visibility two miles with snow showers. The temperature was 33°, the dewpoint 28°, wind calm, and the altimeter 30.02. The forecast for the time of arrival at home base was: ceiling 2000 lowering to 600 feet. Visibility five miles, lowering to one mile in snow showers. GCA minimums for home base at night were 600 feet and one mile. The base which was listed as the alternate was forecasting 2000 feet and seven miles visibility.

The flight departed at 2020 hours and proceeded to the radio range station. The IP elected to remain in the right seat because, as he stated, he had learned from past experience that pilots just returning to duty after a break in flying were not proficient in radio procedures.

While waiting for a GCA frequency, in a holding pattern at 4000 feet, the local weather was requested and given as: ceiling 300 feet, visibility one mile with snow showers.

1. Question: What would your decision be?

Answer: Request to hold until the weather improves, or if the weather forecast was going to remain below minimums, request a clearance back to the point of departure.

2. Question: According to MM 55-1, which seat should the IP be in at this time?

Answer: Left. MATS Manuel 55-1, Par. 51.13 states: "On difficult takeoffs and landings and during adverse flight conditions, he (the Aircraft Commander) will occupy the left seat and be in control of the aircraft."

The IP elected to attempt a ground controlled approach and radio contact was established with GCA. While he was receiving instructions relative to his run, which was to be made on runway 34, radio reception became intermittent and then stopped completely. The flight was descending in a GCA pattern at this time.

3. Question: What procedure should be followed now?

Answer: Return to the range station, contact approach control and request further clearance.

Climbing to 4000 feet, the IP returned to the range station, where contact with GCA was established again.

Another approach was attempted, with the same results. During the third approach, communications were lost while GCA was trying to turn the aircraft onto the final. When communications were again established, the aircraft had overshot the turn onto final to such an extent that a new pattern was necessary. The IP switched to tower frequency, and while returning to the range, requested an ARTC clearance to return to their point of departure. Over the home range station, waiting for this clearance, he was advised that GCA had changed transmitters and to contact them again if he desired another approach.

4. Question: Would this have influenced you?

Answer: No. The IP should have followed through with his request and returned to the point of departure.

The IP elected to try another approach. During this approach, radio contact seemed to be good, so he decided to continue with the run. On the final, just before the IP heard GCA say, "You are going through GCA minimums," the engineer told the pilots he saw lights ahead. The IP saw a few lights through blowing snow and assuming that they could be runway lights, permitted the approach to be continued.

5. Question: What mistake was made on the final approach?

Answer: The pilot went below GCA minimums.

6. Question: What should he have done?

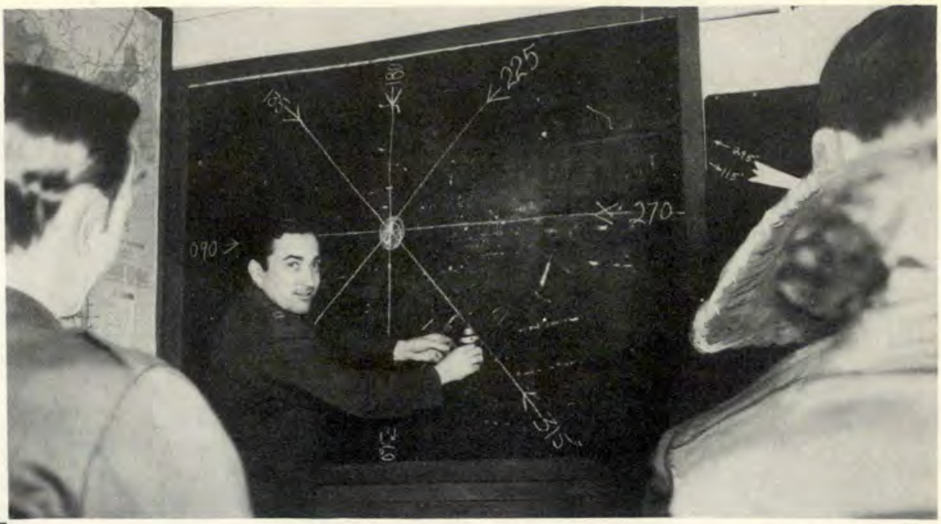
Answer: If positive runway identification cannot be made at GCA minimums, effect a pull-up following GCA emergency pull-up instructions.

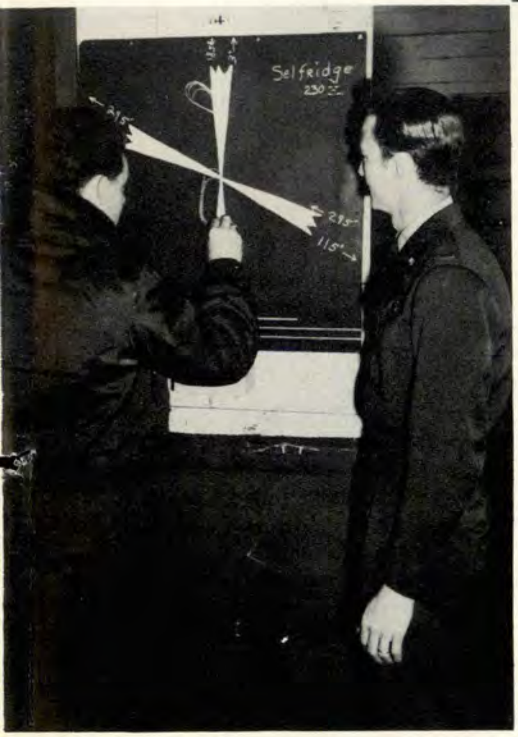
Any pilot continuing an approach without positive runway identification is inviting trouble. Such reasoning has caused aircraft to be landed on

The participants must be alert to the discussion for they may be called upon at any minute to answer a direct question.

•

Blackboards greatly aid this type of presentation. Right and below, everyone gets into the act as group leader and a member of the audience make a point.





ramps where maintenance lighting was bright, and in another instance, when only boundary lighting was sighted, the final maneuver to align the aircraft was so violent that it cost the aircraft a wingtip.

An Air Force runway has green lights marking the beginning, and the runway boundary lights are uniformly spaced, not to exceed 200 feet, located directly across from each other. If the runway cannot readily be identified at GCA minimums, you are not visual.

The last altitude the IP remembered seeing on the altimeter was 700 feet. The pilot at the controls remembered seeing 600 feet. When positive runway identification could not be made, and a dark object loomed up ahead, the IP started to apply maximum power. The aircraft then struck an unknown object. Immediately the manifold pressure on No. 4 engine went to approximately 60 inches, throttle control was lost, and the cylinder head temperature started to drop.

