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FLYING SAFETY

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WINTER ISSUE | *World Wide Weather ..... page 2*

FLYING SAFETY

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We are hunting good photos to use in the magazine. Look in your files and see if you can come up with anything good on winter scenes, survival or aircraft (either airborne or ground) and send them in to us.

CONTENTS

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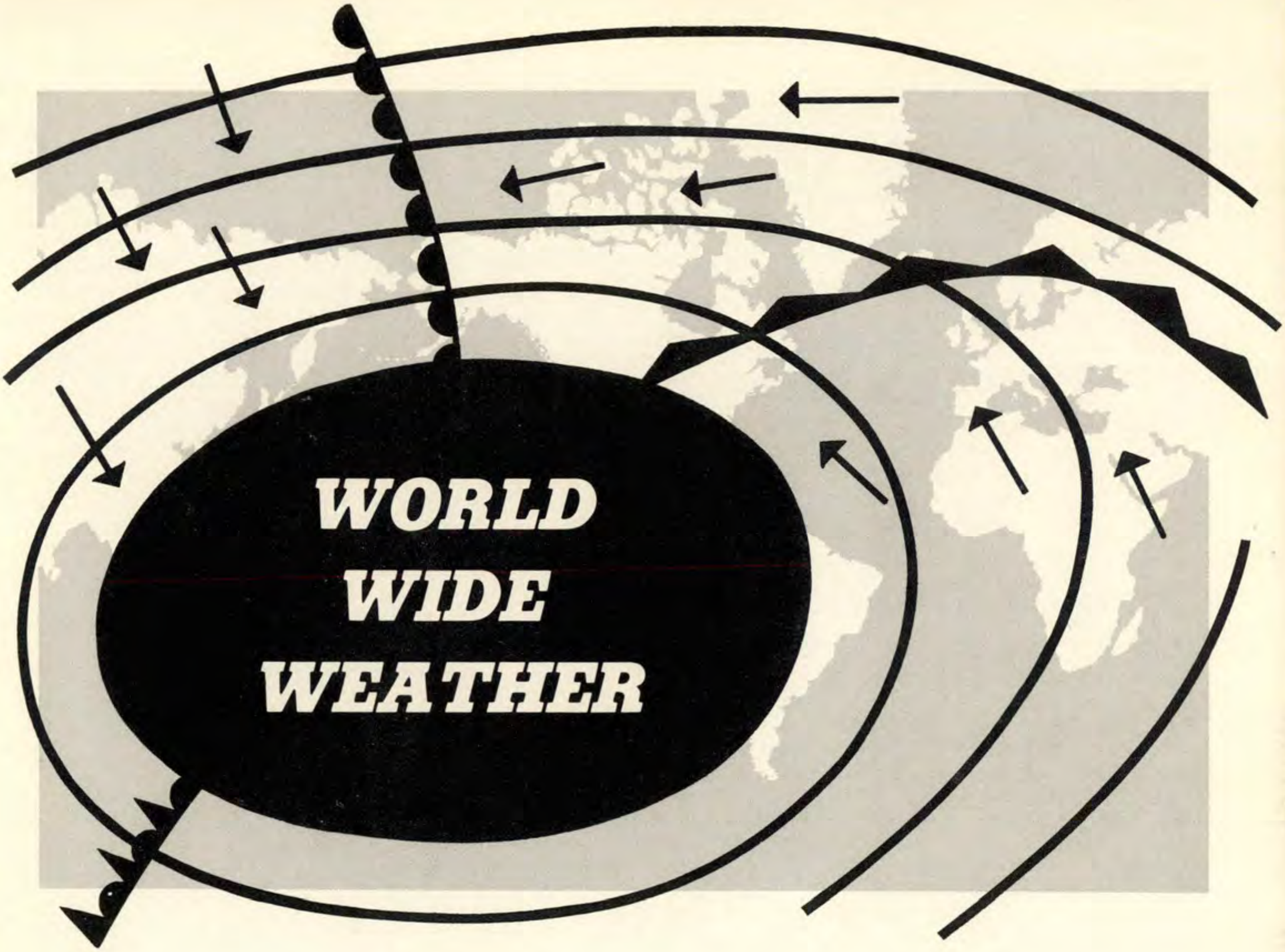

MANY jokes, good and bad, have been made about the weather and the prediction of same. Usually the weather forecaster becomes the object of such witticisms.

Nevertheless, much can be gained by peering into the future for what is likely to be happening in the areas through which you fly as far as ice, snow, fog and other characteristics of winter are concerned.

Every pilot should be able to read a weather map. These maps display much information in a pictorial manner and a brief survey of one, guided by a forecaster, will show in a few moments things it would take hours to describe.

Not every pilot can become an expert at forecasting weather, but each should know some of the principles that the weatherman uses to arrive at the forecast. Then, the pilot will know the limitation of the forecast as well as build confidence in his own decisions on the safest and most efficient method of flying difficult weather.

In arriving at such decisions, the pilot should get and keep in mind a complete picture of the current weather situation; move the picture forward in space and time to cover the route of the flight, and consider the changes that will occur during the time in flight. If the forecast interval is short (three to six hours), it is often possible to use past history to determine the amount of weather motion that will take place.

In addition to reading the weather forecasts, a sharp pilot will study the synoptic situation on the weather map noting especially the frontal weather where the most dangerous icing usually is found. Only two factors are necessary for icing — temperatures near or below freezing and the presence of moisture. However, the rate of ice accretion depends on the size of the water drops.

Usually, heavier turbulence is found in conjunction with cold fronts, while freezing rain is most often found in the cold air under the warm front. If possible, a pilot should avoid flying through water clouds above the freezing level.

On teletype sequences the freezing level for each station making radiosonde observations is easily found. This level is added to the individual sequence as part of the remarks and may be written as RAFRZ 134MSL RH 92. This would read "radiosonde freezing level 13,400 feet Mean Sea Level, Relative Humidity 92 per cent." In this example, in addition to the height of the zero isotherm, the probability of clouds at this level is shown by the high relative humidity; a high humidity means probable cloudiness and a low humidity means clear skies.

With the change of air masses associated with frontal passages over various stations or in flying through a front, the freezing level may change radically within a short period of time or over a short distance. Usually, this may be checked by finding the freezing level within each air mass

Fog results in severe restriction to visibility and reaches its maximum during the winter months.

over stations and considering the past movement of fronts and the approximate point at which the aircraft will fly out of one air mass and then into another.

Although low ceilings and visibilities over the country can be forecast, a pilot still should study the weather maps and sequences of the area in which he will be flying. Two conditions ordinarily cause most of the low ceilings and reduction in visibility. One is the presence of a slow-moving, warm or occluded front with precipitation ahead of it. This often will cause zero-zero conditions to prevail over a large area. This condition then builds up over a long period and will be found becoming progressively worse on successive weather maps and sequences.

Advection fog is the second such condition. This fog is formed when moist air moves over a colder surface, or when air is lifted by prevailing winds up the slopes of mountains. It may persist during the day, but usually will become low stratus with ceilings of 100 feet to 500 feet. With sufficient heating it may break in the afternoon and form again about sunset. Forecasting this formation and dissipation may be tricky and pilots should be sure of an alternate which will remain open before flying into a questionable area.

Radiation fog also should be expected on clear nights with light winds but usually is more localized than the above conditions.

Another danger is the effect on a pressure altimeter caused by flights into an area where there is a pressure or temperature deviation.

When flying from higher pressures into lower pressures or into colder air the altimeter will read higher than the aircraft's actual altitude.

It is possible to forecast, in general terms, the type of weather that will take place in any given area for any given month. By doing this pilots can get some idea of what to expect when flying in that area at that time. For purposes of this discussion the ZI is divided into five sections: The Northeast, Southeast, Middle West, Northwest and Southwest.

THE NORTHEAST

OCTOBER, when the frost is on the pumpkin as they say, is associated with increasingly frequent outbreaks of continental polar air from north and central Canada. Waves develop on the polar fronts and move northeastward along the Atlantic coast and cause fog and precipitation along the coastal states. Frequently these disturbances will cause low ceilings and visibilities for as long as 48 hours. It is well to remember that regardless of the cause (either a wave or a high pressure system) winds with easterly components generally result in overcast and rain or drizzle conditions since they cause advection of moist air from the sea.

October is the worst month of the year relative to ground fog formation in the sunrise period. A combination radiation-advection fog also is fairly prominent during the fall season in the New Jersey-Long Island areas between midnight and the hour after sunrise. Fog in the La Guardia-Mitchell vicinity usually is accompanied by a slight wind from the SSW or SW.

As a result of cold front passages in the northeast section, the weather conditions generally improve rapidly with visibilities of six miles or more. But approaching warm fronts or warm frontal passages often produce ceilings and visibilities of less than one mile. Icing conditions do not occur until late in the winter season.

A common occurrence during winter proper is the "northeaster," a storm with typical warm frontal characteristics that persists for two to three days. The wind blows steadily from the east or northeast and precipitation is continuous in the form of drizzle or wet snow. Clouds are usually very low.

THE SOUTHEAST

THE major percentage of adverse weather conditions that affect the southeast during the winter months is due to the formations of thunderstorms in the western Gulf of Mexico and southeastern Texas. Late October and all of November mark the beginning of the penetration of continental polar air, but by the time it reaches this area the air is modified to the extent that cold frontal passages are infrequent.

Flying restrictions develop with the passage of weak cold fronts which become stationary through Alabama, Georgia and the Carolinas. Consequently, waves develop along the front, producing low ceilings and visibilities for several days. During the winter season, an average of 25 cold fronts pass through this area with poor flying conditions existing 12 to 24 hours before the frontal passage and 4 to 6 hours afterward.

Wave formations originating in this area or in southeastern Texas produce the poorest flying weather for the longest period of time — two to three days. This type of situation covers an extensive area leaving only a few, scattered air terminals open. The poor weather is very general and finding an alternate is almost impossible. Although the greatest hazards are fog and low stratus, through the mountainous sections, icing presents a serious problem to all aircraft.

THE MIDDLE WEST

FALL in the Middle West is the season when there is a pronounced increase in frequency and regularity of weather fronts as opposed to the summer season. The marked change occurs during late October or early November. Precipitation becomes more common and low ceilings and poor visibilities predominate in the area. This combines to create the poorest flying weather in the ZI at this time, with the Great Lakes region normally exposed to the highest frequency of fog and low ceilings.

The chief cause of low ceilings and rain is a low pressure system or frontal wave in southeastern or southwestern Kansas with resultant over running warm, moist tropical air. In October a polar high pressure system brings bad weather to the eastern side. The air blowing over the Lakes becomes unstable and this instability occasionally is strong enough to set off small thunderstorms. After October, icing presents a hazard to flying as the average height of the freezing level is about 9000 feet over the Alleghenies. Conditions are favorable for lightning strikes on IFR flights through these squall conditions.

In the Plains States, October brings a few cold fronts, one or two active lows and a tendency toward ground fog formations during the sunrise period. The average freezing level lowers to about 12,000 feet.

In the Midwest, the chief cause of low ceilings and rain is a low pressure system or frontal wave.

THE NORTHWEST

IN this region October and early November usually usher in the first real foul weather of the season. The Pacific high pressure cell, which throughout the summer produces the major weather influence, retreats to a more southern position. This occurs in conjunction with the penetration of colder polar air from the Aleutian low pressure system. This polar air, with accompanying troughs, is characterized by fronts, low clouds, poor visibility and precipitation. The peak of intensity of this condition usually is reached in late December and early January. These frequent penetrations produce many days of ceilings and visibilities below minimum VFR flight conditions. The abundance of precipitation enhances the importance of pilots being alert to restricted windshield visibility and to the problem of wet, slippery runways.

The probability of low level icing increases as the average freezing level lowers to 8000 feet MSL. Even though the passage of fronts, usually occlusions, means improving weather, quite often in this area post-frontal fog forms. This is particularly significant in the northwest coastal areas. Over the northwest mountain ranges turbulence and icing, associated with the production of cumulus clouds due to forced lift and frontal lift, are often severe and should be avoided.

THE SOUTHWEST

IN the extreme southwestern area the rainy season becomes established by early November with total rainfall about double that of October. However, the frequency of rain is low compared with the eastern part of the country. On the whole, the California coast has a high percentage of fog and low ceilings during this period. The San Francisco bay area has a sharp increase in fog and at Los Angeles the frequency of fog is almost equal to that of December, the worst month of the year.

The Las Vegas region generally has fine weather during autumn, but the rest of the plateau region is exposed to the first winter types of frontal and air-mass weather. Average height of the freezing level is down to about 8500 in the northern section and 10,000 in the southern section which puts most flights in the icing zone. The most persistent foul weather in mid-winter usually is found in the interior valleys of California. Better flying weather prevails around the east slope of the Rockies due to the prevalence of strong downslope winds from westerly quadrants.

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Much valuable information also can be learned of the weather in other parts of the world in which USAF aircraft are operated. Too often pilots fly into these areas without even a general knowledge of the weather. Capt. Gerald Breen, AWS, prepared the following breakdown of weather outside the Z. I.

ALASKA

THE greater portion of this vast area possesses a climate as favorable as that of many portions of the United States. It is true though that some parts of the area, such as the Aleutian chain and the tundra region north of the Brooks Range, have a very unfavorable aspect. The temperature regime through Alaska varies widely. Although Alaska covers a number of northern latitudes, and it would be expected that temperatures would be much lower in the north than in the south, this latitudinal effect is overcome by other temperature-controlling processes in some areas. In winter, when incoming heat from the sun is minimized and most of it is reflected by snow cover, the ground continues to radiate heat to space, resulting in very low temperatures. The lowest and highest temperatures occur in the interior.

The southern coastal area from Ketchikan to Attu has a mild and humid climate with abundant precipitation in winter. On the adjacent mountain slopes, heavy snowfalls are quite frequent. Throughout the high coastal region, winter temperatures are unusually warm for these high latitudes. On the other hand, as a result of occasional polar continental outbreaks, minimum temperatures of 5 to −5 degrees F. sometimes occur along the continental coast line. Cloudiness is predominant and fogs are quite frequent.

There is a rapid northward decrease of temperature along the west coast of Alaska. The low-lying coastal region from 60 degrees N to Mackenzie Bay on the Arctic Ocean is a region of cold arctic winters. The prevailing easterly winds result in frequent invasions of cold continental polar air across the west coast, which produce low temperatures. Over the northern section of Alaska, cold air masses are generally present throughout the year. The winter precipitation minimum near Barrow is consistent with the presence of a cold high-pressure center.

The climate of the interior of Alaska is characterized by extremely cold winters. The high coastal mountains generally prevent the invasion of maritime polar air masses at ground level. Radiational cooling during the long winter nights produces very low surface temperatures, while at upper levels, warmer temperatures prevail.

High coastal mountains often act as barriers to the invasion of moist, cloud-forming air masses. Alaska and the Northwest are typical areas where cloudiness prevails west of the high mountains.

JAPAN

JAPAN experiences a climate that is dominated by the Asiatic monsoons. The climate is one of many contrasts — contrasts between the north and south, between the Sea of Japan and the Pacific coasts of the main islands of Japan and between the coastal plains, lowlands and the mountainous terrain.

