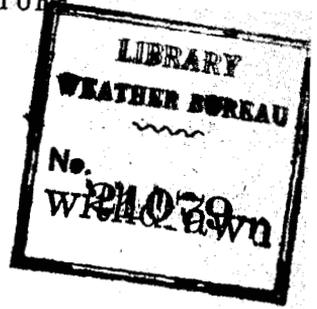


U. S. DEPARTMENT OF AGRICULTURE



REPORT

OF THE

CHIEF OF THE WEATHER BUREAU

FOR

1895.

BY

WILLIS L. MOORE.

[FROM THE REPORT OF THE SECRETARY OF AGRICULTURE.]



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1895.

National Oceanic and Atmospheric Administration Report of the Chief of the Weather Bureau

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REPORT OF THE CHIEF OF THE WEATHER BUREAU.

SIR: I have the honor to submit a report of the operations of the Weather Bureau during the year ended June 30, 1895, prepared from the reports of the Bureau as turned over to me upon assuming office, July 4, 1895. I submit, further, a plan of the work as outlined for the current year, and, in conclusion, submit estimates, based upon such plans, for the operations of the ensuing fiscal year.

Very respectfully,

WILLIS L. MOORE,
Chief.

Hon. J. STERLING MORTON,
Secretary.

OPERATIONS FOR THE YEAR ENDED JUNE 30, 1895.

The following is a statement of the appropriation, expenses, and receipts of the Bureau for the year:

Appropriation	\$878,438.84
Expenses	820,936.10
	<hr/>
Balance of appropriation.....	57,502.74

In addition to the above the following sums were received from various sources and deposited in the Treasury:

Condemned property, waste paper, etc.....	\$969.68
Sale of publications.....	77.99
U. S. Seacoast Telegraph Line receipts	4,450.90
	<hr/>
Total deposited in Treasury.....	5,498.57

DUTIES OF THE FORECAST DIVISION.

This Division has charge of the Forecast work both at the main office and at the stations, including the issue of wind-signal orders and cold-wave, frost, and flood warnings, and the verification of forecasts and warnings, the supervision of the wind-signal display, special river, and rainfall stations, the publication and distribution of the maps and meteorological bulletins issued on stations, the Tropical hurricane reporting stations, and the Washington meteorological station.

FORECASTS.

The twice-daily forecasts have been issued as usual during the year, for the same periods and territory as for the preceding year.

The forecasts for the territory east of the Rocky Mountains have been issued from the Washington office, except that beginning with October, 1894; the morning forecast for Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, Kansas, Nebraska, North and South Dakota, Montana, Wyoming, and Colorado has been issued exclusively by the official in charge of the Weather Bureau office at Chicago, Ill.

The forecasts for California, Nevada, Arizona, and Utah have been issued by the official in charge of the Weather Bureau office at San Francisco, and those for Oregon, Washington, and Idaho by the official in charge at Portland, Oreg.

Storm warnings have been telegraphed to the lake and seacoast stations and to the director of the Canadian Meteorological Service at Toronto, warnings of frost to fruit, cranberry, tobacco, cotton, and sugar regions, and warnings of severe local storms, cold waves, northers, and dangerous floods, to the threatened districts.

A large number of specific instances are cited in the annual reports of the observers, where the forecasts have been the direct means of saving large amounts of property of various kinds, the value amounting in the aggregate to many thousands of dollars. Following are among the more notable of these extracts, viz :

San Francisco, Cal.—The raisin industry of this State is absolutely dependent upon the Weather Bureau for success. The high-grade crop is sun dried, and if it becomes wet by rain its market value falls below the cost of production. An unexpected rain during the drying season means a loss of hundreds of thousands of dollars. Such losses were prevented by warnings of this office last year. What is true of raisins is true, but to a less degree, of all drying fruits, which is one of the greatest industries in California. Frost warnings in this State are of inestimable value. Warnings of this character this spring, when fruit was in blossom and setting, were doubtless worth hundreds of thousands of dollars. I have been informed of one person, near Red Bluff, who smudged his orchard in response to the warning received, and his crop is now double that of his neighbor who paid no attention to the warning, showing a gain to him of several thousand dollars. These warnings are equally, if not more, valuable in winter to orange growers.

St. Paul, Minn.—Estimated money value saved to shippers and dealers in fruit on account of cold-wave warnings, \$100,000 annually in the last two years. Many thousands of dollars saved to railroad men.

