on the mountains and in the canyons and is always sufficient to produce a flood, if rapid melting occurs over the entire country. Should the melting occur at intervals or be gradual, as is usually the case, then high water occurs, but not a flood. A flood will not occur if the country drained by the Snake loses its snow before the snow melts from the upper Columbia country, but should the snow melt over both sections at the same time, as in 1894, a flood is inevitable. The greatest amount of snow is usually found in the mountains of northeastern Oregon and northern Idaho. An examination of the physical condition prevailing over the Pacific northwest will make it clear why this is so. A very large amount of snow is found in eastern British Columbia and the northern portion of central Washington; in the other sections the snowfall is of much less amount, hence it is not so important for the purpose of this paper.

In 1893–94, the greatest excess of precipitation occurred in January, December, and March. In 1898–99, there was no month with any marked excess of precipitation occurring in the entire district under discussion. Considering that a deficiency of precipitation occurred at all places named, and such was the case in 1898–99, it is reasonable to assume, and it is assumed, that a similar deficiency occurred over the surrounding mountain region; if this be true, then there was not the amount of snowfall in the mountains during the past winter that there was in the winter of 1893–94. Floods in the Columbia do not depend so much upon the total precipitation of winter, as upon the amounts of snow in the mountains when the thawing in April begins. It is well known that the influence of chinook winds removes great quantities of snow from the foot hills and lower mountains during the winter season, and an absence of chinooks or even normal temperatures will allow much of the snow that falls during the winter to remain unmelted until spring. Such snow packs, hardens, and becomes a greater mass, for each new fall of snow adds to that already fallen and remains unmelted. These facts being established, the temperature conditions during the winter then become as important as the precipitation.

[Here follow statements giving the departure from the normal temperature, at various places for the winters of 1893–94 and 1898–99.—ED.]

A summary of the these shows that the various places were colder in 1898–99 than in 1893–94, as follows: Spokane, 3.7°; Walla Walla, 12.4°; Idaho Falls, 3°, and Helena, 19.5°. At Baker City, owing to the warmth of January, 1899, the past winter has been 2.7° warmer than the winter of 1893–94. This warmth was purely local at Baker City, and can have no material influence on the subject as a whole.

The winter of 1893–94 had, on an average, over the country drained by the Columbia and tributary rivers, 10.22 inches of precipitation, and in 1898–99 it had 7.34 inches; or the former had 2.88 inches more precipitation than the latter. While this is true as regards the precipitation, the temperature record shows that the last winter averaged 5.2° colder than the winter of 1893–94. Considering the absence of the usual number of chinook winds during the last winter, and the almost continuous deficiency in temperature, the consequent increased accumulation of snow, for up to April 1, there has been practically no melting, it is reasonable, therefore, to assume that there is, on April 1, 1899, as much or possibly more snow in the mountains than there was on April 1, 1894. This deduction from the actual records is proven by the reports from over 200 persons, living at the present time, nearest to the snow line.

Assuming, then, that there is as much snow in the mountains on April 1, 1899, as on the same date five years ago, it is apparent that the Columbia will have to carry to the ocean the same number of gallons of water during the next three months that it carried in 1894.

The amount of snow now in the mountains is sufficient to produce a flood, if May has a period of warm weather. If there are alternate warm and cool periods there is less possibility of a flood. If the warm weather covers Idaho and Oregon before it reaches Washington, British Columbia, and Montana, the water will not be as high in the river as it will be should the warm weather invest the entire Pacific northwest at the same time.

It can safely be assumed that the river at Portland will rise to from 20 to 25 feet, and at Umatilla about 2 feet more; at The Dalles the height will be from 37 to 45 feet. These heights will probably occur during the month of June; higher water in the river will prevail if temperatures much above the normal prevail during the latter part of May and the fore part of June.

NOTES BY THE EDITOR.

CLIMATOLOGICAL DATA FOR CANADA.