The winter monsoon develops as a large northerly current of continental polar air on the east side of the main Asiatic high-pressure system. The full winter monsoon persists steadily for days, and it usually moderates slowly in strength. During this period, the weather is cloudy or overcast with occasional rainshowers or light rain in the vicinity of the polar front, and longer periods of light or moderate snow and rain over the sea of Japan and the main islands of Japan, especially over the windward or Japan Sea slopes of northern Honshu and Hokkaido.

Precipitation is common during all months of the year throughout Japan. Seasonal maxima, however, in amount of precipitation are found in winter along the coastal plains and mountain slopes of northern Honshu that face the Sea of Japan. Much of the precipitation that falls over the main islands of Japan during winter and spring is in the form of snow, especially over Hokkaido and northern Honshu. The lowest temperatures are likewise experienced in winter.

Highest wind speeds are generally reported in the winter. However, winds of greater force may be experienced during the passage of typhoons in summer and autumn than during other seasons.

KOREA

THE climate of Korea is quite variable, being controlled largely by its peninsular nature and by its location between the world's largest land mass and seas contiguous with the world's largest body of water.

Although the prevailing flow of air during the winter is from the north, the actual direction of the monsoon varies between northwest and north-northeast. The slightly modified polar continental air mass produces almost cloudless days and low temperatures. Often the passage of an intense cold front may bring snow or rain, especially early in the season, but more often has no pronounced weather other than gusty, northerly winds and occasionally dust or sandstorms.

The monsoon is generally strong, with wind speeds exceeding gale force for some hours after the front has passed. However, it soon moderates, and nighttime temperatures are extremely low. In the interior of Korea, temperatures often fall below 0° F.

PHILIPPINE ISLANDS

THE climate of the Philippines is primarily maritime, characterized by heavy showers, high humidity, light winds and high temperatures. Lower temperatures are experienced in the mountains and highlands, and along the immediate coasts during the day when sea breezes predominate. Typhoons occasionally interrupt the climatic monotony. They normally bring continuous rains, lower temperatures and higher wind speeds which are locally destructive and often cause tidal waves.

From November through early March the Philippine Islands are influenced by a northeasterly air stream, composed of air originating over the cold interior of the Asiatic mainland. The cold air periodically surges westward onto the warmer Pacific, where it is warmed and humidified. Much of the moisture is deposited on the northward and eastward-facing slopes of the various mountain ranges, while regions to the west of these mountains have a distinct dry season. February is the month of maximum development of the northeast monsoon.

In a similar way, cloudiness, humidity and temperatures vary across the Philippines during the winter. Thus, on the windward or eastern slopes, cloudiness is abundant, humidities are fairly high and temperatures are comparatively low. On the western slopes, cloudiness reaches its annual maximum, humidities are lowest and temperatures range from cool at night to hot during the day. The influence of the northeast flow decreases southward and is rarely felt in the southern portions of Mindanao Island.

ARABIAN PENINSULA

THE climate of the Arabian Peninsula is dry and hot. Average annual rainfall is less than 5 inches, except in some of the highland areas. Temperatures are moderate in winter. Only the northern and eastern parts of the peninsula normally are affected by frontal systems associated with extratropical disturbances. These disturbances are most frequent in winter, when three or four a month affect the area. Cloudy skies, rain and sometimes thunderstorms are associated with frontal passages.

In winter, afternoon temperatures in the coastal areas are normally between the middle 60's and middle 80's; nighttime temperatures range from about 50 to 70 degrees F. Relative humidity is high throughout the year at coastal locations.

Surface wind directions are variable, being diverted by local topography. Wind speeds are generally low. However, strong winds often accompany fronts and cause extensive dust storms, especially in the interior regions.

Cloudiness is, in general, most extensive in the colder months, except over the central and eastern part of the south coast.

NORTH AFRICA

DURING the winter months, the land area north of the Equator is subjected to cooling in contrast to thermal heating south of the Equator. The cooling results in the formation of a ridge of high pressure across North Africa. The frontal systems that traverse the Mediterranean Sea cause a large variation in the day-to-day weather of the Mediterranean coast and the mountainous regions behind the coast. Southern Morocco and the desert regions to the south of the Atlas Mountains are much less susceptible to these influences, and consequently the daily weather is much more stable.

Winter temperatures along both the Atlantic and Mediterranean coastal regions are mild, and freezing temperatures are infrequent. Wintertime precipitation shows a large variation from one region to another. However, precipitation amounts generally decrease from north to south almost everywhere. For the most part, moderate amounts of precipitation fall on the coastal plains and plateaus of northern Morocco, on the more northerly portions of the Atlantic-facing slopes of the Atlas Mountains and on the Mediterranean coast and the adjacent seaward slopes of the mountains between Tangier and Tunis. At some exposed coastal and mountain localities in northeastern Algeria and northwestern Tunisia, precipitation amounts are often large. At low elevations, all of the winter precipitation occurs as rain, but with increasing elevation, snowfall becomes progressively more common, and at high elevations in the Great Atlas Mountains the snow cover is persistent.

There is considerable cloudiness on the Mediterranean coast between Tangier and Tunis, on the seaward slopes of the mountains facing the

Mediterranean and, to a lesser degree, farther southward. Most of the cold-season cloudiness is of the cumuliform type. This cloudiness is associated mainly with cold frontal and post cold frontal activity.

Frontal thunderstorms occur during the colder months of the year. Air operations are hampered to a great extent by these frontal thunderstorms since they usually are extensive and are not easily circumnavigated.

Northern Africa is susceptible to the formation of the "sirocco," an excessively hot, dry and often dusty wind which blows from the desert toward the coasts. The minimum frequency of this type of wind is encountered in winter. The chief characteristic of the sirocco is its dryness; there may be considerable dust when the sirocco is strong, but the dust does not usually occur in dense, black clouds. Local sandstorms of varying intensities frequently occur, being largely influenced by the nature of the local ground surface. During such storms, visibility may fall to 200 yards, but it is usually variable with periodic improvements.

SPAIN

THE Iberian Peninsula is large enough to develop a likeness to a continental climate. In winter, because of the cold, there is high atmospheric pressure with outflowing winds. The Meseta of central Spain is different in many respects from the coasts. The winters are far colder inland than on the coasts. Long spells of frost with temperatures as low as 15° F. are not uncommon. In the mountains and plains, traffic is often seriously impeded by snowstorms. The high pressures of winter check the ingress of the rainstorms of that season, so that February is not much rainier than July.

The north coast of Spain has a west European coastal climate, with warm winters and equitable temperatures and heavy rainfall, usually more than 50 inches a year. The south and southeast coasts are sheltered by the Sierra Nevada. The rainfall is small (maximum in November). During the winter, the west coast is very mild, with a small temperature range, damp air and abundant rain.

FRANCE

THE major airflow over France is part of the circulation around the semi-permanent North Atlantic or Azores high, the center of which migrates roughly between latitudes 25 degrees N and 40 degrees N throughout the year. During winter the Azores high is weaker and is displaced southward, while relatively high pressure prevails over the continent and lows frequently move eastward over the Mediterranean. This type of pressure distribution results in frequent southwesterly winds over the western lowlands, northwest and north winds over the interior highlands and more variable winds over the Mediterranean coast.

Cold continental air from northeastern Europe or warm, continental air from northern Africa may occasionally cover much of the country during the winter season. However, maritime air masses are experienced about five times as often as continental air.

In the western lowlands of France the winters are, on the whole, quite mild, particularly near the coasts. Temperatures decrease from south to north and from the coasts inland. Very low temperatures may occur with a strong flow of air from the east. Relative humidities are high at the coasts, with a general decrease inland. Cloudiness is extensive throughout the region, with slight diurnal variation. Precipitation amounts are greatest on the coasts and decrease toward the interior of the country. Precipitation falls on more than half of the days, except in the northeastern part; the frequencies generally decreasing from north to south and from the coast inland. Snow falls on relatively few days and a snow cover is infrequent. Fog is frequent at many places in the region.

Temperatures are somewhat lower in the interior highlands of France, except at the higher elevations where they are normally below freezing all of the time. Snowfall here is more common than it is farther west. It is most frequent at the high levels, where a lasting snow cover is established. Cloudiness is extensive, with a slight diurnal variation. Fogs are common, particularly at exposed mountain stations.

Temperatures are highest in the region of the Mediterranean coast. Snow falls on only a few days. This is the least cloudy region of France, and fog occurs on one or two days a month in winter.

ENGLAND

BEGINNING in October, temperatures in the United Kingdom steadily decline. By November, readings below freezing are occasionally present, with snow occurring on one or two days in the northeast portion of Britain. Averages of relative humidity become fairly high in all sections. With an increase in the relative humidity, cloud bases gradually lower and stratus cloudiness predominates.

Low-pressure centers which reach the British Isles from the western North Atlantic are responsible for the prevalence of the southwesterly wind. The air masses reaching the British Isles in winter normally have a long overwater trajectory. Surface temperatures are therefore rarely below 32 degrees F. when the air first reaches the coast, but as the air moves across the higher terrain, rain and snowshowers are common occurrences. When the flow of air ceases, skies generally clear and temperatures frequently drop below 32 degrees F. at night. Lowest temperatures are recorded during the period of stagnation following an outbreak of cold air from the north or northeast.

Winter is the season of highest relative humidity, except along the immediate coasts where values remain high throughout the year. Fog and cloudiness also reach a maximum during the winter.

GERMANY

DURING the winter there are many storms migrating in from the Atlantic affecting Germany with extensive cloudiness, poor visibilities, strong winds and mild temperatures. Occasional outbreaks of cold air from the east result in very cold weather, sometimes for extended periods. Northern and central Germany lie within a region of predominant airflow from the west. This region, subject to the winds from the Atlantic, has relatively equitable temperatures in both winter and summer. Southern Germany, including the northern slopes of the Alps, has greater temperature fluctuations because of the stronger continental influence.

The frequency of frontal activity increases slowly throughout winter and is at a maximum in February and March. Frontal activity usually ranges from 5 to 22 days per month, averaging about 13 days in December and 16 days in February. Northern Germany has a greater frequency of frontal activity than the southern portion. In winter the cloud structures normally are not as high as in summer and turbulence or thunderstorms do not occur as frequently.

During December and January in particular, a mean cloud cover of 77 per cent is observed. Most of this cloudiness is of the low stratus variety. The cloudiest regions of Germany are the western slopes of those mountains in the north and northwest that are open to both the southwesterly winds of winter and the more northwesterly winds of summer.

Most of Germany receives an annual precipitation ranging from 20 to 35 inches, about half of this falling in winter, much of it in the form of snow. This is especially true in the east, the south and in the mountain ranges of central Germany.

Daytime winter temperatures generally fluctuate between 25 degrees and 35 degrees F., and slightly higher in the coastal regions. Very low winter temperatures occur occasionally in connection with invasions of cold air masses from the east. Most of the fog occurring in Germany is of the radiation type, and for this reason is at a maximum in the early morning hours during the season.

Germany lies in a region of rather well-developed westerly circulation. Considerable variation in this westerly flow can occur however, in connection with any particular weather situation. Strongest winds are observed during winter. In January, Germany becomes a zone of prevailing southwesterly winds. Occasional gales occur, usually in connection with frontal squalls.

GREENLAND

GREENLAND consists almost entirely of a high plateau with occasional peaks extending above 10,000 feet. The elevation favors the presence of cold, dry air masses. Strong downslope winds are observed along the periphery of the country. Topographical factors cause decided local variations in wind force and direction. The high plateau prohibits the passage of pronounced frontal systems across Greenland. Consequently, frontal precipitation is slight over the interior. The high land mass favors lower surface temperatures than over the neighboring low-lying regions, such as the Arctic Ocean. Even though Greenland is principally south of latitude 80 degrees N, northern Greenland is colder than the North Pole.

Winter is the stormiest season, characterized by considerable cloud cover, poor visibility in precipitation and fog, local gale winds and turbulence in the lowest layers near the surface, and icing in clouds.

Gale winds which, in general, occur most frequently during this season, vary considerably in frequency from one locality to another, being closely associated with topographic features. Daylight in winter varies from a short duration in the extreme south to none at all for a period of two months in the extreme north.

Lows, or storms in the general circulation accompanied by much cloudiness and precipitation, are frequent on both the eastern and western coasts. They also start on the southern tip of Greenland, and then usually move up along either coast. These storms are most intense during the winter months.

THE CARIBBEAN REGION

THE climate of this region is distinctly tropical and the dominant control is the northeast trade wind system. In general, excellent flying conditions prevail, but some serious hazards exist. These are the hurricanes of autumn, winter storms from the north and thunderstorms in all seasons. During the colder months, occasional outbreaks of cold air travel southward and cover all or parts of the Caribbean. In some instances, the pilot will encounter a line of thunderstorms associated with this condition.

The greatest danger to flight is presented by tropical storms, sometimes of hurricane intensity, which occur from June through December, mainly in September and October. Seven or eight hurricanes are observed in an average season. Hurricanes are accompanied by winds over 75 miles per hour, heavy rainfall, widespread cloudiness, low ceilings and poor visibility.

Cumulus clouds are the most prevalent type in this region, although stratus clouds sometimes occur, most of them associated with the winter storms. Occasionally a well-developed thunderstorm cloud may cover the entire sky.

Although the prevailing wind direction is easterly, other directions are encountered in winter when storms move southward over the region. Temperatures are remarkably uniform, resulting from the domination of the trades and the small variations of the sea-surface temperature. Precipitation is plentiful at all locations. There are generally two periods of maximum rainfall, the first occurring in May or June and the second in September, October or November. Very heavy rains occur frequently, and torrential rains sometimes accompany tropical storms.

This article presents the worldwide weather picture. But remember, check that weather before you go. ●

It's best to know the symptoms and the Dash One procedures for your aircraft because

ICE is where you find it

UPON return from the mission a jet penetration was made from 20,000 feet. There were three layers of clouds between 20,000 feet and 1700 feet that the jet fighter had to pass through. The lower layer was approximately 2500 feet thick, with icing conditions prevailing. The aircraft was flown on final approach at a speed of 150 knots, was slowed to 140 knots over the end of the runway and on the round out for landing the aircraft stalled at 135 knots, while still approximately eight to ten feet in the air. Normal touchdown is 120-125 knots.

The aircraft dropped in on the right main gear, but was brought under control by the pilot and the landing roll completed. The hard landing broke a hydraulic line to the wheels causing the loss of brakes. The aircraft completed the roll approximately 7650 feet down the runway. The leading edge of the wing had a layer of rime ice 3/8 of an inch thick, and the vertical fin and horizontal stabilizer were covered to a depth of 1/2 inch. The ice had coated approximately four inches of the underside of the wing from the leading edge, aft.

Without becoming academic and just to refresh memories on ice producing conditions, let's review some fundamentals that apply in the foregoing accident.

Ice forms when two conditions exist. Moisture in liquid form must be present in the air and the effective temperature must be freezing or lower. All clouds contain moisture in one form or another so icing can be expected if the temperature is at or below freezing. In fact, light ice or frost forms when an aircraft flies from a cold area that has reduced the temperature of the airplane itself to freezing, into a saturated cloud where the temperature is above freezing.

Super-cooled water droplets can exist in the atmosphere as a liquid at temperatures of —35°C. to —40°C. These droplets do not freeze because of the surface tension of the drop, its salt content, and most important, the liquid is undisturbed. Once it is disturbed or broken, as when it strikes an airplane, it turns into ice.