Minneapolis, Minn.—The total number of cold-wave warnings displayed during the year was 19, and they gave excellent satisfaction. It is estimated that fully \$100,000 worth of property alone was saved in this vicinity by means of these warnings.

Raleigh, N. C.—The warnings of the severe cold waves in February, 1895, were of great value to the railroad men, as precautions were taken to prevent the freezing of water pipes, and perishable fruit was ordered removed from the depots. It is estimated that about \$50,000 worth of property was saved by the warnings this year.

Montgomery, Ala.—The cold-wave service is really one of the most important features of the Weather Bureau work in this section. The warnings are widely distributed by mail, telegraph, and telephone. The warnings of February 6 and March 1 were especially beneficial to the early truck planters of this vicinity; also to shippers of perishable goods likely to be damaged by cold, who watch our reports and warnings closely. It is estimated that these warnings saved \$45,000 to the truckers of this section, and it is safe to say that the money value of these warnings to other interests in the past year is \$25,000. The river warnings are also of great benefit to the river commerce and lumber interests. It is difficult to form an estimate of the money value of these warnings to the

various interests, but it is safe to say that during the past year it would aggregate \$300,000.

Harrisburg, Pa.—It is estimated that the railroad companies alone saved in the vicinity of half a million of dollars by timely warnings of storms and cold waves. I never saw so much interest manifested by railroad officials before in the weather reports as at present.

Columbus, Ohio.—The warnings were very timely and gave unusual satisfaction, especially so during the severe cold waves in February. The expression from the different classes was one of great satisfaction with the promptness and benefits derived. During cold-wave periods, besides the publication, the warnings were telephoned to sixty individuals, railroads, and shipping houses in this city. It is difficult to estimate the amount of property saved by this means, but several hundred thousand dollars would be a low estimate. Over 50 car loads of perishable produce were held in safe places on several occasions during the severe winter weather. The ice and coal men conducted their business to greater advantage than ever before, and were greatly benefited. The breweries shipped all bottled goods on daily advices from this office and expressed their great satisfaction with the service.

Buffalo, N. Y.—October 5, large fleet of vessels detained by storm, ample warning having been given on the 4th. At least one million dollars' worth of property represented. The steam barge *Arnold* with two barges and the steam barge *Rhoda Stewart* with one barge cleared in early morning against the advice of the local forecast official and were compelled to return. November 2, warning given to-day was it marked success; wind reached a maximum velocity of 59 miles an hour from the southwest. Navigation entirely suspended. The warning was worth a million of dollars. Special request from Port Colborne, Canada, and other places for information as to duration of storm.

Chicago, Ill.—During the severe storm which swept the Lake region September 22-24, 1894, and for which storm signals were hoisted well in advance, the observers and the displaymen at the different ports, in answer to telegraphic instructions from this office, reported that 250 vessels were held in port as a result of the storm warning.

The Chicago Journal of September 12, 1894, editorially says:

"Several hundred cranberry farmers of Wisconsin were warned nearly twenty-four hours in advance by the Chicago bureau that a frost was to occur in that locality last Monday night. This gave them ample time to flood the marshes and prevent the freeze which otherwise would have ruined their crop. The bureau is keeping a close lookout for the coming of the first frost in the cranberry section, and the perfect manner in which it was forecast and the news circulated is sufficient evidence that the bureau is efficient. The correct forecasting of Monday night's frost and the large saving of property thereby are facts worth remembering. The press and public are always swift enough to censure the Weather Bureau when its forecasts go wrong. It is but simple justice that it be complimented when it so deserves."

St. Louis, Mo.—The following specific cases of benefits by forecasts may be cited: During the protracted cold weather from January 23 to February 15, 1895, 200,000 tons of ice, valued at \$150,000, were cut and housed according to the forecasts issued from this office each day. To properly appreciate the great importance of these particular forecasts to the ice interests, it is only necessary to state that the loss of a single day's work, due to an incorrect forecast, would have resulted in a loss of \$2,000 to one ice company alone, and it is a pleasure to state that no such loss occurred. This office was besieged each day before 9 a. m. by fruit and produce shippers anxiously inquiring whether or not they could ship on that day, and the advice in all cases was followed in confidence. One firm estimates its actual gain in money from these particular forecasts at over \$1,000, and a saving in perishable stock of about \$10,000. On this basis the saving to the fruit and produce men alone during the season of cold weather probably amounted to not less than \$300,000.

