FLEET AIR WING 4

WEATHER NOTES FOR PILOTS

Summer Fogs and Winter Winds of The Aleutian Islands

and how to fly despite them

TO THE PILOTS

The author of this pamphlet, Lieutenant Commander John Tatom, U. S. Navy, has been for two years the Aerological Officer of Fleet Air Wing FOUR. He has not only made a close and special study of Aleutian weather but he has continuously flown in it. He is an "aviator's weatherman" who knows by first hand experience what weather means to you, the pilot. This booklet is therefore not just an arm chair study but the result of extensive research on the spot, and in the air above it.

Study it well; be guided by its precepts, and if you can navigate at all (and if you can't, you have no business here anyway), you'll find that Aleutian weather can be flown - and safely.

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WEATHER NOTES FOR PILOTS

AUTHOR'S NOTE:

Aleutian weather has been widely publicized since the outbreak of World War II. In numerous magazine and newspaper articles and over the radio we have heard that the Aleutian area is the home of one of the largest "lows" of the northern hemisphere, that here is the breeding place of the storms, and that here exist the icy gales and the perpetual fogs.

The "newcomer" to the Aleutians is at a disadvantage in comparison with those who have accumulated a first hand knowledge of weather in this area in that the "newcomer" has learned about only one side - and certainly the worst side - of the story of our weather.

Also, there is occasionally an "old timer" who is still at a disadvantage because he has not studied in sufficient detail the weather he has experienced to realize the most important fact of all, - namely, that the weather in the Aleutians is of the same types that may be encountered anywhere, and that the same decisions that one has to make in other localities are the ones that should be applied here.

"Weather Notes for Pilots" neither replaces any meteorological course nor modifies existing instructions regarding navigation and flight procedures. It is solely a compilation of observed facts which are considered useful knowledge for pilots flying in the Aleutians.

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SUMMER FOGS
of the
ALEUTIAN ISLANDS

DESCRIPTION OF SUMMER FOG CONDITIONS

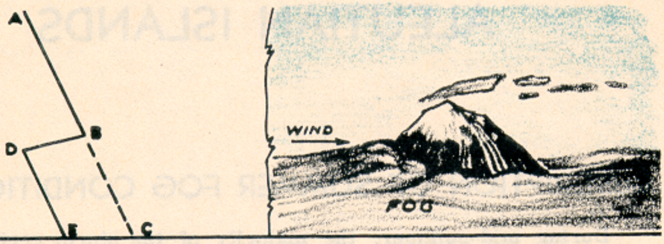
During mid-summer, the majority of the storm centers in the Aleutian area travel northeastward from Japan, passing into the Bering Sea in the vicinity of the Kamchatka Peninsula, or into the Sea of Okhotsk. High pressure prevails over the Pacific Ocean with the highest pressure usually found along the latitude belt between thirty-five to forty degrees north. The centers of the individual high pressure areas are usually so located that the air over the north Pacific Ocean and the Bering Sea has traveled northward from the tropical or temperate zones.

During the latter part of this journey, the cold waters of the north Pacific have cooled the air from its sub-tropical temperature of about seventy degrees to the north Pacific temperature of fifty degrees or less. This chilling of the air is more than sufficient to lower its temperature to its condensation point. Also, the chilling increases the density of the lower layer of air which is in contact with the water, and prevents it from rising into the lighter, warmer air above it. As a result, the lower layer of cold air, laden with moisture because of its saturation, covers wide areas of the Pacific Ocean and Bering Sea with a blanket of fog.

The area just south of the Kamchatka Peninsula has the distinction of being the foggiest place in the northern hemisphere in summer. Although there is slightly less fog to the eastward, its frequency along the Aleutians is still very great. Over the open sea, there is little daily variation in fog amount as the sun is ineffective in "burning it off". Unlike other types of fog, high winds often fail to dissipate it, or lift it off the water.

STRUCTURE OF THE FOG

As aircraft must fly either in or above the fog, it is important that its vertical structure be known to the pilot. This is best described by means of the cross-section shown below.