7. Question: What would you do now?

Answer: When at minimum safe altitude, and control of the aircraft had been established, feather No. 4 propeller.

The IP feathered No. 4 propeller and continued his climb to 9000 feet. During the climb the aircraft began to buffet severely. Ten degrees of flaps were lowered and the climb was continued. At 9000 feet he leveled off, maintained 140 IAS, proceeded to point of departure, and landed.

8. Question: What could be attempted to reduce the buffeting?

Answer: Slow the aircraft. Lower flaps, if necessary. When the flaps are lowered it establishes a higher position for the empennage and the flaps effect a downwash of the airstream.

If the turbulent air is originating within the area of the wing, the flaps assist in removing the empennage from the flow of turbulent air.

Investigation after landing revealed that a two-foot section of telephone pole was imbedded in the leading edge of the wing between No. 3 and No. 4 engines. There was no damage evident to No. 3 and No. 4 propellers, even though it seemed necessary for the pole to have passed between the two props.

NOTE: The aircraft struck the telephone pole 2700 feet before reaching the landing end of the runway, 117 feet to the right of the center line, and 56 feet above the elevation of the runway.

Conclusion

It was concluded that the instructor pilot, knowing the weather conditions and the minimum letdown limitations at his home station, descended below these minimums where the aircraft struck a telephone pole causing major damage.

It was also concluded that the IP did not exercise proper judgment in allowing the student to make GCA runs under the existing weather conditions.

Here we have but one example of how the "Pilot Judgment Quick Decision Exercise" works. We feel sure, however, that after reading this article, you will envision immediately applying these principles of group discussion and it doesn't matter whether your organization flies C-124's or L-5's, the same realistic approach will pay rich dividends.

We feel that the factor of paramount importance centers around the very real "personal touch" of all discussion participants. Every pilot in the group will have the feeling that he will be called on next to answer a question. He's got to have his response prepared long before the question is asked and consequently will be on his toes throughout the entire exercise ready to answer.

Why don't you try this same approach at the next flying safety meeting? Bet you'll be surprised at the response. ●

CROSS FEED

LETTERS TO THE EDITOR

More On "Scotchlite"

This office is extremely interested in your article, "Detection Through Reflection," published in the October issue of FLYING SAFETY. It would be greatly appreciated if you could furnish three or four copies for distribution to the Airline Transport Association and to the Air Line Pilots Association.

E. W. Burton, Actg Chief
Special Ops Br, CAA.

Flying Safety's happy to oblige!

★ ★ ★

Our Slip Is Showing

I would like to express my appreciation for the work your organization is doing. I read and digest every article in the FLYING SAFETY Magazine and over a period of years have learned many interesting items about aircraft accident prevention. It is, therefore, with a good deal of humble respect that I submit the following criticism:

In the August 1953 edition, in your article, "That UNLUCKY Old Sun," on page 22 you state: "At high temperatures these cables may become slack." This statement is contrary to all laws of physics. The Air Force has published a number of rigging charts on the subject that should be recalled — the graphs run 180° opposite what they are now, i.e., the hotter the temperature, the higher the cable tension. In addition, take into consideration the expansion characteristic of steel and aluminum, also the area of each airplane or cable exposed to the higher temperature.

George J. Doerner
AF Inspector
Edwards, Calif.

In your August issue of FLYING SAFETY, in your article, "That UNLUCKY Old Sun," you state that control cables may become dangerously slack due to high temperatures.

I think you will find that this is an erroneous opinion shared by many people. In some of our early type aircraft of steel frame construction, this condition was possible, but with modern aircraft constructed of aluminum, the converse of this is normally true.

If you will check the coefficients of linear expansion of aluminum and steel you will find that aluminum in the framework of a plane will expand or elongate nearly two and one-half times as much as the steel control cables. Therefore, when the temperature increases, the control cables will actually tighten.

Major Francis H. Morris
21st Maint. Sqdn
George AFB, Calif.

This letter is about the article, "That UNLUCKY Old Sun," printed in the August issue of FLYING SAFETY. On page 22, under the subheading "Check Control Cables" it says in part: "at HIGH temperatures these cables may become slack and your controls may become loose to the danger point."

No statement could be more erroneous. The expansion of aluminum dural is almost three times that of steel.

I would like to call your attention to TO 01-1A-8, Sec. IX, Par. 9-17. This paragraph is about temperature compensations. I believe that after your referral you will or should print a retraction of this statement.

Woodrow F. Hurst
A/C Wgt & Bal Insp
SMAMA, McClellan AFB, Calif.

All three writers are correct. Our faces are red.

★ ★ ★

To All in The Fifth

I noticed in the September 1953 issue of FLYING SAFETY Magazine that you had a picture page praising the Pilots and Crews of the Fifth Air Force for their contribution to the Korean conflict.

In the article, you gave credit to all outfits, or type of aircraft, except ours, the 6167th Air Base Group. We used C-47 and C-46 type aircraft and were not a part of Troop Carrier. I am proud of my old outfit and I think they deserve a pat on the back, too, for a job well done.

I thank you in advance for any consideration you may give this letter, and I would like to give FLYING SAFETY a hearty handshake for the swell job they are doing in keeping air crewmembers up to date on current events in flying.

A/2c Charles M. Clark
776th TC Sq (M)
Lawson AFB, Georgia

Space limitations prohibited our mentioning each unit attached to or type of aircraft used by the Fifth Air Force in Korea, but our "Well Done" was intended for ALL outfits of the Fifth.

★ ★ ★

A Word of Warning

Here's an item that should be brought to the attention of all C-47 pilots and the idea should certainly be flight checked in other twin-engine type aircraft.

The C-47 cannot maintain altitude and airspeed with a runaway propeller which cannot be feathered. To check this for accuracy, I suggest that C-47 pilots simulate this condition by throttling one engine all the way back, placing that propeller in low pitch (high rpm), and then try to stay in the air. Skeptics, beware!

An incident of this nature happened at this overseas station when a pilot held the button in too long on an unfeathering procedure and the propeller stuck in low pitch (high rpm). The aircraft was landed wheels down in a favorable cow pasture. If the propeller had run away at night you can assume that the results would have increased our accident rate.

To preclude this situation we have published a directive that practice feathering will be conducted at a minimum altitude of 5000 feet and within gliding distance of a USAF base.

Lt Col Thomas M. Glassburner
Prs., 5th Air Div Stand Bd
APO 118, c/o PM, NY.

