Snake River, and a description thereof would be but a repetition of the disasters of the early winter. Whitman County, Wash., was probably the chief sufferer, and it is estimated that the losses there were at least $1,000,000. The losses over the remainder of the State were about as much more. In the vicinity of Caldwell, Idaho, the losses amounted to about $200,000. These estimates do not include the losses to the railroads, which can not be given at this time. While no regular flood warning service is possible over the greater portion of this district, a general flood warning issued from the local office of the Weather Bureau at Portland, Oreg., on February 26, was of considerable value.

The flood in the Willamette River was, of course, forecast at the proper time, and a large amount of freight was removed from the docks at Portland before the arrival of the flood waters. The flood stages were general from Albany, Oreg., to the mouth of the river, with a crest stage of 19.6 feet, or 4.6 feet above the flood stage at Portland on March 5.

Nothing of interest occurred in the Sacramento watershed except the rapid disappearance of the winter snows, presaging a shortage of water during the coming season.

ICE.

The dates of breaking up of the ice in some of the more important rivers were as follows: Mississippi River, at Fort Ripley, Minn., on March 14; at Dubuque, Iowa, on March 16, and at Keokuk, Iowa, on March 3. Navigation was opened at Keokuk on March 15, and on Lake Pepin on March 24, the latter date said to have been the earliest on record. The lowest point at which ice was observed was at Chester, Ill., where there was some floating ice on March 2. Missouri River at Bismarck, on March 13, and Omaha on March 4. Red River of the North at Wahpeton, N. Dak., on March 7; Moorhead, Minn., on March 19, and Pembina, N. Dak., March 28.

Navigation on the Hudson River was opened on March 17, and at Hartford, Conn., on the Connecticut River, on March 8. The ice went out at Bellows Falls, Vt., on March 26, but the Penobscot River was not open throughout its entire length until March 27, although the ice went out at Mattawamkeag, Me., on March 8.

All dates were unusually early owing to the high temperature of the month.

Hydrographs for typical points on several principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.

SPECIAL PAPERS ON GENERAL METEOROLOGY.

COMMENTS ON PROFESSOR SWAIN'S ARTICLE ON FLOODS AND FORESTS.

(In American Forestry, April, 1910.)

By THOMAS P. ROBERTS, United States Engineer Office, Pittsburg, Pa.

The underlying motive of Professor Swain's argument in the Engineering News of April 14 is to connect the forest problem with the navigability of rivers and hence the questions involved are of considerable national importance. The position of the "foresters," of which body Professor Swain is a prominent representative, may be briefly stated as follows, to wit:

First. The forests, especially on the mountain slopes about the headwaters of the streams, tend to equalize the discharge of water from rains and melted snow restraining the floods on navigable rivers, and at the same time increasing their low water discharge from reserves of ground storage.[1]

Against this proposition some of the engineers engaged on river improvements contend that observations of river gage records and calculations of stream discharge lend but little, if indeed any, support to the theories of the foresters. Among other things it is contended that the per cent of rainfall discharged by the rivers during the winter or flood months, indicates, at least for most of the Ohio Valley, but a limited contribution to ground storage during that time and that this storage capacity is usually taxed to its utmost limit before the close of winter, and hence its restraining influence would seldom be of any importance. It must be the case that the line of permanently saturated soil and rock on great areas is much nearer the surface than it is commonly thought to be. This is undoubtedly the case where short-lived "wet weather" springs abound, the most prolific of which cease to flow in a few hours after the storms have passed.

Second. On the part of the foresters it is claimed that the destruction of forests leads to such soil waste or erosion about the headwaters as to result in the silting up of the beds of our navigble streams and thus to interference with traffic upon them.

