It is very much to be hoped that this latter record will also be discovered. The first Fahrenheit thermometer used in this country is supposed to have been that of Dr. Lining, of Charleston, S. C., March, 1738. His instruments were a thermometer by Fahrenheit, presumably graduated according to Fahrenheit's fourth or last method, and the same as now used; another thermometer by Thomas Heath, of London, divided into 90 equal parts, having No. 65 at the freezing point, No. 49 at temperate, and supposed to be the same as Hawksbee's. The hygroscope was a whip cord, which stretched five inches between its saturated and its driest point; these five inches were divided into a hundred equal parts analogous to our modern scale of relative humidity.

In 1742, Dr. John Winthrop, professor at Harvard College, began his record at Cambridge, Mass. He used Hawksbee's alcohol thermometer. "The scale is divided into 100 parts, beginning from a certain point above marked zero, and the hundredth degree falls just about at the bulb of the thermometer. The freezing point is numbered 65°. The divisions are upward to 8° above zero. The instrument shows the highest temperature, but not the lowest, for it goes into the bulb. How it was adjusted in London I know not, but it appears to me that the freezing point is marked considerably too high, for having plunged the bulb into a vessel of snow, I found that the spirit fell down to 76.5 and there rested."

In 1748, John Bartram began his record at Philadelphia, using a thermometer graduated to the Celsius scale. There seems to be a gap in his record between 1748 and 1758.

The record by Richard Brooke, in Maryland, extends only from 1753 to 1755. Much more information as to early observers may be found in the memoirs by Prof. A. J. Henry and others in Bulletin 11, part 2, but undoubtedly manuscripts and rare printed volumes, or almanacs and newspapers still exist and should be brought to light.—*C. A.*

WEATHER AND CROPS IN ARIZONA.

For the benefit of present or prospective Arizona farmers the Agricultural Experiment Station of that State has issued its Bulletin 48, Relation of Weather to Crops, by Alfred J. McClatchie. Observations under ordinary climatic conditions are scarcely applicable to Arizona, with its exceptionally low humidity and wide range of temperature. The report is based upon observations made during the past six years, and the effects of the weather upon each crop are considered in some detail. Almonds, olives, dates, and pomegranates are among the crops that may be successfully cultivated. According to the author:

The total amount of agricultural products that Arizona will yield is limited principally by the quantity of water available for irrigation, but the nature of these products is determined principally by the climate of the region. The lowest temperature recorded at the experiment station during the last eight years in a shelter 5 feet above the ground was 17° F., and the highest 119°. The mean relative humidity is 35 per cent, and the annual rainfall is only from 5 to 8 inches. A larger number of crops endure the low temperatures that occur than endure well the high ones, a condition the opposite of that existing in the northern portion of the country. Instead of crops being grown between two winters, as is the case in the North, the most of them are grown between two summers, the number that grow through the summer here being about the same as live through the winter in the North.

In considering the effect of weather upon different crops, some difficulty is experienced in distinguishing with certainty between the results caused by the different phases of the weather and those caused by soil conditions. Differences in the physical and chemical conditions of the soil, especially differences in the amount of alkali present, cause more or less marked differences in the ability with which crops resist unfavorable weather conditions. * * *

Crops affect considerably the temperatures about and among them. Through the cooling effect of evaporation and radiation combined the temperature becomes lower among growing plants than it is over bare ground. The temperatures to which crops are subjected are, therefore, more trying during frosty nights and less trying during hot days than thermometers situated outside of their foliage would indicate. * * *

During weather too cool for the normal growth of a plant, direct sunshine promotes its activities and results in benefit. The almost continuous bright sunshine of our winters is, therefore, a distinct advantage to vegetation. During the warm portion of the year parts of many plants become overheated in direct sunshine and injury to tissue results. This is especially true of exposed stems, fruits, and vegetables. Since the leaves are continually being cooled, more or less, by the evaporation of moisture from their tissues, they do not become as highly heated as do stems and tree trunks, from which no evaporation is taking place. Hence, a plant or tree with heavy foliage that shades the other parts has a distinct advantage over one with slight foliage, provided it is supplied with sufficient water. * * *

Of the 80 crops discussed in a preceding part of the bulletin, 74 thrive best in an atmosphere having a somewhat higher relative humidity than prevails in southern Arizona. In some cases deciduous trees, though abundantly watered, are so affected by the dryness of the winter and spring atmosphere that they put out their leaves very tardily and incompletely, presenting the appearance of having been injured by extremely low temperatures. Very rarely is the atmosphere of the region too damp for the proper development of any crop. * * *

The direct effect of the local rainfall is not great. The higher humidity that accompanies it is a benefit, and the lower temperatures that accompany the summer showers are a relief to most crops. Local rains are heartily welcomed, chiefly because rain falls at the same time in the region furnishing the supply of water for irrigation.