FLIGHT ASPECTS OF THE

MOUNTAIN WAVE

This article, prepared by The Air Force Cambridge Research Center, provokes some speculation into the causes of hitherto unexplained aircraft accidents.

IN the past, some very experienced pilots and crews have been lost in air accidents due to unexplained circumstances. These mishaps apparently occurred for no reason other than miscalculated positions, with subsequent flight directly into the mountains while on IFR. In some cases these occurrences were almost unbelievable, considering the vast flying experience possessed by the crews involved. How could they have happened? All too often, after a thorough investigation had been made, the inevitable answer was pilot error.

Atmospheric research has advanced some ideas as to the possible causes of such accidents. In fact, quite a few of the accidents which have been attributed to pilot error, for lack of any other obvious cause, might have been prevented had the pilots been properly informed of the hazards in flying a strong mountain wave. A mountain wave is a disturbance of the atmosphere set up by mountain barriers and characterized by a wave-like airflow in which severe turbulence, vertical currents, and altimeter errors combine to form dangerous flight conditions.

Preliminary results of the "Mountain Wave Project" confirm that the conventional conception of the wind flow pattern over mountain ranges

An ideal mountain wave, with right to left flow, photographed from the ground. Note rotor cloud, center, lenticular clouds, above, and cap clouds obscuring the mountain peaks to right.

is in error. This is particularly true when a strong flow exists perpendicular to the ridge lines, as required for the formation of a mountain wave.

It is intended that this survey provide pilots with a more complete picture of the wave and with a detailed description of its structure. Additional meteorological information on the subject is contained in Air Force Survey in Geophysics No. 15, "Forecasting the Mountain Wave," Sept. 1952.

Let us first accompany a pilot as he attempts to traverse a strong mountain wave without sufficient knowledge of its characteristics. A great deal of flight experience in the study of such waves has been incorporated here in an attempt to give pilot readers a feeling of what they might encounter were they unaware of the experiences to be expected. Later in this report the wave phenomenon will be explained as to its formation and features.

Mountain Wave Encounter

Let us suppose you are fighting strong head winds at 10,000 feet altitude in a moderate-speed aircraft. Two hundred miles ahead on your flight course is X-Mountain. It may be one of the Rocky Mountain ranges when you are heading west; it may be the Alps when you are heading south or it may be just a small, little-known ridge.

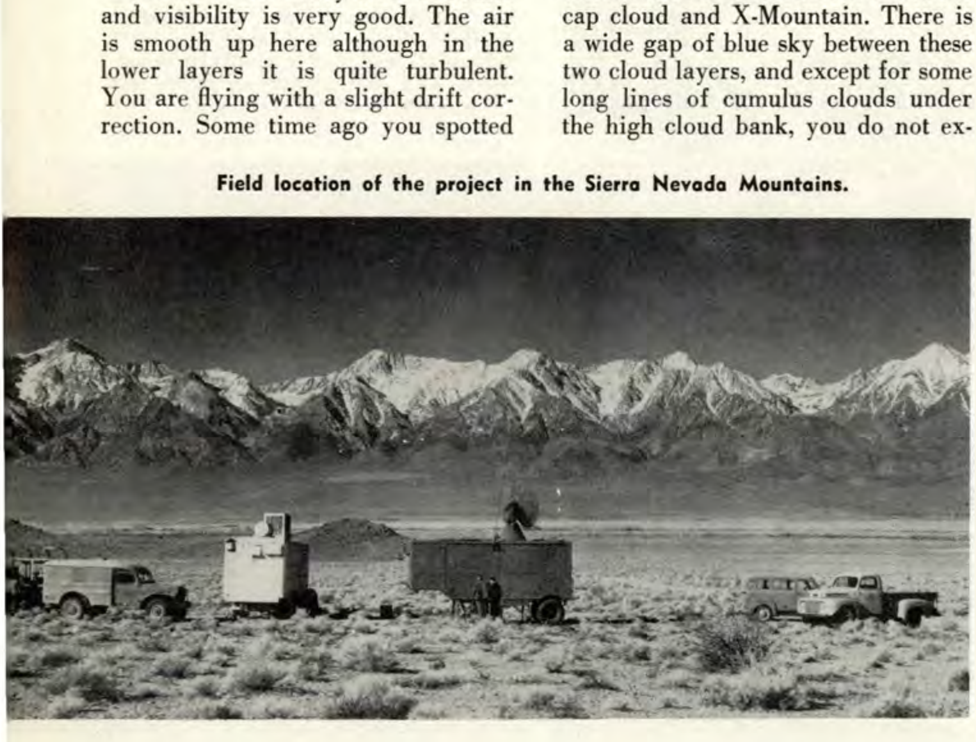
There are not many clouds around and visibility is very good. The air is smooth up here although in the lower layers it is quite turbulent. You are flying with a slight drift correction. Some time ago you spotted a long white cirrus band over the horizon far ahead. At about 100 miles from X-Mountain you notice that this cloud bank seems to extend just along the mountain range although at a much higher level than the peaks of the range. Apparently it does not move, despite strong upper winds. The summits of X-Mountain cannot be seen. They are covered by a flat, white cloud blanket.

Every minute you can see more details. The high cirrus cloud ahead consists of a few parallel banks extending from right to left, normal to the wind. As you approach this cloud it does not look as white and harmless as it looked from 200 miles away. There are dark, dense parts in it and you would not dare to guess how high it is. You would not even call it a cirrus cloud any more. It looks more like a big altocumulus cloud. You can see that this cloud is composed of a number of layers staggered vertically like pancakes. The leading (upward) edge appears quite sharp and seems to follow every band in the long mountain range.

Farther upwind blue sky extends over the flat cloud blanket (cap cloud) which covers the mountain tops. The high cloud extends only downwind of the mountain range. It is a so-called lee cloud.

You are now 50 miles from X-Mountain. Climbing slowly you should be able to pass below the high altocumulus cloud and then above the cap cloud and X-Mountain. There is a wide gap of blue sky between these two cloud layers, and except for some long lines of cumulus clouds under the high cloud bank, you do not expect any clouds at all on your flight path and head directly into this gap.

Field location of the project in the Sierra Nevada Mountains.



Apparently there are two of these cumulus lines extending from right to left just this side of the mountain range. They look so harmless that you really do not worry about penetrating them. The row nearer you consists only of some broken, ragged cloud pieces (fracto-cumulus). They seem to be just about as high as the mountain tops and the cap cloud. The cloud line nearer the mountain range looks much more dense and builds up higher than the cap cloud over the mountains, although it is certainly not comparable in depth to the big shower clouds you have had to penetrate sometimes. None of the cumulus clouds here give any indication of precipitation.

