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## A CLIMATOLOGICAL REVIEW OF THE ALASKA-YUKON PLATEAU

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[Weather Bureau office, Fairbanks, Alaska, July 1934]

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### INTRODUCTORY

Along the western edge of North America the Pacific Mountain system extends in an unbroken chain from Lower California to Attu Island. This great mountain system includes the Sierra Nevada of California, the Cascades of Oregon and Washington, and the Coast Range of British Columbia. In Yukon Territory and Alaska they are known by a number of names in different localities and include the Chugach Range, the Saint Elias Range, the Wrangell Mountains, the Alaska Range, and the Aleutian Range. Here are found the loftiest and most rugged mountains on the continent; Mount McKinley, the highest, being 20,300 feet. The glaciers of this region contain a greater amount of ice than the total of all others in the world, outside of Greenland and the Antarctic. Muir Glacier alone is greater than the 1,100 Swiss glaciers combined.

In the interior, and roughly paralleling the coast, the great Rocky Mountain chain extends the entire length of the continent. In Alaska these are known as the Endicott Mountains and are said to be the least known of any in North America. Extensive areas still remain unexplored. A bold headland at Cape Lisburne marks the westernmost limit of this great mountain system.

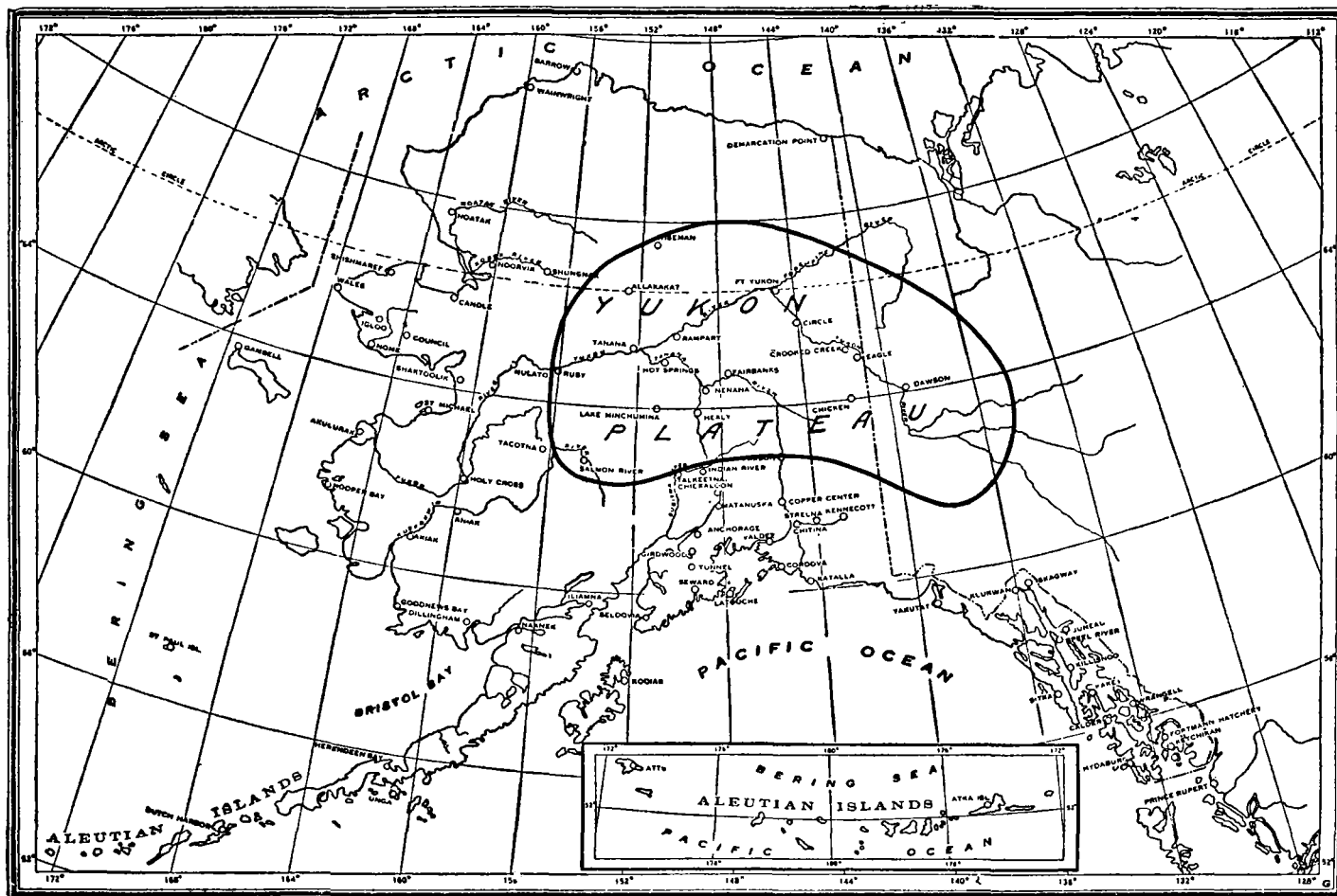
Between the Pacific Range and the Rocky Mountain chain is located a high semiarid plateau, varying greatly in width and gradually decreasing in altitude from the highlands of Nevada northward until the coast of Bering Sea is reached. Four river systems provide drainage for this region. The Colorado in the south, the Columbia and the Frazier near the center, and the Yukon in the far north. These streams possess individual features that make them unique. The Colorado is noted for the Grand Canyon. The Frazier and the Columbia are among the few rivers of the world that have cut out passages through a main range of mountains. The Yukon River flows between the two mountain systems much as the Colorado

does at the southern end of the great inland plateau. However, the Yukon possesses several characteristics that are exceptionally interesting. The source of this great stream is only 25 miles from the coast, yet the water must travel 2,300 miles to reach the sea. The level tundra land near the mouth of the stream is so low that the 4-foot tides of Norton Sound are noticed at Andreafsky 120 miles inland. For about 6½ months of the year the river is frozen over. The spring break-up usually occurs during the second week of May and soon thereafter the river is clear of ice. However, ice in Bering Sea sometimes remains until the latter part of June and Lake LeBarge near the source of the river is not free of ice until about 3 weeks after the stream opens. Hence, for a few weeks after the spring break-up, the river is open to navigation for 2,000 miles of its course, and yet it is closed at its source and closed at its mouth.