The author made a series of temperature observations by decades for three years, with a sheltered thermometer 5 feet above the ground, and with three unsheltered thermometers at elevations of a few inches, 5 feet and 10 feet, respectively, and also, with the view of obtaining the temperatures to which the foliage of plants of various heights is actually subjected, with three unsheltered thermometers at elevations of a few inches, 5 feet and 10 feet, respectively. These last results have little quantitative value, as a bright-bulb thermometer exposed to the sun gives neither the temperature of the atmosphere on the one hand, nor, on the other, the temperature of foliage similarly placed, but probably approaches more closely to the former than to the latter.

The author also compares his results with the sheltered thermometer with those obtained from a thermometer at Phoenix, 2 miles distant, in a shelter 50 feet above the ground, and finds that the minimum temperatures recorded at Phoenix are from 3° to 6° higher. While the dry atmosphere of Arizona is favorable to temperature inversion, it is hardly safe to assume, with the author, that "this difference is evidently due entirely to the difference in elevation." He finds a decrease of about 2° in the mean maximum temperature at the higher elevation.

The undersigned is acquainted with but few researches that suffice to show, for moderate elevations, the effect upon the maximum temperature of height above ground. Some that have been published are of little value, on account of their short duration or the faulty exposure of the thermometers. Wild, observing at Pulkowa from September, 1872, to October, 1874,[1] with sheltered thermometers at heights of 1.9 meters, 15.9 meters, and 26.3 meters, obtained from the 1 p. m. observations the following mean departures from the readings of the lowest thermometer:

	Difference in ° C.	
	At 15.9 meters.	At 26.3 meters.
November–March....	+0.12	+0.11
April–September.....	−0.35	−0.37

Dines, in England,[2] September, 1876–September, 1878, found a mean maximum temperature of 58.7° F. in a shelter 4 feet from the ground, with a difference of —1.23° at an elevation of 50 feet. Glaisher, at the Royal Observatory at Greenwich,[3] with thermometers at 4 feet, 22 feet, and 50 feet, found in the mean temperature at 2 p. m. a decrease of 1.4° at 22

[1] Repertorium für Meteorologie, vol. 5, No. 2.

[2] Quarterly Journal of the Meteorological Society, vol. 8, p. 190.

[3] Proc. Met. Soc., vol. 5, p. 29.

feet and of 3.5° at 50 feet. But his observations cover only a few weeks in the hottest part of the year, from June 25 to August 6, and there is some uncertainty as to the protection of the thermometers.

G. J. Symons,[4] with observations from April to December, inclusive, at elevations of 4 feet and 170 feet above ground, finds a decrease of 1.9° F. in the mean maximum temperature at the upper station.

This matter is also discussed by Professor Abbe in the MONTHLY WEATHER REVIEW for 1897, vol. 25, p. 253, second column.

It is not at present practicable to answer the complex question as to what may be the exact nature and amount of the reduction of a temperature, wind velocity, or rainfall from elevated stations down to the exposure near the surface of the open ground. Undoubtedly on our elevated buildings the temperatures are slightly lower, the rain catch considerably smaller, and the wind velocity frequently larger than for stations at the surface of the ground, but comparison with other stations shows that the differences do not seem so large as has often been feared. So far as temperature is concerned, it is much more difficult to determine the true temperature of the air near the ground than at the top of a tall building, because at the ground the wind is much diminished and is liable to bring special streaks of hot and cold air. At the higher level, the special streaks of hot and cold air have all merged into one homogeneous mass, and the strength of the wind facilitates the ventilation of the thermometer shelter.

F. O. S.

THE WEATHER OF ICELAND AND EUROPE.

An interesting paper was read by Professor Hann before the Academy of Sciences at Vienna on January 7, entitled "The anomalies of the weather in Iceland, during the interval 1851–1900, and their relations to the simultaneous anomalies of the weather in northwestern Europe." It is well known that for many years the meteorologists of Europe have desired telegraphic information from Iceland, with the assurance that daily weather reports from that locality would certainly be very helpful in making daily weather predictions. By analogy it has been supposed that similar telegrams from Hawaii and from the Aleutian Islands would be exceedingly useful to the forecasters on our Pacific coast. It has even been argued that inasmuch as weather changes do not always mean from west to east, it might sometimes happen that reports from Iceland would be useful to the American forecaster. In fact, when a great area of low pressure is central in Iceland, there really is reason to believe that it does influence American weather by drawing the air from our extreme north southward over Canada and New England.