Charlotte, N. C.—It is estimated that fully \$100,000 were saved to the people of this section by the displays during the past winter. A notable instance of the benefit of these displays was on February 8, when the temperature reached the lowest point ever recorded for February. A warning of this expected severe weather was received, the cold-wave signal displayed, and notices telegraphed to fifty-five points in the State nearly twenty-four hours in advance, thus giving all interests ample time to make preparations to meet the severe weather predicted.

Dodge City, Kans.—The Weather Bureau work is better appreciated at this place than at any station I have ever before served. The warnings have saved a

number of human lives. Two lives were saved beyond a doubt February 3 last. Two men started out to drive to a point 30 miles south of here. Shortly after the severe cold-wave warning was received, the editor of a weekly newspaper sent after them and they came back to this city. They could not have lived through the storm and there was no shelter on the route they had taken. This city is surrounded by vast prairies on all sides and it is seldom any one ventures to drive very far out on them during the winter months without first consulting this office.

Charleston, S. C.—Much good was accomplished by the Bureau in predicting the severe storms of September 26–27, 1894. Property to the value of \$1,500,000 was saved in this locality through the timely warnings given. Upon the announcement of the storms mentioned there were seventy-six vessels of all classes detained in port. A careful estimate obtained from all available and obtainable sources of the money value of the property saved to the community by cold-wave warnings, during the past cold-wave season, amounts to \$425,000. Of this amount over \$110,000 was saved alone by the announcement of the cold wave of February 8, 1895. The frost warnings resulted in a saving of about \$180,000 to the truck gardeners, florists, and private gardeners. The river service in this center has been the means of saving upward of \$110,000 to the rice planters, farmers, stock breeders, lumbermen, raftsmen, and steamboat men, along the Edisto, Santee, Congaree, Wateree, Great Peedee, Black, Little Peedee, Lumber, and Waccamaw rivers, since October of this fiscal year.

The estimated value of property saved by the warnings of cold waves alone was \$2,275,000. It is reasonable to suppose that this amount, large as it is, does not represent 10 per cent of the value of property actually saved throughout the whole country. Probably \$10,000,000 would be a conservative estimate of the value of these warnings.

A marked instance of the value of the forecasts and storm warnings issued by the Bureau occurred in connection with the tropical hurricanes of September 24–29 and October 8–10, 1894, which passed northeastward along our Atlantic coast. The reports showed that during these two storms 10,305 vessels, valued at \$36,283,000, exclusive of the cargoes, remained in port throughout the period for which the warnings were issued. It is probable that a large proportion of these vessels would have gone out but for the warnings, and it is fair to assume that, had they done so, nearly all of them would have encountered the storms and been more or less damaged, if not entirely lost, as the records, so far as obtained of those vessels which went out in face of the warning, show that in nearly every case they suffered severe injury or were destroyed. In many instances the owners plainly state that, but for the warnings, their vessels and cargoes would have been total losses.

WIND-SIGNAL DISPLAY STATIONS.

The value of the service rendered to the public by the display of the wind signals has been very marked during the past year, and the recognition of that value is evidenced by the increased demand for the establishment of wind-signal display stations at the smaller harbors on the coast and Great Lakes. Thirty-one of these stations were established during the past year and at very slight additional expense, as in all but seven instances the displaymen agreed to serve without compensation in order to get the service, the Bureau simply furnishing the equipments and sending the warnings.

There are few harbors of any importance in the country now where wind signals are not displayed.

LOCAL WIND SIGNALS.

At the suggestion of the lumber shipping interests on the Gulf coast, the observers at Pensacola and Mobile have been authorized to hoist a signal, called the "local wind signal," whenever winds are indicated that are liable to cause injury to those interests. Instances have already occurred where the signal has proven of marked value.

HURRICANE SIGNALS.

Arrangements have been perfected during the year for a more thorough and effective distribution of the warnings of tropical hurricanes and other severe storms.

A new signal called the "hurricane signal" has been added, and the cooperation of the Customs Service, the Life-Saving Service, the Lighthouse Service, and the Revenue-Cutter Service, in the dissemination of the warnings, has been secured.

Many life-saving stations and custom-houses and the vessels of the Revenue-Cutter and Lighthouse Services and several steamship lines have been furnished with hurricane flags to be displayed when warnings are received, and arrangements have been made to give warning to the islands and coasts of the South Atlantic and Gulf by means of tugs and other steam vessels, which will display the flags by day, and send up rockets by night, blowing whistles to attract attention to the same.