The line "ABC" shows the temperature-height curve of the air when it was in low latitudes. As the air traveled northward, it was cooled several degrees at the surface, but aloft it has changed its temperature but little as it has neither been in contact with the water, nor mixed with the air which has been in contact with the water. Its change in temperature with altitude when it has reached the Aleutians often is as shown by the curve "ABDE", where "DE" shows the cooling resulting from contact with the water and "DB" shows the transition layer between the air which has been cooled and the air which has not been cooled.

The air below the height "D" is trapped below the inversion layer "DB" as it cannot rise into the warmer and therefore lighter layer above it. Moisture from the ocean is thus forced to remain in the lower layer which usually causes this layer to be one of solid fog. The height of the fog may vary from a few feet to four thousand feet, occasionally higher. The height depends upon wind velocities, length and time of travel, and several other factors.

ICING AND TURBULENCE

Away from the land, over the open sea, the air isn't very turbulent, even in a strong wind. This fact should be remembered as new pilots may make the mistake of underestimating the wind velocity because of the lack of turbulence.

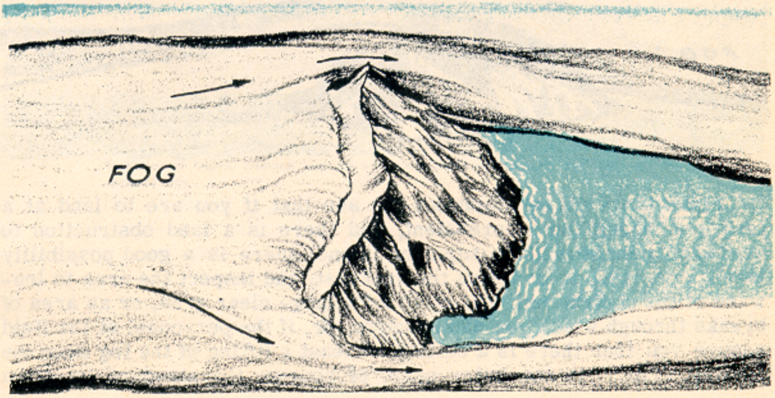
The air which is found in the typical Summer fog condition of the Aleutians is very smooth and in marked contrast to the turbulent conditions which so often obtain in the Winter.

Icing is not usually encountered during the summer fog conditions because surface temperatures are several degrees above freezing and the air aloft may be warmer than it is at the surface. Eventually, of course, the temperature decreases to freezing and below freezing at high altitudes, but usually the air at these levels is comparatively moisture free and no icing results.

Thus, we find that turbulence and icing are seldom problems in the Summer. The major problems encountered during summer flying are fog over or near the landing area, and uncertainty as to the force and direction of the wind when flying on top. Fortunately, there is a solution to both, and each will be discussed in detail in the following.

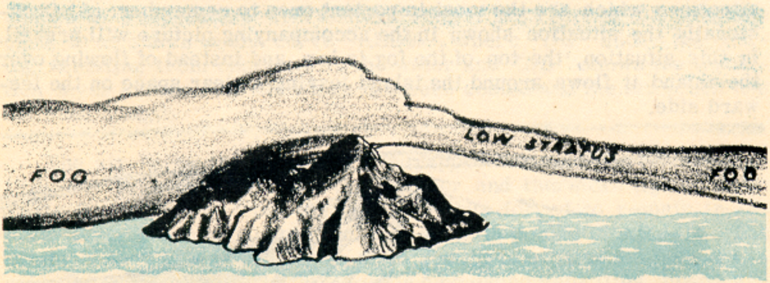
EFFECT OF ISLANDS ON FOG

Whenever fog is widespread near a terminal, breaks in the fog or a lifting of the fog sufficient to give a little ceiling and visibility near land may often be found in the lee of the islands. There are three situations which are the most important ones to remember: (A) Occasionally the situation shown in the accompanying picture will prevail. In this situation, the top of the fog is low, and instead of flowing over the island it flows around the island leaving a clear space on the leeward side.