The very fine moisture particles (which form at about —10°C. and below) are the kind that formed the rime ice on the jet described above.

In its purest form, it is found generally in stable weather conditions where vertical atmosphere motion is restricted. Such conditions are typified by the stratus type clouds through which the jet let down.

It tends to conform more closely to an airfoil section than does clear ice. The weight of rime per unit is less than clear ice; however, the danger lies in the added drag or the disfiguration of the airfoil.

Clear ice is formed from large, super-cooled water droplets and is most likely to form at temperatures from —0°C. to about —10°C. It is tenacious, harder and smoother and is more difficult for de-icer boots to remove once it has built up. At times it has a roughened appearance but it is never granular. Remember this when attempting to distinguish the nature of your super cargo. Actually, most structural ice is a mixture of rime and clear.

The airflow about the plane has little effect upon the pattern that clear ice will assume. It usually builds forward from the leading edge of the wing and has a pronounced effect on the aerodynamics of the airfoil.

Clear ice usually starts forming

Above, care should be taken to remove all ice and snow from the wings prior to taking off. Left, ice on the leading edge of the wing on this fighter caused a premature stall during landing.

by closely following the wing contour as does rime, but if allowed to go unchecked it builds forward in a blunt, unstreamlined mass. It piles up quickly and has forced aircraft down in as little as 10 minutes after beginning to form.

The main effect of wing ice is to disturb the normal airflow about the wing. This results in loss of lift, in varying degrees, and increases the drag. Basically, it is the shape rather than the weight of ice that is the troublemaker. A half-inch of clear ice on a C-54 will increase the gross weight by approximately 6500 pounds, yet fuel consumption increases only 20 gallons an hour. However, what that extra 6500 pounds of surplus weight does to stalling speed is something to think about.

Four factors govern the rate of ice build-up: the amount of super-cooled water present, the temperature of the air, the area and roughness of the surface exposed and the airspeed of the aircraft.

The first of these factors can be estimated in flight by the darkness of clouds encountered and their vertical development. Sharpness of the contour of clouds indicate active build-up and consequently larger amounts of water vapor in the air. In stratus clouds the lower levels contain the most moisture.

One should remember that under normal conditions the lower the air temperature, the less relative amount of water present. However, one should also remember that as long as moisture is present there is a possibility of ice forming.

Any rough surface over which air flows not only cuts down aerodynamic cleanliness of the plane, but also becomes an anchoring point for ice. Rough paint, rivet heads and frost particles are especially bad. Frost is unquestionably the worst of the offenders, as ice forms on this base almost immediately.

Speed versus amount of ice accumulation is a highly controversial subject. This much is known however, the rate of accumulation is always higher at higher airspeeds, but the amount of accumulation may be greater at slower speeds.

Although it is usually impossible to see the empennage from the cockpit, it may be safely assumed that if ice is observed on the leading edge of the wing it is also forming on the tail surfaces. As you'd expect, ice on the horizontal and vertical stabilizers results in a tendency to yaw.

Proper use of de-icer boots demands an understanding of their capabilities and limitations. Ice that does not cover two or more of the parallel tubes in the boot should be left alone. It will not be sufficient to cause serious consequences, and if the boots are turned on only a part of the ice is likely to be broken loose. The chunks that remain not only destroy the airfoil more than the original formation, but act as a rough base for additional ice to adhere to and build up unevenly.

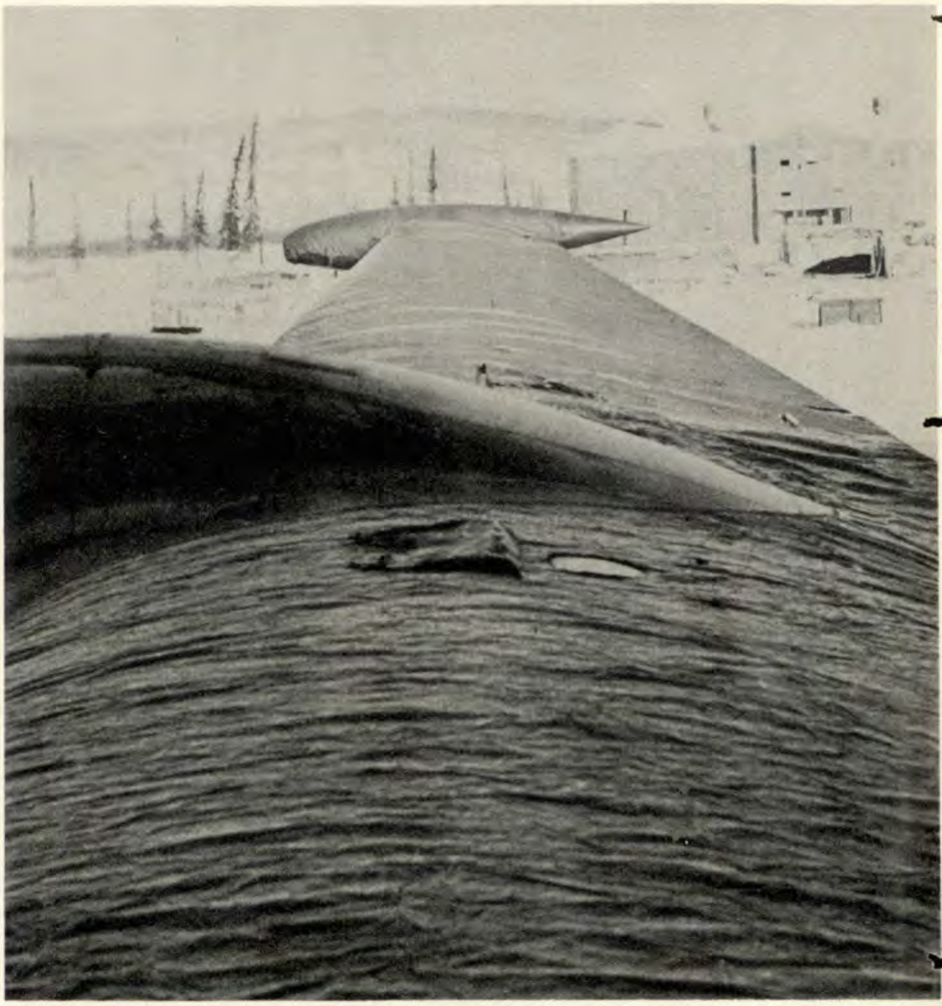
Since rime ice usually forms on the wing leading edge, the aerodynamic efficiency of the wing is not greatly impaired. And, because it is granular in make-up, you stand a better chance of its breaking off in large chunks when the boots are employed, if you allow it to build up properly. The strength of the boots generally will handle considerable rime satisfactorily, provided not too much clear ice is mixed with it to strengthen its cohesive qualities.

Much more care must be taken when clear ice forms on the wing. It is highly tenacious and it must be broken before it reaches a strength that the boot cannot break. If corrective action is taken too soon, the ice will merely crack along the line between the inflated and deflated sections of the de-icer and will not break off. Experience shows that about one-eighth of an inch to one-quarter of an inch is the correct thickness to begin boot operation. It is better to begin too soon than too late. Once ice is thick enough to make the boot inoperative, you are at its mercy.

If either clear or rime ice is encountered for a short time only and you are certain you will be in clear air soon, leave it alone. Use the boots after you are through the icing area to break up all that will come off and let evaporation clean up the rest of the wing for you. Fly manually through icing and move the control surfaces from time to time if the air is smooth to prevent them from freezing at the hinges.

Prior to takeoff, remove snow, frost, sleet and any other foreign particles that have frozen to the aircraft. Never be satisfied with less than an aerodynamically clean plane. Wing covers are available at most cold weather bases, and ten minutes taken to put them on may save many hours of trying to de-ice the plane. Do not warm up where slush and moisture can be picked up by the props and thrown back over the wings and tail surfaces of the aircraft.

In landing with ice, make wide shallow turns, turn the de-icers off and *maintain plenty of airspeed.*



Ten minutes spent to put on wing covers can save many hours of work later, removing ice and snow.

Propeller Icing

Propeller ice reduces the efficiency of the prop, reduces airspeed and, in turn, usually demands increased fuel consumption. When ice forms only on one or two of the blades the resulting vibration can reach disastrous proportions. Although it normally forms on all blades at the same time, quite often it breaks free from one blade. And the shake-up is terrific. Prop ice is likely at any time wing ice is picked up.

A propeller rarely ices its entire length. Slower RPM is more conducive to icing, but at normal cruising RPM, one-half to two-thirds of the length of the blade is as far as icing will extend. Even this amount of ice is serious and the wise pilot takes preventive measures before entering known ice areas.

Propeller anti-icers should be turned on prior to entering icing areas. The blades should be thoroughly coated with fluid, after which the flow should be reduced to about two quarts per hour, per prop. The trick is to use just enough to keep the blades clean and not exhaust the supply needlessly.

At night it is often difficult to determine if propeller ice is forming except by falling back on the old flashlight. Throw the light beam on the whirling disk near the hub. Spinning circular streaks will indicate that ice is forming. It's a fairly sure bet that if ice is forming on the spinner, it is building up on the blades also.

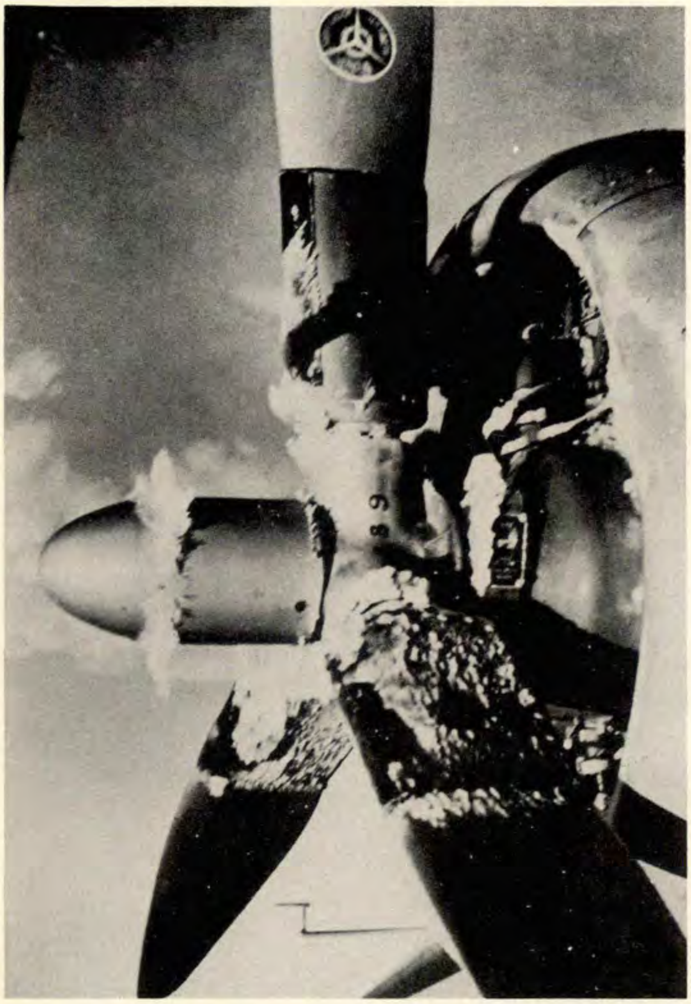
Icing on props is indicated sometimes by engine vibration and loss of airspeed resulting from decreased propeller efficiency. If prop ice catches you unawares and de-ice fluid has no effect, increase and decrease RPM several times, then use fluid to keep the blades clean.

Pitot tube icing is extremely dangerous since it causes inaccurate readings of the pitot system instruments. It is the easiest to combat, however. The heating element in the pitot tube is sufficient to melt ice under the most adverse conditions and should be used whenever visible moisture is present.

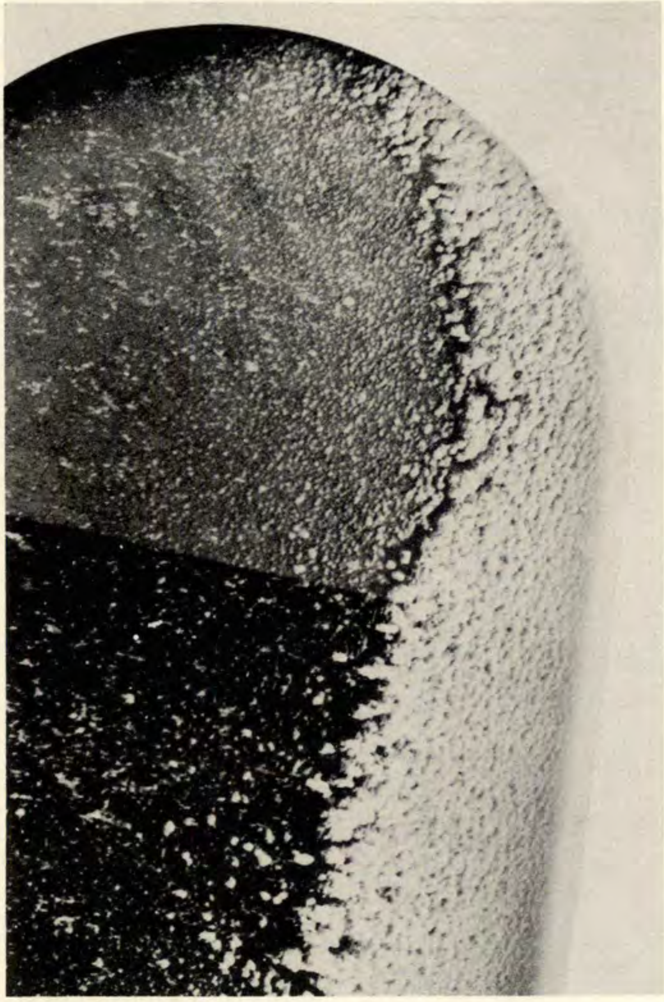
Radio antenna icing can be serious and is relatively hard to prevent. It causes the mast to vibrate and the wires to sag and sometimes break under the increased weight.

Ice bridging over the insulators thus grounding the antenna to the plane's structure, can cut off all communication. The only remedy is to change altitude and find a warmer layer of air where the ice will melt. Sometimes it is possible (but not very practical) to melt ice from the antenna by holding the transmitter key down and setting up enough induced current to do the job.

Windshield ice can be tolerated



If ice forms on spinner, it probably is forming on the prop blades.



Propeller icing, as shown above, often will result in severe vibration.

until landing time. From then on forward vision is imperative. Many windshield de-icing systems are employed, and all work to a degree. In addition, most non-jet aircraft have side windows that may be opened when all other means of forward visibility fail.

Carburetor Ice

Air at 18°C. and 100 per cent relative humidity contains 11.2 pounds of water vapor per 1000 pounds of air. Air at 0°C. and 100 per cent relative humidity contains 3.8 pounds of water vapor per 1000 pounds of dry air. Thus, if air at 18°C. and 100 per cent humidity is cooled in the carburetor to 0°C., the moisture in excess of 3.8 pounds per 1000 pounds is condensed out as free water and at this temperature it will freeze.

To give you a practical idea of the quantities involved, a C-124, powered by four Pratt and Whitney engines and cruising at 1700 brake horsepower, consumes approximately 60,000 pounds of air per hour. Under these conditions, over 100 pounds of free water passes through each engine every hour.