The object of Professor Hann's investigation is to arrive at a few general ideas as to the relation between the weather of Iceland and of northern Europe. He has studied the monthly and annual averages of temperature, pressure, and precipitation for the last half century, as recorded at Stykkisholm, and more especially the departures of the individual months from the general average, as compared with corresponding departures for the stations at Greenwich, Brussels, and Vienna, and with those for Ponta Delgada. The following sentences contain some of his more interesting results.

As regards barometric pressure, the departures of barometric pressure in northwestern and central Europe are in the opposite direction to the simultaneous departures at Stykkisholm in 70 per cent, of the cases. The same is true of temperature in only 56 per cent, and of precipitation in only 68 per cent, when we compare Iceland with Brussels.

The relation between the departures in pressure at Stykkisholm and the simultaneous departures in temperature over central and northwestern Europe is much more pronounced. When negative departures in pressure prevailed at Stykkisholm, then the probability of a simultaneous positive departure in temperature in Europe is 82 per cent. Inversely, when the pressure departure is positive at Stykkisholm, then the temperature departure is negative in 73 per cent of the cases for northern Europe.

An area of low pressure is almost stationary during the winter in the neighborhood of Iceland; if this low pressure falls decidedly, the winter temperature of Europe rises; if the central low pressure is higher than usual, the temperature of Europe is lower. The three largest temperature departures for each month and the year at Greenwich were compared with the similar departures in Iceland. Out of eighty-three cases, 84 per cent occurred simultaneously with a great departure in pressure in the opposite direction at Stykkisholm. In general, present investigation confirms the rule first enunciated by Buchan that a mild climate in northwestern and central Europe is associated with low pressure over Iceland.

Professor Hann then investigates the relation between the simultaneous anomalies of pressure at Ponta Delgada, Azores, and Stykkisholm; also the general relation between the high pressure of the tropical Atlantic and the low pressure of Iceland. On the average of forty-two cases, a rise of 4.5 millimeters at Ponta Delgada means a fall of 2.4 millimeters at Stykkisholm, and a fall of 5.1 millimeters at Ponta Delgada means a rise of 4.4 millimeters at Stykkisholm. In general, the probability of an opposite change at these two stations is 77 per cent.

Already in 1897, Hildebrandsson, in his researches on centers of action in the atmosphere, has given tables for ten years and charts bringing out in a general way the relation between pressures throughout the globe; but Hann's studies for fifty years give us a numerical result showing that to a certain extent the great areas of high and low pressure over the land vary inversely. The greatest positive departures of pressure at Stykkisholm correspond in 80 per cent of the cases to negative departures at Ponta Delgada, and the great negative departures at Stykkisholm correspond to positive departures at Ponta Delgada in 87 per cent of the cases. If the pressure over the Azores is higher than the average and at the same time the pressure over Iceland is lower, as happened in 70 or 80 per cent of the cases, then the gradient of pressure over the Atlantic Ocean is increased. The atmospheric machine works more intensively, and vice versa. The mean gradient difference in pressure between the Azores and Iceland is 14.7 millimeters in December, 18.3 in January, 14.3 in February, and 9.8 in March. The cases where the pressure over the Azores is unusually high and over Iceland unusually low are especially interesting; they are not to be considered as a result of the location of the subtropical belt of high pressure, but as a consequence of an increased intensity in the atmospheric circulation. If the northeast trade blows more powerfully than usual, it increases the maximum pressure on its right-hand side; but by this process the great whirl in the North Atlantic Ocean is intensified and the pressure of the atmosphere at its center near Iceland is diminished. Therefore, the above-proven contrasts in the pressure anomalies over the Azores and Iceland operate like cause and effect.

The last section of Hann's memoir deals with the relation between Stykkisholm (65° 4′) and the nearest station on the east coast of Greenland, namely, Angmagsalik (65° 37′), distant about 800 miles from each other. Stykkisholm is on the western coast of Iceland. Between it and Angmagsalik flows the cold polar stream on the west and the warm Irminger stream on the east, giving Greenland a cold climate and Iceland a relatively warm one. On the average of seven years of observations, 1895–1901, the mean difference of temperature between the two stations is greatest in February, 8.1° C., and on the annual average is 5.3° C. The gradient of temperature per degree of a great circle (111 kilometers, 59.9 geographic miles, 69.1 statute miles) is 1.1° C. in winter and 0.9° on the annual

[4] Proc. Roy. Soc., vol. 35, p. 349.