humidity. Diurnal ranges in temperature of 45° to 50° have been noted in the forested areas of the north when favorable pressure distribution prevails.

As a rule, more forest fires occur in the spring than during any other season of the year, due to the fact that there is then a plentiful supply of dead vegetation on the ground; the days are long, allowing much sunshine; the deciduous trees are leafless or nearly so, allowing the sunshine to strike the forest fuels and dry them out quickly; the relative humidity is at its lowest; and finally, there is usually plenty of wind movement to help dry out the fuels and fan the flames, once a fire is started. However, the year of 1930 proved an exception to the rule in this respect. The long, hot drouth in August and September caused an unusually severe summer fire season that was much more severe than the preceding spring fire season. Michigan and Wisconsin experienced this year one of the worst summer fire seasons, if not the worst, in the history of their respective forest services. The fall fire season is short, as a rule, due to the fact that the days are short and the nights are cold. The relative humidity may be low during the middle of the day in autumn, but only for a few hours, and it is nearly always high then at night, which, with the low night temperatures, is sufficient to either extinguish most ordinary fires, or to check them to such an extent that they may be easily extinguished. The forest rangers say that a cold night is worth the services of 100 or more men in putting out a big fire. While the fall fire season is short and usually less severe than the spring season, it is a singular fact that most of the great conflagrations of the north have occurred in autumn. However, these great fires have always followed drouthy summers.

Fire protection in the Lake States is a problem that has to do largely with care exercised by man; therefore, to a large degree, it is an educational problem. Ninety-nine per cent of all forest fires that occur in the Lake States are man-caused, either directly or indirectly. The other one per cent is caused by lightning. There are areas in the Western States where 35 to 50 per cent of the fires are caused by lightning, thereby creating a very difficult problem; but the number of lightning fires in the Lake States is so small that lightning is given no consideration in the forecasts. The number of fires that occur in the Lake States annually is very large, but of course varies considerably from year to year, depending on the weather. During 1929 about 6,500 fires occurred in these States, burning over about 450,000 acres. This year's totals are not yet available, but it appears that there were probably as many as 7,500 fires that burned over more than a half million acres. Such is the heavy toll exacted by fire, man's greatest friend, it has been said, but perhaps at the same time his greatest enemy.

AIRPLANE LANDINGS IN GUSTY SURFACE WINDS

By PAUL A. MILLER

[Weather Bureau Airport Station, Bolling Field, D. C.]

When surface winds are moving at velocities over 25 miles per hour considerable difficulty is often encountered in landing an airplane. During such times the air currents moving along the surface are considerably retarded by friction, while a few feet above the surface the flow is unhindered. This results in a turbulent condition near the surface, which makes a treacherous landing support for an airfoil passing through it, especially if the wind is gusty.

An airplane landing in still air is glided down within about 2 feet of the ground, where it is leveled off. Flying along level with the motor cut off, it soon loses speed and support. However, it is kept from falling by gradually raising the nose, which presents the airfoil surfaces, at a larger and larger angle to the air, with consequent very gradually decreasing support, but rapidly lessening speed. Presently the speed is so low that the airfoils, no matter what their angle, can no longer fully support the plane, and it settles slowly to the ground in a 3-point landing, i. e., the wheels and the tailskid touch at the same instant. During this time, since the air is still, it has not been necessary to correct for the lateral or longitudinal position of the plane.

How different the case where a strong, gusty surface wind is present. Long experience then becomes necessary to make a good landing, for the plane is buffeted, raised, or dropped unceasingly, and the pilot must have the delicate touch and feel to anticipate and overcome the hazards before they place the plane in a perilous position. If the plane is kept in the proper position to make a landing in still air, the landing will be extremely hazardous. For, if the plane is glided down at normal speed, it will encounter gusts and vertical currents which will raise it, drop it, or throw it over on one wing. Also when leveling off to land, the pilot does not dare to lose much flying speed, for he must have positive control to overcome gusts, and this can be maintained only with an excess of flying speed. For instance, an ordinary mail plane, well loaded, usually lands with an air speed of about 55 miles per hour. Now, if a 30-mile wind is blowing, the plane will land with a ground speed of about 25 miles per hour. Let us assume that the pilot intends to land in the manner used in still air and that he is leveled off and just ready to touch the surface. A sudden gust raises the wind velocity temporarily to 40 miles per hour, giving the plane an actual air speed of 65 miles per hour, and at the large angle the airfoils now present, the plane will suddenly be lifted to a height of 10 or 15 feet. The gust passes, leaving the plane stalled, as the gust has also taken a part of the plane's forward speed. Now, if the pilot has not quickly speeded up the engine and put the nose down in order to gain air speed the plane will actually fall to the ground, with considerable damage to it and a bad shaking up or worse for the pilot. Complicate this situation during landing with the fact that there may be rather violent vertical currents present, which will throw the plane over on one wing or raise or drop it suddenly, and it will readily be seen that under conditions of gusty winds a landing can not be made in the normal manner with any degree of assurance.

Under such conditions, most pilots of experience bring the plane in with an excess of flying speed, probably 10 or 15 miles per hour over the normal speed. Then if the plane is thrown into an abnormal position, the controls have a quick action and the plane can be righted quickly. However, with this excess of flying speed, the plane will not settle to the ground, but must actually be flown down until the wheels touch the surface, it being understood, of course, that the excess speed is gained by nosing down at a steeper angle than normally rather than by the use of the engine. When the wheels touch, the tail is kept up in flying position, which causes the airfoils to present a small

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angle of attack to sudden gusts. The plane is kept in the position until considerable speed is lost and the tail drops of its own accord due to lack of support. The weight of the plane and its lower speed then make it practically independent of further gusts.