In the United States and southern Canada the great plateau region was fairly well explored early in the nineteenth century and in a comparatively few years became crossed by railroads and dotted with settlements. How different were conditions in the far north! Alaska was discovered in 1741 and for more than a century the Russians devoted their time and energy to the lucrative fur trade of the coastal areas. Long after the first transcontinental railway had ended the covered wagon days on the Oregon Trail and the frontier villages of the west were developing into important commercial centers, the great interior region of Alaska remained virtually unknown. Traders of the Hudson Bay Co. drifted down the Yukon River and in 1847 established a post at Fort Yukon. For years this remote outpost of England was the only white settlement in the interior, a region as large as the State of California. Nearly two centuries have elapsed since white people first came to Alaska and for 67 years the country has been a possession of the United States, yet the mass of the public is profoundly ignorant of its climatic features. During the Russian

occupation and for 30 years of American rule almost no effort was made to record accurate meteorological observations in the interior. The United States Weather Bureau was organized<sup>1</sup> in 1870 and soon thereafter a few stations were established in Alaska. These were all located along the coast and records of the interior were dependent on more or less incomplete data gathered by explorers and survey parties. The most important of these were: the Western Union Telegraph Expedition of 1865-67, the Coast and Geodetic Survey parties sent out in 1880 and 1891 to determine the intersection of the one hundred and forty-first meridian with the Yukon River, and the Geological Survey expeditions of 1898-1903. Fort Yukon was found to be in Alaska and in 1869 the Hudson Bay post was moved up the Porcupine River

an area of about 24,000 square miles, equal to the State of West Virginia, and resembles very much the flat prairie regions of the Middle Western States. In a milder climate it would be dotted with farms and villages and perhaps supporting a population of 1,000,000. But it is now wholly uninhabited except for a few mining communities along the northern border. As is true with practically all of interior Alaska the valley is composed of small sluggish streams and marshes and niggerhead swamps interspersed with thickets of willow, alder and scrub spruce forests. Between the Tanana and the Yukon Rivers lie the Tanana Hills, a rough region with gentle rolling hills and domes reaching a maximum altitude of 5,000 feet. The valleys contain fairly good stands of timber consisting of spruce, tamarack, birch, and poplar.



into Yukon Territory. The first American settlement in interior Alaska was Circle City founded in 1893. Gold was discovered in nearby streams and the population of Circle City soon reached 10,000. The miners proudly acclaimed it the largest log cabin city in the world.

The plateau section of Alaska and Yukon Territory lies principally between 61° and 67° north latitude and extends westward to the Kokrine Hills and the Kuskokwim Mountains in 155° west longitude. The area included covers about 150,000 square miles and the present population probably does not exceed 10,000. Along the southern margin are the loftiest and most rugged mountains to be found in North America, while to the north are the little known Endicott Mountains. From the Alaska Range on the south to the Tanana River is located the level Tanana Valley. This valley has

Where trees are absent their place is taken by thickets of willow and alder while almost everywhere may be found clumps of cranberry and blueberry bushes. As timberline at this latitude is about 2,500 feet above sea level the summits of practically all the hills are bare of trees but are covered with a dense growth of moss and grass and a great abundance of wild flowers. The Yukon Valley lies just north of the Tanana Hills and is mostly a region of low rolling hills. An exception to this, however, is a region below Circle known as the Yukon Flats. Here the river spreads out into many channels until its extreme width is about 15 miles. The great stream is ever changing its course and wearing new channels in the frozen ground until the territory included in "The Flats" is a maze of channels, sloughs, and swamps. This enormous swamp has an area of about 10,000 square miles or approxi-

<sup>1</sup> As a weather service under the Signal Corps.

mately the size of Massachusetts and Rhode Island combined.

From surface to bedrock the soil of practically all interior Alaska is perpetually frozen. In prospecting shafts frozen ground has been reported to a depth of over 300 feet. In this frozen muck are found the remains of many prehistoric animals. The bones and tusks of the mammoth are the most numerous. In fact, it seems that few extinct animals have left such abundant traces behind them. One wonders what killed off these great beasts and how their bones became buried deep in the perpetually frozen muck. Their enormous size may be judged by a tusk unearthed near Fairbanks in 1932. This specimen measured 12 feet and 11 inches in length and weighed 295½ pounds.

As is true in all regions where mining is the main industry, the population of the interior country has shifted about as one field became exhausted and another discovered. Gold was first found on Mastadon Creek in 1893 and an army of prospectors soon gathered in the country around Circle City. At its height Circle is said to have contained 10,000 inhabitants. When the richer gold fields of the Klondike were discovered in 1896 the population shifted to Dawson which soon became the leading metropolis of the interior and contained 30,000 people. The Klondike field reached its peak in 1900 when \$22,000,000 in gold was produced. But as the richer claims were taken up the population shifted to the Seward Peninsula where gold was discovered on the beach at Nome. As activities at Nome began to decline, a great number of prospectors explored the interior country and the rich fields north of Fairbanks were discovered in 1902. Gold production increased rapidly until the peak was reached in 1909 when the output for the year was valued at over \$9,500,000. From 1902 to 1931 the Fairbanks district alone produced \$90,830,000 which sum is nearly 10 times the amount paid by the United States for the entire Territory. By 1920 the rich claims were so exhausted that the expensive hand labor was scarcely profitable and Fairbanks seemed doomed to the inevitable period of decay so characteristic of mining towns the world over. However dredges were installed and the gold production has steadily increased until in 1931 the output was \$2,655,000. Geological surveys indicate that placer- and lode-gold deposits in this region will not become exhausted for 25 years, so Fairbanks will no doubt continue to be the metropolis of the interior for a quarter of a century.

#### METEOROLOGICAL HISTORY

In 1882 the Signal Service of the Army began a system of meteorological observations at old Fort Reliance near Dawson, Yukon Territory, and at old Fort Adams near Tanana. A volunteer observer also began observations at this time at Fort Egbert (Eagle). Observations were made by the Coast and Geodetic Survey expedition in 1899 at Camp Coloma on the Porcupine River in latitude 67°25' N., also at Camp Davidson, Yukon Territory in 1890. Observations began at Circle in 1897 and at Fort Yukon in 1899. These represent the only records kept in this region prior to 1900 and even these are far from complete. Some, in fact, extend over a period of but a few months as was the case at Camp Coloma. The stations were equipped in most cases with self-registering maximum and minimum thermometers and rain gages. Three observations were made daily, 7 a. m., 2 p. m., and 9 p. m. The records kept by the Signal Corps operators at Eagle, Fort Yukon and Tanana are excellent. The

observers at these lonely, isolated stations have given faithfully and conscientiously their time and energy to the work.

Observations began at the Experiment Station Farm, 4 miles west of Fairbanks, in September 1904 and, excepting for a few months of the early years, the records are complete. Fairbanks was made a first-order station in 1929 and the office moved into town with quarters in the Horseshoe Building on First and Cushman Streets. The thermometer shelter was located on the bank of the Chena River, the elevation of the thermometer being 11 feet above ground. On July 1, 1933, the office was moved to the present quarters on the fourth floor of the new Federal Building. The thermometer shelter was moved to the roof of the building at an elevation of 68 feet. This exposure proved very unsatisfactory. In cold weather there invariably occurs a remarkable temperature inversion aloft. A change in elevation of 100 feet always shows a decided rise in temperature. Experiments during the winter of 1932-33 often showed a difference of 10° to 17° between the temperature on the roof of the Federal Building and that recorded in the thermometer shelter on the river bank. Due to this unsatisfactory exposure the shelter was moved to its former location on December 1, 1933.

#### GENERAL CLIMATIC CONDITIONS

The interior country, located as it is between two great mountain systems, has a decidedly continental climate. Extremes in nearly all climatic elements occur such as are recorded in Utah, Nevada, and in eastern Oregon and Washington. The rugged Alaska Range furnishes complete protection from the continuous storms that sweep across the Gulf of Alaska while the Endicott Range on the north is effective in turning aside the steady winds that blow in from the ice floes of the Arctic Ocean. To the west are the Kokrine Hills and Kuskokwim Mountains, a low detached range extending north and south across the plateau country. They are usually effective in obstructing the tempering influence of the Bering Sea. Upon rather rare occasions storms move up the coast of Siberia to a point north of the Aleutian Islands before swinging eastward. These move up the Yukon Valley behind the protecting coast range and produce mild weather with rather heavy snowfall and furnish some relief from the intense cold of winter. The severe storms that move along the Pacific coast each winter have little effect upon the interior. A pressure gradient of 1.25 inches over the distance of 300 miles between Fairbanks and Cordova seems to be necessary before coast storms are able to pass across the mountains. When this occurs the effect is a slight moderation of temperature, but little or no snow is produced.