Against this it is replied that on the Ohio at least, by reason of the greatly diminished number of snags and the effect of training works constructed by the Government at occasional points, there is much less silting than formerly, and that in consequence the navigable depth is somewhat better and very much safer. With the reduction in numbers of snags and tree trunks, which, in old times, formed the nucleus of sand bars, the force of the flood currents tends to create and maintain a more uniform cross section with less undermining of the banks and consequently greater stability of shore bars. Speaking of the San Francisco River in Brazil the late W. Milnor Roberts, C. E., said the permanent shore and other bars were a distinct advantage to the navigation of the stream by contracting the discharge in wide places and thus, with a given volume of water, increasing the navigable depth. The present writer, whose experience on western rivers dates from 1866, and who is very familiar with the stories of pilots extending back to 1837, takes this occasion to emphasize the statement that the Ohio is greatly improved over its old-time conditions in every respect. Regarding the Ohio's low water discharge, certain United States Indian Commissioners, in 1785, reported such tributaries as the Little Miami, 1,800 square miles drainage area, near where Cincinnati has since grown up, so low that there was no water visible flowing from it into the Ohio.[2] The figures of measured discharge, reported by Col. Charles Ellett at Wheeling, and Major Sanders at Pittsburg, in 1838, were as low as the discharge for 1908. The year 1854 is thought to have been about the same as 1838 and 1908, but the actual minimum discharge was not obtained in 1854. Also, regarding high water discharges, attention is invited to Judge Hugh Brackenridge's (afterwards Chief Justice of Pennsylvania) account, published in 1786 in the Pittsburg Gazette, of a flood in the Allegheny scouring away the river bank near Fort Pitt, totally destroying a long row of houses with their gardens. Viewing these extremes, it is difficult to believe that the operations of man during the past century have resulted in any detriment to the river.

Professor Swain admits, and it should be generally understood, that grave doubts are entertained by some of our national legislators as to the right of Congress to authorize expenditures for the purchase of land and reforesting same unless it can be clearly shown that such expenditures will result in a benefit to the public and made necessary for the improvement of inland navigation.

[1] To amount to anything for the benefit of open river navigation, the volume of such reserve water must be very great.

[2] The commissioners reported that their flat boats were frequently aground on the shoals, which were as bad below Wheeling as above that point.

It is only, however, quite recently that the foresters have proposed to take the navigable rivers under their wings. Formerly it was the matter of diminishing timber supply and advancing prices, to which they patriotically directed the attention of the country, and to this good work no one ever raised a voice in opposition. When, however, they encountered the constitutional difficulty above referred to they at once proceeded to annex river improvement plans to their field of enterprise.

Some of the first claims of the foresters against the operation of the river engineers were ridiculous in the extreme. Thus, for instance, that with forest conservation, aided by occasional reservoirs over the basin of the Ohio, locks and dams would be useless, that perennial depths of 6 or more feet could be maintained from near the heads of the principal tributaries which would afford unobstructed navigation the year round. It was also claimed that the floods could be kept below the danger line and that the income from water powers would compensate for the necessary expenditure.

Propositions looking to these ends were put forward in a most illuring manner in magazines and newspapers, and through boards of trade, and lecture bureaus, while university professors stepped into the field to work for the common cause. There is no doubt about it, it was a common cause, for the people everywhere agreed with the editors, professors, and lecturers. Even to-day if the question were to be decided by numbers the foresters would win by a tremendous majority, and it is rather odd they have not before this secured their desired legislation. There must be, it appears, some things which almost every one thinks should be done, which are not done because of the restraining advice of but a few individuals. It is probably the case that while the mass of the people are with the forestry leaders in sentiment they are not overly excited and are ready and willing to listen to representations of the "corporal's guard" in opposition to the foresters. It was so in 1885 when the present writer was actually invited by the American Forestry Congress to appear before that body and address it, the invitation being accompanied by the friendly advice that the guest would be appearing before an audience unanimously hostile to his views. A personal appearance was not possible, but the congress very generously published his paper without an axe mark in its proceedings.