It can be seen from the foregoing that a knowledge of the prevalence of gusty winds at landing areas is of vital necessity if safe landings are to be made. From a meteorological viewpoint, the occurrence of winds that will cause dangerous landing conditions can be forecast with considerable accuracy. While this is being done more and more as time goes on, there is still room for considerable improvement in the knowledge of local areas where landings are dangerous in gusty weather. Surveys of various terminal airports to determine the areas of maximum turbulence in various winds are becoming a necessity with the increase of passenger flying now occurring. A survey of this kind would give the meteorologist the knowledge necessary to advise the pilot in the air of the gusty condition prevalent and the best landing area on the airport. This advice would be especially helpful at night when landing passenger planes, and would constitute another safety factor to aviation in general.

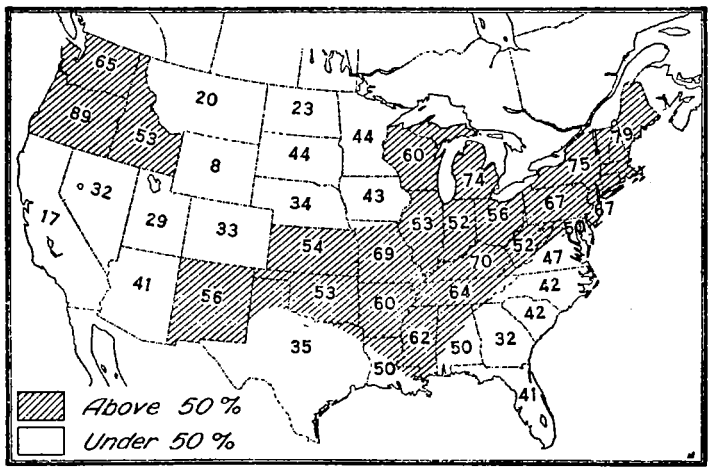
As an illustration of the value of being forewarned of the prevalence of such conditions, the following instance is cited. During January, 1929, a large area of low pressure passed over the middle Western States followed by a rather intense northwestern high. This pressure distribution caused extremely high, gusty surface winds along the Kansas City-Chicago Airway. Winds aloft were also extremely strong, reaching velocities of over 70 miles per hour. A mail pilot took off at Kansas City for the afternoon trip to Chicago, carrying one passenger. The pilot found when he was aloft that it was necessary to crab the plane into the northwest wind at an angle of over 45° in order to remain on the course. The air was so rough that at times they would drop 300 feet and then be driven upward the same amount, both actions being so violent that the wings vibrated alarmingly. The landing lights in the wings were shaken loose and hung in the air stream, banging against the wing with such force as to threaten to tear the tips off. After a 4-hour fight they arrived over Moline Airport, where red landing flares had been put out to advise them that a landing was dangerous. However, the ship was almost out of fuel and a landing had to be made. Wind velocties, as shown by the airport anemometer, were regularly over 40 miles per hour and during gusts reached as high as 58 miles per hour. Through the forethought of the field manager, an ambulance and fire truck had been summoned to take care of any contingencies that might arise in attempting to make a landing. The pilot circled the field and came into the wind, where he found that it was necessay to keep the engine almost wide open to make progress against it. He nosed the ship down and gradually lost altitude. When nearing the fence a sudden gust struck the ship, forcing one wing down until it was almost vertical, but it had sufficient air speed to overcome this and was quickly brought to normal. The pilot then actually flew the ship to the ground, where with its slow ground speed it stopped almost at once. He experienced great difficulty in taxying up to the shelter of a hangar, as with the least access of speed the ship wanted to take off again. However, his previous knowledge of the landing conditions prevailing, combined with his long experience, had enabled him to make a safe landing where none was thought possible.

RELATIONS BETWEEN WINTER TEMPERATURE AND PRECIPITATION

By THOMAS ARTHUR BLAIR

[Weather Bureau, Lincoln, Nebr., Jan. 2, 1931]

What is the relation between winter temperature and winter precipitation in the United States? The lowest temperatures of winter generally occur with fair weather near the center of an anticyclone. The heaviest winter precipitation usually falls with mild or moderate temperatures. May we assume, then, that as a rule warm winters are wet and cold winters dry. The following table and chart are an attempt to answer that question.



The data were taken from the tables of comparative State means printed in the annual summaries of climatological data by each section center. They are for the three winter months, December, January, and February, and only those years are counted in which the average temperature departure was ±2° F, or more. Table I, in which the States are arranged by regions, gives for each State or section the number of times departures of temperature and precipitation were of like sign and of unlike sign and the percentage of the total having like signs. The percentages are entered by States on the chart, and areas where the percentage is greater than 50 are shaded.

In the shaded areas warm and wet winters are likely to occur together and cold and dry winters together. The presumption that the winters will occur in this way is strongest in Oregon, Michigan, New York, and New England. In these States three-fourths of the winters averaging 2° F. warmer or colder than normal have precipitation departures in the same sense. On the other hand, the chances are better than even that warm winters will be dry and cold winters wet in the South Atlantic States, Texas, the western upper Mississippi Valley, the Missouri Valley, the Rocky Mountain region from Colorado northward, the southern Plateau States, and California. They occur in this association nine times out of 10 in Wyoming, more than three times out of four in California, Montana, and North Dakota, and two times out of three in Nevada, Utah, Colorado, and Georgia.

The area of percentages above 50, which extends northeastward from New Mexico to the Great Lakes