(B) Occasionally the situation shown in the accompanying picture will prevail. Here the fog thickness is so great that it flows over as well as around the island, but the down draft on the lee side of the island is sufficient to cause breaks to appear in the canopy of fog overhead.

(C) Occasionally the situation shown in the accompanying picture will prevail. Here the fog thickness is so great that the down draft on the lee side of the island is insufficient to cause breaks, but some ceiling with fair visibility exists for a short distance downwind from the island.



From these three situations we see that if you are to land at a terminal where fog is prevalent, and there is a land obstruction to windward (sometimes an adjacent island) there is a good possibility that if you come in on top of the overcast, and inspect the area to leeward of the obstruction, you may find a large clear area, or an area of breaks through which you can let down, or, if the personnel at the field assure you that there is a ceiling, at least a lifting of the fog over the landing area. In the latter case, of course, the standard let-down procedure may take you so far to sea that you are still in the fog at the end of your let-down. However, at some point on the final approach you are assured that the fog base will be off the water and that you can fly contact from there to the field. In this situation, there is little possibility of trouble if your operational personnel assure you, just prior to let-down, that a standard let-down is feasible.

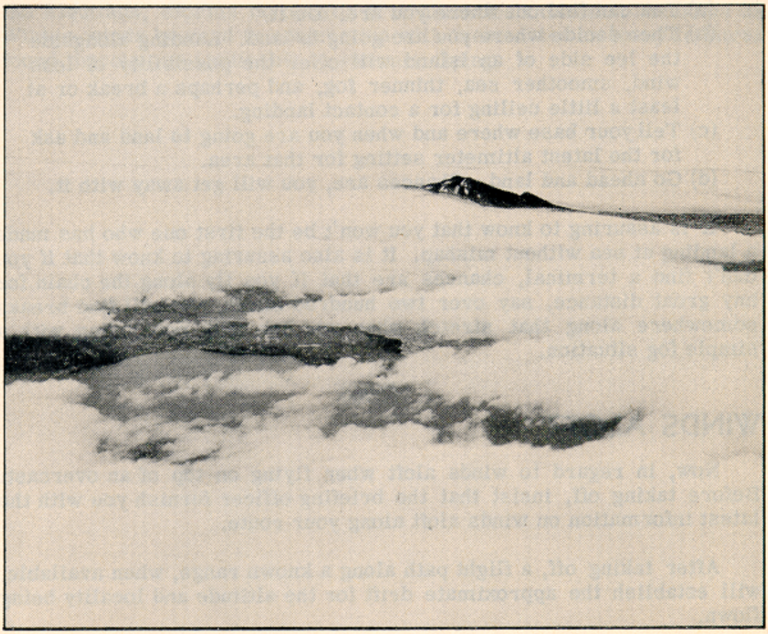


Illustration of breaks, clearing, overcast with some ceiling on lee side, and "pile up" on windward side.

LANDING AT SEA

If your terminal is closed by fog, and you have no alternate terminal, eventually of course, you must land. And it can be done at sea safely, even with land planes. So make your plans and follow them out. Remember these points:

(a) You can find out where you are. Do it.
(b) Then decide where you are going to land. Landing alongside the lee side of an island will offer the possibility of less wind, smoother sea, thinner fog, and perhaps a break or at least a little ceiling for a contact landing.
(c) Tell your base where and when you are going to land and ask for the latest altimeter setting for that area.
(d) Go ahead and land. Chances are, you will get away with it.

It is assuring to know that you won't be the first one who has made a landing at sea without mishap. It is also assuring to know that if you can't find a terminal, chances are that if you fly along the chain for any great distance, say over two hundred miles, you will find breaks somewhere along that stretch when you are only contending with a simple fog situation.

WINDS ALOFT

Now, in regard to winds aloft when flying on top of an overcast: Before taking off, insist that the briefing officer furnish you with the latest information on winds aloft along your route.

After taking off, a flight path along a known range, when available, will establish the approximate drift for the altitude and locality being flown.

When flying on top, and where mountain peaks penetrate the overcast, the piling up of the clouds on the peaks gives a good indication of the wind direction and a rough indication of velocity.