To-day, however, the number of those in so-called "opposition" to the claims of the foresters regarding river improvements is larger and increasing in numbers, and the congressional committes are willing to hear them. Not for one moment should the river engineers and their little band of friends be considered as hostile to the proposed expenditure of $5,000,000 for Appalachian and White mountain lands for the purpose of converting them into national forests, but they do not believe in attempting to justify such an expenditure on the ground that it will better the navigable conditions of the rivers, or in any way reduce the expenditures necessary to complete the projects now under way for the improvement of inland navigation.

Too much biased or, rather, extravagant opinion, unaccompanied by the data on which it is based, creeps into the discussions of the forest and flood problems, as presented by such writers as Professor Swain, and which really does his side of the question more harm than good. It has been pointed out frequently by meteorologists how common it is for erring humanity trusting to individual recollections, to assume that the climate is changing, especially as to snowfall, and then come ill-founded deductions and theories based upon them, all firmly believed; the more so because they are rarely contradicted, but nevertheless wrong. Thus, for instance, Professor Swain goes back as far as the 1879 report of the Chief of Engineers, U. S. A., to quote Maj. Charles O. Allen, as follows:

> The weight of evidence collected by various writers upon the subject of rainfall seems to indicate that reforesting of extensive areas of country is followed by a more equable distribution of the rainfall throughout the year.

More personally painful is the statement that Professor Swain lays bare regarding the present writer's weakness and ignorance when he wrote in the same 1879 report, as follows:

> The clearing of forest land, I believe, is followed by greater fluctuations in our rivers. I think the storm waters undoubtedly reach the streams more rapidly now than formerly.

This exposure makes the present writer feel more disposed to forgive the weakness of others who lingered longer outside the "true faith" than he did. The present writer began to be converted in 1883 and was nearly turned around to the side of recorded facts, especially those of long-continued European river observations, when he was called to appear before the American Forestry Congress in 1885.

Maj. Charles W. Raymond, writing in the Chief of Engineer's Report for 1891, is also quoted by Professor Swain as follows:

> The destruction of forests from the mountain crests and slopes of a water shed is undoubtedly the principal cause of the increase of the average magnitude of floods. The evidence collected during the past 25 years, establishing this conclusion, is well nigh overwhelming, and it is verified by repeated observations not only in the mountains of Europe, but also in our own land.

Then a few lines below Major Raymond continues as follows:

> Colonel Torrelli affirms as the result of careful observations that four-fifthsof the precipitation in forests is absorbed by the soil or detained by the surface of the ground to be gradually given up in springs and gentle rills and only one-fifth of the precipitation is delivered to the rivers rapidly enough to create floods. Upon the same slopes and surfaces denuded of their forests the proportions are reversed.

It is to be noted that this is a difference of four to one in favor of the forests. There are so very many negative results shown in the studies of river records as to leave no standing whatever for such wild claims as those made by Colonel Torrelli.

Professor Swain should not speak of "careful observations," when quoting others, without looking them up, especially in view of the fact that in other parts of his paper he disclaims some of the extravagant claims made for forests in restraining floods.

On the subject of erosion also Professor Swain can be criticised. In the place where he is trying to corner Prof. Willis L. Moore, as if to illustrate, he says:

> The immediate effect of deforestation on floods and in the deposition of sediment will clearly be felt first in the upper reaches of the streams, on the Ohio River, for instance, at Pittsburg and points above.

The case probably looked good on the map, but the professor could scarcely have made a greater mistake than in choosing the upper Ohio. In many places in western Pennsylvania and West Virginia very steep hillsides may be seen which have been plowed and cultivated for decades and still they are planted in wheat and corn without the least attempt to fertilize them and with little done with ditches to carry off surface water. When left fallow the bared ground is productive of grass quite sufficient to prevent their gullying. There are regions of steep slopes in the glacial drift areas of the upper Allegheny, formerly heavily covered with pine trees, now bare excepting for grass, while the streams issuing from such comparatively bared regions have the largest low water discharge per unit of area of any streams in Pennsylvania, unless exception be made of the limestone district of the Cumberland Valley west of Harrisburg. The Monongahela River is much clearer at medium flood and low stages now than in early periods, for it was formerly muddy the year around and was called, in some Indian dialect, "The Caving Bank," or the "Muddy River," "Monongahela" meaning muddy or caving bank. Its extreme clarity at low water periods of later years, it is proper to say, is due to acids reaching it from coal mines and galvanizing establishments.