The winters are extremely cold and usually very little snow falls. The wet season comes in June, July, and August and the rain falls mostly as light drizzles. Storms of the thunderstorm type sometimes move in from the southeast and the rainfall produced may be rather excessive, that is, excessive for this country.

The growing season ranges from an annual average of 105 days at Nenana to 50 days at Allakaket. This may appear too short for farming but owing to the fact that there is continuous daylight all during the growing season, this is sufficient for many crops. The precipitation of 7 to 16 inches seems far too light for agricultural purposes. However, half of the annual precipitation falls during the growing season. In addition to this the perpetually fro-

zen muck keeps the surface water from draining away and becoming lost. As a result there seldom is any lack of moisture in the soil. Such vegetables as potatoes, turnips, radishes, lettuce, cabbage, and greens are easily grown. Tomatoes and cucumbers are grown in hot-houses. Beans and peas may be grown during some years. The season is not favorable for melons, sweet corn, okra, etc. Field crops include hay, barley, oats, and rye. It might be said that truck gardening is the only practical type of agriculture and even this would not be profitable were it not for the local markets at the mining camps. As long as interior Alaska is so isolated and remote from any centers of population and competition is so great it is very doubtful if agriculture will ever become a leading industry. For a market the truck farmer must depend entirely upon the shifting population of the mining camps.

#### TEMPERATURE

From the past records at seven stations the mean annual temperature of the interior country is found to be 22° F. There are few inhabited regions of the world where such prolonged periods of extreme cold are recorded. From old settlers one often hears stories of isolated camps where the thermometer falls below -80° and remains below -70° for days. However much one may doubt the accuracy of such statements, this extreme cold is not at all impossible. The records from a network of cooperative stations at the various mining camps throughout the country would furnish very interesting statistics and might reveal some unusually cold locality similar to the famous region at Verkhoiansk, Siberia. Old inhabitants are of the opinion that the settlement of Birches, below Tanana on the Yukon River, is the coldest place in Alaska. Whether this is due to extremely low temperatures or to a combination of cold weather and high winds remains to be determined. The lowest temperature accepted as official for any Alaskan station is -76° at Tanana in January 1886. While the lowest for the entire region is -80° recorded at old Fort Reliance near Dawson, Yukon Territory.

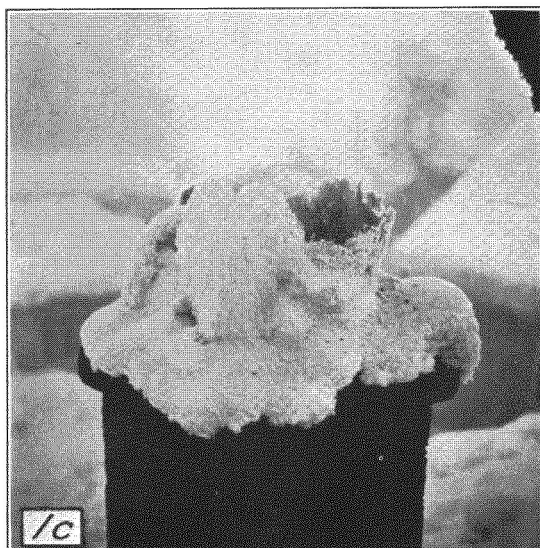
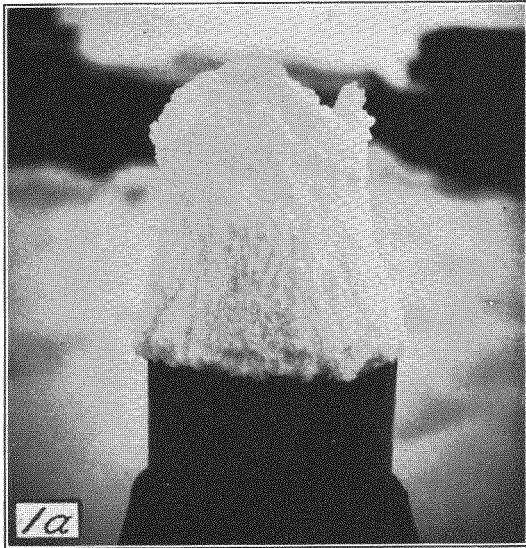
It is common knowledge the world over that temperature decreases with altitude, but the early settlers in interior Alaska must have been considerably surprised to find just the opposite condition here. Elevated points are always decidedly the warmer in winter. Gardens on the hillsides may have a month longer growing season than those in the valleys. The aviators were quick to take advantage of this condition and planes often take off in temperatures of -50° or lower, then climb to about 4,500 feet where the thermometer may record only 10° or 15° below zero. No definite information was known regarding this unusual condition until aero-meteorograph flights were inaugurated as part of the Polar Year program in 1932. The plane regularly ascended to altitudes of 17,000 feet or over and on frequent occasions the temperature aloft at no point was as low as that which prevailed on the ground. Slight temperature inversions were first recorded in October. As the cold weather of winter became more severe the temperature inversions became more pronounced and continued until the latter part of March. Only at rare intervals were they recorded during the summer months. The most striking example was recorded on the evening flight of December 28 when the surface temperature was -41° and a temperature of 1 above zero was recorded at an elevation of 4,000 feet. At times when surface temperatures were around 40° below zero it was somewhat amusing to hear the pilot complain of the heat aloft. The heavy fur parka and

mukluks worn on the ground were uncomfortably warm in the higher temperatures aloft. The shutters on the motor cowling were not adjustable from the cockpit and when the motor was cowed down for cold weather flying it would at times become overheated in the warm air aloft and prevent the plane from attaining its maximum altitude.

Extremely cold weather is practically an annual occurrence. Almost every winter the thermometer falls to -60° or lower and occasionally zero or lower is recorded every day in a month, and again there are times when the thermometer never rises above zero during an entire month. At Fairbanks there is an average of 120 days each year with zero temperatures, and freezing weather occurs on 234 days in the year. The coldest year on record in the interior was 1909 with a mean annual temperature of 18.7°. The ice in the streams usually freezes to a thickness of 3 or 4 feet, depending a great deal upon the amount of snow that falls early in the season. The greatest thickness recorded on the Chena River at Fairbanks is 56½ inches in March 1933. In small pools about the gold dredges ice sometimes measures 9 feet or more. Frosts have been known to occur every month of the year but ordinarily the first frost of fall comes late in August. At this time there usually occur a few freezing nights then follow 2 or 3 weeks of delightful Indian Summer weather. The mosquitoes are gone, the summer rains are over and the wild berries are to be found everywhere. This period is without doubt the pleasantest time of the entire year. Freezing temperatures and snow flurries are common after the middle of September. The first zero temperatures occur by the second week in October and the rivers are soon frozen over. With the closing of the streams, winter begins. Temperatures of -30° are common in November, and in December the thermometer frequently falls to -50° or lower. January is the coldest month with temperatures of -60° or lower recorded at some point in the interior each winter. In February the extreme cold begins to moderate, however temperatures of -50° and -60° are sometimes recorded. By March the severe cold is over and the thermometer seldom falls below -40°. Subzero weather occurs early in April but by the latter part of the month the signs of spring are numerous. Freezing temperatures are common in May but the lengthening hours of sunlight melt the winter snow and the surface layer of soil begins thawing. The streams rise and the ice in the rivers breaks up early in the month. The average date of the opening of the Yukon River at Fort Yukon is May 10. On the Tanana River at Nenana the average opening date is May 7. The Porcupine River does not open until the last few days of May.