Two positive fixes, in connection with the course and speed between fixes, establishes the drift. Everyone knows this, but the important thing to remember is that when you have a chance to get your drift, don't fail to get it. You may need it later.

When occasional breaks in the overcast are encountered, estimate the surface wind. The lower the altitude of the plane, the better this wind estimate will serve for that altitude.

You can always request the latest information on upper winds. Often upper air soundings will have been taken after your take-off.

Although fog is the predominant feature of the summer weather of the Aleutians, storms do occur. It is most desirable that the notes on Winter winds be read in conjunction with these notes as many features found therein are applicable to summer flying.

WINTER WINDS of the ALEUTIAN ISLANDS

FEATURES OF WINTER WEATHER

The Summer season of widespread fog and only occasional storms of moderate or weak intensity is followed by increasing storm activity in the early Autumn. The paths of the storms are often close to the Aleutian Chain, although as Autumn gives way to Winter, the storms pass farther to the south.

By the end of September, the northern land masses of Alaska and Siberia have cooled markedly in comparison with their Summer temperatures. The air flow from the north becomes progressively colder with the onset of winter and is thus able to penetrate farther and farther southward before heating to the temperature of the seas. As the temperature contrast between the southern air masses and the northern air masses increases, the storms become more violent and more frequent. Also as the northern air masses become colder than the waters of the ocean, these air masses become turbulent and showery from heating and from water absorption from the Bering Sea and the Pacific Ocean. As these cold air masses move southward, tropical air masses are unable to displace them over the Aleutian Chain, and consequently the warm air masses, when present, are found aloft over the colder air. This effectively puts an end to the typical summer fog conditions.

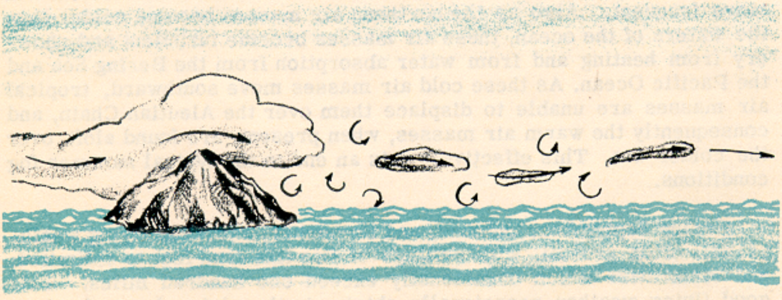
During September, October, and November, excellent flying weather will often prevail, with ceilings of two thousand feet to unlimited, and visibilities which occasionally exceed one hundred miles. This good flying weather occasionally obtains in the winter, but is far less frequent. Fog is quite rare from September through April.

On the other hand, temperatures are near freezing, and wind velocities may be quite high. These two factors introduce dangers due to turbulence, low visibility, icing, large errors in navigation and in altimeter settings. The chief points of interest from the standpoint of safety in flight are outlined in the following:

TURBULENCE

Strong winds are greatly influenced by the islands. Near land masses, and especially in the lee of land, there is an area of disturbed air currents. The position of this area cannot be fixed exactly as it depends upon the contour of the land, strength of the wind, direction of the wind, and degree of stability of the air itself. Accordingly, no thumb rules are available for locating exactly the areas of disturbed air. Just remember that strong winds are disturbed by land masses, especially IN THE LEE OF LAND.

These disturbed air currents are known locally as "Williwaws". The air in striking land masses, or in blowing through passes, is deflected in such a manner that rotary currents are started. At a given point, these currents may be constantly changing in both direction and velocity.



The above sketch serves to show the eddy nature of the air flow which is superimposed on the general large scale ascending and descending current. Williwaws are sometimes detected by clearing in the lee of hills, by areas of roughened water, and by unusual lense shaped clouds in the lee of land.

These disturbed air currents are described by aeronautical engineers as "sharp-edged gusts". The reactions of aircraft to flight through "sharp-edged" gusts are still a matter of concern to aeronautical engineers, involving questions of structural strength and flight control; - they must also be of concern to pilots for reasons of safety.