It is, however, time that a treaty of peace be made between the contending factions of the forestry and flood problem. The present writer believes that the river engineers will join with the foresters any time for the salvation of our forests. They may

want to stand on the proposition, however, that the *irregularities of the rivers are due to their habit of following the irregularities of precipitation, irrespective of the nature of the cover on the ground.* The present writer, who claims to be a disciple of the river engineers, would like to present as an article for the treaty of peace, that there is an analogy between the annual discharge of the upper Ohio and the variation of levels of the Great Lakes, for the purpose of showing that whatever it is which produces extremes of drought or high water in the Ohio, has its seat of operation in the Gulf of Mexico and the Pacific Ocean, that the forested areas of the central United States are creations of those operations, and that cutting away the forests has in no wise interfered with them, or reduced or increased the volume of the Ohio returned annually to the ocean.

It is to be feared, however, that no lasting peace can be made until the meteorologists and the hydrologists have worked up all their available data (they are the court of last resort) and deal only with facts and figures, as indeed the engineers have tried to do, but have not always been well treated by the popular tribunals.

SUMMARY OF THE CLIMATOLOGICAL DATA FOR THE UNITED STATES, BY SECTIONS.

By Prof. FRANK H. BIGELOW, in charge of the Climatological Division.

The climatological data of the United States, which have accumulated for the last half century, have been recently collected together in a series of summaries, 106 in number, covering the United States by sections, as given on the accompanying chart. It has been found convenient for various purposes to bring the data together for ready reference, in order that the numerous inquiries addressed to the Central Office or to the section directors may be more readily answered. The summaries also serve the purpose of special studies on the part of engineers and others interested in water resources, in farming operations, and in climatological matters generally. The records of the Central Office have been carefully compared with the retained copies on the stations, and all possible errors have been eliminated from these tables. The Annual Report of the Chief of the Weather Bureau will contain similar data for the years succeeding 1908, so that the record will be continuous for the future. The summaries contain a statement of the topographical and climatic features of the region, with remarks of a practical nature such as are likely to be of interest to the reader. The tables include the precipitation for the section, giving the monthly, annual, and average amounts of rain or the equivalent of snow in inches and hundredths. Some gaps which have occurred in the records are filled in by interpolation of data from surrounding stations, such interpolated values being printed in bold faced type.

A series of subordinate tables follow, giving (*a*) the average number of days with 0.01 inch or more of precipitation in each month; (*b*) the mean temperature; (*c*) the highest temperature; (*d*) the lowest temperature; (*e*) the average hourly wind movement in miles; (*f*) the mean relative humidity in percentage; (*g*) the prevailing wind direction; (*h*) the frost data, etc.

A brief summary of hydrographic data for the section, furnished by the United States Geological Survey, is added, which gives some of the relations between the precipitation and the discharge of the important rivers for each month, namely, the maximum, minimum, and mean discharge in second-feet; also per square mile, together with the run-off as depth in inches on the drainage area and total in acre-feet.

Diagrams are added showing the comparative monthly distribution of precipitation at a number of stations, and a chart showing the boundaries of the sections, the location and number of reporting stations, river systems, and general elevation above sea level.

These summaries will finally be brought together in a volume and this will give a history of the climate of the United States in as convenient a form for reference as is practicable.

RECENT PAPERS BEARING ON METEOROLOGY AND SEISMOLOGY.