As you cannot estimate how much space exists between X-Mountain and the cumulus lines you have to decide now if you want to pass beneath, above or through the cumulus clouds. Had you heard about the "Mountain Wave" earlier, you would have made up your mind a long time ago. You would know by now that the harmless cloud picture ahead displays all indications of impending danger. Now you have to learn it the hard way!

You decide to continue your flight towards the cloud gap by climbing steadily. You will probably pass through the first tiny cumulus line which is now only a few miles ahead. Fixing your eyes on some of the cloud fragments you notice that they show strong rolling motion. You remember having heard of a roll cloud and anticipate some turbulence.

Upon contact with the first cloud pieces, your ship banks steeply and you are thrown against the ceiling of your cockpit. You have your hands full to regain control of the plane and you do not find any time to watch your altimeter or rate of climb indicator. Nevertheless, you feel that the plane is climbing and descending rapidly in what you would call severe turbulence.

This dance lasts only one or two minutes; then suddenly the air is smooth again and you have a good rate of climb. You have passed the first roll cloud and have time now to fasten your shoulder straps and to think your situation over. Looking upwards you notice that the high cloud is now huge and compact, completely shading the countryside. Your decision to climb over the cumulus lines seems justified by your first experience.

The rate of climb is unusually good after passing the first roll cloud. You can already see over the next cloudline, which seems to be five to ten miles ahead, and you should have plenty of height to clear even the highest cloud tops of this roll cloud. With the air quite smooth you are confident that you are out of trouble by now. Looking down at the valley floor you notice that jet-like dust streaks indicate strong surface winds. Your progress is slow. Apparently the upper winds are very strong. As a consequence you have to change your drift correction to stay on course.

Now you are high enough to look down on the next roll cloud. The cap cloud over X-Mountain ahead is snow-white in the brilliant sun. It seems to pour down the mountain slope like a cloud waterfall. Farther upwind the cap cloud merges with the horizon and it is hard to estimate whether you are higher than this cloud layer or not.

The huge altocumulus cloud above is even darker now. The leading (upwind) edges of the different pancake layers are staggered toward the wind. The highest one is still far ahead and shows a brilliant white rim. Now you can see the profiles of the staggered layers. They are lens - shaped and you remember having heard meteorologists say that lenticular clouds occur frequently over mountains.

Something unexpected must have happened suddenly. The roll cloud ahead has started to build up quickly in front of you. Looking downward you notice that the plane does not seem to be making any headway. Now the first cloud drifts by under the plane. If the cumuli continue to rise that way, you are not sure that you can make it.

A glance at the rate of climb indicator reveals what is going on: the plane is descending at over 2000 fpm in completely smooth air. What you need now is groundspeed. With the nose down and full power, clouds seem to shoot by underneath the plane but the ground still does not show noticeable movement. The rate of descent is now 2500 fpm. A big cumulus turret builds up ahead and engulfs the plane within seconds. You have fallen from above into the roll cloud.

What follows is no longer controlled instrument flight. Heavy gusts make all the instruments dance. The speed drops down, then shoots up, the rpms are changing rapidly and the engine is howling. Several times you hang in your belt without the slightest idea of attitude. You have not encountered anything like this before. You recall a thunderstorm flight which scared you to death but the turbulence was nowhere near this bad.

Suddenly you drop out of the cloud base and the view startles you: everything seems to have changed. X-Mountain looks down on you like a big barrier, the clouds sweeping down its slopes in front of you. You are about ready to turn back when your plane is lifted with enormous power. In heavy vertical gusts your rate of climb jumps to 1000 fpm, later to 2000 fpm.

The leading edge of the cumulus line is now just above you. To avoid being pulled back into the roll cloud you push the nose down. Apparently you now have a good groundspeed and the plane is climbing fast in front of the cloud line which looks like a long railroad train. Suddenly the gusts die out. The air becomes smooth as glass. But your rate of climb is now 2500 fpm. You are stunned by the fact that such extreme degrees of smoothness and turbulence can coexist so closely in the atmosphere.

Looking back after a few minutes you notice that you are already higher than the top of the cumulus line. That should be enough, finally, to cross X-Mountain and the cap cloud. You are now flying at a safe level. Your altitude is 3000 over X-Mountain and probably 2000 feet over the cap cloud. There is no roll cloud line ahead now and you have reason to believe that you are out of trouble.

The foot of X-Mountain lies just below you. The trailing edge of the cap cloud is only one mile ahead. The cloud mass pouring down the mountain slope and dissipating is a fascinating spectacle. The upwind edge of the high lenticular cloud is directly overhead, maybe between 30,000 and 40,000 feet.

The plane makes good headway now but the updraft is slowly tapering off and you have to use more power to keep altitude and groundspeed.

High as you are above the low-level clouds you feel almost—but not quite—safe. This completely smooth air has proved treacherous before and you are not sure what it has in store for you this time. The crestline of the mountain is not yet passed and groundspeed seems to drop again. After another minute the low clouds look nearer. There has been no indication of what your altimeter and rate of climb now reveal: You are descending again at 1000 fpm, and full throttle does not help. You feel if you can go another mile upwind you should be through.

But once more there is this unfortunate combination of a jetlike headwind and a strong downdraft. You have been running through several consecutive up and downdraft areas.

This is indeed the pattern of an atmospheric wave. In another minute you will know if you can pass X-

A project sailplane soaring over a mountain wave cloud formation.