TROPICAL HURRICANE REPORTING STATIONS.

Daily observations were taken from July 15 to October 15, 1894, at Kingston, Santiago de Cuba, and St. Thomas, by paid observers of the Weather Bureau, and telegraphic reports of the occurrence of hurricanes forwarded, which were of great value. These stations will be continued during the coming season, and arrangements have been made whereby the Bureau will receive similar reports from Merida, Yucatan. The Bureau also has an arrangement with the Meteorological Service of the Antilles and the Meteorological Department of Belen College, Habana, whereby those institutions forward by telegraph to this office any reports of threatening conditions received from their correspondents, located in nearly all the West India Islands.

LAKE MARINE SERVICE.

The work of this service during the past year resulted in the collection of important data relative to the currents of the Great Lakes, and wrecks and casualties to vessels occasioned by storms and unfavorable weather conditions, and a current chart and a wreck chart containing an orderly arrangement of these data were issued. During the season of 1894, daily meteorological observations were taken under the direction of this service by a large number of vessel masters on the Lakes, but at the beginning of the season of 1895, the collection of these data having been taken up by the Hydrographic Office of the Navy Department, its collection by this Bureau was, by the direction of the Secretary of Agriculture, discontinued.

A pamphlet entitled Circular of Information Relating to the Display of Wind Signals on the Great Lakes, containing a description of the different signals, a list of the regular and special display sta-

tions, and of the places where storm-warning messages are posted, has been prepared in the Forecast Division, and 5,000 copies of it have been published for distribution to the lake marine.

The professors and forecast officials on duty at this office have, as a rule, continued the work of making practice forecasts from the a. m. charts, and those on duty in this division, when not otherwise engaged, have been employed in the preparation of reports on subjects bearing on practical forecasting. Among the papers of this kind completed during the past year were reports on Types of Storms in the United States for each month in the year.

During the months of November and December, 1894, and January, February, and March, 1895, six officials of the Bureau were given a two months' course of instruction in the preparation of charts and the making of practice forecasts.

STATION WEATHER MAPS.

Three million one hundred and forty-eight thousand eight hundred and ninety-five weather maps, at 74 stations, were issued during the year, being an increase of 241,115 in the number of maps and 2 in the number of issuing stations as compared with the year ended June 30, 1894. On June 30, 1894, 8,139 maps were issued; on June 30, 1895, the issue had increased to 10,680 daily weather maps. The quality of these maps as to appearance and accuracy has been well maintained and there has been an increased appreciation of and demand for them on the part of the public generally.

At the larger stations the number of maps that can be printed at a single issue by the present method has nearly reached its limit, and effort is being made to devise a means of printing a larger edition.

The expense of lithographing the weather map, as is done at Washington, is too great to be allowed at other stations. The present milligraphic method is not entirely satisfactory. Experiments are now being made with the view of devising a more economical method—one that will insure a more legible print and more lucidly present the weather conditions to the public.

RIVER AND FLOOD SERVICE.

The river service consisted on June 30, 1895, of 37 river centers and 147 special river stations. Forty-seven special rainfall stations may be considered as tributary to the river work, and will be included in this review of the year. The duty of warning communities when their interests are affected by floods falls naturally upon this Bureau, and in various appropriations, under the subhead "River and Flood Observations," the work has been recognized and provided for.

The duty of forecasting floods and dangerous river conditions is entrusted to the local forecast officials at the principal river centers.

New stations have been established during the year as follows: Bluff City, Tenn.; Speers Ferry, Va.; Radford, Va.; and Stoyestown, Pa., in the East, and Wenatchee, Wash.; Lewiston, Idaho; Weiser, Idaho; and Newport, Wash., on the Columbia and Snake rivers. An effort was made during the year to improve the river service along the Ohio, so that shippers of coal from Pittsburg to lower points on the Ohio and Mississippi might have fuller knowledge of the stages of the water in the lower Ohio. The towing fleets must be in readi-

ness for what is known in the parlance of the trade as barge or coal stages. For this purpose the amount of rainfall at the headwaters of the rivers tributary to the Ohio is of much importance.

An interesting experiment has been made during the year in the distribution of river information to river men by means of a large bulletin carried on one of the Mississippi steamboats. To W. T. Blythe, local forecast official at Cairo, Ill., belongs the credit of suggesting and devising this plan.

