AC 00-6A

AVIATION WEATHER

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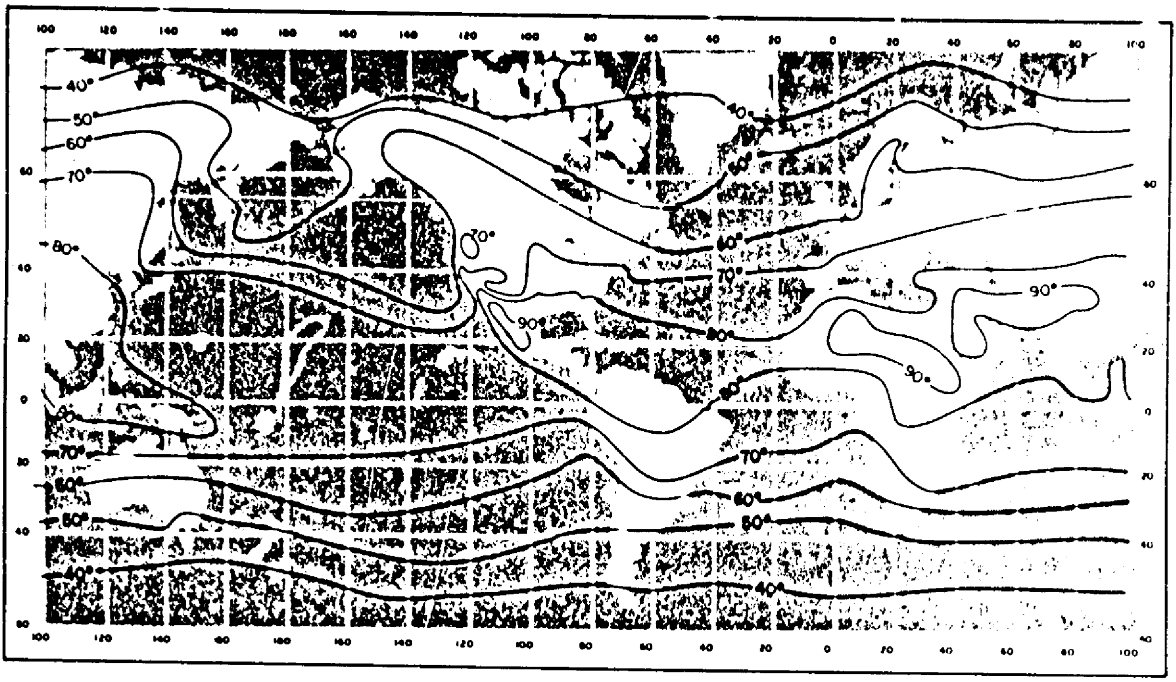


Figure 4. World-wide average surface temperatures in July. In the Northern Hemisphere, continents generally are warmer than oceanic areas at corresponding latitudes. The reverse is true in the Southern Hemisphere, but the contrast is not so evident because of the sparcity of land surfaces.

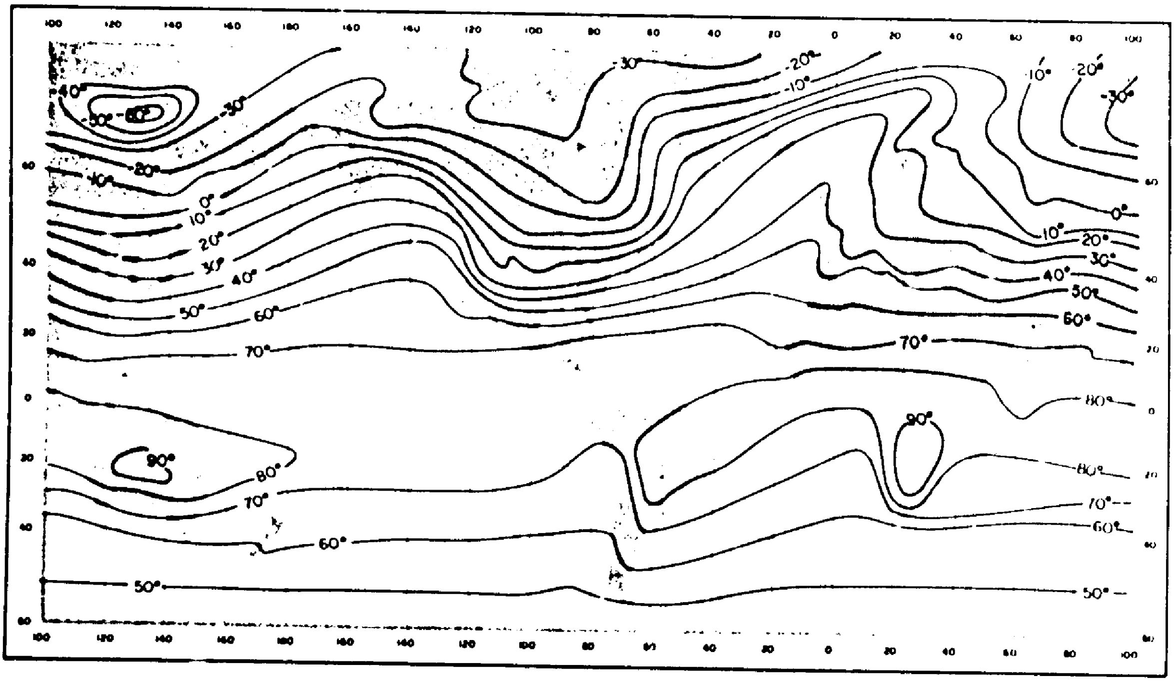


Figure 5. World-wide average surface temperatures in January when the Northern Hemisphere is in the cold season and the Southern Hemisphere is warm. Note that in the Northern Hemisphere, continents are colder than oceanic areas at corresponding latitudes, and in the Southern Hemisphere continents are warmer than oceans.

Altimeter Setting

Since the altitude scale is adjustable, you can set the altimeter to read true altitude at some specified height. Takeoff and landing are the most critical phases of flight; therefore, airport elevation is the most desirable altitude for a true reading of the altimeter. *Altimeter setting is the value to which the scale of the pressure altimeter is set so the altimeter indicates true altitude at field elevation.*

In order to ensure that your altimeter reading is compatible with altimeter readings of other aircraft in your vicinity, keep your altimeter setting current. Adjust it frequently in flight to the altimeter setting reported by the nearest tower or weather reporting station. Figure 15 shows the trouble you can encounter if you are lax in adjusting your altimeter in flight. Note that as you fly from high pressure to low pressure, you are lower than your altimeter indicates.

Figure 16 shows that as you fly from warm to cold air, your altimeter reads too high—you are lower than your altimeter indicates. Over flat terrain this lower than true reading is no great problem; other aircraft in the vicinity also are flying indicated rather than true altitude, and your altimeter readings are compatible. If flying in cold weather over mountainous areas, however, you must take this difference between indicated and true altitude into account. You must know that your true altitude assures clearance of terrain, so you compute a correction to indicated altitude.

Corrected (Approximately True) Altitude

If it were possible for a pilot always to determine mean temperature of the column of air between the aircraft and the surface, flight computers would be designed to use this mean temperature in computing true altitude. However, the only guide a pilot has to temperature below him is free air temperature at his altitude. Therefore, the flight computer uses outside air temperature to correct indicated altitude to approximate true altitude. *Corrected altitude is indicated altitude corrected for the temperature of the air column below the aircraft, the correction being based on the estimated departure of the existing temperature from standard atmospheric temperature.* It is a close approximation to true altitude and is labeled *true altitude* on flight computers. It is close enough to

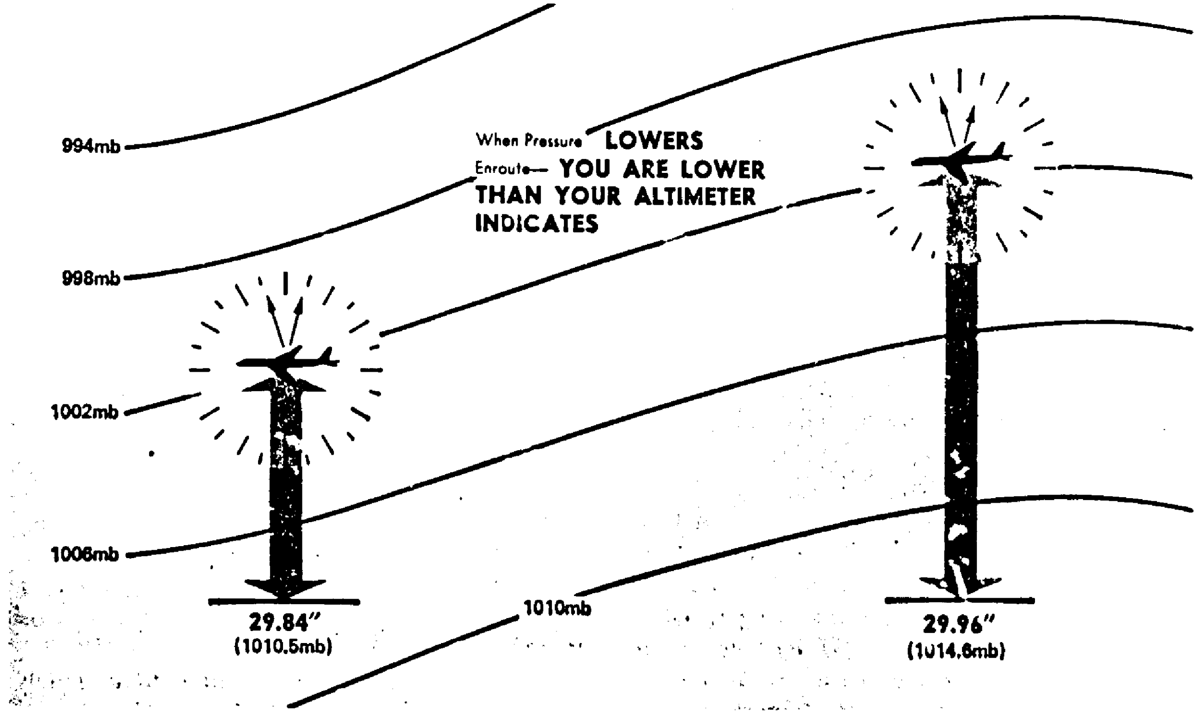


FIGURE 15. When flying from high pressure to lower pressure without adjusting your altimeter, you are losing true altitude.