In 1913 Hudson Stuck, leader of the first successful ascent of Mount McKinley, left a self-registering thermometer at an elevation of 15,000 feet on the mountain. Nineteen years later the thermometer was found. The minimum temperature reading will never be known as the thermometer was graduated to -95° and the indicator in the tube had been forced back into the bulb, apparently indicating a temperature of more than 100° below zero. However, a temperature even of -95° is lower than any natural temperature ever before recorded on the earth's surface. There seems to be some doubt among certain authorities as to whether or not the thermometer was exposed properly. One member of the expedition was interviewed at the Fairbanks office and both still and motion pictures were exhibited of the thermometer when it was found. There seems no reason to doubt the accuracy of the incident. It was





Rime caps.

Snow cocks.

stated that the thermometer was resting in a slightly inclined position with the bulb end uppermost. By using the temperature of  $-95^{\circ}$  and the maximum temperature of  $100^{\circ}$  recorded at Fort Yukon we have an absolute range of  $195^{\circ}$  for interior Alaska. However, the unusually low temperature occurred high on the slopes of the mountain and entirely out of the inhabited portion of the country. The absolute range for the inhabited region is  $180^{\circ}$  and the absolute range for any one station is  $178^{\circ}$  at Fort Yukon.

Rapid changes in temperature sometimes occur, one of the most remarkable of which was recorded at Fairbanks in January 1934. On the 6th the maximum temperature was  $34^{\circ}$  and on the 14th it had dropped to a minimum of  $-66^{\circ}$ , making a range of  $100^{\circ}$  in 8 days. Later in the month a change of  $72^{\circ}$  was recorded in 2 days. To the people of the far North the extremely low temperatures are not as objectionable as might be imagined. To the residents of Dixieland a plain account of the cold no doubt may sound dreadful. The difference lies in the manner in which one is prepared for winter weather. With warm clothing and well-insulated houses a temperature of  $-40^{\circ}$  produces scarcely any inconvenience whatever. The fact that the thermometer falls to  $60^{\circ}$  below, or lower, means very little to the daily life of the people. The extreme cold causes no more inconvenience than zero temperatures in the South. The mere cold alone can easily be endured, but when it is combined with even the slightest breeze it becomes almost unendurable. Another disagreeable feature always associated with extreme cold is the winter fog. At Fairbanks dense fog always accompanies temperatures of  $-45^{\circ}$  or lower. The records for January 1934 show 348 hours with temperature  $-45^{\circ}$  or lower and during this time there were 320 hours of dense fog. On one occasion the dense fog prevailed for 155 consecutive hours. During the coldest period there were three successive days with mean temperature  $-60^{\circ}$ . It is very interesting to observe the formations of hoarfrost in cold weather. At  $-50^{\circ}$  brick and stone chimneys leading from heated stoves always develop crowns of hoarfrost 6 or 8 inches high which resemble very much the formations around geysers and hot springs. A similar crown of frost forms on the ventilator outlets of heated buildings. The telephone wires, trees, fences, and all exposed objects become festooned with hoarfrost and produce very picturesque landscapes. Mounds of frost are built up around the base of all shrubs and small trees and if the extreme cold continues for a few weeks the plants may become entirely covered. A weird sight it is to look out across the level snow-covered country and see thousands of these frost mounds 2 feet or more in height dotting the landscape. Truly interior Alaska in midwinter is a photographer's paradise.

Although the winters are very cold, the summers are at times uncomfortably hot. Accounts of the early explorers on the Yukon River no doubt greatly astonished their readers. Lieutenant Schwatka, leader of an expedition in 1878, wrote as follows:

The 29th of July was a hot, sweltering day with the sun and its thousand reflections sending their blistering heat into our faces. In fact, our greatest inconvenience, near the short Arctic strip of the stream, was the tropical heat \* \* \*. We drifted down the hot river by low banks that needed nothing but a few breech-clouted negroes to convince us that we were on the Congo.

Dr. W. H. Dall, leader of another expedition, wrote in 1870:

At Fort Yukon I have seen the thermometer at noon, not in the direct rays of the sun, stand at  $112^{\circ}$ , and I was informed by the

commander of the post that several spirit thermometers, graduated up to  $120^{\circ}$ , had burst under the scorching sun of the Arctic mid-summer.

And again:

In midsummer on the upper Yukon the only relief from the intense heat, under which the vegetation attains an almost tropical luxuriance, is the brief space during which the sun hovers over the northern horizon, and the voyager in his canoe blesses the transient coolness of the midnight air.

The account of Dr. Dall is somewhat misleading. It is very improbable, though not impossible, that a temperature of  $112^{\circ}$  was ever recorded by a properly exposed thermometer anywhere in Alaska. Most certainly no properly exposed thermometer has ever gone to  $120^{\circ}$ . It is not at all uncommon to see thermometers in the sun standing at  $110^{\circ}$  or over. The highest temperature recorded by a properly exposed thermometer is  $100^{\circ}$  at Fort Yukon. The maxima at other stations are: Fairbanks,  $99^{\circ}$ ; Tanana,  $91^{\circ}$ ; Rampart,  $97^{\circ}$ ; Circle,  $96^{\circ}$ ; Eagle,  $93^{\circ}$ . Anyone who spends a summer in interior Alaska or Yukon Territory will most certainly be convinced that some days are unbearably hot and sultry. As a rule the long days of summer are cloudy and cool, but brief hot spells do occur in late June, July, and early August. Days with maximum temperature of  $80^{\circ}$  or over are very sultry and oppressing, producing a feeling of discomfort equal to a temperature of  $100^{\circ}$  in the mid-western States. In addition to the discomfort caused by the heat, one must endure the hoards of vicious mosquitoes and the troublesome gnats. Some idea of the Arctic mosquitoes may be gained from the following account of C. F. Hall:

Among the numerous visitors that greeted us on our arrival, I was astonished to find myriads of mosquitoes. Little did we expect so warm a reception in the Arctic regions. Talk about mosquitoes in the "States" as being numerous and troublesome! Why, no man who has not visited the Arctic shores in the months of July and August can have a good idea of these liliputian elephants. In the "States" the very hum of a mosquito is enough to set any one upon his guard. How many a poor soul there has been kept in a state of torment all night by the presence of only two or three mosquitoes! But here, in the North, it is a common, every-hour affair to have thousands at one time around you, some buzzing, some drawing the very life blood from face, hands, arms, and legs, until one is driven to a state approaching madness. Even the clothing worn in the "States" is no protection here against the huge proboscis with which each lady mosquito is armed.

It can truthfully be stated that the mosquitoes are just as numerous now as they were 74 years ago when Hall first journeyed to the Arctic regions.