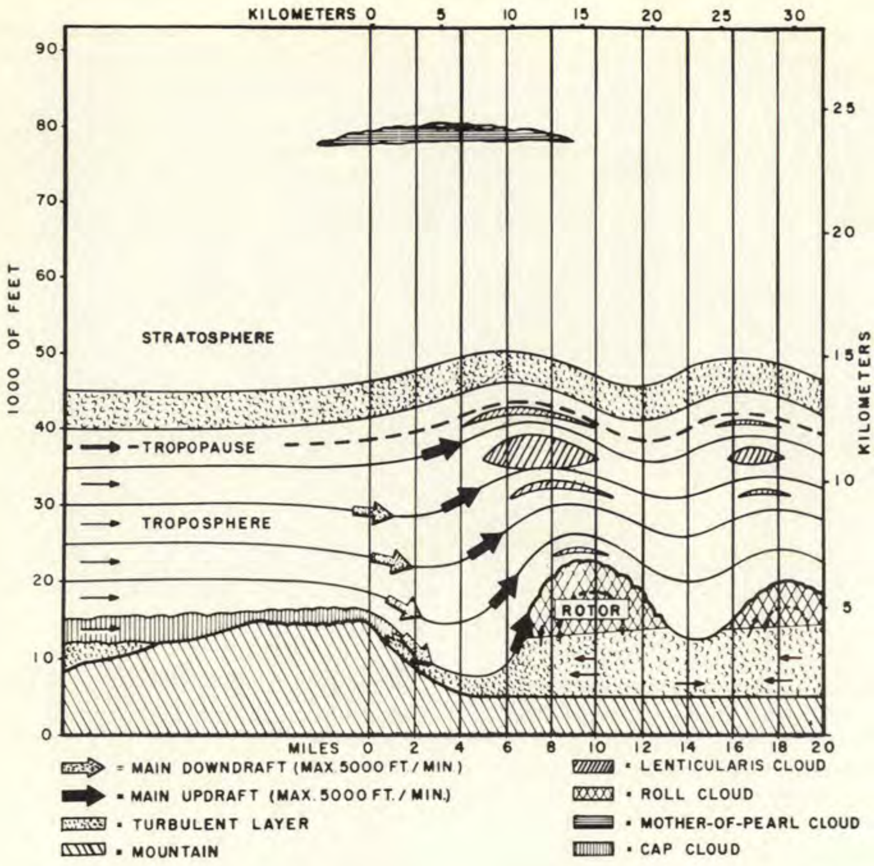


Fig. 1. A cross section depicting the conditions generally associated with a typical mountain wave, frequently referred to as the foehn phenomenon.

A typical cap cloud or a "foehn wall" is sweeping down a mountain slope.

The smooth cloud texture and well defined edges indicate a laminar motion.

Mountain. The cloud waterfall is directly beneath the plane now. But in front of you the cap cloud climbs fast. The air is still quite smooth, but now you are descending at about 3000 fpm. Three thousand feet per minute? That means you will crash into the mountain within another minute. What does your altimeter show? A thousand feet above the highest peak of X-Mountain. But now you can see a mountain peak through the cap cloud. That is certainly not 1000 feet below you. It is just about your present height. Is the altimeter wrong? Only a quick decision will save you. Turn back.

While you bank in a steep left turn the air becomes hazy. A glance at the instrument panel and the mountains shows that you are descending at almost 4000 fpm into the lower end of the cloud waterfall. Suddenly a terrific gust banks the airplane into a steep right turn towards the mountain. For a moment you see the rocks of the mountain rapidly coming nearer. Then you succeed in maneuvering the plane away from the stone wall.

You are right in the foot of the cloud waterfall which looked so smooth from above and the airplane shoots with a tremendous tailwind 1500 feet out over the valley floor. As the heavy gusts diminish you look back on the towering mountain range and the cap cloud which only a few minutes ago lay below the aircraft.

In a matter of minutes you have passed under the two roll clouds and the nightmare is over. You decide to do what you should have done in the first place: change your flight course, fly around X-Mountain and avoid traversing a full-scale "Mountain Wave."

The foregoing probably describes a typical mountain wave experience. In this case, the pilot encountered a very powerful wave, but with the favorable factor of good visibility which enabled him to recognize cloud types and thus orient himself and maneuver the ship out of immediate danger. It is conceivable that the situation would have been more serious if the wave were very dry, with no clouds to give any indication of hidden danger; or on the other hand, if the mountain wave were completely obscured by a massive cloud layer.

Mountain Wave Project

To investigate this type of airflow, the "Mountain Wave Project" was implemented under the joint sponsorship of the Geophysics Research Directorate of the AF Cambridge Research Center and the Office of Naval Research. It was conducted by the University of California in cooperation with the Southern California Soaring Association and several government and private organizations.* The field tests were carried out during 1951-1952 in the Sierra Nevada mountain range in California under the direction of the Geophysics Research Directorate.

Specially instrumented sailplanes were used to trace the streamlines and the temperature and pressure field in the neighborhood of the mountain range when a strong flow existed perpendicular, or nearly perpendicular, to the ridge lines. Conditions were investigated up to a record height of 44,500 feet by use of these sailplanes which were

*These included the U. S. Weather Bureau, the Air Weather Service, the Naval Ordnance Test Station at Inyokern, the Hastings Instrument Co., the Symons Flying Service, the Institute of Numerical Analysis, the Air Force Shadow Mountain Lab and others.

A typical stationary roll cloud formed downwind of partially obscured peaks.

The tops of the rotor cloud are starting to merge with the lowest lenticular clouds.

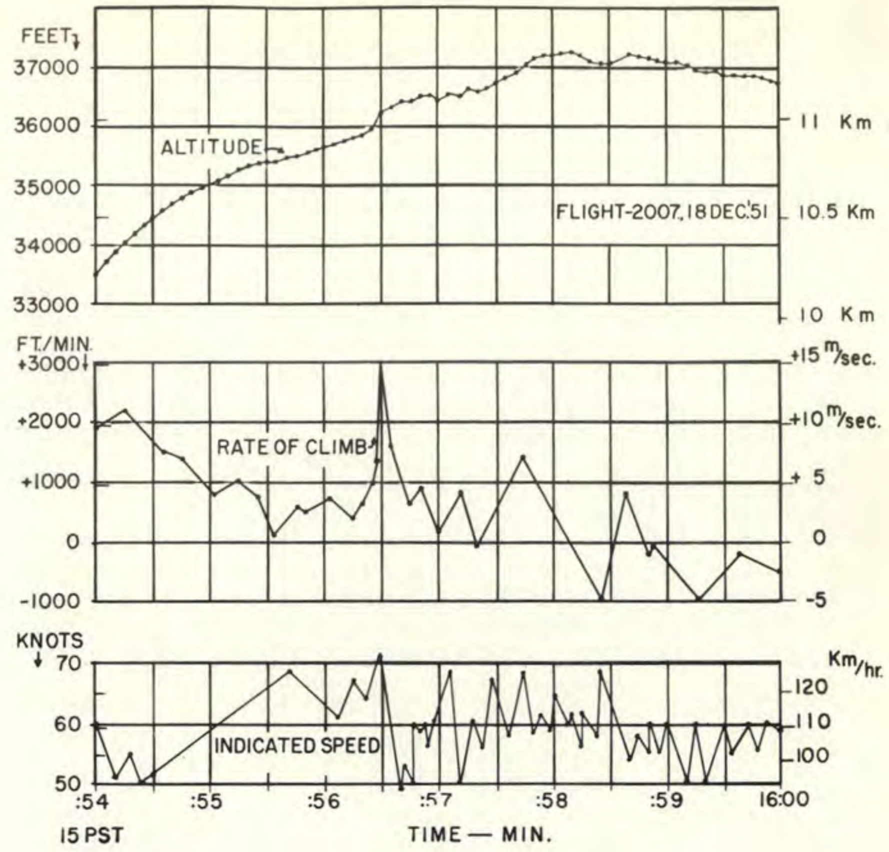


Fig. 2. High level turbulence encountered between 36,000 and 37,000 feet by one of the project gliders in the same wave which is depicted on page 26.

tracked by radar, Raydist and cinetheodolites. Time-lapse cameras took motion pictures of the associated cloud structures from the ground to supplement the data taken by the sailplanes. Meteorological stations were established on both sides of the mountain range from the valley floor up to an elevation of 9000 feet.