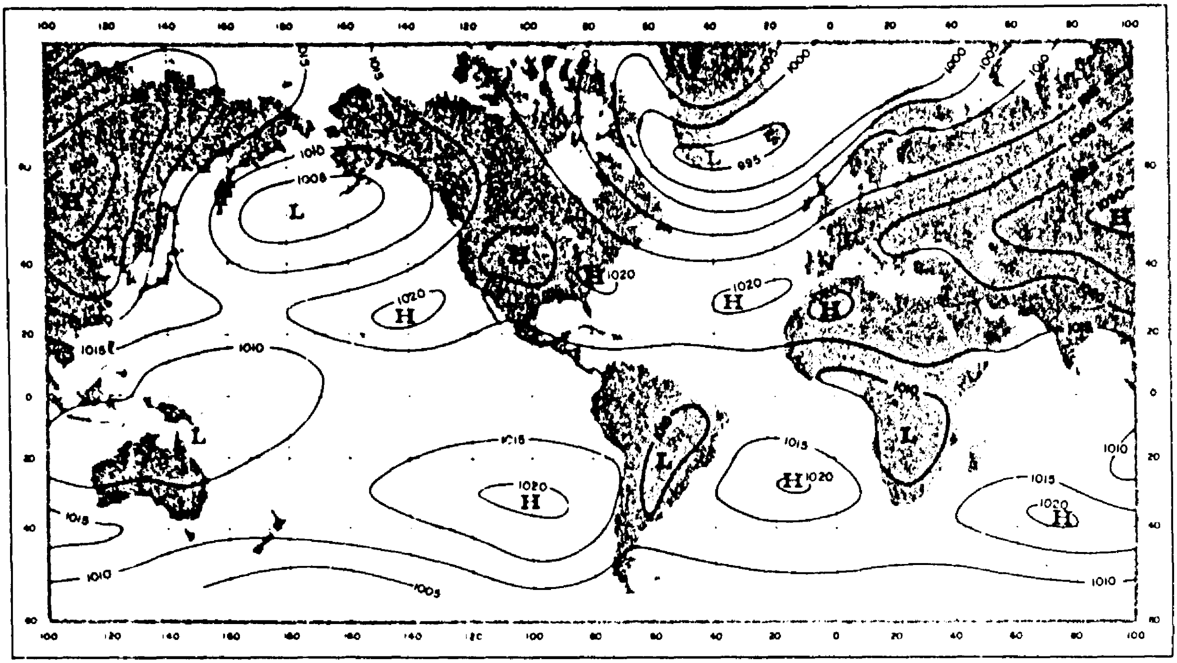


FIGURE 24. Mean world-wide surface pressure distribution in January. In this season, the pattern in figure 23 is reversed. In the cool Northern Hemisphere, cold continental areas are predominantly areas of high pressure while warm oceans tend to be low pressure areas. In the warm Southern Hemisphere, land areas tend to have low pressure; and oceans, high pressure. The subtropical high pressure belts are evident in both hemispheres. Note that the pressure belts shift southward in January and northward in July with the shift in the zone of maximum heating.

areas of low pressure and the relatively cool oceans, high pressure. In winter, the reverse is true—high pressure over the cold continents and low pressure over the relatively warm oceans. Figures 23 and 24 show this seasonal pressure reversal. The same pressure variations occur in the warm and cold seasons of the Southern Hemisphere, although the effect is not as pronounced because of the much larger water areas of the Southern Hemisphere.

Cold outbreaks are strongest in the cold season and are predominantly from cold continental areas. Summer outbreaks are weaker and more likely to originate from cool water surfaces. Since these outbreaks are masses of cool, dense air, they characteristically are high pressure areas.

As the air tries to blow outward from the high pressure, it is deflected to the right by the Coriolis force. Thus, the wind around a high blows clockwise. The high pressure with its associated wind system is an *anticyclone.*

The storms that develop between high pressure systems are characterized by low pressure. As winds try to blow inward toward the center of low pressure, they also are deflected to the right. Thus, the wind around a low is counterclockwise. The low pressure and its wind system is a *cyclone.* Figure 26 shows winds blowing parallel to isobars (contours on upper level charts). The winds are clockwise around highs and counterclockwise around lows.

The high pressure belt at about 30° north latitude forces air outward at the surface to the north and to the south. The northbound air becomes entrained into the midlatitude storms. The southward moving air is again deflected by the Coriolis force becoming the well-known subtropical northeast trade winds. In midlatitudes, high level winds are predominantly from the west and are known as the prevailing westerlies. Polar easterlies dominate low-level circulation north of about 60° latitude.

These three major wind belts are shown in figure 25. Northeasterly trade winds carry tropical storms from east to west. The prevailing westerlies drive midlatitude storms generally from west to east. Few major storm systems develop in the comparatively small Arctic region; the chief influence of the polar easterlies is their contribution to the development of midlatitude storms.

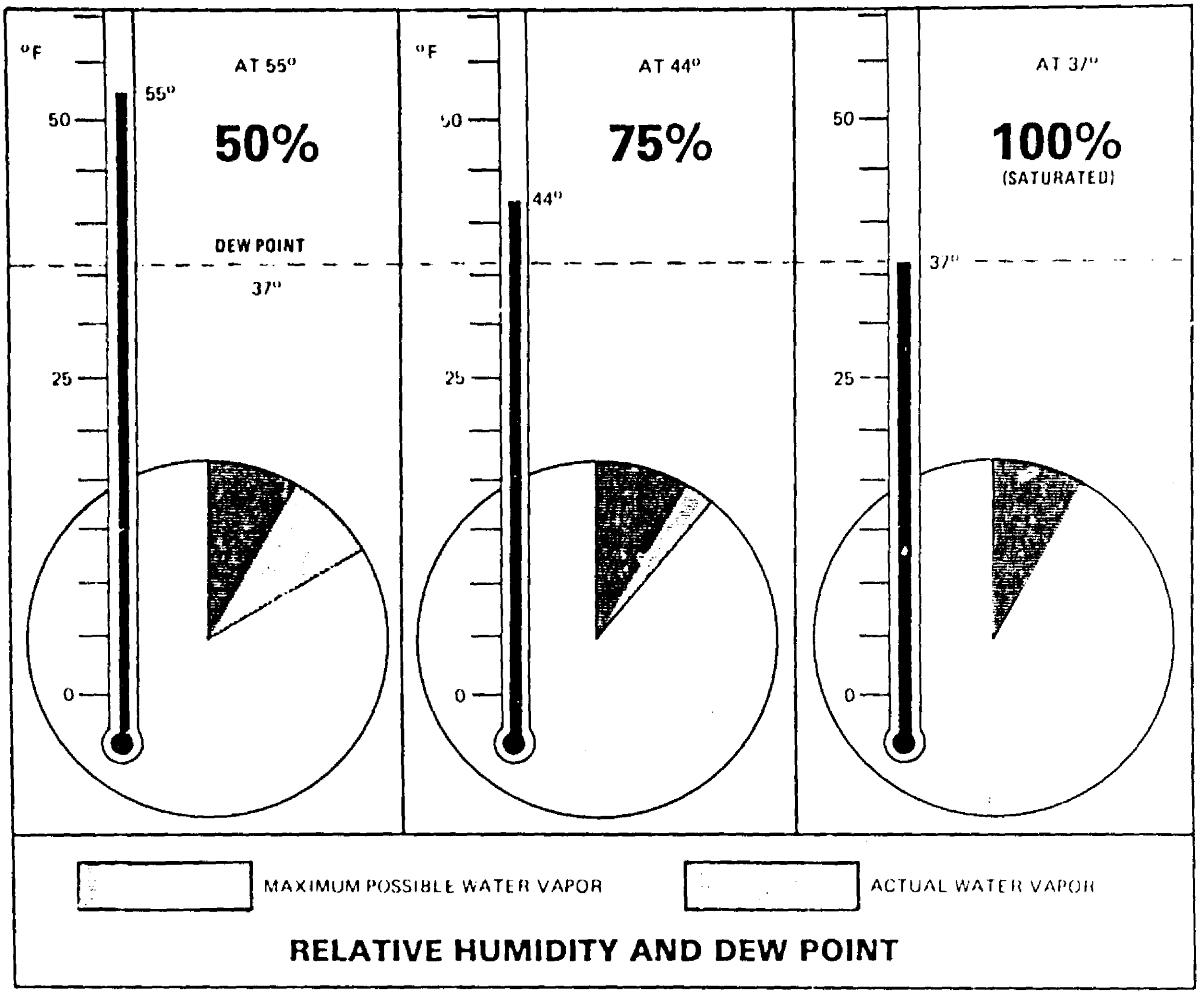


FIGURE 33. Relative humidity depends on both temperature and water vapor. In this figure, water vapor is constant but temperature varies. On the left, relative humidity is 50%; the warmer air could hold twice as much water vapor as is actually present. As the air cools, center and right, relative humidity increases. As the air cools to 37° F, its capacity to hold water vapor is reduced to the amount actually present. Relative humidity is 100% and the air is now "saturated." Note that at 100% humidity, temperature and dew point are the same. The air cooled to saturation, i.e., it cooled to the dew point.

Sometimes the spread at ground level may be quite large, yet at higher altitudes the air is saturated and clouds form. Some rain may reach the ground or it may evaporate as it falls into the drier air. Figure 34 is a photograph of "virga"—streamers of precipitation trailing beneath clouds but evaporating before reaching the ground. Our never ending weather cycle involves a continual reversible change of water from one state to another. Let's take a closer look at change of state.