Specifically, the following points are to be remembered:

(1) Sharp-edged gusts exist.
(2) Wind gusts may exceed 100 miles per hour.
(3) Vertical currents may cause such sudden vertical displacement of an airplane that crew members may be knocked unconscious, all loose gear may be thrown about in the airplane, hydraulic systems may be damaged, and considerable altitude may be gained or lost very suddenly.
(4) Vertical currents cause a change in flight attitude of the airplane even though the attitude of the airplane is unchanged with respect to the earth.
(5) It is possible to have a strong eddy current strike one wing but not the other.
(6) Rate of descent of down drafts may exceed your maximum rate of climb.

Remedial measures within the control of the pilot are:

(1) Choice of tracks most likely to avoid eddy currents. In general, sharp cliffs, bluffs, peaks, valleys, and passes should be regarded as sources of gusts. If visibility is sufficient on the windward side of the land, this side is preferable because it is less turbulent. If the leeward side is taken, the greater the distance from land, the more diffuse will be the gusts encountered.
(2) Watch the water for cross winds and concentrated "white cap" areas which reveal down drafts.
(3) Insist upon proper stowage of material in the airplane.
(4) Require the use of the safety belt at all times by the pilot actually controlling the airplane, and by all personnel for whom safety belts are available when the wind is strong and the airplane is near land.

(5) Avoid the necessity for sharp banks in changing course near land by coming in at small angles of approach.
(6) Maintain sufficient altitude to permit recovery from strong down drafts before the aircraft is forced to the surface.
(7) When there is a possibility of down-drafts, make power-on approaches.
(8) If you must climb to "top" hills from the lee side, gain your altitude before reaching the area of down-drafts. The closer you get to the hill, the stronger the down-draft will be; so don't expect to continue to gain altitude as fast as you were doing during the first part of your approach.

VISIBILITY

Visibility is better in the Autumn and Winter than in the Summer; however, it is often reduced by rain, snow, snow pellets, and "sea smoke".

When visibilities are bad, the following remedial measures are available to the pilot:

(a) The lee side of islands will usually offer the best visibility, and a route may be chosen to take advantage of this fact. It must be remembered however that if the visibility is sufficient on the windward side, that side has the advantage of less turbulence, especially when the winds are high.

(b) Regardless of the side of the islands chosen, the advantage of contact flying may be lost by choosing a course too far off shore. For example, a track line ten miles off shore may be beyond the range of visibility, while a track line three miles off-shore would have allowed contact flying from one island to the next. In flying close to shore in reduced visibility, it is wise to chose a course which does not approach land any closer than the tangent bearing to the point of land ahead. In this connection it must be pointed out that at this time - 1943 - charts of the Aleutians are still unreliable.

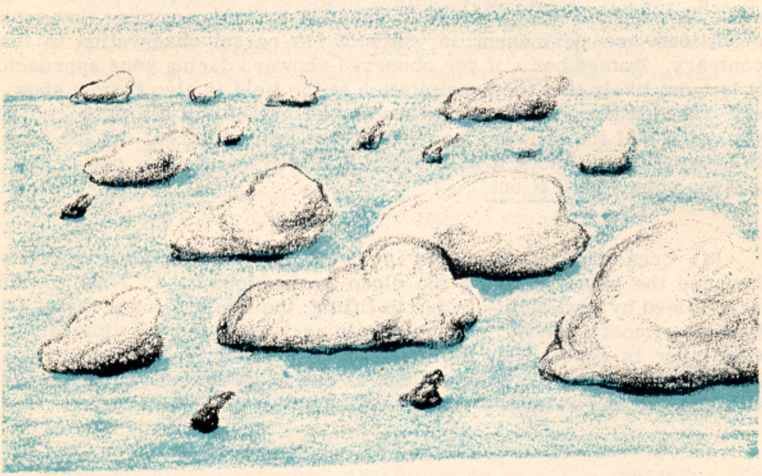
(c) Often visibility is reduced to near zero on the landing field because of passing showers of rain or snow. In such cases the pilot can usually wait for the shower to pass. Too often a pilot flies through or around passing showers while enroute, yet upon finding near zero conditions at the field upon his arrival, assumes that such conditions are permanent in spite of his recent observation to the contrary. Remember - if you observed showers during your approach, it is most likely that the precipitation at the field is also from a shower. These shower clouds move with the velocity of the wind;- so, if you noted that the showers were about five miles in area, and the wind is blowing twenty knots, it will take just fifteen minutes for one to pass a given point. Wait it out.