Gliders were preferred to powered planes or balloons in this project because of their small sinking rate, low speed, maneuverability, and accuracy of calibration. They can remain aloft for many hours traversing the wave using updraft areas to gain altitude and, due to their low speeds, can be used to investigate the structure of severe turbulence which higher-speed, conventional aircraft try to avoid.

Airflow and Clouds

Figure 1 is a cross-section depicting the conditions generally associated with a typical mountain wave, which meteorologists often refer to as the foehn phenomenon.

The picture on page 21 is an actual photograph of such a wave. As indicated in Figure 1, the mountain range at the left extends to about 14,000 ft. MSL and the wind flow is from left to right. In the flight described earlier in this report, our pilot was flying from right to left and the diagram illustrates the wave-like motion of the flow and the different cloud types he encountered.

The cap cloud in the lower left corner of Figure 1 hugs the tops of the mountains and flows down the leeward side with the appearance of a waterfall. Since it hides the mountains and is connected with the strong downdraft area on the leeside of the peaks, the cap cloud is dangerous.

Looking from the valley floor toward the mountain this cloud mass sometimes gives the appearance of a cloud wall, which is responsible for the name "foehnwall," frequently used for this cloud type.

The downdrafts can be as strong as 500 fpm. As our pilot discovered, one must have more than the minimum required clearance to traverse such powerful down currents.

Some distance downwind of the cap cloud (lower center of Figure 1) the air shoots up again almost vertically, forming the rotor or roll cloud. At times its base is below the mountain peaks and its top reaches considerably above the peaks, sometimes to twice the height of the highest peaks and occasionally to over 30,000 feet.

The rotor cloud may well extend to a height where it merges with the lenticular clouds to be described in the next paragraph. While often appearing harmless, the rotor cloud is dangerously turbulent with updrafts of up to 5000 fpm on its leading edge, and equivalent downdrafts on its leeward edge. There is a constant boiling motion in and below this cloud.

In overall shape and location, it is effectively a stationary cloud constantly forming on the windward side and dissipating to the lee. There are instances where the roll clouds build up to such a height that precipitation and even thunderstorms form.

Frequently a number of consecutive roll cloud lines extend parallel to the mountain range, each marking a wave crest. The initial roll cloud may be present anywhere from a position immediately to the lee of the mountain peaks to a distance 10 miles downwind. In the latter case one might naturally assume that the lift zone ahead of the rotor would be very broad and gradually taper off.

This is not true, however; the updraft area can be just as sharply defined as the roll clouds closer to the mountain.

The lenticular or lens-shaped clouds (Figure 1) which appear in layers sometimes extending to well above 30,000 feet are relatively smooth. The tiered appearance of these clouds is consistent with the smooth laminar flow in this section of the wave and is due to the stratified character of the humidity in the atmosphere and to the lifting effect of the wave on the whole depth of the atmosphere, which creates condensation in the humid layers.

These lenticular clouds, like the rotor, are stationary, constantly forming on the windward side and dissipating to the lee. There might be up to 10 or more consecutive lenticular clouds downwind of the ridge, each marking another lee wave.

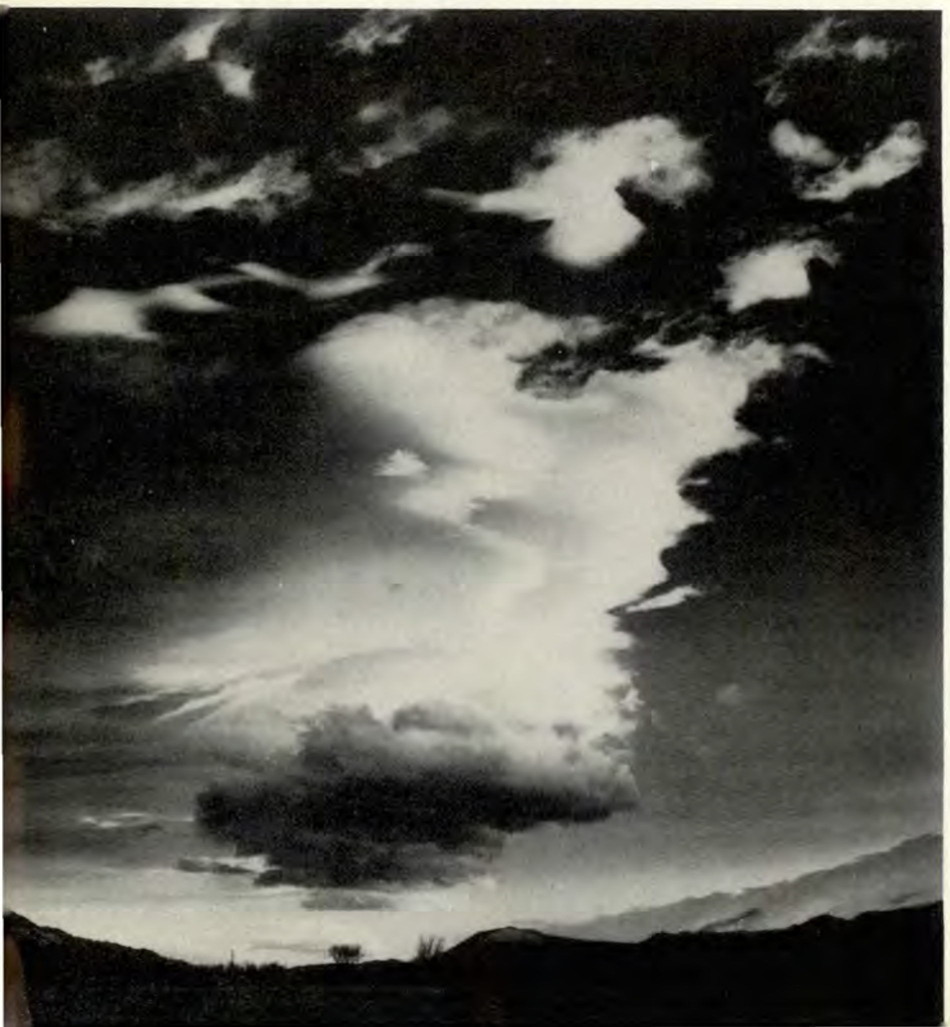
At times, severe turbulence is encountered above the extremely smooth lenticulars (see the turbulence band in Figure 1 above 40,000 feet). This is especially true if a typical jet stream combines with the wave in the upper troposphere. The turbulence layers above and below the lenticular levels are comparable to ball bearings, allowing the atmosphere between to flow through at very high speeds.