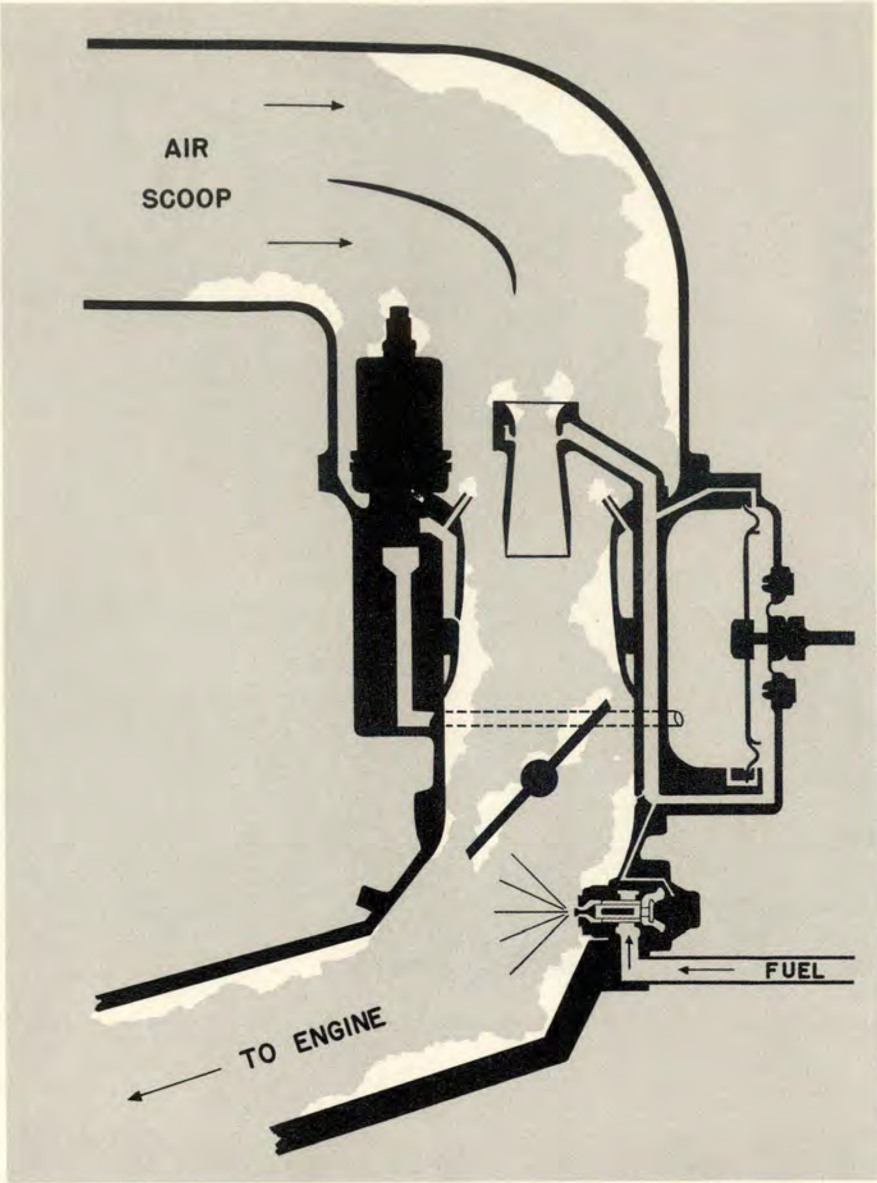
Ice may be formed in the reciprocating-engine inductions system by these processes:

- *Impact Ice*—formed when supercooled water strikes a surface that is at sub-freezing temperature. It collects on scoop inlets, duct walls, carburetor-inlet screens, exposed metering elements and other protuberances in the induction system. These ice formations may reduce the airflow and thereby reduce the engine power. In addition, the ice formation upsets the carburetor metering by disturbing the airflow pattern.
- *Throttle Ice* — formed because of the cooling effect of the fuel evaporating after it is introduced into the airstream. This ice probably occurs most frequently in actual operation because it may form at carburetor air temperatures considerably above 0°C.

Experiments with carburetors have shown fuel-evaporation icing at inlet-air temperatures as high as 39°C., indicating a tremendous local temperature reduction.

Most of the heat necessary to evaporate the fuel is taken from the air, which causes it to drop in temperature. Ice may affect airflow by blocking off the supercharger entrance, affect fuel-air ratio by interfering with the fuel flow and affect mixture distribution or quantity of mixture to individual cylinders by upsetting the fuel flow at the fuel nozzle distributor or airflow distribution at the supercharger entrance. Under certain conditions of high humidity, this ice may form with carburetor air temperatures as high as 28°C.

Float-type carburetors, which mix fuel with the air within the venturi, cause fuel evaporation to occur dur-



Carburetor ice can occur under a wide range of temperatures and can result in complete engine failure. Ice forming can disturb the airflow and upset the fuel metering process.

ing the throttling process and make the throttle region especially critical to icing. Pressure-type carburetors, which incorporate a fuel nozzle located in close proximity to a wake-producing protuberance, have been observed to cause eddying of the fuel spray in sufficient quantity to cause ice formation on the protuberances. Butterfly-type throttles or fuel nozzles mounted on a central web are particularly susceptible to the effects of fuel recirculation.

How can you detect carburetor ice? It depends on the type of carburetor-engine combination, the location of the ice and the supplemental equipment used on the installation. Airplanes flying at a constant pressure altitude and throttle setting, may experience an airflow loss due to blocking by ice formations resulting in *reduced manifold pressure.* A torquemeter also serves notice of power loss because of ice. Engines with fixed pitch props show power loss from icing by reduced engine speed. Icing on fuel metering parts is indicated by a change in fuel flow, if a flowmeter is installed, and also by engine surging, roughness, backfiring and, in extreme cases, engine stoppage. At reduced power or idling it is frequently impossible to operate the engine if the metering parts of the carburetor are iced up.

For engines equipped with automatic manifold-pressure regulators, the presence of ice in the air passage may not be known until the throttle is in the wide-open position unless a throttle-position indicator is used.

Carburetor icing is probably the most insidious form of aircraft icing. It can occur under a wide range of temperatures and can result in complete engine failure. As previously noted, carburetor icing can occur when the atmospheric temperature is relatively or fairly high although generally it is encountered only between 13° and 18°C., when accompanied by a high relative humidity, rain or overcast. Below 13°C., the danger of ice formation in the air is slight. However, once the ice begins to form in the carburetor, the power can be seriously affected in less than a minutes time.

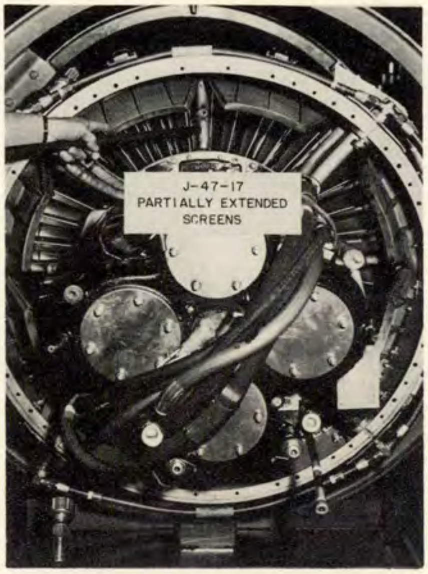
The carburetor in performing its function of metering fuel and air induces the following changes in the fuel and intake air which contribute to the refrigeration of the moisture:

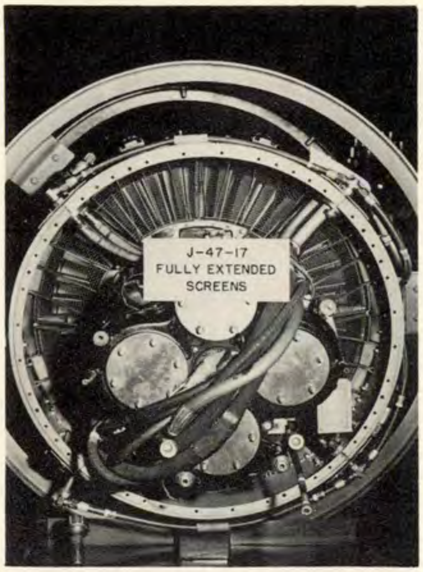
- Vaporization of the liquid fuel.
- Changes in intake air and mixture velocity and consequently a pressure change.
- Evaporation of moisture present in the intake air.

Of all these factors, the vaporization of fuel contributes the greatest by far to the refrigeration of the mixture and is always present, regardless of atmospheric conditions with respect to moisture. The vaporization of the fuel requires heat, and this must come from the intake air. The temperature drop due to vaporization of fuel may be as much as 15°C. Thus, even in summer operations the temperature in the carburetor at the throat, throttle or the adapter can be 0°C. or lower, and, if at the same time the atmosphere has a relatively high humidity or if the flight is through clouds or rain, an ice formation will occur.

The phenomenon of icing in rain or overcast conditions is less surprising than the icing that can occur in clear skies and high relative humidity.

Whenever icing is suspected, preventative action should be taken at once. Apply full carburetor heat for about one or two minutes, then after moving the control to the full cold position, see if the manifold pressure returns to the same value as before.





Ice forms on the fixed or extended inlet screen and compressor inlet guide vanes resulting in loss of thrust and a rapid rise of tailpipe temperature.

If it shows a higher reading than previously, you had ice.

If ice has formed and heat is not sufficient to melt it off, the induction system de-icing alcohol will usually do the trick. Alcohol should be used only to remove ice, as small quantities of alcohol aggravates icing due to the temperature drop caused by the vaporization of the alcohol. If heat is used properly and in time, the icing has to be rather severe before it is necessary to use alcohol.

One final warning concerning the use of carburetor heat: The amount of moisture in the air affects the ability of the carburetor heat control to effect a given rise in temperature. The higher the moisture content, the harder it is to raise the temperature. This is important to know when flying through heavy precipitation.

Also, if icing is encountered, move the carburetor heat control a few times to prevent the door from freezing in any one position.

Jet Engine Icing

Centrifugal compressor type jet engines, such as the J-33 and J-48 are relatively free from icing difficulties. While it is possible for these two types to ice up under extreme conditions, such cases are rare. Axial flow power plants, on the other hand, are seriously affected by icing.

The initial indication of jet engine icing is increased exhaust gas (tailpipe) temperatures. This is all too often the only indication prior to complete engine failure.

Ice forms on the fixed or extended inlet screens and compressor inlet guide vanes (stator) and restricts the flow of inlet air. This causes a loss of thrust and a rapid rise in tailpipe temperatures. As the airflow decreases, the fuel-air ratio increases, which in turn raises the temperature of the gases going into the turbine. The fuel control attempts to correct any loss in engine rpm by adding more fuel, aggravating the condition.

Complete turbine failure may occur in a matter of seconds after ice builds up in the engine air inlet. Critical ice build-up on the inlet screen can occur in less than one minute under severe conditions.

The idea that heating due to ram pressure at high speed will prevent icing is erroneous. The heat generated at subsonic speed is insufficient to prevent ice formation.

Serious inlet duct icing can occur without the formation of structural ice, and it is necessary to understand what causes this type of icing in order to anticipate it. When jet aircraft fly at velocities below approximately 250 knots TAS and at high power settings, the intake air is sucked, instead of rammed into the compressor inlet. This suction causes a decrease of air temperature (adiabatic cooling). Under these conditions, air at an ambient temperature above freezing may be reduced to subfreezing as it enters the engine.

The maximum temperature drop which can occur in most jet engines is approximately 5°C. The greatest temperature drop occurs at high rpm on the ground and decreases with (1) decreasing engine rpm and (2) increasing airspeed.

In sub-freezing temperatures, the rate of engine icing remains fairly constant up to approximately 250 knots TAS. Above 250 knots the rate of icing increases rapidly. It takes no genius to see that a reduction of airspeed will reduce the rate of engine icing under these conditions.

Because engine icing forms at such a rapid rate, speed in getting the engine anti-icing system into operation is essential. On takeoff and landing, under icing conditions, place the anti-icing system into operation first. (Of course, the procedures differ with aircraft type, and the Dash-One will give you the info on *your* particular type of aircraft.

The old school solution, "avoid known areas of icing conditions" still applies. Many areas of probable icing conditions can be avoided by careful flight planning.

If icing is encountered, immediate action should be taken to get the engine anti-icing system into operation, change altitude or vary course to avoid clouds, reduce airspeed when in freezing air and reduce engine rpm as necessary to prevent any excessive tailpipe temperatures.

The majority of jet icing difficulties are encountered below 6000 feet. But let's face it, ICE IS WHERE YOU FIND IT. Know the symptoms, know your Dash-One procedures, and you're all set. ●

Winter Weather Hazards

Weather Maps Prepared by Air Weather Service

IN CASE you haven't realized it, you are going to wake up one of these mornings and find winter isn't just around the corner, it's HERE. In order to help you to be prepared better for its foul antics, a rundown on how winter weather flying affects our accident rate appears in order.

Throughout the years there has been a general decrease in major accident rates. The entire Air Force team deserves a hearty pat on the back for this continuing rate reduction. However, let's not assume that winter weather is no longer a serious hazard to flight just because the rates for winter months keep decreasing.

To establish the facts and to determine the extent of seasonal influences, data covering an extensive period were subjected to recognized procedures of statistical analysis by The Directorate of Flight Safety Research. The findings definitely indicate that patterns of seasonal variation exist in accident frequency.

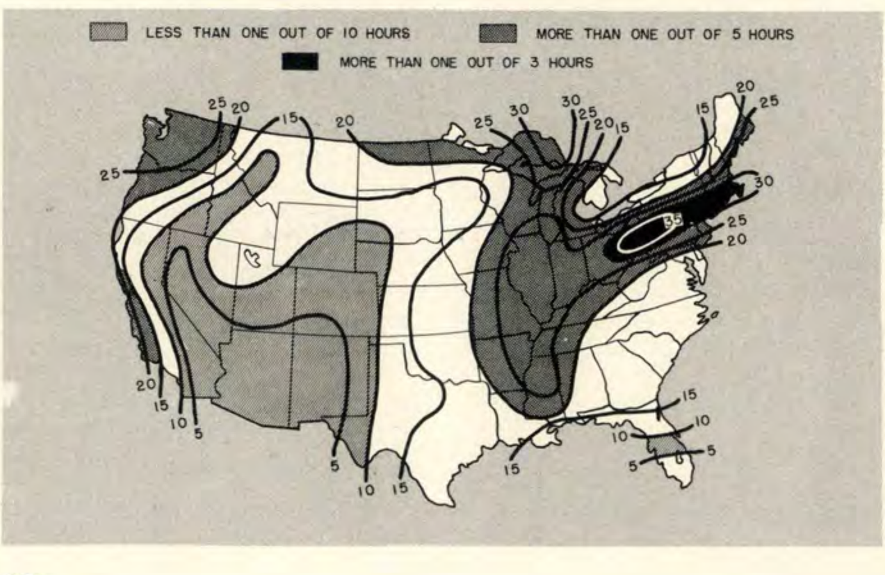
The thing we're attempting to point up is that weather is a factor to be considered during the winter months. The charts show that weatherwise the ZI has been carefully plotted. Although these curves represent averages, they should assist somewhat in flight planning.