CHANGE OF STATE

Evaporation, condensation, sublimation, freezing, and melting are changes of state. Evaporation is the changing of liquid water to invisible water vapor. Condensation is the reverse process. Sublimation is the changing of ice directly to water vapor, or water vapor to ice, bypassing the liquid

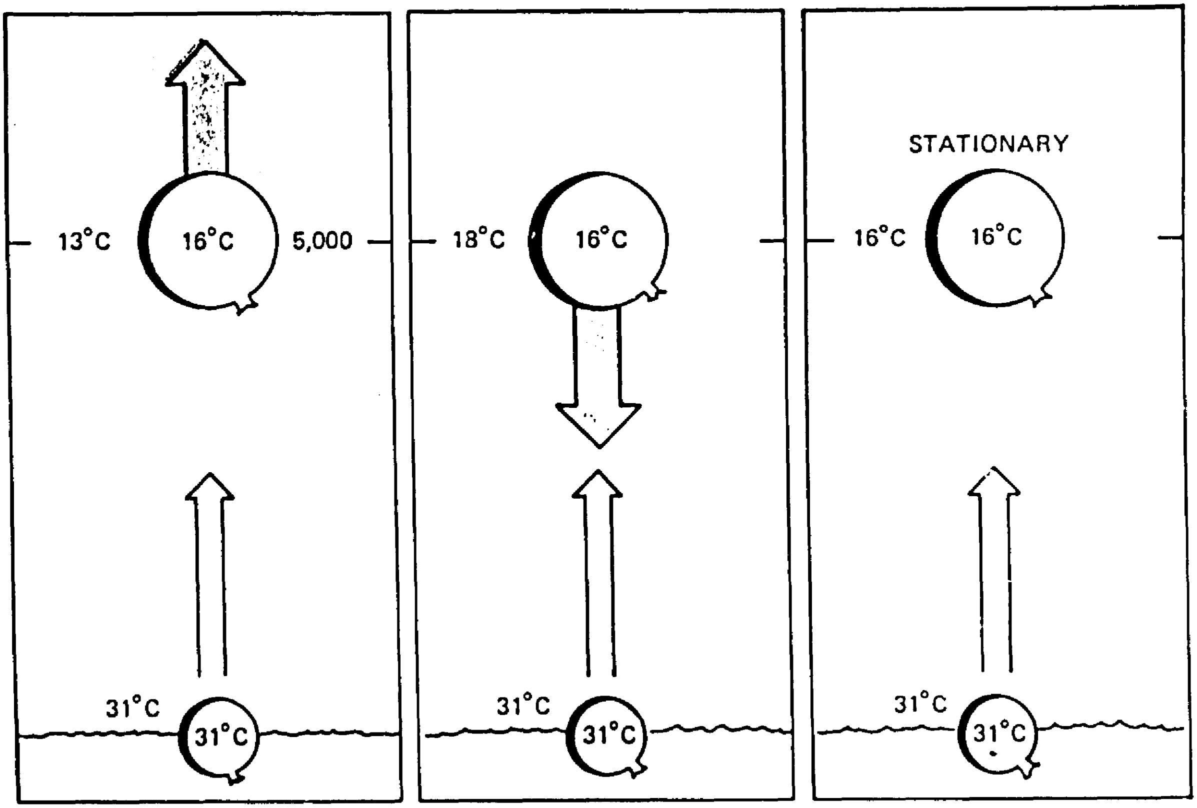


FIGURE 42. Stability related to temperatures aloft and adiabatic cooling. In each situation, the balloon is filled at sea level with air at 31° C, carried manually to 5,000 feet, and released. In each case, air in the balloon expands and cools to 16° C (at the dry adiabatic rate of 3° C per 1,000 feet). But, the temperature of the surrounding air aloft in each situation is different. The balloon on the left will rise. Even though it cooled adiabatically, the balloon remains warmer and lighter than the surrounding cold air; when released, it will continue upward spontaneously. The air is unstable; it favors vertical motion. In the center, the surrounding air is warmer. The cold balloon will sink. It resists our forced lifting and cannot rise spontaneously. The air is stable—it resists upward motion. On the right, surrounding air and the balloon are at the same temperature. The balloon remains at rest since no density difference exists to displace it vertically. The air is neutrally stable, i.e., it neither favors nor resists vertical motion. A mass of air in which the temperature decreases rapidly with height favors instability; but, air tends to be stable if the temperature changes little or not at all with altitude.

CLOUDS—STABLE OR UNSTABLE?

Chapter 5 states that when air is cooling and first becomes saturated, condensation or sublimation begins to form clouds. Chapter 7 explains cloud types and their significance as "signposts in the sky." Whether the air is stable or unstable within a layer largely determines cloud structure.

Stratiform Clouds

Since stable air resists convection, clouds in stable air form in horizontal, sheet-like layers or "strata." Thus, within a *stable* layer, clouds are *stratiform.* Adiabatic cooling may be by upslope flow as illustrated in figure 43; by lifting over cold, more dense air; or by converging winds. Cooling by an underlying cold surface is a stabilizing process and may produce fog. If clouds are to remain stratiform, the layer must remain stable after condensation occurs.

Cumuliform Clouds

Unstable air favors convection. A "cumulus" cloud, meaning "heap," forms in a convective updraft and builds upward, also shown in figure 43. Thus, within an *unstable* layer, clouds are *cumuliform;* and the vertical extent of the cloud depends on the depth of the unstable layer.

FIGURE 52. NIMBOSTRATUS. Nimbostratus is a gray or dark massive cloud layer, diffused by more or less continuous rain, snow, or ice pellets. This type is classified as a middle cloud although it may merge into very low stratus or stratocumulus. Very little turbulence, but can pose a serious icing problem if temperatures are near or below freezing.

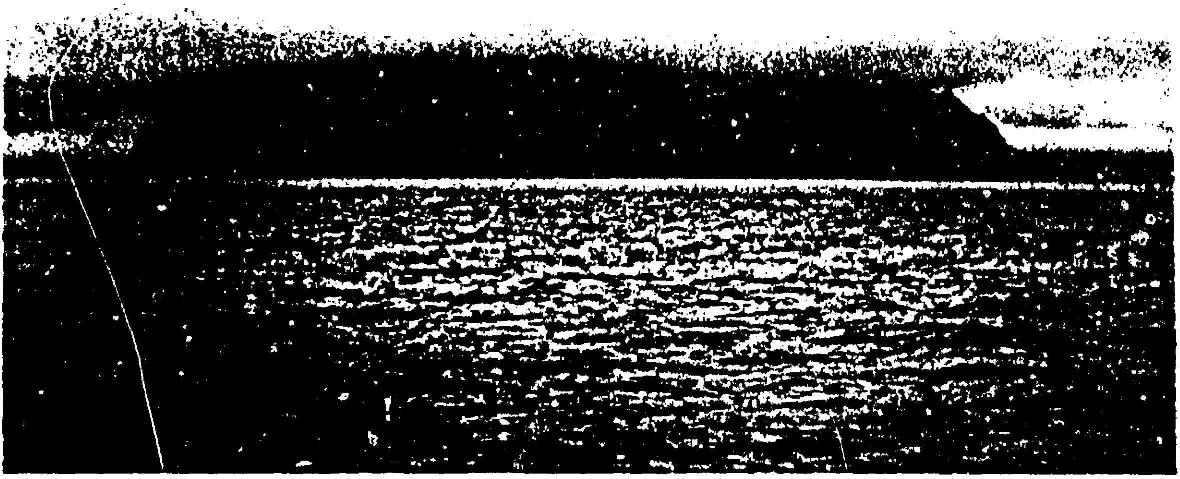


FIGURE 53. STRATUS. Stratus is a gray, uniform, sheet-like cloud with relatively low bases. When associated with fog or precipitation, the combination can become troublesome for visual flying. Little or no turbulence, but temperatures near or below freezing can create hazardous icing conditions.