Occasionally, a breakdown of the laminar flow sets off a formation of severe turbulence throughout the whole depth of the wave. When this happens, the highest lenticular clouds show very jagged, irregular edges rather than the normal, smooth edges. The turbulence near the tropopause then reaches a degree which might cause structural damage to aircraft.

Figure 2 shows what happened to a glider which flew through this kind of severe high level turbulence. The picture on page 26 was taken during the time the glider was flying. The juxtaposition of very turbulent and very smooth flow, however, is typical in the wave. This was one of the conditions which surprised our pilot.

As indicated in Figure 1, the lenticular clouds in most cases tilt toward the mountain range as ascent is made through the layers from the rotor cloud to the highest lenticular layers. As a consequence of this tilting, the streamlines are packed closer together in the downdraft side of the rotor. Thus, the wind speed is considerably increased in the downdraft areas and local jets form which introduce an additional flight hazard by retarding the aircraft in downdraft.

The high lenticulars show very rough edges indicating extreme turbulence at high levels between 32,000 and 42,000 feet. Wind from right to left.



The mother-of-pearl cloud (upper center, Figure 1) is a rare, high-level lenticular cloud appearing usually in the polar regions at about 80,000 to 100,000 feet under wave conditions. This type of cloud is an indication of the enormous vertical extension and horizontal dimensions of a mountain wave.

In the Sierra Nevada, for example, the wave clouds can extend several hundred miles parallel to the ridge line with a well-defined leading edge following all bends in the mountain range. These clouds are visible from great distances and can provide the pilot with a warning of the existence of wave conditions long before the mountain range is in sight. Our pilot did not have enough knowledge of the wave to recognize this warning.

If there are several consecutive wave crests, the amplitude and intensity of the waves decrease as you go downstream. The distance of the first wave crest from the mountain peaks varies with height and depends on the wind speed, the type of wind profile and the lapse rate. So does the wavelength (between crests) which is of the order of five to ten miles, occasionally more or less. In levels over 30,000 feet the leading edge of the wave cloud is generally directly over the summits; in low levels, a few miles downwind.

While the overall context of the cloud formation is stationary over a considerable period of time, the clouds can change position, shape and structure in an extremely short time, and there is continuously a considerable amount of motion in and around the clouds. Extensive clouds can form or dissipate in a matter of minutes.

Any mountain range with crests of 300 feet or higher can produce a wave. Over low mountains, the wave effect has been observed up to a height 25 times that of the range but the roll cloud is sometimes missing. The intensity of the wave is, in part, a function of the mountain height and the degree of slope of the mountain range as well as the strength of the flow, all three contributing positively to the wave intensity.

The Invisible Mountain Wave

There may be times when meteorological conditions are favorable for the creation of a mountain wave, but the lack of moisture in the atmosphere prevents the formation of clouds. This cloudless or "dry" wave is rare but can approach the waves previously discussed in turbulence. It can be dangerous even to pilots experienced in mountain wave flying, since it lacks the warning features that the recognizable clouds in most waves will provide.

Most serious is the case where the wave flow is completely obscured by a thick overcast with low ceiling. The wave is present and might be powerful but it is hidden to the pilot who is occupied with instrument flying.

Additional hazards are present in the form of precipitation and icing. In the opinion of the authors it is practically impossible to penetrate the lower parts of a strong rotor cloud in controlled instrument flight. The majority of accidents in the mountain wave has occurred under these conditions.

Mountain Wave Formation

The phenomenon of the mountain wave is essentially the same as the flow of water over a barrier which forms rapids and waves downstream. However, the fact that the atmosphere is a gas and that temperature, humidity and wind are changing with height introduces considerable modifications. In the airflow model described in Figure 1 the troposphere consists of two layers. They are separated by a temperature inversion on top of the cap cloud. Consequently, at least two processes work simultaneously:

(a) A "spill-over" of the lower layer shoots down the mountain slope with increasing speed after passing the crestline, at the same time sweeping away pockets of stagnated air in the valley. It then jumps up into the rotor clouds in a manner related to the hydraulic jump of water.

(b) An internal lee wave in the upper layer forms in the wake of the mountain barrier and over the rotor zone.

The interaction of these two effects probably determines the height and position (with respect to the mountain) of the rotor cloud, as well as the amplitudes of the waves. Complications are introduced by the changes of winds with height, and further, by the existence of the stratosphere, basically a third atmospheric layer.

RULES FOR FLYING THE WAVE

★ If possible, fly around the area when wave conditions are indicated. If this is not feasible, fly at a level which is at least 50 per cent higher than the height of a mountain range.

★ Do not fly high speed aircraft into the wave; particularly, do not fly downwind. Structural damage may result.

★ Avoid the rotor (roll) cloud.

★ Avoid the cap cloud (foehn-wall) area with its strong downdrafts.

★ Avoid high lenticular clouds if the edges are very ragged and irregular, particularly if flying high.

★ If flying against the wind, updraft areas, especially the one upwind of the rotor clouds, may be used as an aid in gaining the altitude necessary to pass through the downdraft areas and cross the mountain range.

★ Do not place too much confidence in pressure altimeter reading near the mountain peaks.

★ Avoid penetrating a strong mountain wave on instrument flight.