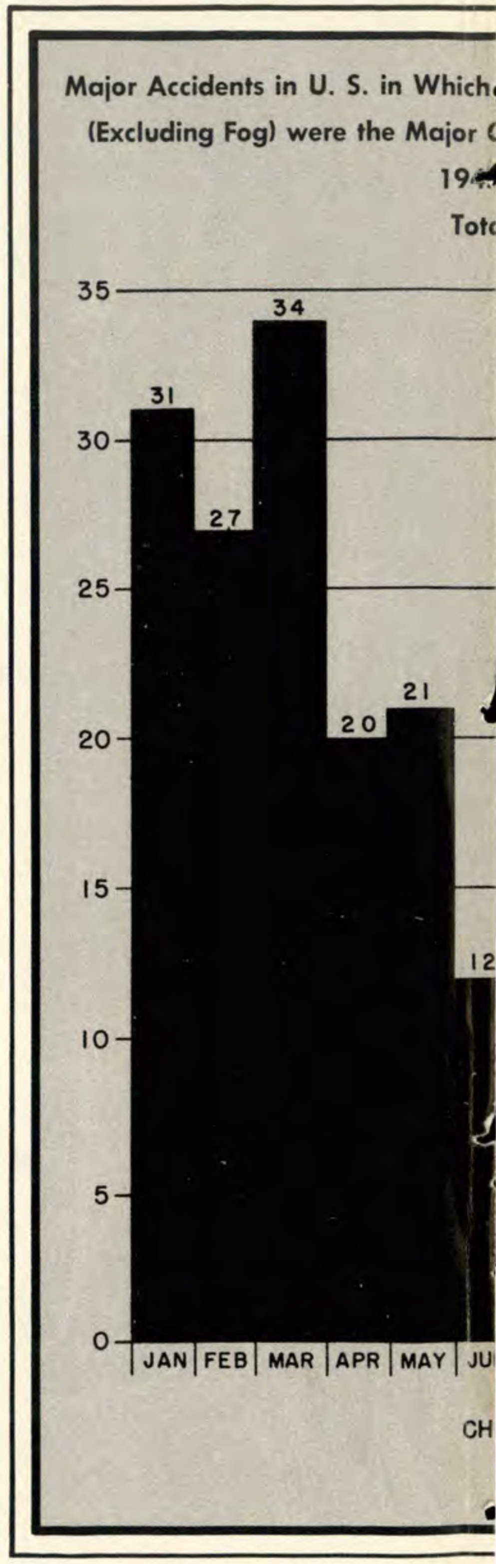
Over a period of seven years a total of 246 aircraft were involved in major accidents in the U. S., in which weather was a contributing factor, as shown in Chart I. Boil that down to yearly averages and you come up with 35.14 accidents per year (you may find it hard to reconcile .14, but that's the way it comes out). You'll note from the chart that the majority of accidents have occurred during the winter months.

In the final analysis the weather accident *potential* is greater during the December-April period. Winter weather phenomena that contribute to accidents vary, of course, with geographical locations. The charts make this very clear.

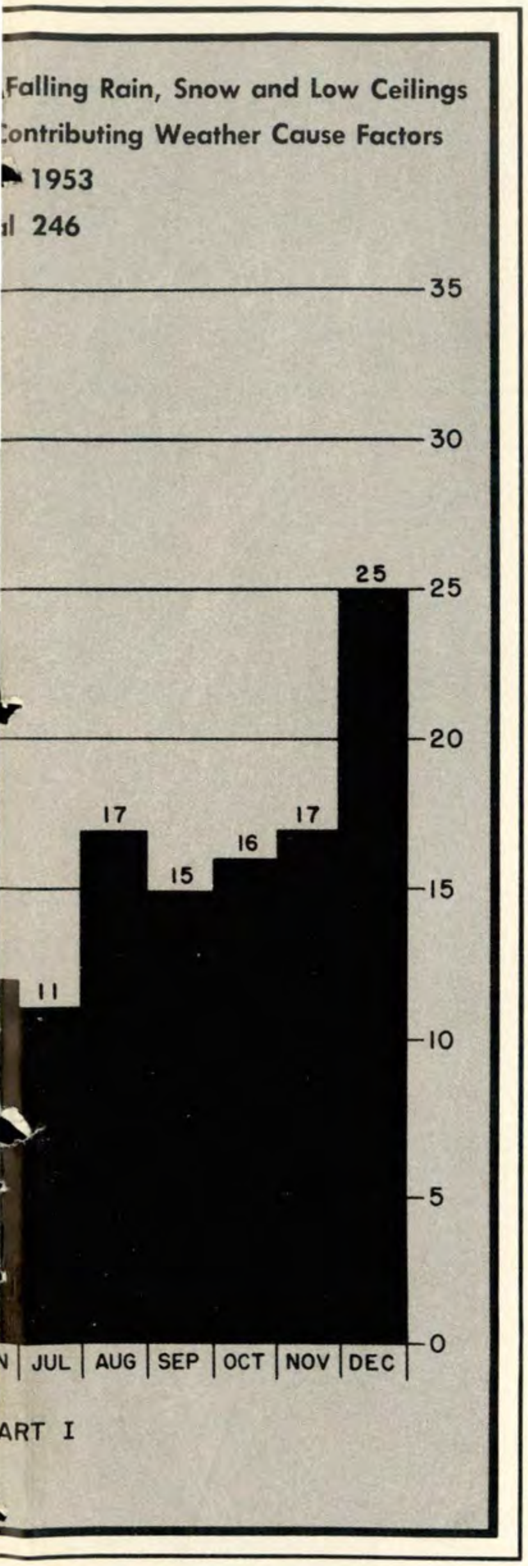
Knowing what parts of the country are most affected by fog, rain, snow or low ceilings is of considerable value for flight planning purposes. Naturally, you'll consult the weather forecaster before leaping off, and if his current weather charts are at variance with the *averages* reproduced here, don't be surprised. ●

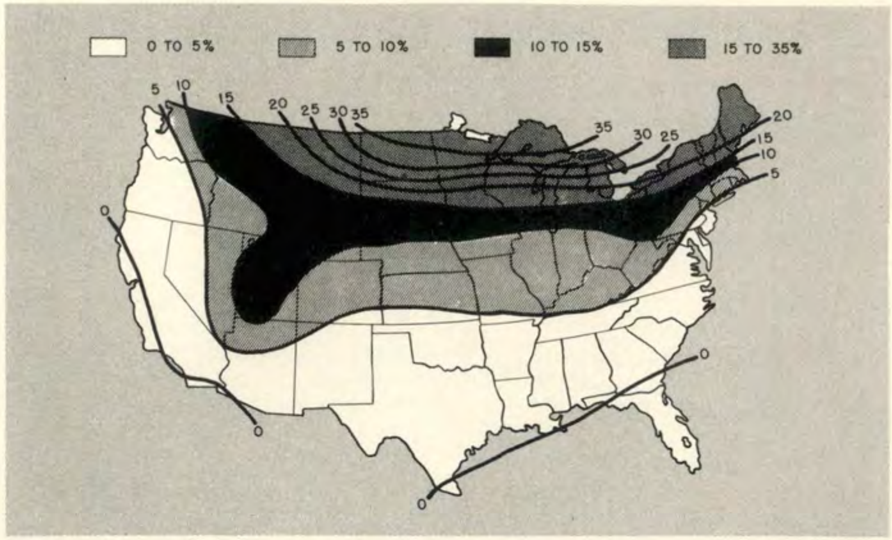
Frequency of ceilings of 1000 feet or less, forward visibilities of three statute miles or less.



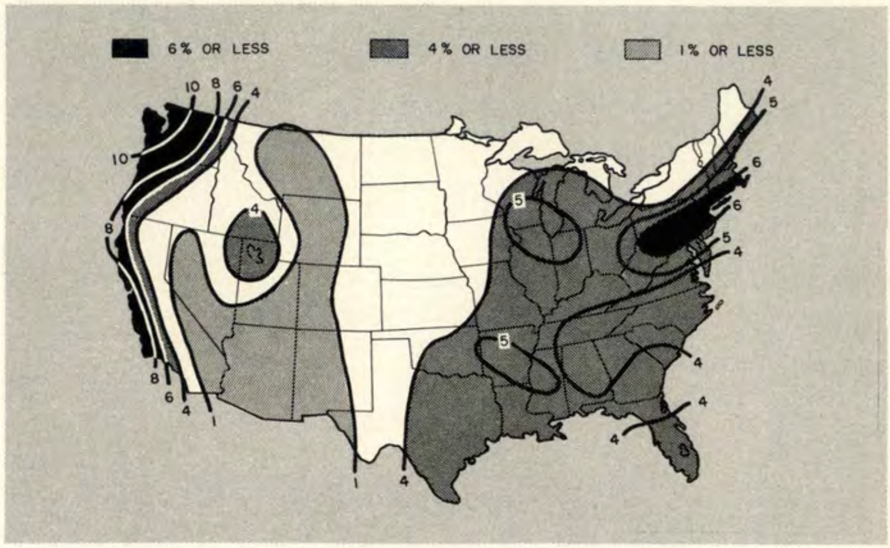


In the wintertime, snow, rain, fog, low ceilings and restricted visibility all gang up on the unsuspecting pilot. Here is a graphic presentation of winter weather flying hazards.

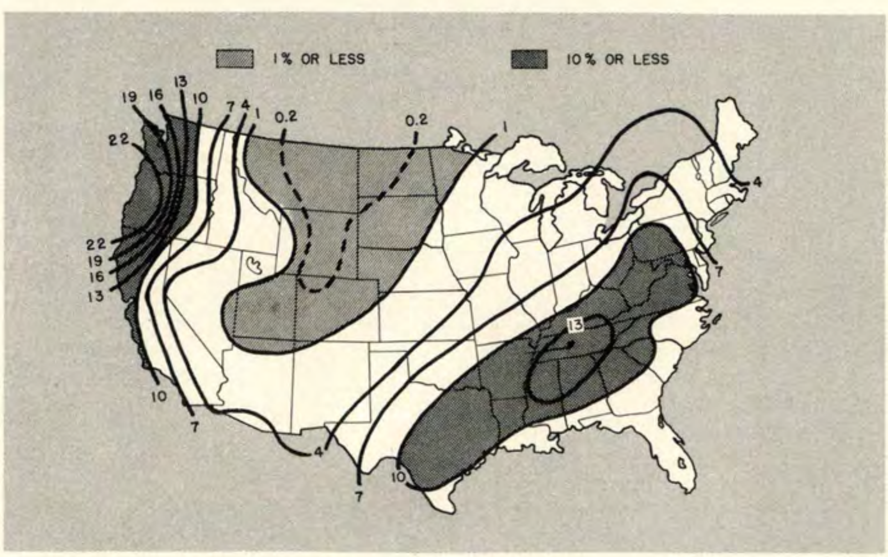




Above, percentage of time snow falls in winter. Below, percentage of time fog forms in winter.



Below, percentage of time rain falls in winter.



.... HAZARDS by the

THOUSANDS of tons of hazardous material will be delivered soon to many Air Force bases. It will arrive by air, unpackaged and at unscheduled intervals during the next few months, and every pilot should review the rules for dealing with it.

The soft white flakes which comprise this material can be a grave menace to the accident rate. For within a matter of hours they become dingy gray snowbanks piled along runway edges and overruns, where a hapless pilot may drive into them. Or they melt on the runway surface and turn into slick, rutted ice, a perfect setting for runup and taxi accidents.

Certainly every pilot knows he must keep his eyeballs uncaged when landing at an airfield where there is snow cover. Many an accident investigating board has determined that a collision with a snowbank was caused by lack of judgment, lack of planning or poor technique on the pilot's part. Until a completely new method of snow disposal is found, however, snowbanks will remain a problem and the pilot's only recourse is to remain ever alert to their presence. At night he must be particularly aware of the snowbank danger and should use lights for taxiing. When parking or when turning into position for engine runup prior to takeoff, he must be certain there is sufficient clearance before swinging the tail.

Few commanders will require a pilot to taxi when in the pilot's opinion it is unsafe to do so. Any time he feels it is hazardous to taxi because of slippery surfaces, it is not only the pilot's right but also his responsibility to stop the plane and call for a tug. There is a technique to taxiing on icy surfaces, and it can be learned best through practice. Pilots of multi-engine planes should use power almost exclusively in taxiing on icy surfaces, yet they must not use so much power as to start a turn which cannot be stopped without brakes.

During any preflight, most pilots make a visual inspection of aircraft surfaces and check to insure that controls move freely and properly. These two items are doubly important during the winter. Frost, ice or snow on wings, fuselage, tail surfaces or props should be removed thoroughly, not so much because they increase the aircraft weight but because the rough surfaces induce additional drag and disrupts the airflow. So far as controls are concerned, snow can sift into the smallest openings and either freeze the controls in one position or become packed so that movement may be restricted later. If a pilot must take off from a slushy runway, it's a good idea to move the landing gear through at least one complete cycle after climb has been established. Otherwise slush thrown into the wheel wells may freeze so that the gear cannot be lowered for the next landing.

Although snow removal is the responsibility of the installations and operations officers and not a concern of the average pilot, some of the details of the snow removal program may be of interest to the pilot since the results directly affect him.

During the summer the installations officer sees that snow removal equipment is cleaned up and properly stored, and new equipment ordered. He gets his men lined up for 24-hour duty during the storm season, and sees that they are checked out in the equipment they will have to use. The installations officer supplies both equipment and men for all snow removal operations.

Because the movement of aircraft is affected by the snow removal program, however, the operations officer has over-all control. It is up to him to call for the work to begin. The weather officer advises the operations officer when a snow storm is impending, but the operations officer ordinarily does not ask installations to begin work until the snowfall is about two inches deep. Work is done by pre-arranged priority; that is, the prevailing-wind runway is cleared first, then the access ways.

When crews are working on the airfield proper, the operations officer must schedule aircraft parking and

TON

Runway edges marked with small trees give a pilot a check point in white-out conditions.

take-off so as to interfere as little as possible with the snow removal work. If you are ready to take off some cold winter day and the tower tells you to wait a few minutes until the snow removal crews finish a pass, don't lose your patience. It's easier to hold an aircraft on the ramp for five minutes than to pull an entire snow removal crew off the runway.

There are two attendant factors to snow removal which are part of the over-all program and which are important to pilots. The first of these is the marking of runways, taxiways and ramp areas. At many bases in the north, edges are marked with spruce boughs or trees, erected at each runway light point and at other points spaced along edges of taxiways and ramps. They offer an added advantage by giving the landing pilot a reference point in white-out conditions, where perspective might otherwise be lost.

Another system for runway marking employs sea marker dye. (See ORANGE AID, page 28.) The dye is mixed (five parts water, five parts sea dye, one part alcohol) and poured in a large drum under pressure so that it can be sprayed on the snow. Runway edges, thresholds, taxiways, ramps, and in some cases runway centerlines, are marked with the colored solution. Without runway markings such as these, lack of contrast between the runway and the surrounding areas may cause the runway to disappear from sight entirely on the final approach even though it was clearly visible from directly overhead.

Whenever ice, fog or snow flurries are present, it's good practice for a pilot to ask for the runway lights to be turned up to full intensity. The lights will aid in judging height above the runway and at the same time will help him to keep oriented in the traffic pattern when other runway markings are not visible.