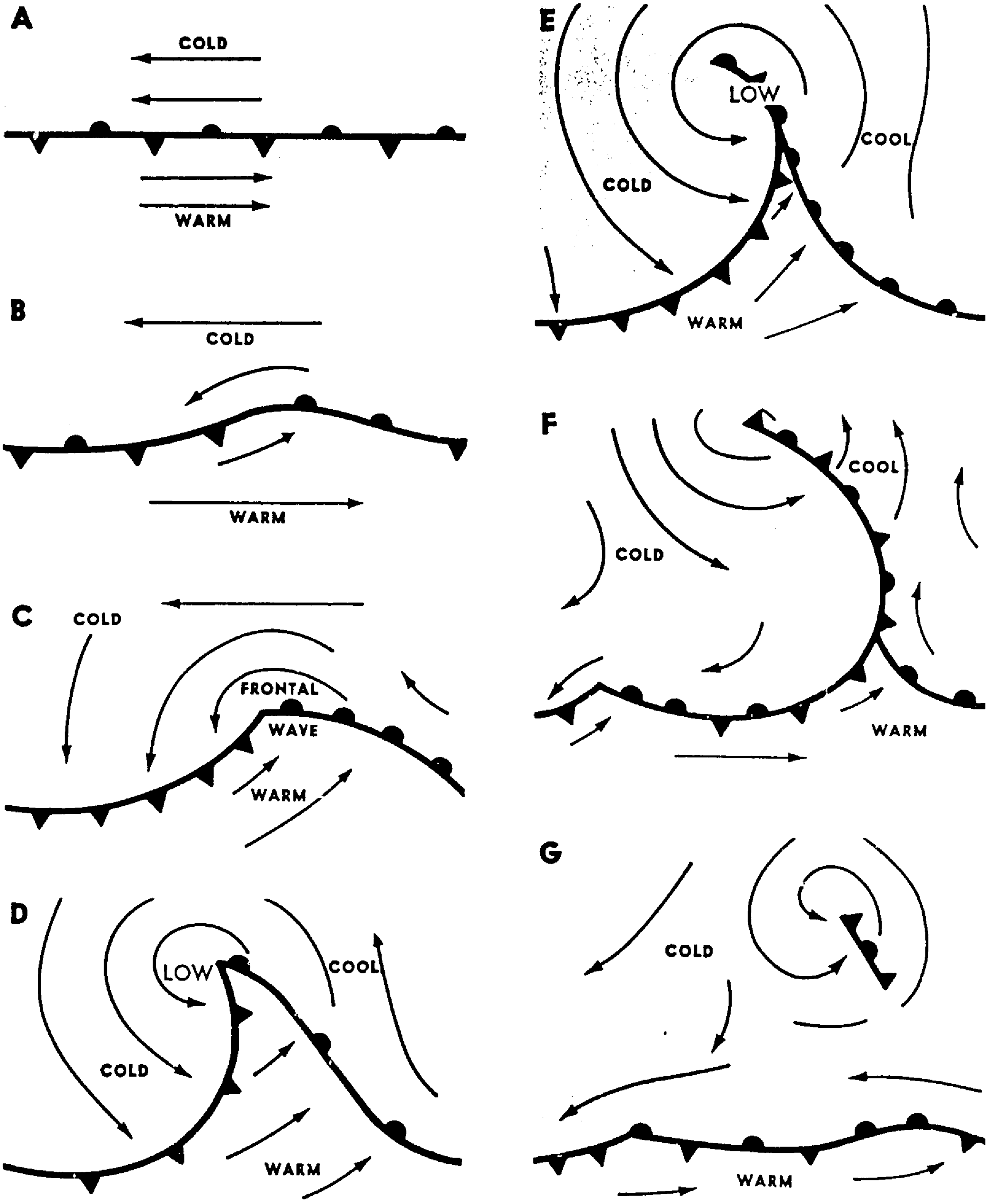
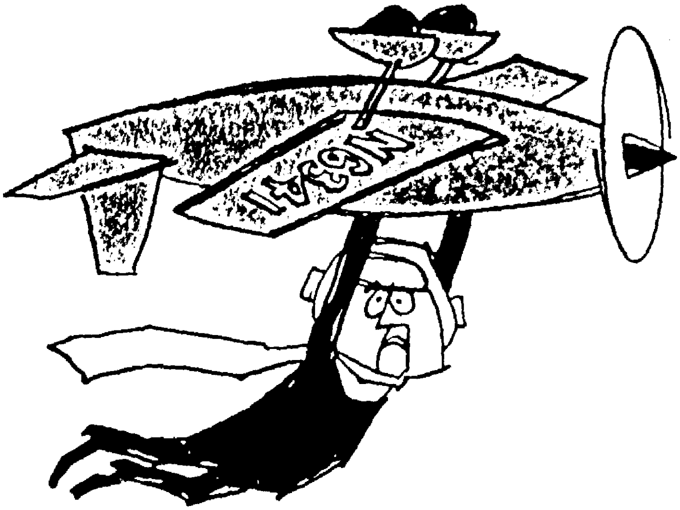


FIGURE 62. The life cycle of a frontal wave.



Chapter 9
TURBULENCE

Everyone who flies encounters turbulence at some time or other. A turbulent atmosphere is one in which air currents vary greatly over short distances. These currents range from rather mild eddies to strong currents of relatively large dimensions. As an aircraft moves through these currents, it undergoes changing accelerations which jostle it from its smooth flight path. This jostling is turbulence. Turbulence ranges from bumpiness which can annoy crew and passengers to severe jolts which can structurally damage the aircraft or injure its passengers.

Aircraft reaction to turbulence varies with the difference in windspeed in adjacent currents, size of the aircraft, wing loading, airspeed, and aircraft attitude. When an aircraft travels rapidly from one current to another, it undergoes abrupt changes in acceleration. Obviously, if the aircraft moved more slowly, the changes in acceleration would be more gradual. The first rule in flying turbulence is to reduce airspeed. Your aircraft manual most likely lists recommended airspeed for penetrating turbulence.

Knowing where to expect turbulence helps a

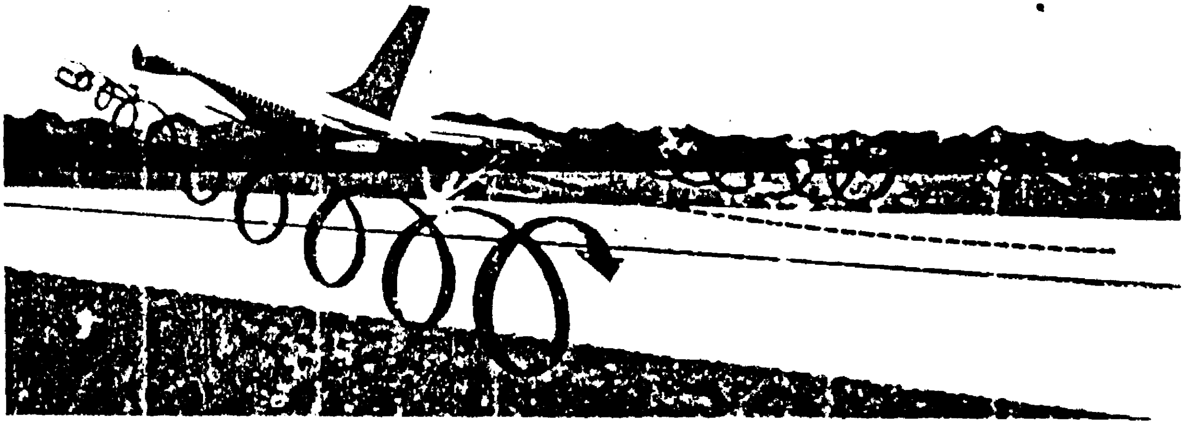


FIGURE 87. Wake turbulence wing tip vortices developing as aircraft breaks ground. These vortices develop when the aircraft is rotated into a flying attitude and the wings begin developing lift.

These vortices spread downward and outward from the flight path. They also drift with the wind. Strength of the vortices is proportional to the weight of the aircraft as well as other factors. Therefore wake turbulence is more intense behind large, transport category aircraft than behind small aircraft. Generally, it is a problem only when following the larger aircraft.

The turbulence persists several minutes and may linger after the aircraft is out of sight. At controlled airports, the controller generally warns pilots in the vicinity of possible wake turbulence. When left to your own resources, you could use a few pointers. Most jets when taking off lift the nose wheel about midpoint in the takeoff roll; therefore, vortices begin about the middle of the takeoff roll. Vortices behind propeller aircraft begin only a short distance behind lift-off. Following a landing of either type of aircraft, vortices end at about the point where the nose wheel touches down. Avoid flying through these vortices. More specifically, when using the same runway as a heavier aircraft:

(1) if landing behind another aircraft, keep your approach above his approach and keep your touchdown beyond the point where his nose wheel touched the runway (figure 88 (A));

(2) if landing behind a departing aircraft, land only if you can complete your landing roll before reaching the midpoint of his takeoff roll (figure 88 (B));

(3) if departing behind another departing aircraft, take off only if you can become airborne before reaching the midpoint of his takeoff roll and only if you can climb fast enough to stay above his flight path (figure 88 (C)); and

(4) if departing behind a landing aircraft, don't unless you can taxi onto the runway beyond the point at which his nose wheel touched down and have sufficient runway left for safe takeoff (figure 88 (D)).

If parallel runways are available and the heavier aircraft takes off with a crosswind on the downwind runway, you may safely use the upwind runway. Never land or take off downwind from the heavier aircraft. When using a runway crossing his runway, you may safely use the upwind portion of your runway. You may cross behind a departing aircraft behind the midpoint of his takeoff roll. You may cross ahead of a landing aircraft ahead of the point at which his nose wheel touches down. If none of these procedures is possible, wait 5 minutes or so for the vortices to dissipate or to blow off the runway.

The foregoing procedures are elementary. The problem of wake turbulence is more operational than meteorological. The FAA issues periodic ad-

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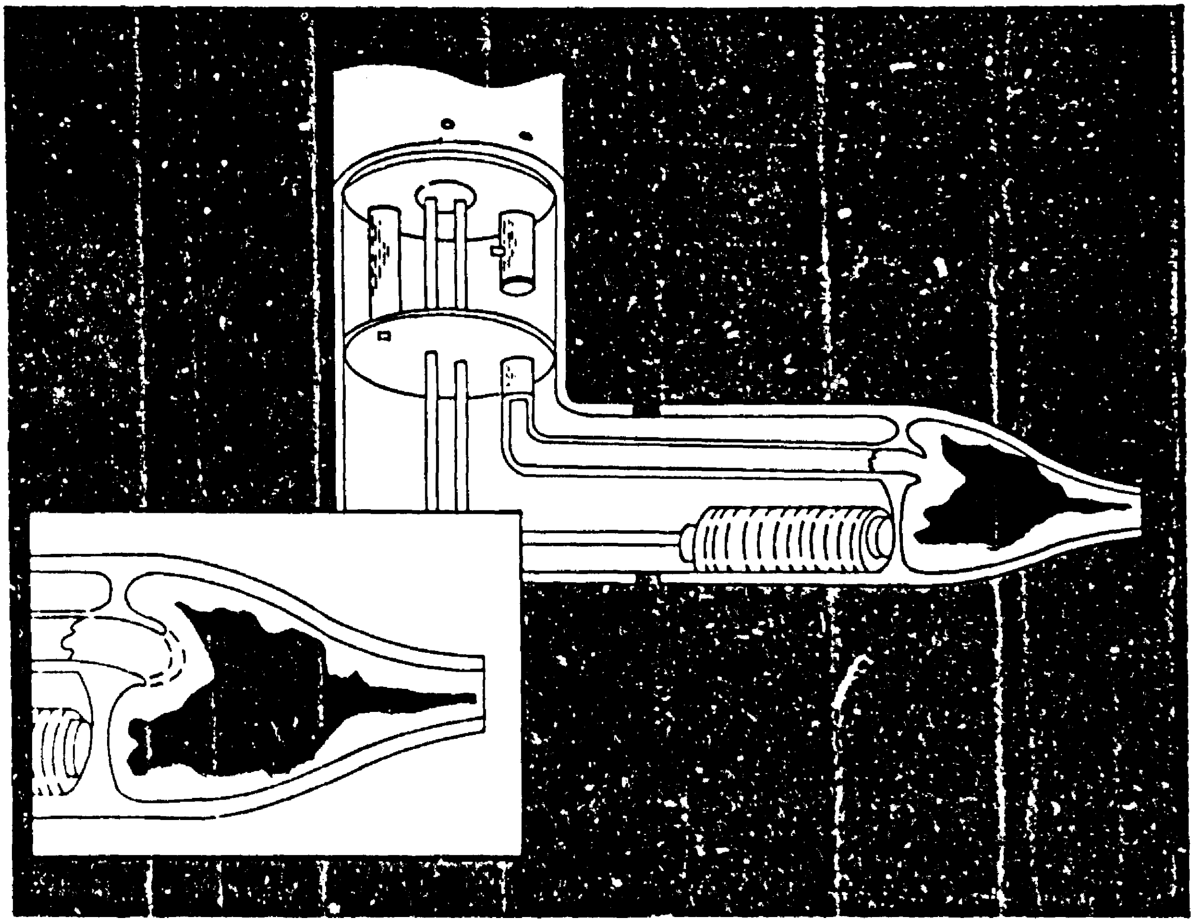

FIGURE 96. Internal pitot tube icing. It renders airspeed indicator unreliable.