(d) Occasionally, advantage is not taken of existing good visibility because the plane is flying too close to the cloud base. When clouds are formed by cooling of air due to lifting, the air just under the cloud base is almost a cloud. Its humidity is very high, and the visibility in this layer is necessarily lower than it is at lower levels. Sometimes by decreasing your altitude as little as one hundred feet you will more than double your visibility range.

ICING

The icing problem and its solution is the same along the Aleutians as it is elsewhere, with one important exception which will be described below. It is true, however, that icing conditions occur along the Aleutians more frequently than over land areas. This is because of the fact that during the Winter the temperature at the surface is often near freezing, and the fact that the great expanse of ocean area offers a constant source of moisture to saturate the air.

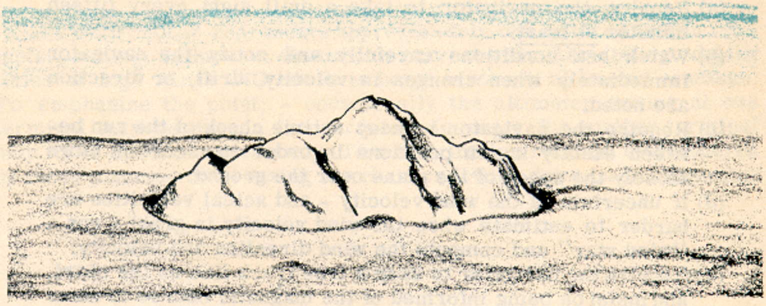
The icing problem mentioned above which is peculiar to the Aleutian area is brought about as follows: Very cold air from the interior of Alaska or Siberia is occasionally found along the Aleutians. The temperature of the ocean water is many degrees warmer than that of the cold air. As a result, water vapor from the surface of the ocean is condensed as soon as it leaves the surface, forming a fog which is known as "sea smoke". On occasion, the sea smoke builds up to heights of over 5000 feet, and instead of being a fog, is actually a convective cumulus cloud with its base on the water.



"Sea smoke" building into cumulus clouds and narrow steam columns with bases on the water.

Vertical currents in this type of cloud vary markedly, giving rise to a condition in which the cloud is composed of ice crystals and of water droplets some of which are at above freezing temperatures and some at below freezing temperatures. Fortunately, the vertical or convective nature of the air currents in this situation often cause the area to have clear spaces between clouds as is the general rule with cumulus, and a passage relatively free from clouds may be found through this zone. If not, best procedure is to go over the top or to turn back if icing cannot be successfully combatted.

Occasionally the "sea smoke" lies on the surface of the water as a ground fog as shown in the picture following. In this situation, it can usually be topped easily.



Sea smoke lying on the water as a ground fog.

The thing to remember is that with the temperature of the surfaces of the plane well below freezing, and with water droplets at both above and below freezing in the "sea smoke" in both of the types described above, icing can be both rapid and heavy. Often though, a test run at various altitudes in these clouds will reveal an altitude where the water particles have already frozen and icing at this level is negligible. This usually occurs when the cloud has lost its turbulence.

NAVIGATION

The strong winds associated with Winter weather in the Aleutians tend to introduce large errors in navigation. These errors are introduced because:

(a) Wind velocity may change radically with change in altitude.
(b) Wind direction may change somewhat with change in altitude.
(c) Navigators may disregard (a) and (b) above and use the estimated surface wind regardless of the altitude of the airplane.
(d) White caps and swells are not always representative of the surface wind, so estimated surface winds may be in error. This is especially true near shore, in the lee of the land, and near frontal zones.
(e) Wind velocity or direction, or both, change rapidly, and the navigator, busy with other duties, fails to "keep up" with his changing wind factors.