The second attendant factor in the snow-removal program which should be of interest to flight crews is the use of abrasives and salts for ice control on runways and ramps. Some of the more common of these materials are cinders, sand, washed pea-gravel, coke screenings, sawdust, calcium chloride and sodium chloride. Abrasives are spread carefully so that they will not be sucked up by jet intakes; a multiwheel, rubber-tired roller, for instance, distributes sand evenly. Some bases are following the practice of commercial airports and using a weed-burner, mounted on a truck and following the sand spreaders, to embed the sand in the ice with heat.

Salts have an injurious effect on aircraft as well as motor vehicles, pavement surfaces and adjacent vegetations, and you will find them used only where all other methods of ice control are unsatisfactory. Should aircraft metal be corroded by calcium chloride or salt, Banox No. 1 will be helpful in nullifying the effect.

Pilots can be of assistance in the snow-removal program by reporting runway conditions when they go into operations after landing. A pilot preparing a flight clearance cannot always depend on NOTAMS being absolutely up-to-the-minute in stormy winter weather. Operations should keep a blackboard in the dispatch section on which ground conditions, as reported by the alert crew and landing pilots, are logged hourly.

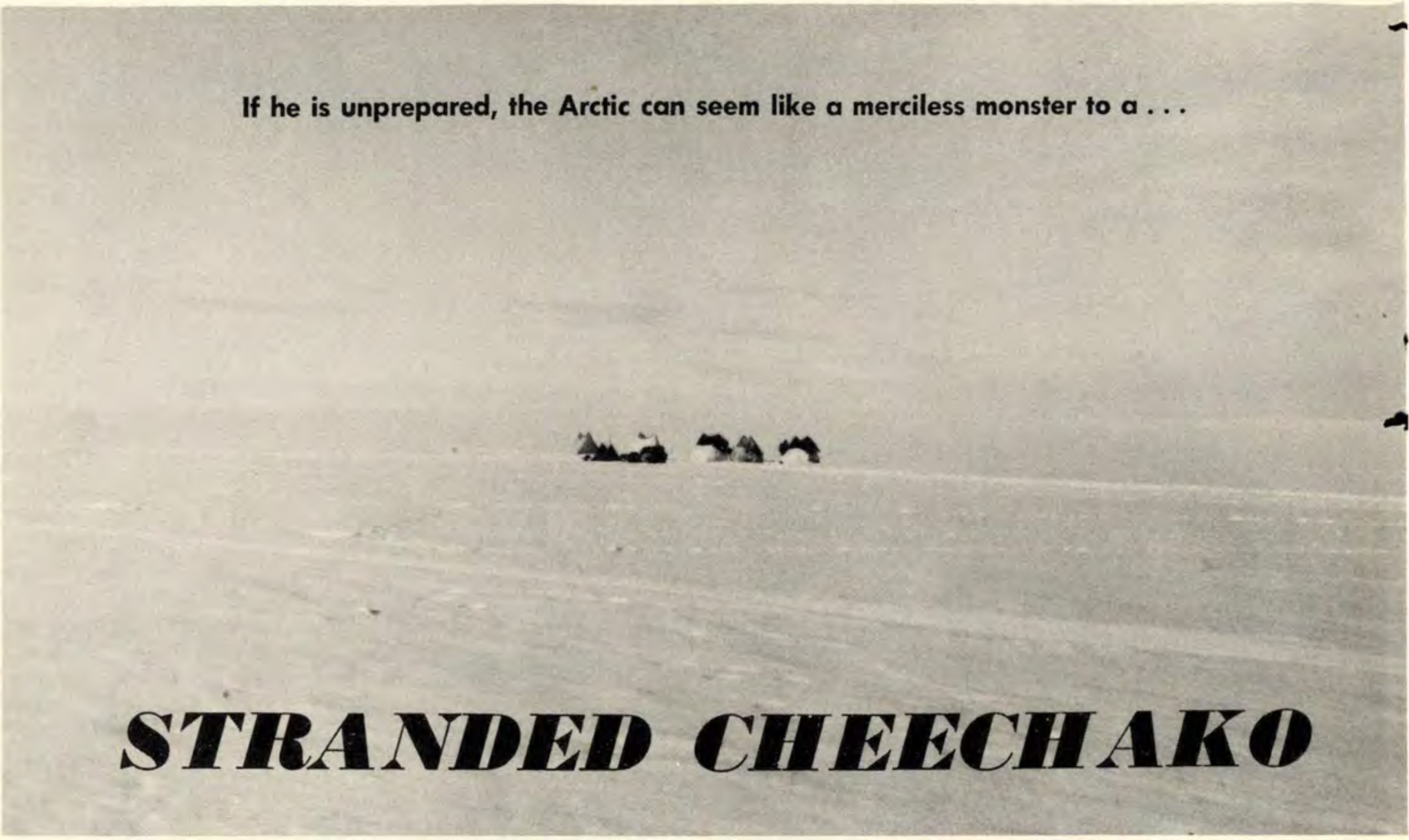
Possibly this reminder about winter weather hazards should end with a few cases in point. For instance, the F-94 pilot who last winter skidded a little on an icy runway, applied too much brake pressure and sailed into a snowbank. The plane bounced into the air, careened tail-first into another snowbank, and was in flames by the time the pilot got out.

Or the F-80 pilot who reached 120 mph on takeoff roll but could not become airborne. When he cut power and applied brakes, the aircraft slid off the runway into a snowbank. Investigators found patches of ice three or four inches in diameter and 1/8th inch thick binding the leading edge of the wing surfaces.

Or the C-47 which was covered by a thin layer of water when the pilot made his preflight. He discounted the danger of the water, loaded 21 passengers aboard and took off. When about 15 feet in the air, the '47 sank to the left. The pilot applied right aileron and pushed the throttles forward; the left wing came up but the right wing immediately dropped. The plane touched down again about 200 feet beyond the runway with gear still extended, and crashed into a snowbank. The water on the fuselage of course had frozen when the C-47 entered the colder air above the runway.

Remember, dashing through the snow in a one-horse open sleigh may be a real picnic; driving through it in an airplane is something else again. The snow-removal crews will do everything possible to reduce the hazard of ice and snow on the ground. After that, it's up to the pilot to remember the common sense rules. ●

When parking or turning, be certain there is sufficient clearance before swinging the aircraft.



If he is unprepared, the Arctic can seem like a merciless monster to a . . .

STRANDED CHEECHAKO

THE Arctic will seem like a conscious, bone-freezing conspiracy against his life to a Cheechako (newcomer) stranded in the icy hinterlands. That's not true, but the Far North is totally indifferent to man and his yen to live.

The Arctic is a vast chunk of frigid real estate answering only to its thermostat, which is the varying tilt of the earth's axis with relation to the sun. Human life is no factor in this relentless bit of astrophysics. It causes extreme climatic effects that most of us will never face; effects that force a temperate zone man to alter radically his normal habits — or else.

Simply put, the facts freeze down to this: The Far North is neither for nor against you. It's just an impersonal set of rugged conditions you must accept and learn to live with. You'll get less than nowhere battling these conditions with Kid No-Know in your corner as second.

Going down in the Far North isn't a death sentence; far from it.

For untold ages man has lived there without an Uncle Sugar back home to fly him prime beefsteaks, stove oil, ear muffs, and radios. The Arctic today is Home, Sweet Home to tens of thousands of people, many of whom wouldn't leave if you offered them the Empire State Building along with till tapping privileges on the Golden Gate Bridge.

Some of these folk are so primitive they're using Stone Age implements. Yet, making-do with materials at hand, they wrest a livelihood from the icy seas and barren lands. If these people can survive, so can you, providing you know how and are properly equipped.

The U. S. has backlogged a wealth of experience in Arctic living, dating back to the gold rush over Chilkoot and White Horse passes into the Klondike. Wartime air routes over Canada, Alaska, Greenland, Iceland and the north Atlantic expanded this knowledge. Since the war the problem has been scientifically and minutely studied as flying activities stepped up along the eaves of the world's roof.

Should you ever get stranded in the Northlands, the refined essence of this knowledge will be available to you in simplified form. Furthermore, you can be certain that you will be diligently sought by Arctic rescue experts as long as a chance exists that you are alive.

If you are a crewmember making regular flights "down North," you will have had excellent survival training. Should you be a passenger, you'll be glad that such skilled personnel are aboard with you.

However, in case you find yourself separated from the experts, you'll need some knowledge of the dangers that lurk around you. Otherwise you may be like the unfortunate who found himself unarmed in a battle of wits.

Trite, obvious and academic as it sounds, Arctic survival can be summed up in two words: "be prepared". This means preparedness by knowing the conditions you will meet, having the things you will need and knowing how to use them.

The Far North is towering, ice-clad mountains and it is level, treeless plains; it is an ocean hidden under floe ice and wandering iceberg islands boasting weather stations; it's frozen rivers and big spring floods caused by ice jams; it's glaciers that occasionally disgorge ancient animals in good condition; it is temperatures ranging from $-80°F.$ to $100°F.$; and it's Greenland, that gigantic chunk of ice doing business as a super iceberg plant.

Necessary survival and rescue methods depend on where you are when you are there. Just how do winter Arctic conditions differ from those we normally meet? 1) It's killing cold; 2) all forms of life (man included) are few and far between; 3) apparently mild sunlight can blind you for a week; 4) you need more food, particularly fats; 5) overland travel is laborious; 6) if you work up a sweat, you're likely to find yourself encased in a sheath of ice later, and 7) during one period the sun never comes up and at another it never goes down, just lazing around and around the horizon.

"Arctic survival" is somewhat of a misnomer, for its methods are often needed in the sub-Arctic, and at times in temperate zones. There are plenty of interior, lowland sub-Arctic places where nature can give you the deep-freeze treatment. Being lost afield in a Dakota blizzard can be worse than camping out at the North Pole.

A trench, dug in a drift and roofed with snow blocks or tarpaulin, provides a warm shelter.

There is only a thin fringe of people in the Far North, and virtually all of them cling to the coastline. There's almost nothing to be found back in the inland tundra before you get far enough south to reach the timber line. Further down you begin to find people and larger animals. In the spring, some of the coastal people head south to meet the northern surge of caribou at well known passes. But they have little use for the sparse barrens above the timber line.

Normally the people are found at the head of navigable bays at the mouth of rivers. There are reasons for this, of course. The weather's generally more moderate, and the sea's big larder is at hand. The sea can be used at the peak of summer to bring in heavy supplies.

The frozen rivers can be used as highways for dog sleds and tractor trains in the winter.

Generally speaking, a heavy stillness hangs over much of the Arctic, and violent winds are unusual. Turbulent weather is usually local in nature, and often is a product of the surrounding terrain. The high winds are encountered along coasts backed by tall mountains, and inland due to spotty heating effects and mountains.

Once you get aloft, Arctic flying is very good. A smooth, quiet ride is the rule rather than the exception. You will meet far less turbulence in the Northlands than you will in the interior of the United States. "Iron Mike," the autopilot, really gets in his licks up there.

Perhaps this is more than enough of generalization, so let's get on with the story of you, the Arctic and an air emergency.

As the first item of safety, a flight plan will be filed by the pilot, and traffic controllers will keep an eye on your progress through position reports. If you become overdue, Air Rescue is alerted. A wide-scale search is certain to be launched if you are missing after your fuel-time-limit has elapsed.

If an aircraft develops trouble, a position report should be radioed immediately. A good position report is the best insurance that you can get for a speedy rescue. It centers the search on you, and prevents wasteful needle-in-the-haystack hunts over great areas.

This report should be sent over the aircraft's long range liaison set, and if the situation is grave it should be in the form of an SOS or "Mayday" call. Radio bearings will be obtained on your signals if direction-finding stations can receive you.

Every effort should be made to get a signal out over the strong liaison set while you are still aloft, because your radio might be damaged in a crash landing. In such an event, thereafter you will have only a short-range emergency transmitter available to you — providing it weathers the crash or parachute fall.

It will do wonders for your morale, too, if you can get an acknowledgment that your distress message has been received. If all of this goes well, you can be located by a pinpoint search with no lost motion. Even if your aircraft and survival kits are lost, a search airplane should be overhead before long to drop you

This survivors' signal, as seen from the air, tells the rescue aircraft overhead that all passengers and crew of an aircraft downed in Labrador are safe. Signal on the ground reads, "16 are O.K."

Three man lean-to

One man shelter

Tree pit shelter

Snow cave shelter

Snow "fighter" trench

food, fuel, medicine and necessary survival gear.

After the distress call, the aircraft commander faces a tough decision. What will it be, belly-in or bail out?

As every Arctic pilot knows, the answer is belly-in if possible. A frozen lake is an ideal spot for such a landing. Your chances of survival and rescue in a remote area are infinitely better if you stick with the aircraft.

Aerial searchers can spot an airplane on the ground far easier than they can a person. Furthermore, you will find your aircraft a treasure trove of equipment that you will need. If you jump, you will have a bare mimimum of clothing and survival material. You may land so far from others in the party that you cannot rejoin them, forcing you to face the Arctic alone.

Of course, there are emergencies that make a jump imperative. Sometimes the terrain and timber will make a crash landing impracticable. It may be so dark that you cannot make a landing, or you may be on fire and in imminent danger of an in-flight explosion.

If an unavoidable jump is made, the parachutists should try to keep track of the aircraft and other 'chutes. If they can mark the spot the aircraft hits, they should attempt to work their way to it as a rallying point for all survivors. Even badly wrecked, there is a lot of material in the airplane that you can use.

Say the aircraft has been successfully crash landed; now let's take a quick run-through on the initial actions to be taken:

- Clear the aircraft immediately with all readily available survival gear. Keep away until the possibility of an explosion has passed.
- Give first aid to injured; treat anyone in shock.
- Construct emergency shelter and build a fire.
- Get the emergency radio on the air on schedule.
- Organize camp. (Determine what's to be done and assign set duties to all personnel.)
- Prepare ground signals.
- If unknown, try to determine your position.
- Keep dry; avoid snow blindness and check for frostbite.
- If in winter, DO NOT attempt to use the aircraft for shelter—even a hole in the snow is much warmer.

Some of these first-firsts can be accomplished simultaneously if you have sufficient people with northern survival training.

Now, to go back over that in more careful detail.

Persons on potentially dangerous flights in the Northlands should wear most of their Arctic clothing and keep the rest of it close at hand. This should be done, even if it means that cabin heating has to be reduced. Thus, in case of a quick bailout, you at least start your ordeal with adequate clothing and a minimum of survival material attached to the back or seat of your parachute.

Survival kits and items should be lashed down in a manner so they can be quickly released near the exits. They should be placed so that the items of highest priority are near the exits.

Crew Training

The ideal situation is for the entire crew to have received survival training, and then to practice coordinated plans for jumping, crashing and ditching. Each airman should know his duties well and have knowledge of the responsibilities of the others. This is important in case one man is knocked out, then the others can carry on with his assigned chores.

If you belly-in, quickly get injured personnel out and clear of the aircraft. Take out all emergency kits, gear, parachutes, tools and other useful equipment, storing them away from the aircraft in one place. The threat of fire, immediate or delayed, is the reason for this action.

Although the prepared emergency kits are your first targets, don't overlook anything useful, such as pliers, hammers and screwdrivers.