ICING AND CLOUD TYPES

Basically, all clouds at subfreezing temperatures have icing potential. However, drop size, drop distribution, and aerodynamic effects of the aircraft influence ice formation. Ice may not form even though the potential exists.

The condition most favorable for very hazardous icing is the presence of many large, supercooled water drops. Conversely, an equal or lesser number of smaller droplets favors a slower rate of icing.

Small water droplets occur most often in fog and low-level clouds. Drizzle or very light rain is evidence of the presence of small drops in such clouds; but in many cases there is no precipitation at all. The most common type of icing found in lower-level stratus clouds is rime.

On the other hand, thick extensive stratified clouds that produce continuous rain such as altostratus and nimbostratus usually have an abundance of liquid water because of the relatively larger drop size and number. Such cloud systems in winter may cover thousands of square miles and present very serious icing conditions for protracted flights. Particularly in thick stratified clouds, concentrations of liquid water normally are greater with warmer temperatures. Thus, heaviest icing usually will be found at or slightly above the freezing level where temperature is never more than a few degrees below freezing. In layer type clouds, continuous icing conditions are rarely found to be more than 5,000 feet above the freezing level, and usually are two or three thousand feet thick.

The upward currents in cumuliform clouds are

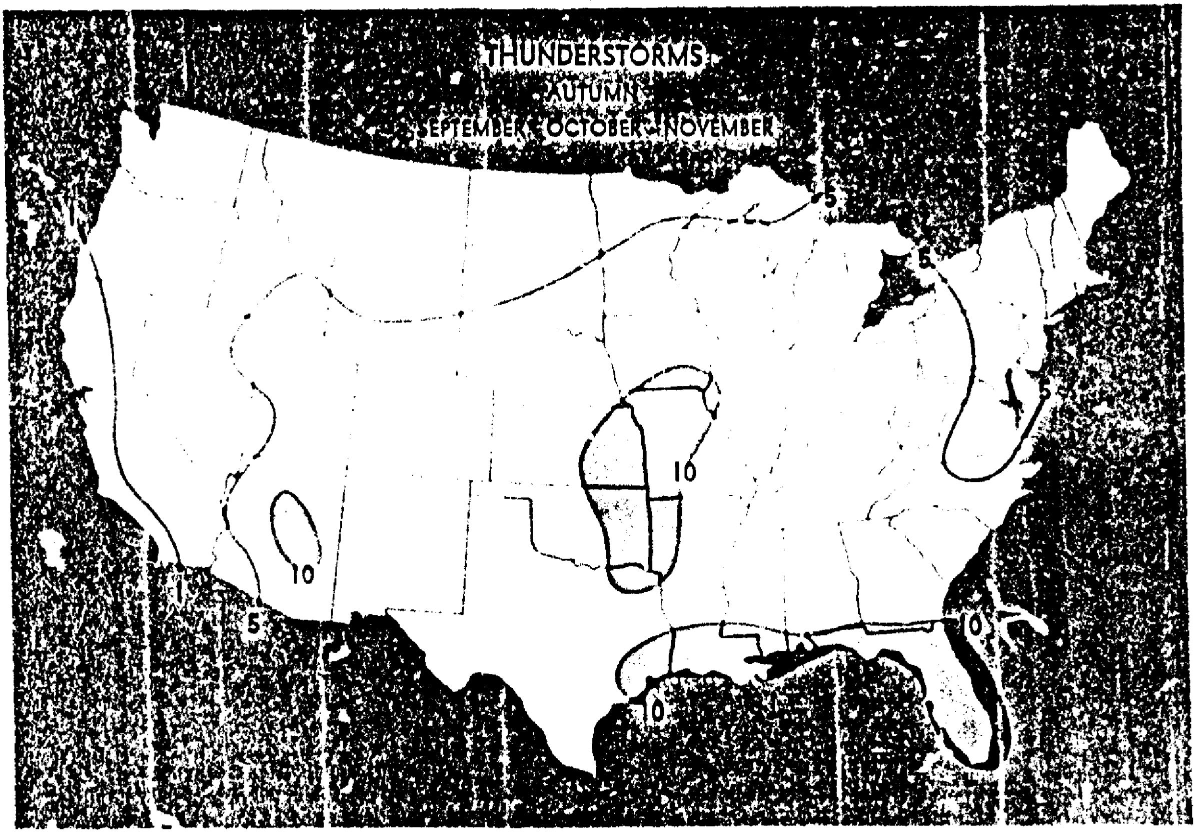

Figure 103. The average number of days with thunderstorms during fall.

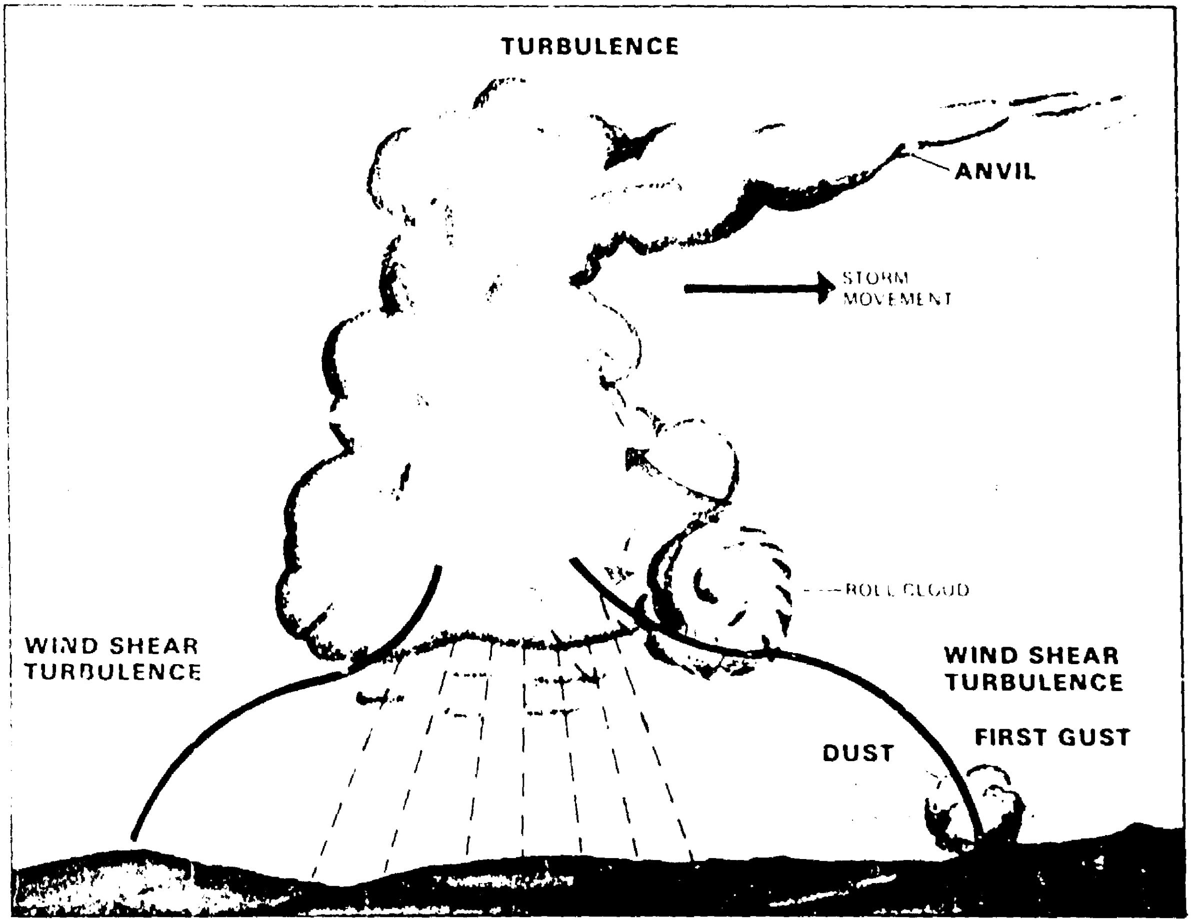

FIGURE 113. Schematic cross section of a thunderstorm. Note areas outside the main cloud where turbulence may be encountered.

may occur in any dry area where loose sand is exposed to strong wind.

Blowing snow can be troublesome. Visibility at ground level often will be near zero and the sky may become obscured when the particles are raised to great heights.

FIGURE 121. Aerial photograph of blowing dust approaching with a cold front. The dust cloud outlines the leading surface of the advancing cold air.