Meteorological Conditions

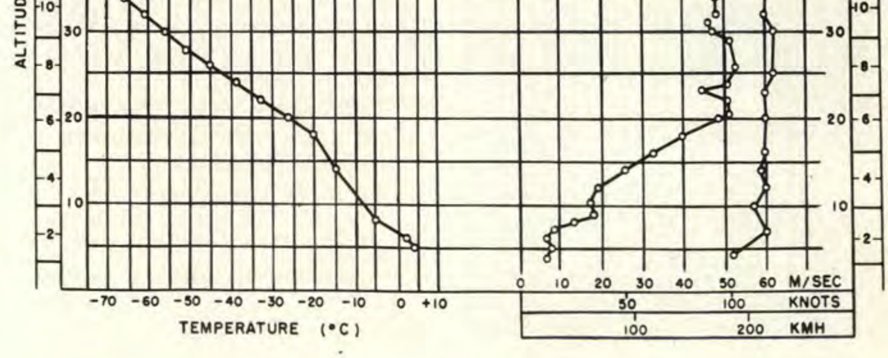
As previously stated, a favorable condition for the formation of a wave is for the wind at the mountaintop level to flow perpendicular to the mountain range. Actually, the wind direction can vary somewhat (50° being the maximum deviation from the perpendicular) and still cause a wave, but the most intensive waves occur with a strong, perpendicular flow. The stronger the flow, the more severe are the effects to be expected on the leeward side.

There is a minimum of waves in summer and a maximum in winter. During the latter season, for example, over a range like the Sierra Nevada, waves can be expected during one out of four days with two or three strong waves per month included.

In the western United States where these waves have been frequently observed, it has been noticed that the strongest ones develop when there is a cold front approaching the mountains from the northwest and a trough aloft approaching from the west. This produces a strong westerly flow over the mountain ranges which have a north-south orientation.

In accordance with the two-layer model of Figure 1 there is generally a stable layer or temperature inversion present on the windward side of the range up to an altitude slightly above the peaks. A pre-frontal area usually includes this condition. The top of this stable layer is just above the cap cloud and dips to its lowest level at a point directly over the downwind foot of the mountain. In

Fig. 3. On the day these charts were plotted a project sailplane soared to a world altitude record of 44,400 feet, with a rate-of-climb which was still over 1000 fpm.



the valley, the winds are frequently parallel to the mountains or even reversed. Without this stable layer, convective instability would tend to break up the wave pattern.

The most favorable wind profile for the existence of a high wave has winds exceeding 25 knots at the mountain top level. There is usually a rapid increase in the wind speed with altitude in the level of the mountain range and for several thousand feet above with a strong, more uniform flow up to the tropopause or higher. The character of the wave varies with different wind profiles. An exceptionally strong increase of wind with height (perhaps from 40 knots at mountain top to 100 knots 5000 ft. higher) can eliminate the wave, leaving only stagnant air in the valley. A strong wave frequently is associated with the jet stream, the zone of strongest wind flow, when the latter is located in the neighborhood of the range. The strength of the flow during such a strong wave may be from 75 to 150 knots in the upper troposphere. In this case one has to watch out for high level turbulence.

The same type of wave pattern as found in the Sierra Nevada has been observed all over the world. In fact, sailplane pilots have made use of these waves as an aid in soaring on all continents for years.

The following is a summary of the meteorological criteria which should serve to alert a pilot to the probability of a mountain wave:

(a) Wind flow perpendicular to the range line and with a speed of more than 25 knots at mountain top level.

(b) A wind profile which shows a strong consistent flow extending several thousand feet above the mountain tops, or an increase in speed with altitude.

(c) An inversion or stable layer somewhere between the mountain tops and the 600 millibar level.

"Mother-of-pearl" cloud at 100,000 feet.

The P-38 from which this picture was taken climbed in the updraft zone from 15,000 to 30,000 feet even though both the propellers on the aircraft were feathered.

Hazards of the Wave

The most dangerous feature of the wave is the combination of downdrafts, jet-like winds, horizontal turbulence and altimeter errors. These dangers cannot be stressed too highly. Pilots should avoid direct flights upwind through a full scale mountain wave, either by circumnavigating the area, delaying the flight, or flying at extremely high altitudes.

The downdrafts to the lee of the rotor, and the updrafts below it, can carry a plane into the rotor cloud while a pilot is attempting to pass above or below this cloud.

The best procedure for one caught in the rotor cloud is to nose down to pick up speed and attempt to reach the updraft area in advance (upwind) of the rotor to regain altitude. If the aircraft approaches the crestline of the mountains from the downwind side with insufficient height it will be practically impossible to climb through the jetlike currents near the mountain slope. These conditions, plus the fact that the peaks are hidden most of the time by the cap cloud, make it very likely that a plane fighting strong headwinds at minimum clearance altitude would fly into the mountain peaks.

As the barometric pressure is considerably disturbed in the mountain wave, altimeter errors are associated with the wave conditions. Since the wave is mostly a winter phenomenon, the temperature error in the altimeter reading frequently neglected by pilots contributes to an overestimation of the flight altitude.

The maximum total error possible has been estimated to be about 1000 feet. However, altimeter errors as high as 2500 feet near the mountain peaks have been claimed by pilots although this seems an extreme figure.

Data are not yet evaluated to prove or disprove these figures. At a certain level the maximum positive "altimeter error," indicating greater than actual altitude, can coincide with the downdraft area immediately to the lee of the mountain range, leading to very hazardous conditions. Under wave conditions, pilots should not place too much confidence in their altimeter readings.

Pilots who have the greatest experience in both soaring and flying under wave conditions relate that they consistently lost all control for short periods while under the influence of the roll cloud. They report they have experienced more hazardous flight conditions in the wave than they have encountered in any thunderstorms. In fact, effective gust velocities measured in the sailplanes at heights up to 40,000 feet were of the order of 40 feet per second. This is more than has been measured in the extensive Air Force-Weather Bureau Thunderstorm Project. In wave flight, full controls have to be used to maintain a heading.

Although vertical displacements of aircraft flying downwind through the wave are generally moderate, the turbulence effects may be worse. Estimates show that high speed aircraft (jet class) flying downwind through the rotor zone would experience accelerations which could be structurally dangerous. ●

1954

As is our custom, we're starting off this new year by resolving many wonderful things. And, as is also our custom, we'll soon forget all about our resolutions. That's just human nature. But, it's fun to think of all sorts of ideas and ideals even if they do spin out of the pattern in short order.

We'd like to suggest one resolution that you'll want to keep forever, even after all the rest fall away, and make this a permanent one. . . .

PLAN YOUR FLIGHT • FLY YOUR PLAN • FLY SAFELY

Mal Function

Mal's recalled to fly again
A real hot rock from way back when

He's ready and off, to the old wild blue
To show these youngsters a thing or two

But planes have grown hotter the past few years
And Mal finds his skills are much in arrears

He snaps on his back, he can think of nothin'
In desperation, hits the panic button

Wild-eyed commander fills Mal with remorse
Too late Mal learns value of refresher course.

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