#### COLD WAVES

The term "cold wave" as applied to regions in the "States" has little meaning in the interior of Alaska unless one thinks of a cold wave as lasting 2 or 3 months. There are times when minimum temperatures of zero or lower are recorded each day for a period of 1 or 2 months. There are occasions when the maximum temperature remains below zero for an entire month. In the Northern States a cold wave means a drop in temperature of  $20^{\circ}$  in a 24-hour period, to a minimum of zero or lower between December 1 and March 15, and to a minimum of  $16^{\circ}$  between March 16 and November 30. Cold waves are not as frequent in this country as might be supposed, for when winter begins the temperature falls and remains fairly constant over long periods of time. At times, however, high-pressure areas move in from Siberia and send the temperature from its already low point down to a figure far below the limit of mercurial thermometers. The first cold wave in the fall is important, as it marks

the ending of the season's work on the gold dredges. As mining is the main industry, most activity ceases and the laborers spend the winter in town or go "outside". It is interesting to follow these cold waves southeast across Canada and on until the Atlantic States are reached about 2 weeks later. The cold wave that set a new record of  $-66^{\circ}$  at Fairbanks in January 1934 was felt in Massachusetts 15 days later. After being in operation more than 20 years the station at Fort Yukon was closed and official records ended on January 12, 1934, with a minimum temperature for the day of  $-64^{\circ}$ . Had the station been in operation 2 days later, a new low temperature record would have been established for Alaska. At 9 a. m. on the 14th the temperature given in an Airways report was  $-75^{\circ}$ , and later in the day the thermometer was observed at  $-78^{\circ}$ . This is  $2^{\circ}$  lower than the official record established at Tanana in 1886. In February 1932 a privately owned thermometer at Alatna, near Allakaket, registered  $-82^{\circ}$ , but this thermometer was destroyed by fire before it could be secured for testing at low temperatures. During 19 years of concurrent records at Allakaket and Tanana the minimum temperatures for January and February were invariably lower at Allakaket, the average being  $9.4^{\circ}$  for January and  $11.7^{\circ}$  for February. During this period  $-70^{\circ}$ , the lowest, was registered three times at Allakaket; the corresponding minima at Tanana were  $-68^{\circ}$ ,  $-62^{\circ}$ , and  $-68^{\circ}$ . There can be little doubt that temperatures lower than  $-76^{\circ}$  have occurred at both Fort Yukon and Allakaket since the record was established at Tanana. The most severe cold period on record at Fairbanks was that of January 1934, when the temperature averaged  $-51.0^{\circ}$  for 2 weeks. The minimum was  $-66^{\circ}$  and there were 2 days when the maximum was  $-56^{\circ}$ . However, this cold period falls far short of the one that occurred in December 1917 at Dawson, when the temperature averaged  $-51.3^{\circ}$  for the month. To better comprehend this extreme cold one has but to compare it with other regions of the world. The lowest temperature encountered by Peary on his dash to the North Pole was  $-53^{\circ}$ . As yet the lowest temperature recorded in the Antarctic is  $-73.3^{\circ}$ , reported by Amundsen at Framheim in 1911. Some members of the Scott Expedition were said to have encountered a temperature of  $-77^{\circ}$  near Cape Crozier in 1911.

The following table is a record of the minimum temperature and the lowest monthly mean recorded by various polar expeditions as well as for a few inhabited regions of the world that are noted for extremely cold winters. It is interesting to compare these with similar records for the Alaska-Yukon country.

	Minimum	Lowest monthly mean		Minimum	Lowest monthly mean
	°F.	°F.		°F.	°F.
First Byrd Antarctic Expedition	-72	-44.7	Tibet	-40	19.0
Amundsen Antarctic Expedition	-73	-48.1	Leh, Kashmir (11,500 feet)	-19	17.3
Belgica Antarctic Expedition	-46	-10.3	Misti, Andes Plateau, altitude, 19,200 feet		121.4
Cape Adare Antarctica	-43	-13.4	Mount Washington, N.H., 1932	-46	5.0
McMurdo Sound Antarctica	-60	-21.5	Fort Reliance (Dawson)	-80	-51.3
2nd Grinnell Expedition, latitude $78^{\circ}37'N$	-69	-38.1	Fort Yukon	-78	-48.4
Peary Expedition to North Pole	-53	-31.7	Tanana	-76	-36.7
Verkhoyansk, Siberia	-92	-59.0	Eagle	-75	-45.8
			Allakaket	-70	-44.8
			Fairbanks	-66	-36.6
			Mount McKinley	-100	

<sup>1</sup> Lowest monthly normal.

<sup>2</sup> The lowest monthly mean  $-48.4^{\circ}$  at Fort Yukon is much too high as  $-39^{\circ}$  was used as the maximum temperature on 26 days when mercury was frozen. This occurred in December 1917.

<sup>3</sup> Absolute minimum unknown.

## PRECIPITATION

Located within an area protected by mountains the interior country is semiarid. However, the term semiarid is somewhat misleading. For 6 months of the year the ground lies frozen beneath a mantle of snow. In summer the deep layer of moss and decayed vegetable matter acts as a mulch which effectively holds the moisture in the 2-foot layer of thawed ground. The precipitation is light. In the northern section Fort Yukon has an annual average of only 7.28 inches. To the westward the precipitation steadily increases as the distance to the Bering Sea decreases. With the exception of the slopes of the Alaska Range the greatest precipitation is recorded at Hot Springs, the annual average there being 16.15 inches. The variation in the greatest precipitation recorded in 24 hours is considerable, ranging from 4.0 inches at Tanana down to 0.07 inch at old Fort Reliance. This shows that the maximum rainfall in a day, like the mean annual precipitation, is greatest in the western section nearest the Bering coast. The period of heaviest rainfall occurs in June, July, and August, while the least is recorded in February, March, and April. At Fairbanks there is an average of 92 days annually with 0.01 or more precipitation. As is indicated, the rains are light, rarely measuring as much as 0.25 inch in a day. Due to the thick covering of moss over the frozen ground the soil is cool and damp. Evaporation takes place slowly and the humidity of the air is greater than in most semiarid regions. The water vapor is carried aloft and upon cooling is formed into cumulus clouds that produce occasional thunderstorms. At times there are heavy showers of short duration followed by clearing skies, but most of the rain falls as steady light drizzles that may continue for several days. The greatest precipitation for any one month on record is 8.19 inches, in August 1930, at the experiment station near Fairbanks. At rare intervals the thunderstorms are accompanied by hail. The hailstones are about the size of buckshot; and as the storms last but a few minutes, there is little or no damage done. An exception, however, occurred at Allakaket in July 1921 when a hailstorm was severe enough to damage the garden crops. At Fairbanks hail has been recorded but 10 times during the past 5 years.