After this first flurry of activity is over, the clothing of all personnel should be checked for adequacy. This is no country for low quarter shoes and baseball caps. Clothing that is wet either from water or perspiration, should be removed and dried. Old Man Arctic detests moisture, and he converts all of it that he can find into ice. Be sure that he doesn't turn your perspiration into an icy union suit. That's why the northern experts harp constantly on the theme of "keep dry." Nature keeps arid in the Arctic through the freezing process. Most people associate ice and snow with moisture, but that's not true up north. Both the snow and ice are bone dry until heat is applied. Newcomers are puzzled by the itchiness of their scalp; it's because of the dryness of the atmosphere.

Here are a few pointers on Arctic clothing that should be helpful:

You create heat internally and it is dissipated at your skin's surface. Clothing merely traps bodily heat and prevents the wind from blowing it away. Insulated air really retains your body warmth. Consequently, two loose-fitting, lightweight garments are warmer than one heavy one. That layer of air does the trick.

You need an outer layer of tightly woven material or animal skin to serve as a windbreaker. Wind is the great thief of your warmth. It sweeps away the still layer of air protecting your body. In the tropics you would be grateful for this as the air evaporates the perspiration in a refrigerating process — but you won't be thankful for it in the Northlands.

So the word is that you need a good windbreaker on the outside and several thin layers on the inside. These layers are handy in avoiding perspiration when you are exerting yourself at hard work or in travel. Just peel off enough layers to keep from sweating. The Air Force and other agencies are constantly striving for perfection in their Arctic clothing and bedding issues. In all probability you will have the latest Arctic footwear, clothing and sleeping bags.

Anyone severely injured should be given immediate first aid. The general rules of medication apply here, but they are complicated by the threat of frostbite, which is a polite term for freezing. The injured should be kept warm, dry and comfortable, and it may be necessary to provide a quick shelter and fire for them. Be sure to get some insulation between them and the ground when you stretch them out.

Shock and delayed shock are common in accidents. In deep shock a person may even forget his name. Sometimes this condition does not appear until hours after the accident.

Special attention is required by those who are bleeding. If tourniquets are used, frequent release of pressure is necessary. Also keep warm that part of the body where circulation is cut off. This last thought does not imply that merely a covering be used. Body heat from some other member of the group should be used in keeping that part of the patient's body warm if no other heat is available.

Once on the ice, frostbite is an ever-present hazard, especially when winds are strong. Frostbite is extremely painful in itself, and if neglected it will develop into gangrene. This is serious and usually requires surgery. It can cause death.

Frostbite usually attacks the extremities — hands, feet, nose, ears and face. Poor blood circulation lets frostbite get a running start. For that reason no clothing or footwear should be binding or tight. Gloves, shoes, belts and drawstrings should all be fitted loosely.

Frostbite is sneaky and can occur rapidly. Its first sensation is numbness. In cold weather, make faces from time to time and touch your face for stiffness. Members of the party should watch one another's faces for grayish spots indicating frostbite. Once these spots are discovered the person should be treated immediately.

A frostbite casualty should be placed in a heated shelter. The frozen part should be thawed in tepid water. The ideal water temperature is 107°F. If warm water is not available, apply heat packs.

Sun, Snow and Glare

Sunlight and snow can gang up to blind you in one of the Arctic's most painful experiences. Direct solar rays and those refracted from snow are too much for sensitive eyes. It's like burning a photographic negative with excessive light.

Snow blindness is also sneaky and can occur in foggy, misty weather.

Never be without sun glasses, or their equivalent, during the snow blinding seasons — roughly November through May, inland, and October through May on floe ice. Up toward the pole where the snow is permanent, the danger exists any time the sun is out, and that can be 24 hours a day.

Sun glass substitutes can be whittled from wood, plastic or bones. Cut a horizontal slit 1/16 inch by one inch in the improvised "lenses" so they fit over the pupils of your eyes. The eyepieces should be about ¼ inch thick. Blacken the top and bottom of the slits.

Lacking other material, make a mask of dark cloth, cutting and raveling the slits. It helps to darken the areas of your face around the eyes, using soot or similar material.

Fuel is a prime necessity, and you are in luck if the aircraft's oil and

Log platform for fire

Platform for cooking

Building a pyramid fire

Shavings and dry twigs

Log reflector for fire

Lighting fire with candle

gasoline tanks remain intact. The oil should be removed before the engines cool. It's best to use containers, but they are not necessary. Open the drains and allow the oil to flow out on the snow and ice. It will congeal rapidly and you will have no difficulty in collecting it later as needed. But you'll have beaucoup trouble getting it out of a frozen engine.

Gasoline, on the other hand, need not be drained. What better storage can be found than the aircraft tanks themselves? Accessibility should be considered. If you have tanks that are hard to get at you will want to transfer fuel from them to the main tanks. The ideal is achieved if you can get the auxiliary power unit going to make these transfers.

Watch your hands during this job, being careful not to get gasoline on them. If it's very cold keep your hands off of bare metal. Many a man has grabbed a door knob or wrench and had his bare hand freeze to them.

Now turn your attention to more permanent shelter. (If it's summer, you can stay in the aircraft or make a quick tent by throwing a tarp or parachute over an aircraft wing.) In winter, you will need an insulated outdoor shelter. In selecting a campsite, pick a place for its protection from wind. Get in a timbered spot if possible because the trees will serve as a windbreak and source of fuel. Do not get under snow covered trees, however, for they will soak you when the fire gets going.

Wind-driven snow piles up quickly, and sometimes it avalanches on a steep incline. So it's best not to set up housekeeping at the foot of a sharp slope or cliff.

Where you are and the materials at hand will dictate your choice of shelter, and there are many of them. There are lean-tos, snow caves, tree pits, snow trenches, snow "fighter" trenches, ice houses or igloos and parateepees. In your survival kits will be full instructions on how to build these homes away from home.

Lean-tos are simple to fabricate in timbered country, and they are surprisingly effective. Whatever shelter you select, remember to keep its entrance crosswind. You may find it helpful to erect a wall of snow or ice between your shelter and the chilling wind.

In treeless areas with snow, just burrow into the side of a snowdrift, and "feather your nest" with grass, brush or tarpaulin. Snow caves must be ventilated. If the snow isn't deep enough to support a roof, dig a trench in a drift and roof it with snow blocks, tarpaulin or other materials.

In wooded country make a tree-pit shelter if the snow is deep. Enlarge the natural pit around a tree trunk and roof it with anything available.

Though your instinct may be against it, any shelter will have to be ventilated if you are going to have a fire. Open flame in a tightly enclosed shelter will produce carbon monoxide poisoning.

A sheltered place should be set aside as a toilet. Some crashed parties have used the facilities in the aircraft, or have removed them outside. Adequate shelter, of course, is the chief and immediate consideration.

Fire is life in the Far North. An improvised stove will heat your shelter.

Much of your strength is converted into bodily heat, and you fatigue easily on short rations. Under such circumstances Arctic survivors should get all of the rest that they can, and work should proceed at a leisurely pace. Frenzied efforts at work or travel will leave you gasping frigid air and exhausted. Improvement of your shelter and sleeping bag pays dividends in the rest you will need.

You will not want to sleep directly on snow or ice for obvious reasons. Put boughs or grass down where you are going to sleep. Use your parachute for insulation on top of that, and place your sleeping bag on top of all. Use anything you can for insulation from the cold ground — cushions, tarps or life rafts. An inflated, inverted raft makes a fair bed.

Move the injured to shelter and keep them dry, warm and comfortable.

Use anything you can for insulation from the cold ground and colder snow.

Try to cut fishing hole over deep water where fish tend to congregate.

For three-man shelter, lay boughs from top to bottom, cover with chute.

Of course, a fellow could develop king-sized trouble inflating a raft in an undersized snow cave.

Your sleeping bag is going to be your best friend if you can keep it dry and clean. Some types of bags with feather inner-liners are exceedingly warm — so much so that the inner-liners are seldom used. To keep your bag in good condition, turn it inside out daily and dry it before the fire. Be sure you and your clothing are dry before turning in for the night. If you get frost or ice in your one-man bunk and nightgown, it's hard to get out. Brush and beat it out, because if you melt it before a fire it's difficult to dry completely, and it just freezes again deeper than ever in the fabric.

If you will remember, you have now removed everything that you want from the aircraft to get away from the threat of fire or explosion. With the danger over, place everything back in the aircraft that you do not need immediately. The airplane is an excellent storage place despite its coldness. If there are several feet of snow on the ground, you can lose a lot of tools and materials. They disappear in the snow, leaving no hint of their location. So place your spare stuff back in the aircraft where it will be safe from this thief.

You will not be on the ground very long before you run into the problems of heat and water. There probably will be small stoves of some type in your Arctic gear, but you may have to improvise to make use of available fuel — engine oil, av-gas, wood or miscellaneous flammable material from the airplane. Natives make-do with seal and bear oil.

As for starting fires, there'll be matches in your kit. Furthermore, you personally should carry enough matches to be prosecuted as a potential arsonist. A filled cigarette lighter helps, too. Other methods of fire-making include flint and steel, burning glass, various forms of wood friction, electric sparks and the fusee signal flare.

You can improvise a stove to burn gasoline, lubricating oil or a mixture of both. Put an inch or so of sand in the bottom of a can and add gasoline. Be careful when lighting; the gas may explode at first. Make slots at the top of the can to let flame and smoke out, and punch holes just above the level of the sand to provide a draft. To make fire burn longer, mix oil with gasoline. If you have no can, simply dig a hole in the ground, fill it with sand, pour on gas and light.

Drinking Water

You will have to melt ice or snow for your water. Ice is much better than snow, yielding more water for the heat expended. If you are in coastal regions or on floe ice, remember that old sea ice produces potable water, whereas fresh sea ice is salty. Do not prepare more water than you need because it will just freeze again. If you inadvertently wind up with more water than you need, encourage everyone to drink as much as they can use.

To conserve fuel all heat must be made to do many jobs at once (cook, melt ice for water and heat and light for shelter) and, whenever possible, substitute fuels should be used.

Communications will be the province of the radio operator, and he can do wonders if the aircraft's radio sets survive, and if he has use of the auxiliary power unit. Otherwise, he will have to depend on the hand-powered CRT-3 known as the Gibson Girl. This transmits on the international distress frequency of 500 kcs. or the aircraft emergency frequency of 8280. These signals can be homed on by search aircraft. Instructions for the CRT-3 will be found with the set. There also is a battery-operated VHF transceiver, the URC-4, for parachutists. It worked well in the Far East, but has not been thoroughly tested in the Arctic. It, too, can be homed on.

The group is fortunate if it has a navigator. He normally will save enough of his instruments to pinpoint the party. If that fix can be radioed to searchers, most of your troubles will be over.

Now, for your ground signals. Normally your emergency gear will include Very pistols, signal mirrors, dye marker, panels, fusee flares and flashlights. The Gibson Girl has a light which can be keyed.

In the Arctic, large SOS signals can be tramped out in the snow, bonfires prepared and dye marker spread over the snow or open bodies of water. Trees piled with brush and saturated with gasoline make excellent flash signals.

Fire and smoke are very unusual in the Arctic, and they rivet the attention of searchers. You need heavy black smoke in daytime, such as that produced by lube oil, and clean open flame at night. Even pin-pricks of light can be seen for great distances at night. If possible, rig up several trees for these fire signals.

Conserve all fuel and food at least until aerial searchers have spotted your location.

If weather or some other factor delays your rescue, begin hunting, fishing and gathering herbs to stretch out your food supply.

Extend your land reconnaissance as time goes on, traveling in pairs for safety.

Food Sources

Food is scarce in the Arctic, and hunting and fishing figured very little in the reports of wartime survivors. However, this is a food source which cannot be overlooked if you are down for a long time. An experienced hunter or trapper is a big asset to a stranded party.

Your survival pamphlet will contain information on the hunting and fishing possibilities in the area where you are down.

Large animals of the Arctic and sub-Arctic are moose, musk ox, caribou, bears and walrus. Downed parties seldom get a chance at these and are more interested in seals, rabbits, fox, ground squirrels, lemming, mice and birds. In summer there is an abundance of ducks, geese, loons, swans, gulls and grouse, but in the winter you will only find ptarmigans and owls. Natives depend largely on seals for food, heat and clothing.

The Arctic basin has little to offer in the way of edible fish other than cod and sculpin. The inland lakes and rivers usually contain grayling, trout, ling and white fish. The southern coasts in the sub-Arctic have an abundance of sea food.

It is possible to chop a hole through ice for fishing. Try to locate the deepest part of the lake or pond for the hole, as that is where the fish congregate. To keep the hole from re-freezing, cover it with anything available and then heap loose snow over the cover.

Some plant life in the form of roots, berries, barks, mushrooms and lichens are edible. The subject of Arctic food sources is too lengthy to cover fully here, and further information should be obtained in AF Manual 64-5 long before facing the first trip over the Arctic.

Overland travel in the hinterlands is slow, dangerous and tiring at any time. No one should attempt to "walk out" except as a last resort. In the event of a bailout or crash landing, rest a day or two before making any such decision because your judgment may be impaired by shock. Few Arctic survivors have been able to hoof it to civilization, and many have died trying. The tendency of newcomers is to over-estimate their ability.

Travel is Tough

Tough as it is, travel is easier in winter than during the other seasons. Frozen streams serve as paved roads. In summer the going along the banks of a waterway is difficult; it's a process of stumbling and falling through underbrush, and getting wet crossing tributaries. In winter you can walk over frozen swamps, muskeg, lakes and rivers; you can't do that when water is on the loose.

These warnings against travel however, do not apply in the case of exploring your vicinity. Help may be near at hand in the form of a shelter or a trail leading to people. Get as high as you can on a hill or in a tree for a general survey. In some areas of Alaska and Canada, remote cabins are stored with provisions for stranded persons. There is no charge, but it's a sourdough point of honor to replace anything used.

If ultimately you decide that you must travel, improvise a backpack from your parachute. You'll want a sleeping bag, matches and lighter, compass, a knife, sun glasses, watch, gun and ammunition, wire or shroud lines and food. Wear whatever you have in the way of special northern footwear and clothing. Snowshoes may be worth their weight in gold.

Travel downstream because this will ultimately lead you to larger rivers which wind up on a coast. When not on a waterway, move from landmark to landmark to prevent the usual tendency to circle.