C. FITZHUGH TALMAN, Librarian.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ——.

American forestry. Washington. v. 16. April, 1910.
Roth, Filibert. The Appalachian forests and the Moore report. p. 209–217.
Glenn, L. C. Forests as factors in stream flow. p. 217–224.
Swain, George F. "The influence of forests on climate and on floods." A review of Prof. Willis L. Moore's report. p. 224–240.

Astrophysical journal. Chicago. v. 31. April, 1910.
Barnard, E. E. Observations of the aurora made at the Yerkes observatory, 1902–1909.

Electrician. London. v. 64. March 11, 1910.
—— Some magnetic storm records. p. 891–892. [Includes diagram of earth currents obtained on broken Atlantic cable before and during magnetic storm.]

Engineering news. New York. v. 63. April 14, 1910.
Swain, George F. The influence of forests on climate, floods, and erosion. p. 427–429. [Extracts from discussion of a report by Prof. Willis L. Moore, from an advance copy of a contribution to "American forestry."]
White, Lazarus. The retarding of snow melting by forests in the Catskills. p. 436. [Illustrated.]

Geographical journal. London. v. 35. April, 1910.
Beadnell, H. J. Llewellyn. The sand dunes of the Libyan desert. p. 379–395. [Includes discussion of sand-carrying winds and sandstorms.]
Huntington, Ellsworth. Problems in exploration—Central Asia. p. 395–419. [Outlines methods of investigating possible changes of climate in Central Asia.]

Indian meteorological department. Memoirs. Simla. v. 21, pt. 1. 1910.
Walker, Gilbert T. On the meteorological evidence for supposed changes of climate in India. p. 1–21.

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Bo'ston, W. E. The spectrum of the zodiacal light. p. 470–471. (Feb. 17.)

Nature. London. v. 83. 1910.
Schuster, Arthur. Prof. K. J. Ångström. p. 134–135. (Mar. 31.)
Cook, J. Center of gravity of annual rainfall. p. 125–126. (Mar. 31.)
Watt, Andrew. Center of gravity of annual rainfall. p. 188. (Apr. 14.) [Criticism of Cook's method of comparing annual rainfalls.]

Popular science monthly. New York. v. 77. May, 1910.
Bigelow, Frank H The circulations of the atmospheres of the earth and of the sun. p. 437–461.
Smith, James Perrin. Ancient climates of the west coast. p. 478–486.

Royal society. Philosophical transactions. London. ser. A. v. 210.
Swann, W. F. G. On the specific heats of air and carbon dioxide at atmospheric pressure by the continuous electric method at 20° C. and 100° C. p. 199–238.

Royal society. Proceedings. London. ser. A. v. 83. 1909.
Simpson, George C. On the electricity of rain and snow. p. 394–404.

Science. New York. v. 31. April 15, 1910.
Matthes, François E. Air currents in mountain valleys. p. 577–578.

Scientific American. New York. v. 102. April 9, 1910.
—— A reform in meteorological units. p. 294.

Symons's meteorological magazine. London. v. 45. April, 1910.
Mossman, R. C. Correlation of climatic changes. p. 45–46.

Aérophile. Paris. 18 année. 15 mars 1910.
Lorenc, Vladimir, & Lorenc, Victor. Du rôle du vent dans l'aviation. p. 127–129.

Ciel et terre. Bruxelles. 31 année. 1910.
Neumann, S. Navarro. Le tremblement de terre Ibérique du 23 avril 1909. p. 41–51. (Février.)
V[andevyver]. Vulgarisation de la météorologie. p. 99–106. (Mars.)
—— Le paratonnerre avant Franklin. p. 127–131. (Mars.)
L., E. Électricité atmosphérique et électromètres. p. 140–141. (Mars.)

France. Académie des sciences. Comptes rendus. Tome 150. 21 mars 1910.
Nouailhac-Pioch & Maillet, Edmond. Sur les crues de la Seine en janvier-février 1910. p. 813–816. [Includes summary of the meteorological factors.]