The Annual Reports for the Meteorological Service of Canada for the years 1895 and 1896 have been published in quarto volumes, the previous reports for many years past having been confined to octavo. The new style gives room for the publication of much more climatological data than previously, and doubtless in future years the quantity will be still further increased. The Canadian stations are classified as *first-class* when all observations are made three times a day; *second-class*, when temperature, wind, weather, and rain are observed three times a day; *third-class*, when only precipitation and the general state of the weather are recorded. *First order* (international program), when self-registering instruments are maintained for pressure, temperature, evaporation, and wind, as the Magnetic Observatory at Toronto; *chief stations*, when all ordinary observations are taken at regular intervals not exceeding four hours; *telegraph reporting stations*, when the observations are taken three times a day—at 8 a. m., 3 p. m., and 8 p. m., seventy-fifth meridian time.

There are one first order, about thirty telegraph stations, about two hundred ordinary stations of the first, second, and third class, and eight chief stations whose records are given in the Report for 1895. The first part of the Report gives the monthly and annual summaries from telegraph and ordinary stations of the first class; sixty-four such stations are given on as many pages. Part II gives similar summaries for stations of the second class; in all about one hundred and sixty-three stations are given on eighty pages. Part III contains the monthly and annual mean temperatures and total precipitations for all stations; the mean temperatures are, when possible, computed by the formula $1/4\,(7 + 2 + 2 \times 9)$, otherwise by the average of the daily maximum and minimum or by the observations at various hours corrected to the daily mean by using the normals for Toronto; mean temperatures are given for about two hundred and twenty stations, as also the absolute maximum and minimum and the mean daily range of temperature; the monthly and annual rainfall is given for about two hundred and fifty stations, and the monthly and annual snowfall for the same. In Part IV the amount of sunshine, as registered for each day of the year, is given for fourteen stations, and the temperature observed every two hours for each day of the year at Regina, Kingston, Montreal, and Quebec, and for each hour at Toronto. These

hourly and bihourly observations give valuable data for determining the corrections needed to reduce miscellaneous hours of observation to the normal mean.

The Report for 1896 appears in two volumes and has more than twice the bulk of that for 1895. During this year there were more than three hundred stations of observation, classified as follows: Chief stations, 8; telegraph reporting stations, 30; ordinary first-class, 17; ordinary second-class, 177; ordinary third-class, 68; sunshine stations, 14. Of course, some stations fall into two categories. At the chief stations, the telegraph stations, and a few of the special stations the observers are paid for their time, but at the great bulk of the stations the work is purely voluntary, and the thanks of the public are due to those who, in the interest of their country and of science, devote their time gratuitously to the work. There are thirty telegraph stations whose reports are received in Toronto before 9:30 a. m., and which, combined with fifty-four reports received by exchange from the United States, enable the director at Toronto to issue maps and forecasts similar to those that are published at Washington. There are sixty-seven storm signal stations, thirty-two of which are on the Great Lakes. The daily forecasts are disseminated to agricultural communities and the general public promptly and widely.

The second volume of the Report for 1896 is occupied by Part V, which part does not appear in the report for 1895. This large volume is wholly occupied with minute details of the results of observations at the chief stations during the year 1896. There are eight chief stations, viz: Esquimault, B. C.; Winnipeg, Man.; Toronto, Ont.; Woodstock, Ont.; Montreal, Que.; Fredericton and St. John, N. B., and Halifax, N. S. For each of these stations the Report gives for each hour and day the complete record of the pressure, temperature, vapor pressure, relative humidity, cloudiness of the sky, the dry air pressure, the wet-bulb thermometer, and the dew-point. The whole record occupies 500 quarto pages and responds very closely to the requests of the International Meteorological Conference for the publication of detailed records at a few stations. It is a noble contribution of data needed for the study of climatology in its relation to every matter that interests civilized humanity.

THE ANNUAL SUMMARIES OF THE CLIMATE AND CROP SERVICE.