## SNOWFALL

Upon rare occasions the first snow of Autumn may fall in August and by the middle of September snow flurries are quite common. However, it is not until the middle of October that any appreciable amount of snow falls and remains on the ground. The heaviest snows occur in January, while October and March receive the least during the cold winter. Even during the midsummer month of July snow is sometimes reported at Wiseman. From the latter part of October to the middle of March there are very few occasions when the temperature rises above  $32^{\circ}$ , and as a result the snow accumulates on the ground to a depth of 3 feet or more. This often gives an erroneous impression regarding the total snowfall for the season. The average snowfall in the interior is about 50 inches. Very little difference can be noted between the different sections on the Yukon and Tanana Rivers, as both the greatest and the least mean annual amounts were recorded in the eastern section. The greatest annual snowfall of which records are available is 110 inches at Allakaket in 1921, while the least is 13.9 inches at Rampart. The snow is seldom deep enough to interfere with traffic and there are times when it is so light as

to impede sled travel. Due to the extreme cold, the snow is light and dry. Only rarely does it fall in large feathery flakes so commonly seen in temperate regions. Over most of the country the wind in winter is light and variable, with long periods of calm. As a result the snow remains fairly evenly distributed over the ground. At Fairbanks there is an average of 184 days each year with 1 inch or more of snow on the ground. The snowfall of the winter of 1928-29 is no doubt the most notable of recent years. At Fairbanks the total snow for the season amounted to 94.7 inches. There was little or no property loss, but considerable inconvenience was experienced in keeping the streets cleared and in obtaining fuel. The heaviest 24-hour snowfall on record at Fairbanks is 13.0 inches. One peculiarity of the climate is the extended periods of light snowfall. There are occasions when the fine, dry snow falls continuously for several days yet the accumulated depth may amount to scarcely more than a trace. At times the snowflakes are so small as to be practically invisible unless observed against a dark background. In regions outside of Alaska one sometimes hears the expression, "It is too cold to snow." It would be of interest to know the lowest temperature at which snow has ever been reported. In interior Alaska snow often occurs at temperatures far below zero. During a mild storm on January 16, 1934, Jarvis reported snow at  $-38^{\circ}$ , McCarty at  $-40^{\circ}$ , Richardson at  $-49^{\circ}$ , and at Circle, heavy mistlike snow was reported at a temperature of  $-52^{\circ}$ . Due to the almost total lack of wind during the cold weather, blizzards are virtually unknown over most of the interior country.

FLOODS

Floods occur almost annually on the larger streams and at intervals of several years they assume destructive proportions. The floods are local and are caused by ice jams following the spring breakup. A mild winter with heavy snow is sometimes followed by a cold spring, and water in the rivers remains low and frozen tight. Then with an abrupt change the days become warm and the streams rise, causing the ice to break up quickly. When this occurs the ice is piled up in tremendous jams at the narrow points of the streams and floods follow. In 1930 the Chena River at Fairbanks rose  $12\frac{1}{2}$  feet above the normal water level. Practically the entire town was flooded and it is said that water was 2 feet deep in the business district. Considerable property loss occurred. The Yukon River is sometimes dammed by immense ice jams near Fort Yukon, and when this occurs the stream rises and spreads out over the Yukon Flats until it is 15 to 20 miles wide. At Circle City the stream has been known to rise 25 or 30 feet and flood the entire city until water stood 6 feet deep in the post office. Summer floods sometimes occur on the Tanana River and other streams originating in the Alaska Range. These floods are caused by the rapid melting of the glaciers during the unusually hot weather. Owing to the sparsity of population, about one person for each 15 square miles of land, the damage due to floods is comparatively light. With but one highway and one railway in the country there are but few bridges to be washed out, almost no livestock to be drowned, and few indeed are the towns to be destroyed.

CLOUDS

Almost without exception the semiarid plateau regions of any country are noted for their cloudless skies. How different is the interior section of Alaska, for here prolonged cloudiness is the rule. At Fairbanks there is an

average of 88 clear, 89 partly cloudy, and 188 cloudy days each year. The mean daily cloudiness as determined from 4 years of records is 6.4. The period of greatest cloudiness falls during the summer months, the mean for August being 8.0. During the brief intervals of daylight in winter the sky is usually obscured by ground fog or stratus clouds. As the season of extreme cold ends, the cloudiness decreases and clear skies generally prevail from the latter part of February to early in April. Then when the warm days of spring approach there is a decided increase in daily cloudiness. During the continuous daylight of summer clear days are the exception, but as summer ends and the cool days of the short autumn season begin the cloudiness decreases. The period of clear skies in autumn is very brief, for as cold weather begins, in October and November, the cloudiness increases and continues until the cold days of winter are over. Stratus and alto-stratus clouds predominate in winter. Cirro-stratus clouds are commonly seen and occasionally alto-cumulus are recorded. Strato-cumulus begin to appear in March. About the second week in April the cumulus clouds are first seen. As they are the first signs of spring, they are a welcome sight and are a relief from the dull stratus clouds that prevail during the long cold winter. During the warm summer days moisture evaporating from the wet spongy moss rises and forms picturesque cumulus clouds, the beauty and grandeur of which are almost without equal in other lands. One characteristic of the inland country is the rainless thunderstorms. On almost any clear, calm morning in July a few small cumulus clouds may be seen on the southeastern horizon. These increase and by midafternoon the sky is filled with turbulent thunderheads which roll and tumble about above. They are very dark and threatening and a downpour seems imminent. Perhaps a little rain will fall, but usually as evening approaches the clouds begin dissipating. The phenomenon has all the characteristics of a typical thunderstorm, but there is seldom any thunder to be heard. At Fairbanks thunder is recorded on an average of seven times annually. The sound is usually weak and far distant. The terrific crashes so common in the thunderstorms of the Midwest are seldom if ever heard in interior Alaska. True cirrus and cirro cumulus clouds are sometimes observed in the spring and fall, but only at rare intervals.

HUMIDITY

It is difficult to think of interior Alaska as being a semiarid country. The scanty precipitation is the only feature that is characteristic of such regions. Due to the perpetually frozen subsoil and the surface layer of moss and decayed vegetable matter, the soil seldom becomes parched and dry as is true elsewhere. The mean annual relative humidity at Fairbanks is 71 percent, which is rather high for a semiarid country. The percentage of relative humidity by months is as follows:

January.....	81	July.....	66
February.....	76	August.....	74
March.....	66	September.....	73
April.....	61	October.....	72
May.....	58	November.....	81
June.....	62	December.....	83

As can be seen, the period of highest humidity occurs during November, December, and January. Records fail entirely to uphold the proverbial arguments that due to the dry cold of the interior the winters are more comfortable than the damp foggy cold weather on the coast. At Fairbanks in January 1934 the mean temperature was  $-31.2^{\circ}$ , the mean relative humidity 87 percent and



there were 320 hours of dense fog. However it cannot be denied that there is very little moisture in the air during the extremely cold weather. The argument concerns the difference between absolute and relative humidity. A temperature of 37° and relative humidity of 1 percent would most certainly be considered dry air; but if the temperature of this same air is lowered to -44°, the relative humidity becomes 100 percent and dense fog prevails. The question then seems to be is the air at -44° as dry as it was at 37°? During the numerous foggy days with temperature ranging from -45° to -60° the percent of relative humidity in the outdoor air is very high. However, in business houses and offices where the air indoors is heated to 70° and very little moisture is added, the relative humidity is greatly reduced, often remaining at 10 percent or lower for days at a time. There is often a very great difference between the temperature of the indoor and outdoor air. On the morning of January 14, 1934, the temperature in the office at Fairbanks was 75°, while at the same time the thermometer outdoors stood at -65° making a difference of 140°. The air indoors is so dry that everything becomes parched and so charged with electricity that one is continually receiving electric shocks whenever metal or other conductors of electricity are touched. The peculiar antics of this static electricity are sometimes quite amusing. At times when two persons touch hands they each receive a light shock and a crackling sound is produced as the sparks jump from one to the other. When several carbon copies of a report are being typewritten the onion-skin paper becomes charged in such a way that the pages attract and adhere to each other as if they were lightly glued together. The sheets of carbon paper are charged in the opposite manner and at times they repel each other to such an extent that when removed from the typewriter they will not remain in a drawer unless it is closed. In dwellings where vapor from the kitchens increases the relative humidity of the indoor air, static electricity is not noticed.