Remedial measures within the control of the pilot are;

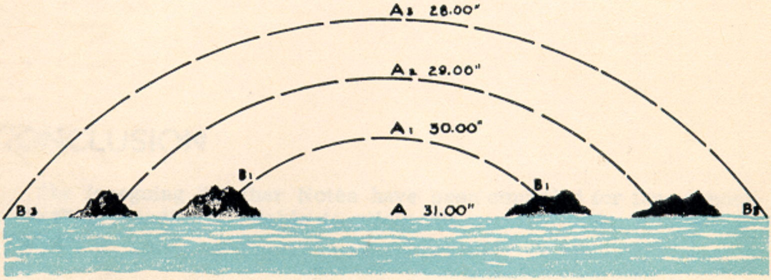
(a) Require the navigator to take a drift sight every fifteen minutes at least.
(b) Watch sea conditions carefully and notify the navigator immediately when changes in velocity, drift, or direction are noted.
(c) Require the navigator to keep a time check of the run between exactly known positions in order to ascertain more closely the speed of the plane over the ground.
(d) If uncertain of the wind velocity - and actual velocities are harder to estimate when the wind velocity is great - run a "wind star" and compute the wind direction and velocity.
(e) Require the navigator to keep a true track line on the chart, and insist on being informed of the magnetic course to steer to reach the track line (when not on the track line), or to stay on the track line once it has been reached. Inasmuch as this course includes, in addition to variation, the drift, - changes of course to stay on the track line will be frequent and should be made even though the change is only a degree or two.
(f) The pilot should insist that with each "magnetic course to steer" report from the navigator, he also be informed of the number of degrees drift included in this course. He may then properly appraise the navigator's estimate of drift by his own personal observation. Often right drift will change to left drift before the navigator notices it.

What has been said in the foregoing is particularly applicable to flights over the ocean away from land. Of course, when in the vicinity of the islands of the chain, other aids to navigation are available, but it is desired to emphasize the advantage which must accrue to a crew trained to navigate without aids from outside sources. You may have to some day.

ALTIMETER SETTINGS

The closer the lines of equal barometric pressure (isobars) are to one another, the stronger are the winds. Also in high latitudes, the isobars must be closer together than they are in low latitudes to give winds of the same velocity. The Aleutians, all north of latitude fifty, are well known for their high winds. Accordingly, during periods of these high winds, the isobars must be very close together, much more so than we are accustomed to in other parts of the world.

As each isobar represents approximately one hundred feet in altimeter setting, failure to obtain the correct altimeter settings during times of high winds will result in large errors in altimeter readings. To emphasize the point; - occasionally the altimeter setting at one terminal may be over a thousand feet in error for another terminal only three hundred miles away. This information must be remembered by those planning on crossing the chain or letting down on instruments.



Aircraft taking off at "A" will have correct altitudes at A_1 to A_3 as the altimeter responds correctly to the decreasing pressure aloft. However upon landing at B_1 to B_3 the altimeter will show the same altitudes as were indicated at A_1 to A_3 respectively unless the altimeter setting has been changed. A good thumb rule for determining the direction of the error is "When going towards low pressure, you are lower than your altimeter indicates".

SPRING AND AUTUMN WEATHER

Spring and Autumn are seasons of transition. Both have features of the summer and winter weather; but they exhibit no peculiarities of their own which merit sufficient attention to be included in this short description of Aleutian weather. Both seasons offer many excellent days for flying, with conditions somewhat better in the Autumn than in the Spring.

CONCLUSION

The foregoing Weather Notes have been compiled for the purpose of making readily available to pilots the main features of Aleutian weather.

The pilot who keeps an accurate check on his position, who keeps informed of present and expected weather at terminals in his area, who habitually keeps an alternate plan in mind, and who knows what he must anticipate from the weather in which he is flying, will find that the flying experience that he has gained in the Aleutians will serve him well - wherever he goes.