PRECIPITATION

Rain, drizzle, and snow are the forms of precipitation which most commonly present ceiling and/or visibility problems. Drizzle or snow restricts visibility to a greater degree than rain. Drizzle falls in stable air and, therefore, often accompanies fog, haze, or smoke, frequently resulting in extremely poor visibility. Visibility may be reduced to zero in heavy snow. Rain seldom reduces surface visibility below 1 mile except in brief, heavy showers, but rain does limit cockpit visibility. When rain streams over the aircraft windshield, freezes on it, or fogs over the inside surface, the pilot's visibility to the outside is greatly reduced.

OBSCURED OR PARTIALLY OBSCURED SKY

To be classified as obscuring phenomena, smoke, haze, fog, precipitation, or other visibility restricting phenomena must extend upward from the surface. When the sky is totally hidden by the surface based phenomena, the ceiling is the vertical visibility from the ground upward into the obscuration. If clouds or part of the sky can be seen above the obscuring phenomena, the condition is defined as a partial obscuration; a partial obscuration does not define a ceiling. However, a cloud layer above a partial obscuration may constitute a ceiling.

An obscured ceiling differs from a cloud ceiling. With a cloud ceiling you normally can see the ground and runway once you descend below the cloud base. However, with an obscured ceiling, the obscuring phenomena restricts visibility between your altitude and the ground, and you have restricted slant visibility. Thus, you cannot always clearly see the runway or approach lights even after penetrating the level of the obscuration ceiling as shown in figure 122.

Partial obscurations also present a visibility problem for the pilot approaching to land but usually to a lesser degree than the total obscuration. However, be especially aware of erratic visibility reduction in the partial obscuration. Visibility along the runway or on the approach can instantaneously become zero. This abrupt and unexpected reduction in visibility can be extremely hazardous especially on touchdown.

IN CLOSING

In your preflight preparation, be aware of or alert for phenomena that may produce IFR or marginal VFR flight conditions. Current charts and special analyses along with forecast and prognostic charts are your best sources of information. You may get your preflight weather from a briefer; or, you may rely on recorded briefings; and you always have your own inflight observations. No weather observation is more current or more accurate than the one you make through your cockpit

FIGURE 128b. Infrared photograph of the system shown in figure 128a. The warmer the radiating surface, the darker the shade; the cold cirrus appears nearly white. Infrared clearly distinguishes the banded jet stream cirrus from other cirrus and lower clouds.

snow over ice caps and oceanic areas and mostly as summer rain over interior areas.

WIND

Strong winds occur more often along the coasts than elsewhere. The frequency of high winds in coastal areas is greatest in fall and winter. Wind speeds are generally light in the continental interior during the entire year, but are normally at their strongest during summer and fall.

AIR MASSES—WINTER

In winter, air masses form over the expanded ice pack and adjoining snow-covered land areas. These air masses are characterized by very cold surface air, very low humidity, and strong low-level temperature inversions. Occasionally, air from unfrozen ocean areas flows northward over the Arctic. These intrusions of moist, cold air account for most of the infrequent wintertime cloudiness and precipitation in the Arctic.

AIR MASSES—SUMMER

During the summer, the top layer of the Arctic permafrost layer melts leaving very moist ground, and the open water areas of the Polar Basin increase markedly. Thus, the entire area becomes more humid, relatively mild, and semimaritime in character. The largest amount of cloudiness and precipitation occurs inland during the summer months.

FRONTS

Occluded fronts are the rule. Weather conditions with occluded fronts are much the same in the Arctic as elsewhere—low clouds, precipitation, poor visibility, and sudden fog formation. Fronts are much more frequent over coastal areas than over the interior.

ARCTIC PECULIARITIES

Several Arctic phenomena are peculiar to that region. At times, they have a direct bearing on Arctic flying.

EFFECTS OF TEMPERATURE INVERSION

The intense low-level inversion over the Arctic during much of the winter causes sound—including people's voices—to carry over extremely long distances. Light rays are bent as they pass at low angles through the inversion. This bending creates an effect known as looming—a form of mirage that causes objects beyond the horizon to appear above the horizon. Mirages distorting the shape of the sun, moon, and other objects are common with these low level inversions.

AURORA BOREALIS

In theory, certain energy particles from the sun strike the Earth's magnetic field and are carried along the lines of force where they tend to lower and converge near the geomagnetic poles. The energy particles then pass through rarefied gases of the outer atmosphere, illuminating them in much the same way as an electrical charge illuminates neon gas in neon signs.

The Aurora Borealis takes place at high altitudes above the Earth's surface and thus has been observed as far south as Florida. However, the highest frequency of observations is over the northern United States and northward. Displays of aurora vary from a faint glow to an illumination of the Earth's surface equal to a full moon. They frequently change shape and form and are also called dancing lights or northern lights.

LIGHT REFLECTION BY SNOW-COVERED SURFACES

Much more light is reflected by snow-covered surfaces than by darker surfaces. Snow often reflects Arctic sunlight sufficiently to blot out shadows, thus markedly decreasing the contrast between objects. Dark distant mountains may be easily recognized, but a crevasse normally directly in view may be undetected due to lack of contrasts.

LIGHT FROM CELESTIAL BODIES

Illumination from the moon and stars is much more intense in the Arctic than in lower latitudes. Pilots have found that light from a half-moon over a snow-covered field may be sufficient for landing. Even illumination from the stars creates visibility far beyond that found elsewhere. Only under heavy overcast skies does the night darkness in the Arctic begin to approach the degree of darkness in lower latitudes.

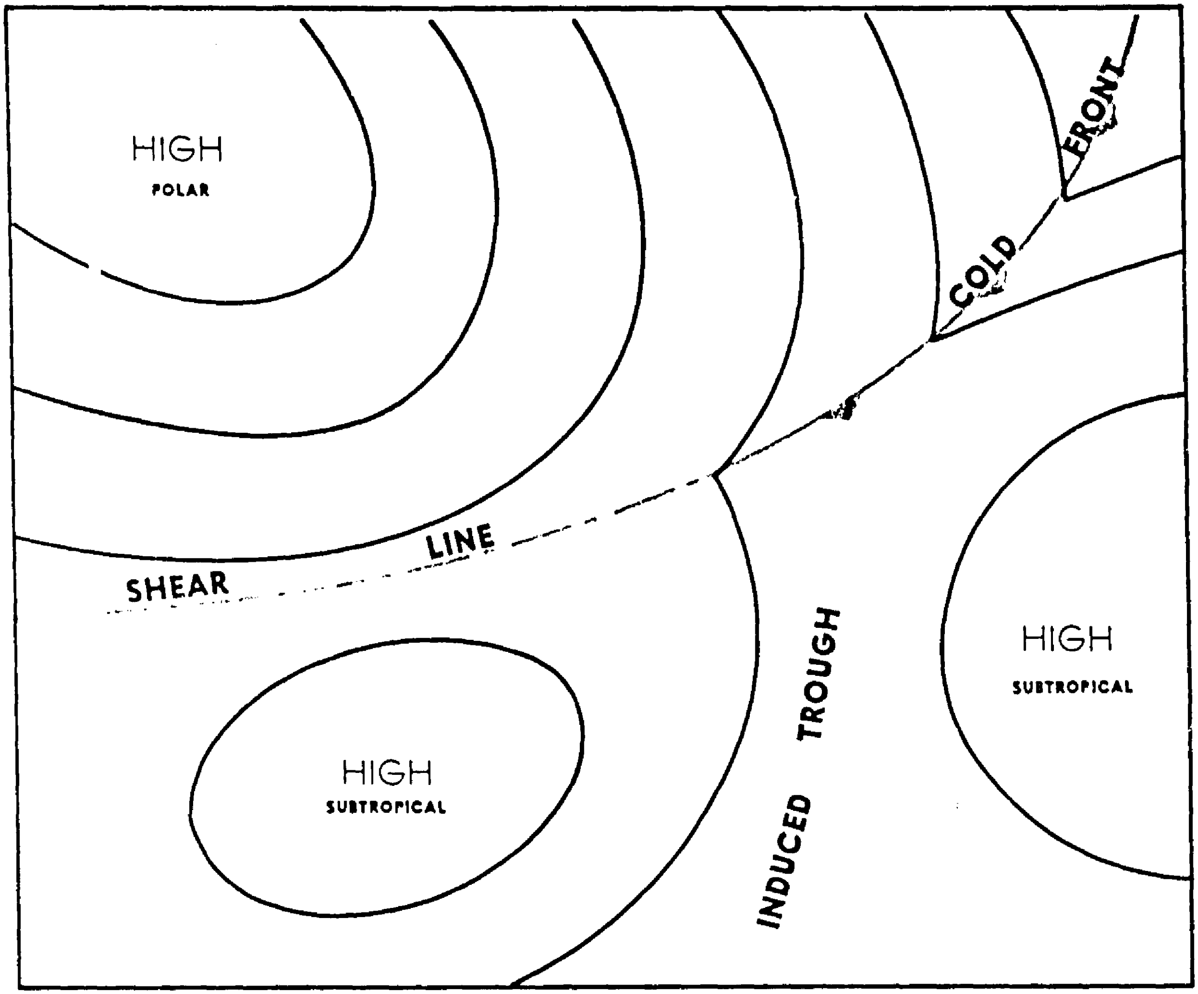

Figure 140. A shear line and an induced trough caused by a polar high pushing into the subtropics.

and sometimes dense cirrus and some convective and clear air turbulence often develop.

Troughs and lows aloft produce considerable amounts of rainfall in the Tropics, especially over land areas where mountains and surface heating lift air to saturation. Low pressure systems aloft contribute significantly to the record 460 inches average annual rainfall on Mt. Waialeale on Kauai, Hawaii. Other mountainous areas of the Tropics are also among the wettest spots on earth.

TROPICAL WAVE

Tropical waves (also called easterly waves) are common tropical weather disturbances, normally occurring in the trade wind belt. In the Northern Hemisphere, they usually develop in the southeastern perimeter of the subtropical high pressure systems. They travel from east to west around the southern fringes of these highs in the prevailing easterly circulation of the Tropics. Surface winds in advance of a wave are somewhat more northerly than the usual trade wind direction. As the wave approaches, as shown in figure 142, pressure falls; as it passes, surface wind shifts to the east-southeast or southeast. The typical wave is preceded by very good weather but followed by extensive cloudiness, as shown in figure 143, and often by rain and thunderstorms. The weather activity is roughly in a north-south line.