#### SUNSHINE

The only automatic sunshine recorder in the country is located at Fairbanks and the records here cover a period of only 3 years. These records show the average number of days each year without sunshine to be 83. The average number of days with 100 percent sunshine is 58. In December 1933 there were 21 days with zero percent and in March 1931 there were 17 days with 100 percent sunshine. During the long days of summer, perpetual daylight prevails over all the country and in the northern section the sun is above the horizon continuously. As there is no darkness at Fairbanks during the Fourth of July celebrations, a midnight ball game is sometimes substituted for the customary display of fireworks. In winter the conditions are just the reverse. In the northern section there is no sunlight whatever for a period of 3 weeks. At Fairbanks the sun reaches an altitude of 1° 42' and remains above the horizon for 3.7 hours on the shortest days. Except for a few days at the time of the summer and winter solstices the change of possible sunlight averages 6 minutes per day. The percentage of possible sunshine by months as recorded at Fairbanks is as follows:

	Percent		Percent
January	29	August	32
February	51	September	28
March	70	October	33
April	67	November	33
May	52	December	38
June	61	Annual mean	45.3
July	50		

Solar-radiation records have been kept at Fairbanks for the past 3 years. Due to the high latitude of the station, the continuous records are of great interest. During the cloudy weather of December there have been days when no radiation whatever was received during the 3.7 hours the sun was above the horizon. The mean daily amount of radiation in gr-cal. per square centimeter for December is only 5.3. In June, with a maximum of 21.9 hours of sunlight, the mean is 476.7. The greatest amount received in any one day was 714.2 on June 22, 1933.

#### WINDS

Fairbanks is the only station at which complete wind records are kept, but it is believed that conditions are very much the same over most of the interior country. Perhaps the most striking peculiarity of the climate is the total lack of wind for long periods during the winter months. January, the month with the least wind movement, has an average of 323 hours of calm. The greatest number of consecutive hours of calm is 51, in 1934. In January 1934 there occurred a period of 82 hours during which but 1 mile of wind was recorded. The hours of calm in January 1933 numbered 399, which is 54 percent of the total hours in the month. The highest wind movement occurs in May, when the mean monthly velocity is 5.7 miles per hour. The highest velocity ever recorded at Fairbanks since the automatic recorder was installed was 32 miles per hour on May 12, 1934. So accustomed have the inhabitants become to the quiet air that velocities of 18 miles per hour or over are very disagreeable. There is an average of 11 days each year with maximum velocities of 20 miles per hour or over, but even these moderate winds are of short duration. The 3 years of records at Fairbanks show a total of 4 days when no wind movement was recorded. Only three times has the daily total movement exceeded 300 miles, the highest on record being 367 miles. The total monthly movement ranges from a minimum of 1,020 miles in December 1931 to a maximum of 5,311 in May 1934. During the winter the light winds are quite variable, there being times when scarcely 2 consecutive hours during a day have the same direction recorded. However the prevailing direction in winter is from the northwest and in summer from the southwest. The highest velocities are usually from the northeast.

The section of country near the confluence of the Tanana and Yukon Rivers is quite exceptional. In this region the river valleys furnish a drainage system for the air from the interior plateau. About 75 miles above Tanana the Yukon River enters a narrow gorgelike valley through which it flows in a series of deep rapids. In winter a high-pressure area usually prevails over interior Alaska while to the southwest is the rather permanent Aleutian low. This pressure distribution is favorable for easterly winds over the interior. In most sections these winds are not encountered to any extent on the surface but down the two river valleys, from Rampart and Hot Springs westward, the easterly gales rage at subzero temperatures frequently throughout the winter. In summer the general pressure distribution is reversed and the westerly winds prevail. No wind records are made in this region but the temperature records show a minimum of -76° at Tanana and -68° at Rampart. Other regions of high winds are reported in the vicinity of Bettles, where the Koyukuk River flows down from the Endicott Mountains, and on the Chandalar River which flows down from the mountains farther to the eastward. Stories are told of high winds encountered on the sled trails with the thermometer

standing at 58° below zero. Truly these regions must closely rival "The Home of the Blizzard" which the Mawson Expedition encountered in the Antarctic. The gales sweep the snow from the rivers and leave the ice polished and smooth as glass. Travel by dogsled is very difficult, for at times the dogs, sled, and driver are blown across the smooth ice and piled up in the brush along the shore. High winds are also often encountered at high elevations such as Eagle Summit, the divide between the Tanana and Yukon watersheds on the trail from Fairbanks to Circle City. With these exceptions the interior of Alaska is noted as a region of very light winds. The mean annual velocity at Fairbanks is 3.8 miles per hour.

#### PILOT-BALLOON OBSERVATIONS

Pilot-balloon observations began at Fairbanks, August 26, 1930. Due to the unusually clear air and relatively light winds aloft, the balloons are sometimes followed to very high altitudes. On March 14, 1931, an observation lasted 122 minutes and if the ascension rate remained constant the balloon was lost at an altitude of 72,600 feet. The records for this unusual observation appear very good for 108 minutes but beyond that point they may be somewhat questionable. The altitude at 108 minutes was 19,530 meters and the horizontal distance 44,800 meters. On May 23, 1933, a balloon was abandoned at a distance of 60,600 meters after being followed for 100 minutes. This is the greatest distance to which a balloon has been followed. The varying conditions under which these observations are made adds interest and variety to the work. In winter the prevailing ground fogs hinder the work a great deal, but observations are frequently made at temperatures below -40°. The coldest run was made at 52° below zero. The winds aloft are usually moderate to fresh and only rarely are velocities of 40 miles per hour or over recorded. It is interesting to note the winds aloft that sometimes prevail during periods of high and low barometric pressure. During an observation on October 12, 1933, the barometer stood at 29.02 (reduced to sea level) and the highest velocity recorded was 4 miles per hour. The balloon entered alto-stratus clouds at 9,200 feet, being only 1,100 feet away horizontally. Eight days later the barometer stood at 30.92 and the balloon observation revealed winds of hurricane force aloft. The velocity at an elevation of 24,000 feet was 78 miles per hour.

#### RADIO METEOROGRAPH OBSERVATIONS

An interesting part of the Second International Polar Year program was the radio-sounding-balloon work. Regular sounding-balloons were released carrying aloft small radio transmitters which automatically sent out temperature and pressure data. The signals were picked up on a short wave receiver in the office. The balloons were also observed through the theodolite and the winds aloft plotted in the usual manner. The balloons were given an ascension rate of 200 meters per minute and under favorable conditions complete records were obtained until the balloons burst. The maximum altitude reached was 18,355 meters and the greatest distance to which the balloons were followed was 62,700 meters. One balloon was followed to a distance of 83,500 meters, but the records for the last few minutes of the observation are somewhat questionable. It is rather surprising to note that in practically every instance the long pilot- and sounding-balloon observations revealed easterly winds high up in the stratosphere. During the spring and

summer that radio sounding-balloon observations were made, the mean altitude of the stratosphere was found to be 11,800 meters.