Each observer in charge of a river center was called upon for a short paper upon the regimen of the rivers under his care, giving all matters of interest connected with the watershed and rainfall of the vicinity, and such notes concerning his own experience in forecasting river changes as he might be able to give. From all these reports a large and, it is thought, valuable compendium of our knowledge of floods has been prepared and submitted for publication.

During the past winter unusual freezing of the rivers occurred, and in one or two instances not less than 2,000 miles of river were frozen. All the ice passed out with very little damage.

TELEGRAPH SERVICE.

The service rendered the Bureau by telegraph companies during the year was prompt and efficient. By readjustment of the rates for local forecasts and cotton-region messages a saving of about \$4,000 was effected. During the year six hundred and thirty-six accounts were audited.

In addition to telegraphing the regular weather reports, wind-signal orders, and forecast messages, full a. m. and p. m. forecasts were telegraphed direct from this office to the Baltimore, Philadelphia, and New York offices of the United Press and Associated Press, which in turn distributed them to all parts of the United States, excepting the Pacific Slope States.

Of the 515 miles of seacoast lines reported in operation at the close of the year ended June 30, 1894, 30 miles were discontinued by the sale, on August 31, 1894, of the line from Wilmington to Southport, N. C. The remaining 485 miles consist of three sections on the Atlantic coast, aggregating 282 miles; three Pacific coast sections, aggregating 166 miles; and a section of 31 miles on Lake Huron.

The Hatteras section (161 miles) remained in efficient working order throughout the year, with the exception of seven times when communication was interrupted for twenty-four consecutive hours. No extensive repairs were necessary, beyond the furnishing of 158 poles to replace those destroyed by lightning or rendered unserviceable from natural decay. Besides supplying the usual weather and vessel reports, this section proved of value in several instances in calling assistance to vessels in distress.

On the Nantucket section (98 miles) the number of whole days on which communication was interrupted amounted to twenty-two. Owing to the construction of trolley lines at Marthas Vineyard it becomes necessary to provide against damage to the submarine cables from high voltage currents, and arrangements have been made with the Southern Massachusetts Telephone Company by which the telegraph line will be moved out of danger whenever it is paralleled by trolley wires. One hundred and twenty-five new poles and 100 cross-arms are reported as needed on this section during the present year.

The Block Island section (29 miles) remained in excellent condition and suffered no interruption whatever during the year.

On the Pacific coast and Tatoosh Island section (80 miles) communication was interrupted during twenty-four days, a decided improvement over the record of former years, mainly due to the establishment of two additional repair stations in the fall of 1893. Beyond moving 7 miles of line and clearing the trail of the Gettysburg section, no general repairs were necessary during the year.

The Fort Canby section (28 miles) worked satisfactorily, with a total interruption of but twenty-two whole days, fifteen of which were due to the failure of the cable across Youngs River, which had to be replaced with 1,600 feet of the spare cable stored at Fort Stevens. General repairs were made during October and November, and additional work will become necessary during the present summer, at an estimated cost of \$101.50.

The line from Point Reyes Light to San Francisco (58 miles) has not been maintained with that degree of efficiency which has characterized other and more difficult sections; although, from the fact that commercial lines could be utilized for part of the way, the number of actual interruptions was reduced to thirty-nine whole days. The lack of promptness on the part of the repairman was, in a large measure, responsible for this unsatisfactory showing. He has been ordered discharged, and steps have been taken to transfer a portion of the wire to Western Union poles, where it can be more readily observed and repaired when in trouble. Since May last the Point Reyes office has been in telephonic connection with the life-saving station, distant about 4 miles, and the connection has already proved of value in rendering aid to vessels in distress. The need of an office building for the observer at Point Reyes Light has been referred to in former reports.

The lines and cables from Alpena, Mich., to Thunder Bay and Middle Islands, Lake Huron, continued in excellent working condition, the number of whole days on which communication was interrupted amounting to but four days on the Thunder Bay section and none whatever on the Middle Island line. Aside from the main purpose served by these lines (the display of wind signals on the islands), they have proved useful on several occasions in summoning aid to vessels in distress. Telephones are used in transmitting messages to and from the displaymen.

Although no specially striking instances were noted during the past year, the value of the seacoast telegraph lines to maritime and other interests—in communicating with and reporting passing vessels, summoning aid in cases of disaster, securing the display of storm warnings at dangerous and isolated points, furnishing important meteorological reports not otherwise obtainable, aiding the work of the Life-Saving and Customs services, and incidentally affording telegraphic facilities to citizens and visitors at isolated localities—is too well known to require more than a brief reference in this report.