Tropical waves occur in all seasons, but are more frequent and stronger during summer and early fall. Pacific waves frequently affect Hawaii; Atlan-

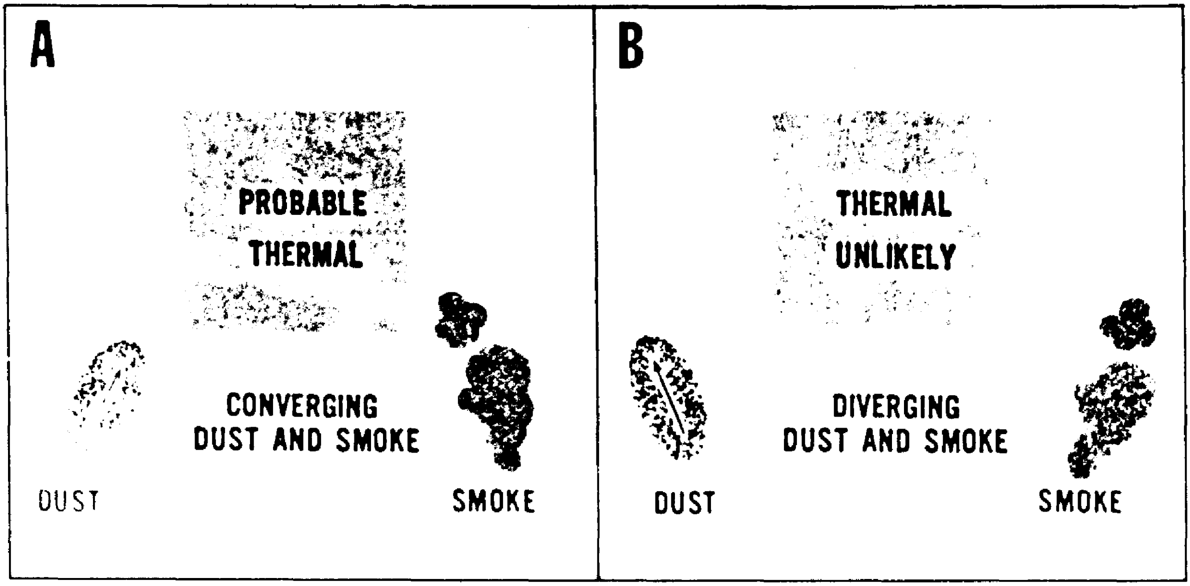

Figure 148. Using surface dust and smoke movement as indications of a thermal. When you have sighted an area which you think will heat rapidly (the red area), look for dust or smoke movement at the surface as an indicator of surface wind. Converging dust or smoke streamers (left) enhance the probability of a thermal. Diverging streamers reduce the likelihood of a thermal.

tering a dust devil: "... at around 500 feet; the pilot turns towards the dust devil and cuts his speed as he approaches it to the minimum consistent with the control of the glider. As he nears the whirling column of sand he makes a circle on the outside of the dust devil against the direction of rotation, care being taken to give it a wider berth on the downwind side. In light of the variometer reading on the initial circle, closer contact is made with the column or a hasty retreat is beat to a safer orbit."

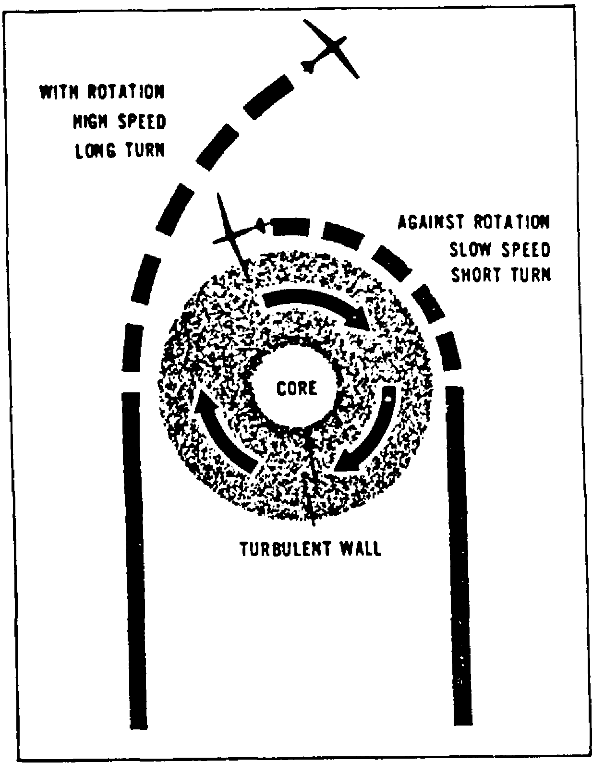

Figure 149. Horizontal cross section of a dust devil rotating clockwise. If the aircraft approaches the dust devil with the direction of rotation as on the left, increasing tailwind reduces airspeed and may result in loss of altitude or even a stall. When the pilot regains equilibrium, his circling speed is the sum of his airspeed and the tangential speed of the vortex; his radius of turn may be too great to remain in the thermal. When approaching against the rotation, the aircraft gains airspeed; circling speed is slowed as the tangential speed of the vortex is subtracted from airspeed. The pilot has much more freedom and latitude for maneuvering. At the center is a core providing little or no lift. Immediately surrounding the core is a turbulent wall.

pseudo-adiabatic chart. If you become familiar with this chart, you can better grasp the meanings of some of these forecast parameters; and you may try a little forecasting on your own.

The Pseudo-Adiabatic Chart

The pseudo-adiabatic chart is used to graphically compute adiabatic changes in vertically moving air and to determine stability. It has five sets of lines shown in figure 160. These lines are:

1. Pressure in millibars (horizontal lines),
2. Temperature in degrees Celsius (vertical lines),
3. Dry adiabats (sloping black lines),
4. Lines of constant water vapor or mixing ratio* (solid red lines), and
5. Moist adiabats (dashed red lines).

The chart also has an altitude scale in thousands of feet along the right margin and a Fahrenheit temperature scale across the bottom.

You might like to get one of these charts from a National Weather Service Office. The chart used in actual practice has a much finer grid than the one shown in figure 160. You can cover the chart with acetate and check examples given here along with others you can develop yourself. This procedure can greatly enhance your feel for processes occurring in a vertically moving atmosphere.

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*Ratio of water vapor to dry air.

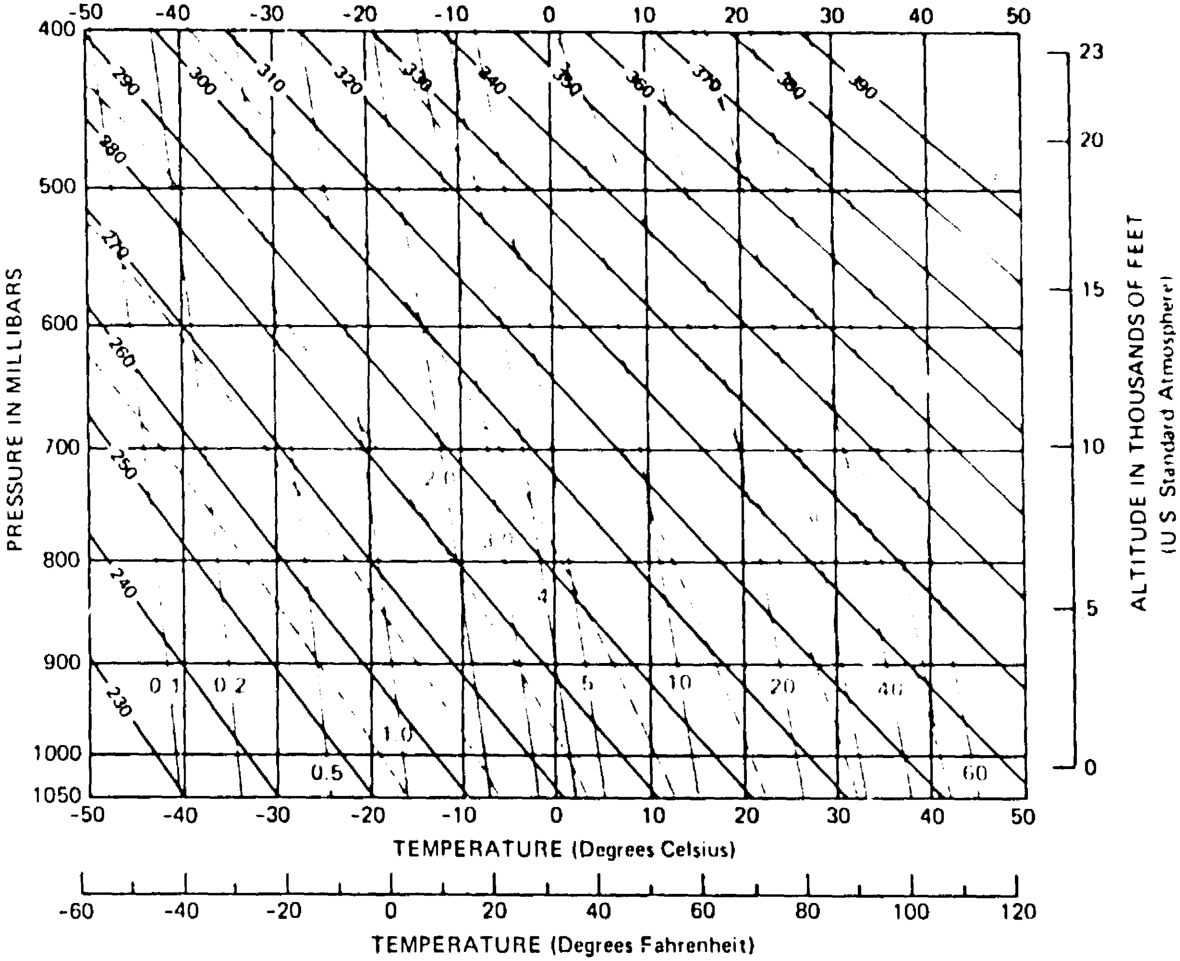

FIGURE 160. The Pseudo-Adiabatic Chart. Horizontal lines are pressure; vertical lines, temperature; sloping lines, dry adiabats graphing the rate of dry adiabatic cooling. Solid red lines are constant mixing ratio, and dashed red lines are moist adiabats graphing the saturated rate of cooling. Since red lines apply only to moist adiabatic changes, they are omitted from subsequent examples.

that moves inland over the Los Angeles coastal plain are two important zones of convergence, shown in figure 166. Sea breezes of different origin meet in the convergence zones producing vertical currents capable of supporting sailplanes. One convergence line is the "San Fernando Convergence Zone;" a larger scale zone is in the Elsinore area, also shown in figure 166. This convergence zone apparently generates strong vertical currents since soaring pilots fly back and forth across the valley along the line separating smoky air to the north from relatively clear air to the south. Altitudes reached depend upon the stability, but usually fall within the 6,000 feet to 12,000 feet ASL range for the usual dry thermal type lift. Seaward, little or no lift is experienced in the sea breeze air marked by poor visibility.