In looking over the annual summaries for 1898 of thirty-seven different sections of the Climate and Crop Service of the Weather Bureau, which are all that have been received up to date, one can but be impressed with the great mass of popular and valuable climatological data thus published in detail. Each summary consists of about five pages of numerical tables, three charts, and from three to seven pages of text. These summaries alone, without the accompanying monthly section reports, will when bound up together, present the general climatic conditions of the year in a form appropriate for many interesting studies into the relations between the climate on the one hand, and the agriculture, forestry, transportation, hygiene, and other important matters.

We notice a very few cases in which the respective section directors have added to these summaries some special study. As the section directors have frequently been encouraged by the Chief of Bureau to publish special memoirs in each annual summary, it may be possible that other papers will be found in the summaries that have not yet been received, viz, those for Michigan and North Dakota.

Mr. E. A. Evans, as section director for Virginia, has compiled a very instructive article on the physical features and flood conditions of the James River Valley, illustrated by hydrographs for Lynchburg and Richmond. This study is especially in line with the investigations now being carried on by the United States Geological Survey.

For California, Mr. McAdie gives a suggestive article by Mr. A. H. Bell, Weather Bureau observer, on the weather conditions along the coast of northern California. For Florida, Mr. A. J. Mitchell gives an instructive chart, showing the limit of freezing temperatures. For Georgia, Mr. J. B. Marbury reprints a short article by Mr. John Hyde, Statistician. For Kansas, Mr. T. B. Jennings reprints a portion of the annual snowfall bulletin of the Colorado section, also an annual summary for the University of Kansas. For Missouri, Mr. A. E. Hackett reprints a portion of Professor Hammon's bulletin on frost prevention. For Nebraska, Mr. G. A. Loveland gives a small chart of the distribution of snowfall during the year 1898. (Is the total annual snowfall for the first and last months of a calendar year as important to agriculture as the total for the four or five months of consecutive cold during one winter?)

For Maryland and Delaware, Mr. F. J. Walz gives diagrammatic curves, showing the relation between monthly normal temperatures or rainfall and the corresponding actual curves for the year, that are very instructive. The prevailing warmth of January, February, and March, the coldness of April, the warmth of the growing season, May 15 to October 15, and the coldness of November and December stand out very clearly.

Among these annual summaries we notice that those for Maryland, Iowa, New Jersey, and New York differ somewhat from other reports, possibly because published partly at the expense of the respective States. Iowa, in fact, compresses its annual summary into a single table appended to the monthly report for December. The annual summaries for Michigan, Nevada, New Jersey, and North Dakota have hitherto usually appeared as octavo pamphlets, but would it not in some cases be practicable, after printing off the octavo edition and before the type is distributed, to arrange the tables in a form appropriate to the quarto page and print a small edition for binding up with the monthly reports?

THE CLIMATE ADAPTED TO TOBACCO.

In the report of the Virginia section for May, Mr. E. A. Evans, Section Director, gives a summary of our knowledge of the soil and climate adapted to raising tobacco. So far as climate is concerned, tobacco raising is profitable over a very wide extent of territory throughout the world. The range of climate that is found in the United States by no means exhausts the adaptability of the plant; in fact, with tobacco it is as much a question of soil as of climate. The climatic peculiarities of the regions in which the best tobacco is grown are not especially dwelt upon by Mr. Evans, but would make an interesting subject for study. The cultivated plant is evidently more susceptible to weather than the native tobacco of Virginia, and is, probably, the descendant of some variety imported by the early settlers, so that both soil and climate must be adapted to it. In general, the agriculturist labors to overcome the natural climate of any spot, and his resulting crop represents not the plant, or the soil, or the climate, but the intelligence of the skilled labor.

We hardly know how one should proceed in order to obtain botanical or agricultural material for a fair comparison between different climates as to their effect upon any given plant. The question of the relation between climate and crop belongs to the Division of Soils even more than to the Weather Bureau, since the meteorological climate must be considered in connection with the underground conditions. The roots have one climate, the leaves and the fruit have another; the crop results from a combination of both, with a very large admixture of agricultural skill.