#### CHINOOKS

A few occasions occur each year when the pressure gradient between the interior and the coast becomes so great that mild storms pass over the mountains and cause a chinook condition to prevail. During these periods, winds of strong to gale force prevail aloft and a few foehn clouds may be observed. Although temperatures may rise 20° or more, the thawing usually associated with chinook winds does not occur, for seldom does the thermometer rise above the freezing point during winter. In January 1934, a storm moved in across the mountains and resulted in what might be termed "chinook conditions." The temperature at Fairbanks rose rapidly to -35°, but when the storm moved away the temperature dropped to -60° for the second time during the month. The warm chinook winds of the Midwestern States are almost unknown in the plateau section of Alaska.

#### BAROMETRIC CHANGES

A somewhat surprising characteristic of the climate is the little effect produced by extremes of barometric pressure. The violent storms usually associated with unusually low barometer readings are unknown. In fact, interior Alaska is a region where violent storms are virtually unknown. Periods of low pressure are often accompanied by mild weather with little or no wind, while the opposite effect is sometimes noticed during periods of unusually high pressure. During the past 3 years the barometric pressure at Fairbanks has been below 29.00 inches on seven occasions, the lowest being 28.73 inches. Two times in 1933 the pressure was above 31.00 inches. On March 1, 1934, a pressure of 28.73 inches (sea level) was recorded. On the 6th the barometer had risen to 30.76 inches, making a range of 2.03 inches in 5 days.

#### HALOS

During the cold days of winter the sun shining through cirro-stratus clouds often produces very interesting halos. The ordinary halo of 22° is frequently observed. The great halo of 46° is noted several times each year and upon rare occasions there occurs a combination of halos, arcs, and parhelia that is truly marvelous. Such a display occurred on April 7, 1933. On this occasion there was a very brilliant circumzenithal arc, a great halo of 46°, a parhelic circle, two parhelia of 22°, and a paranthelia of 120°. The display was repeated on the following day, although not on so grand a scale. This display included the brilliant circumzenithal arc tangent to a great halo of 46°. The parhelic circle and paranthelia of 120° were not observed, but a halo of 22° with a tangent arc on the upper surface was present inside the great halo of 46°, as well as two brilliant parhelia of 22°. On June 23, 1934, a very peculiar halo was observed. The upper and lower surfaces were 22.2° from the sun, while the right and left surfaces were at a distance of 32.7°. In addition, there appeared a quarter arc on the lower right-hand surface at a distance of 39.7°. Then upon the lower surface was a tangent arc parallel to the horizon. Parhelia are observed more frequently even than the halo of 22°, and at times they are exceedingly bright. On January 16, 1934, right and left parhelia were observed, together with a light pillar and the rare vertical parhelia. All were exceedingly brilliant and remained visible for

about an hour. On several occasions paraselenae have been observed, and on clear, cold nights a full moon shining through a few thin alto-cumulus clouds sometimes produces coronas that are wonderful to observe. In this connection might be mentioned the colored alto-cumulus and alto-stratus clouds that are sometimes observed when no parhelia or halo is present. Usually these are small detached clouds about 15° to 20° from the sun. They may include all the colors of the rainbow and resemble delicate mother-of-pearl.

AURORAS

As might be expected in this latitude, auroral displays are frequent. There is an average of 176 days annually on which they are recorded. There seems to be a popular belief that the aurora is generally associated with cold weather. Records at Fairbanks show little connection

disturbance seems to be to the southwest, near the "Valley of Ten Thousand Smokes." Many active volcanoes are located in this region. The eruption of Mount Katmai in 1912 was one of the most terrible known anywhere on the earth.

AVIATION

Commercial aviation is playing such a great part in the development of interior Alaska that this article would hardly be complete without a few remarks regarding this modern means of transportation. For about 15 years following the discovery of gold, the shallow-draft river boats furnished the only means of summer transportation. In winter all traveling was by dog sled and this condition still prevails over much of the country. In 1905 the Alaska Road Commission was organized and a road was constructed from Valdez, on the coast, to Circle City on the Yukon River, a distance of 500 miles. In addition

Form No. 1131-Aer.

U. S. DEPARTMENT OF AGRICULTURE  
WEATHER BUREAU

PILOT'S WEATHER REPORT

Date January 14, 1934 Time A.M. Issuing station Fairbanks, Alaska

STATION	ELEVATION (FEET)	TIME (A. M. OR P. M.)	GENERAL CONDITION	CEILING (FEET)	VISIBILITY (MILES)	WIND DIRECTION AND VELOCITY	TEMPERATURE (DEG. F.)	DEW POINT (DEG. F.)	BAROMETER (SEA LEVEL)	REMARKS—FIELD CONDITION
Fairbanks		8a	dense fog	zero	zero	calm	-62		30.40	
Nenana		745a	clr	unl	unl	calm	-64		30.38	grnd. fog w
Hot Springs		730a	clr	unl	unl	calm	-70		30.02	patches grnd. fog
Tanana		745a	clr	unl	unl	calm	-62		29.95	
McGrath		8a	clr	unl	unl	e 1	-65		29.90	patches gmd. fog
Richardson		745a	clr lt fog	unl	poor	calm	-54			
McCarty		745a	dense fog	zero	zero	e 4	-51			
Jarvis		745a	dense fog	zero	zero	calm	-50			
Circle		730a	clr	unl	unl	calm	-70		29.62	
*Fort Yukon		745a	clr	unl	unl	calm	-75		30.32	lt. grnd. fog on river to S.
Eagle		845a	clr	unl	unl	calm	-49		29.20	
*Temperature on river at Fort Yukon				reached -78° at 11 am.						

between this phenomenon and prevailing weather conditions. No auroras are observed during the summer season, simply because they are not visible during the continuous daylight. By the end of July there is a short period of deep twilight at midnight, and the brightest stars are once more visible. The darkness rapidly increases, and 2 weeks later the first aurora may be observed. The displays are frequent from this time until May, when continuous daylight again prevails. During the past 4 years the physics department of the Alaska Agricultural College near Fairbanks has been measuring the height of the aurora by means of simultaneous photographs at stations about 15 miles apart. The general height as determined from these measurements ranges between 60 and 200 miles.

EARTHQUAKES

No severe or destructive tremors have been recorded in the interior of Alaska. However, the number of light shocks averages eight annually. The center of

to this trunk line a few miles of feeder roads, mostly in the Fairbanks district, have been constructed as the need arose. On the high passes the road is blocked by snow from October to the middle of June each year. When the Alaska Railroad was completed in 1923 the interior country became easily accessible the year round. The railroad extends from Seward, on the coast, to Fairbanks a distance of 470 miles. The weekly trains make connections with the steamboats and one may now travel from Seattle to Fairbanks in 8 days. Upon the completion of the railroad Fairbanks became the distributing center for central and western Alaska. Travel and transportation had greatly improved since the pioneer days at the beginning of the century. However the interior country is a vast region equal in size to the State of California. With but one road and one railway, the transportation system was about equal to that of the Middle West at the close of the Civil War. The introduction of commercial aviation has brought about wonderful changes during the last 10 years. The late Col.