Cape Cod Peninsula

Figure 167 shows converging air between sea breezes flowing inland from opposite coasts of the Cape Cod Peninsula. Later in the development of the converging sea breezes, the onset of convection is indicated by cumulus over the peninsula. Sailplane pilots flying over this area as well as over Long Island, New York, have found good lift in the convergence lines caused by sea breezes blowing inland from both coasts of the narrow land strips.

Great Lakes Area

Sea breeze fronts have been observed along the shore lines of the Great Lakes. Weather satellites have also photographed this sea breeze effect on the western shore of Lake Michigan. It is quite likely that conditions favorable for soaring occur at times.

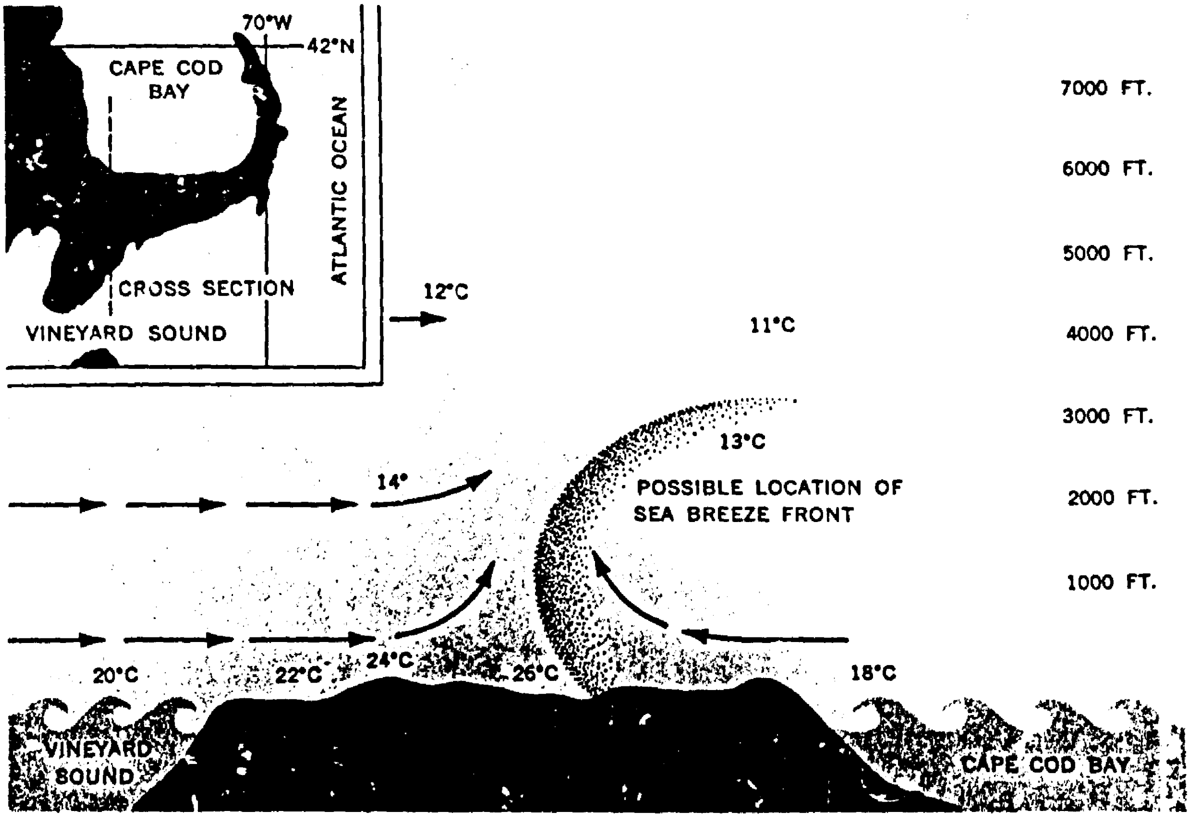

FIGURE 167. Sea breeze convergence zone, Cape Cod, Massachusetts. Sea breezes from opposite coasts converge over the cape.

continental polar air—*See* polar air.

continental tropical air—*See* tropical air.

contour—In meteorology, (1) a line of equal height on a constant pressure chart; analogous to contours on a relief map; (2) in radar meteorology, a line on a radar scope of equal *echo* intensity.

contouring circuit—On weather radar, a circuit which displays multiple contours of *echo* intensity simultaneously on the *plan position indicator* or *range-height indicator* scope. *See* contour (2).

contrail—Contraction for *condensation trail.*

convection—(1) In general, mass motions within a fluid resulting in transport and mixing of the properties of that fluid. (2) In meteorology, atmospheric motions that are predominantly vertical, resulting in vertical transport and mixing of atmospheric properties; distinguished from *advection.*

convective cloud—*See* cumuliform.

convective condensation level (abbreviated CCL)—The lowest level at which condensation will occur as a result of *convection* due to surface heating. When condensation occurs at this level, the layer between the surface and the CCL will be thoroughly mixed, temperature *lapse rate* will be dry adiabatic, and *mixing ratio* will be constant.

convective instability—The state of an unsaturated layer of air whose *lapse rates* of temperature and moisture are such that when lifted adiabatically until the layer becomes saturated, convection is spontaneous.

convergence—The condition that exists when the distribution of winds within a given area is such that there is a net horizontal inflow of air into the area. In convergence at lower levels, the removal of the resulting excess is accomplished by an upward movement of air; consequently, areas of low-level convergent winds are regions favorable to the occurrence of clouds and precipitation. Compare with *divergence.*

Coriolis force—A deflective force resulting from earth's rotation; it acts to the right of wind direction in the Northern Hemisphere and to the left in the Southern Hemisphere.

corona—A prismatically colored circle or arcs of a circle with the sun or moon at its center; coloration is from blue inside to red outside (opposite that of a *halo*); varies in size (much smaller) as opposed to the fixed diameter of the halo; characteristic of clouds composed of water droplets and valuable in differentiating between middle and cirriform clouds.

corposant—*See* St. Elmo's Fire.

corrected altitude (approximation of true altitude)—*See* altitude.

cumuliform—A term descriptive of all convective clouds exhibiting vertical development in contrast to the horizontally extended *stratiform* types.

cumulonimbus—A cumuliform cloud type; it is heavy and dense, with considerable vertical extent in the form of massive towers; often with tops in the shape of an *anvil* or massive plume; under the base of cumulonimbus, which often is very dark, there frequently exists *virga*, precipitation and low ragged clouds (*scud*), either merged with it or not; frequently accompanied by lightning, thunder, and sometimes hail; occasionally produces a tornado or a waterspout; the ultimate manifestation of the growth of a cumulus cloud, occasionally extending well into the stratosphere.

cumulonimbus mamma—A *cumulonimbus* cloud having hanging protuberances, like pouches, festoons, or udders, on the under side of the cloud; usually indicative of severe turbulence.

cumulus—A cloud in the form of individual detached domes or towers which are usually dense and well defined; develops vertically in the form of rising mounds of which the bulging upper part often resembles a cauliflower; the sunlit parts of these clouds are mostly brilliant white; their bases are relatively dark and nearly horizontal.

cumulus fractus—*See* fractus.

cyclogenesis—Any development or strengthening of cyclonic circulation in the atmosphere.

cyclone—(1) An area of low atmospheric pressure which has a closed circulation that is cyclonic, i.e., as viewed from above, the circulation is counterclockwise in the Northern Hemisphere, clockwise in the Southern Hemisphere, undefined at the Equator. Because cyclonic circulation and relatively low atmospheric pressure usually coexist, in common practice the terms cyclone and low are used interchangeably. Also, because cyclones often are accompanied by inclement (sometimes destructive) weather, they are frequently referred to simply as storms. (2) Frequently misused to denote a *tornado.* (3) In the Indian Ocean, a *tropical cyclone* of hurricane or typhoon force.

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deepening—A decrease in the central pressure of a pressure system; usually applied to a *low* rather than to a *high*, although technically, it is acceptable in either sense.

density—(1) The ratio of the mass of any substance to the volume it occupies—weight per unit volume. (2) The ratio of any quantity to the volume or area it occupies, i.e., population per unit area, *power density*.

density altitude—*See* altitude.

depression—In meteorology, an area of low pressure; a *low* or *trough.* This is usually applied to a certain stage in the development of a *tropical cyclone*, to migratory lows and troughs, and to upper-level lows and troughs that are only weakly developed.

dew—Water condensed onto grass and other objects near the ground, the temperatures of which have fallen below the initial dew point temperature of the surface air, but is still above freezing. Compare with *frost.*

dew point (or dew-point temperature)—The temperature to which a sample of air must be cooled, while the


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