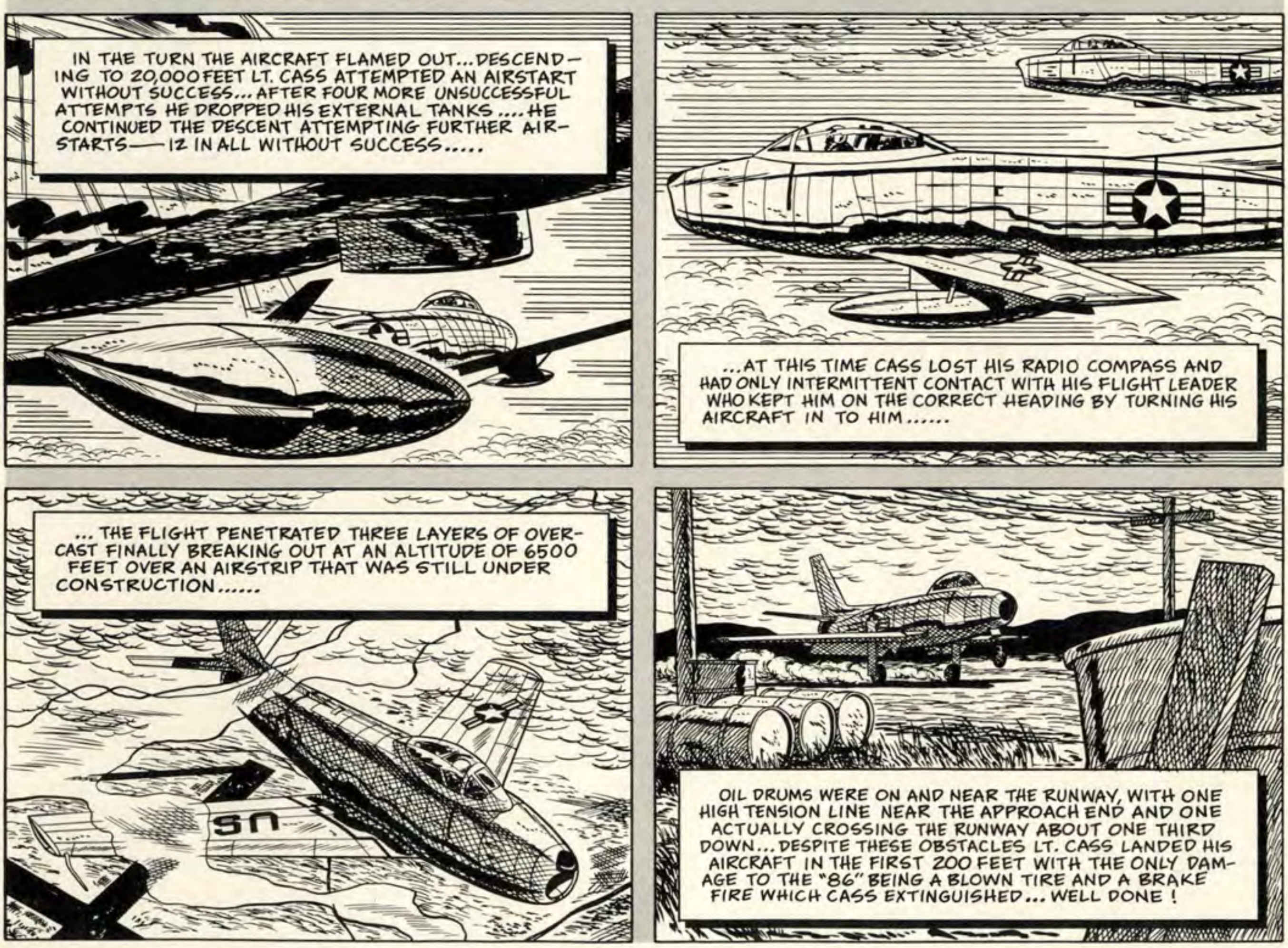
Set an easy pace, for you will be heavily loaded, and make camp early. Halt in mid-afternoon so you can build a fire, cook, make an adequate shelter and get plenty of rest.

You will never go down in the Far North in all probability. But if you do, never give up — remember that Uncle Sam is looking for you and cost is no object. ●

WELL DONE

1ST LT ROBERT L. CASS

22d Fighter-Bomber Sq
36th Fighter-Bomber Gp, USAFE



. . . skis resting on ice which is covered by a thin layer of snow can be unstuck by retracting the skis.

Slick STICKS

WE HAVEN'T touched on ski operation for a couple of years, primarily because there isn't a great deal new on the subject. However, a brief review of techniques appears in order now for some of you may be exposed to this peculiar type of flying this winter.

Just as most of us mastered the rudiments of skiing when we were kids, so too can pilots learn to take off and land on sticks instead of wheels. Years of practice, however, represent the difference between the Olympic champion and the tyro. And it's the same with a competent ski-plane pilot. He has to really *work* to master the art.

There are three prime factors that enter into the operation of any type of aircraft equipped with skis. First, the effect of wind on the plane while maneuvering on the surface. Second, the type of snow that will be encountered, and third, the ability to interpret snow conditions properly while still aloft. The latter really takes a great deal of practice.

There is little difference in the handling characteristics in flight between an aircraft equipped with wheels and one equipped with skis, if the sticks are clean. Should the skis load up with wet snow or slush, however, the added weight and drag will affect the overall handling of the airplane. This is especially true of liaison type aircraft.

Ski-planes have one distinct advantage peculiar to themselves. They can be landed on snow or ice almost anywhere and do not need plowed or rolled runways. But they must be handled gently and with considerable caution while taxiing because of the lack of brakes and lateral control at slow speeds.

To a certain extent, multi-engine aircraft have distinct advantages over single-engine planes when maneuvering on the ground. Turns can be made far easier by proper coordination of throttles and rudder, but the danger of getting into a slide or skid is always present. On the other hand, slow, careful turns demand a wide radius which under some conditions is impractical.

Small craft in the liaison class can be taxied and turned in a very satisfactory manner as long as a severe cross-wind condition does not exist. Often it is advantageous to ease the stick forward while gunning around turns, thereby lightening the tail and placing more weight on the skis. This helps to establish a turning moment. On windy days, however, such practices should be discouraged. It's too easy to get into a skid, hang up one ski and then dig in a wingtip or, even worse, flip over.

Skis without anti-skid type skegs should be confined to soft snow operations whenever possible. They're almost uncontrollable on hard packed snow or ice. Many a light-plane pilot has touched down on glare ice and gone into a merry-go-round act that left him sick and dizzy. Skegs are runner-like projections attached to skis. They'll dig in and act like skates, assisting immeasurably in maintaining directional control.

Wet snow is miserable stuff under any conditions. It's the wise pilot who makes a couple of experimental dry-runs before trying to get off when the snow is piling up over the toe of each ski and freezing. Under such circumstances it's best to make a "runway" for the final takeoff attempt, by taxiing back and forth a few times and establishing some definite tracks.

Takeoff procedures for light planes or multi-engine jobs are approximately the same. Always line up into the wind. Failure to do so, especially in liaison types, may result in a groundloop, induced by weather-cocking. After sufficient speed is built up to allow for good directional control, this no longer presents a problem.

Takeoff run should be made in a tail-low attitude. This must be a compromise between dragging the tailwheel and a level-flight position. Naturally, this will result in slow airspeed when breaking ground and the pilot should then allow the speed to build up as rapidly as possible before attempting to climb.

Soon after takeoff in a light plane, the pilot should visually check the skis to ascertain if the shock cord or hydraulic lifters have pulled the toe up to normal flight attitude. An overload of wet snow will sometimes cause the ski to hang "down at the bow" and greatly reduce airspeed. If this happens, it is best to land and clean the skis. By using original tracks in the snow for the next takeoff, a recurrence may be prevented.

With multi-engine aircraft, directional control on the take-off run is the same as if on wheels. As the plane gains speed, rudder control increases, thereby allowing for increased maneuverability and this in turn permits curved takeoffs, if necessary, because of space limitations or obstructions.

The plane must be held in a tail-low attitude until airborne and then leveled off to gain single-engine airspeed. Only then should the ski control be placed in the UP position. As soon as sufficient speed is built up to cause the skis to "fly" or make the airfoil on the rear of the ski effective, the landing gear should be retracted. If the skis are not "flying" it is possible to damage the oil coolers (C-47) or engine nacelles by retracting the gear too soon.

When taking off in a gooney bird in an area of drifted snow, make the line-up parallel to the drifts which usually follow a definite pattern made by prevailing winds. Such a decision of course is up to the pilot, but attempting a takeoff across drifts can get real hairy.

With power applied, get the tail up just enough to clear the tailwheel and at about 50 mph pop down half flaps. Watch it here though! In a moment you're going to become airborne and the nose of the aircraft must be lowered immediately to pick up speed.

If this precaution is not taken, it is quite possible to lose control of the aircraft in this semi-stalled attitude. As soon as the plane is definitely airborne, place the ski control in the UP position and then carefully milk up the flaps. When they are up, retract the gear and adjust power for desired climb.

One of the primary reasons for pulling off by the boot-straps is to get the aircraft into the air as quickly as possible. Hard-packed snow or ice gives the airframe quite a jolting, and the runs should not be prolonged any more than necessary for a safe takeoff.

Landing Technique

Before attempting a landing, drop down low enough to give the area a good once-over. While dragging the intended landing strip, look carefully for holes, hummocks, hidden rocks and tree stumps. If you're in doubt about obstructions, make a dry-run a few feet above the snow.

CAUTION: On snow-covered lakes or other large areas, it is possible to fly right into the surface because of lack of reference points. This is the same problem faced by the seaplane pilot on glassy water. Here's one solution. Land close to shore, if conditions permit. There you'll have trees, bushes and banks for reference. Of course if you must land in an area far removed from reference points, you'll have to "feel" your way down.

In multi-engine aircraft, power-on approaches should be made with the propellers in high RPM during the last 200 feet of the approach. All ski landings should be made three-point to avoid snubbing the skis and to cut down on the landing slide. Unless the snow or ice condition is known to be hard and smooth, use only quarter flaps. This will preclude the possibility of damaging them. Small pieces of flying ice can penetrate duralumінum like chunks of flak.

In making landings under low visibility conditions and without visual reference in the landing area, start an instrument approach from 500 feet into the forecast surface wind. Maintain a 300-foot-a-minute rate of descent until reaching 300 feet then slow to 150 fpm. Hold this rate until down to 100 feet, then cut descent back to 50 fpm.

The attitude of the plane will be nose-high. A cross check can be made throughout the approach with the radio altimeter. Remember, this is not always too reliable, so use caution. At about 50 feet, visual contact should be made and the landing completed in a three-point attitude. Upon touchdown the throttles should be chopped and the control wheel sucked all the way back and held there during the landing slide.

During all such low-visibility approaches, one pilot should concentrate on the instruments while the other watches out for visual references.

Under some conditions, skis may freeze to the surface while the aircraft is parked. The method of unsticking them will be determined by the surface on which the plane is resting.

If the skis are resting on ice that has a thin layer of snow on it, the skis may be unstuck by retracting them. If the snow is deep and soft, it will be necessary to dig out from under the wheels and place matting beneath them. This may appear somewhat ambiguous. Remember, though, that the skis extend below the wheels when in the DOWN position. A glance at the accompanying illustration should clarify this point.

On light planes, one of the best gimmicks to prevent skis from freezing-in is to place boughs or planks under them before tying down.

Under many conditions, skis will "quick freeze" when the plane is parked for a short while. This condition usually can be alleviated by having maintenance personnel rock the wings while the pilot applies power and bounces the tail up and down by positive application of elevator movement. A bit of caution must be observed to prevent over-controlling. Digging the propeller in could prove embarrassing to explain to an accident investigating board.

One last word of caution: Operations in the open often result in the plane's getting pelted by sudden snow showers. Naturally some of the white stuff is going to cover the wings. Before you attempt a takeoff, *get that snow off!* Coverage only one-quarter of an inch deep can nullify your best attempts. You just won't make it!

In the final analysis, ski flying is practical during the winter months and often the only solution to snow and ice operations. It requires only a bit of preplanning and a modicum of caution. ●

SEA MARKER DYE + • LIQUID • PRESSURE • SPRAYER =

ORANGE AID

COMING in on final, the pilot eased back on the throttle, flicked the trim button lightly and cast a quick glance at the airspeed indicator. The runway appeared to be coming up fast. He applied a touch of back pressure and raised the nose slightly. It was hard to judge distance now. The plowed banks and the white runway blended with each other in a disconcerting manner. The pilot felt as though he were hanging on the white edge of nothing.

The next moment the fighter slammed into the snow covered ground. A grinding impact snapped the pilot against the shoulder harness. Blinding sheets of snow and dirt rose high into the air, momentarily obscuring the plane from view. Twice it bounded with vicious porpoising leaps, scattering pieces of metal like shrapnel. Then it stopped. The clouds of snow settled slowly, quietly.

The pilot was unhurt but the plane was a total wreck. The accident was caused by undershooting. Initial touchdown was 400 feet short of the runway, where drifted snow had formed small but formidable barriers.

Accidents of this nature can, in most instances, be prevented. There are several methods, currently in use, for marking snow banks, runway edges and obstructions. Some bases use evergreen boughs as markers. Others employ colored flags. Often, flare pots are utilized at night. All of these work, up to a point. The suggestions that follow can well be used in conjunction with any of the above.

The problem area, from the pilot's standpoint, exists from the last turn onto final approach to actual touchdown. Many types of markers that are visible directly overhead fail to do the job when approached from an oblique angle. Sometimes it is impossible to judge height above the ground because snow itself will not serve as a reference. A white runway, white banks and white terrain all blend in together.

Recently we received an excellent suggestion for marking snow covered runways and taxiways. This was submitted by Major Wayne L. Daniel, who is stationed at Elmendorf AFB and who reports that the system is paying dividends in that part of the globe. Here is his explanation of methods and equipment.

"Clean the snow from the runways and taxiways as usual, especially exposing the permanent side markings or lights. Then apply a non-hazard longitudinal center stripe down the runways and taxiway, using a suitable coloring material such as a water soluble dye. Such a dye is the standard Sea Marker. When Sea Marker is dissolved in water in a concentration of one-quarter to one-half pound per gallon and sprayed on snow, it will color the surface of the snow a light to a dark orange color, depending on the volume of solution used per unit area of surface. Such a surface gives an excellent contrast against the white surface of the snow. The contrast diminishes in effectiveness as the background color darkens. Thawing will cause this dye solution to spread, but thawing conditions will seldom prevail once winter sets in. In freezing weather, the equipment used to spray this water solution of the dye would have to be prevented from freezing either by applying heat or replacing 30 volume per cent of the water solution with methyl, denatured ethyl, or isopropyl alcohol, which would prevent the solution from freezing down to 0°F.

The only markings needed are the runway and taxiway center lines, one foot in width. An ordinary garden hose of suitable length, and nozzle will give the correct spray, provided the pressure on the liquid is maintained at 20-30 pounds/inch.

"The color contrast is dependent on the volume of dye solution applied per unit surface area and this can easily be controlled by the speed of surface coverage. The degree of color contrast is dependent on variable conditions and should be worked out by actual trial.

"One gallon of the dye solution should cover one hundred to three hundred square feet of surface area. To mark an average Air Force base, approximately 100 gallons of the dye solution would be required, using approximately 25 pounds of dye.

"This dye is standard Sea Marker, AF Stock, Class #27-A, Stock #7300-379000, nomenclature, Dye-Fluorescence in Soluble, packaged in 9½-ounce cans.

"To elaborate a little, here is how we ran the first test: An old water tank was found in salvage. We welded a regular water faucet on the low end of the tank and welded a regular innertube air valve on the top. About five or six feet of garden hose with regular nozzle was attached to the faucet. This tank was put on a trailer and hitched to a cletrac, the necessary air pressure being obtained from the compressor on the cletrac. That's all there was to it. We then pulled this contraption down the center of the runway, varying the speed and nozzle adjustment until we obtained the desired effect." ●

when in Rome....

Do as the Romans do or, in this case, as the sourdoughs do. The lovely in this picture has the right idea. She finds herself in the Far North and is dressing in the proper clothing for the arduous winter weather, although she looks as if she could use some help. Volunteers form right, please.

Flight coveralls and low-cut oxfords just won't do up in Santa Claus land. We heard of one crew that ditched right off the end of a runway and literally almost froze to death before help arrived.

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