The total United States receipts from commercial messages transmitted over the seacoast lines during the year were \$4,450.90; and in addition, \$4,560.39 was collected on account of connecting commercial lines.

STATE WEATHER SERVICE.

The supervision of forty-one State weather service organizations and of the cotton, sugar, and rice services constitutes the work of this division. Through the first named the Bureau collects monthly meteorological reports from more than 3,000 voluntary observers, weather crop reports from about 9,000 special correspondents, and distributes the daily weather forecasts and special warnings to some 20,000 places.

By the cotton, sugar, and rice region services, daily telegraphic reports of temperature extremes and rainfall from 127 stations, grouped under 12 district centers, are collected and published at each district center and at certain other Weather Bureau stations. The cotton, sugar, and rice region reports also afford a large part of the meteorological data used in the preparation of the National Weather Crop Bulletin, supplying reports from 127 stations in the Southern States.

Independent of the great utility of a State weather service in the collection and publication of weather crop information, and the distribution of weather forecasts and special warnings, it would be difficult to overestimate the value of such organizations in other directions. At the Brooklyn convention of the American Association of State Weather Services, held August 17, 1894, the director of the New Jersey Weather Service stated that, had the New Jersey Weather Service been prepared five or six years ago to give the data now in its possession, the city of Newark would have saved hundreds of thousands of dollars in its public works. Numerous communications on file at this office might be quoted as showing the great value of the data being collected and published in convenient form for investigation and future reference. During last winter's session of the New York legislature, when the bill for the support of the State Meteorological Bureau was being considered, there was some opposition to the measure. As a result of this opposition there came from all parts of the State the most urgent appeals in behalf of the local weather service, and the bill providing for its support was promptly passed. Among many other communications from prominent officials in the State, the following are given as representing the appreciation of the State Weather Service in that State:

BUFFALO, N. Y., *February 23, 1895.*

To Hon. Senator HIGGINS,
Capitol, Albany, N. Y.:

I am quite familiar with the work done by the weather bureau of the State of New York, and as a civil engineer beg to state that I appreciate its value.

To-day the question of water, storage, sewers, waterworks, relations of climate to health, plant life, etc., depend upon the rainfall, temperature, and evaporation.

We are designing stupendous and costly works to-day, knowing the relation with rainfall and stream flow, the deliveries of areas in their streams, etc. All this information was furnished accurately in a reliable manner by the weather bureau of the State of New York, and practical men have begun to depend upon this information.

(Signed)

T. GUILFORD SMITH,
*Chairman Regents Standing Committee on State Museums,
University of the State of New York.*

OFFICE SYRACUSE WATER BOARD,
Syracuse, N. Y., February 8, 1895.

To DIRECTOR, etc.,
Ithaca, N. Y.:

DEAR SIR: I have among my papers a complete set of the monthly reports of your Bureau. These I appreciate very highly and consider them the most complete reports of this character that have come under my notice. I consider them almost invaluable in determining the best available source of water supply for a city or village. The capacity of a watershed in any particular locality can best be determined by the aid of your reports.

Without these, two very grave mistakes might be made in the construction of waterworks. In one case they might expend a large amount of money in the construction of a plant, and later find that they are without water for the reason that their reservoir is of insufficient capacity. On the other hand large sums of money might unnecessarily be spent in the construction of reservoirs beyond the requirements.

There are many urgent needs for your reports other than to aid hydraulic engineers. A report over a long period is most valuable, and it would be a great loss to discontinue a good work.

In my opinion every city and village should take a great interest in this matter.

(Signed)

W. R. HILL,
Chief Engineer and Superintendent.

In Iowa, Maryland, Michigan, Nebraska, New Jersey, New Mexico, New York, North Dakota, Ohio, Oregon, and Pennsylvania, State weather services have been supported by legislative enactments. It is regretted, however, that the bill providing for continued support of the Pennsylvania service, which the legislature recently passed, was vetoed by the governor. The State that fails to provide means for publishing its climatic advantages, and obtaining the other benefits to be derived from the Weather Bureau, neglects an important duty, and those Commonwealths that have recognized the value of the State weather service, and made provision for its support, are already receiving returns which more than repay the outlay, which is generally small. Much can be accomplished with an appropriation of \$1,000 per annum, and in some instances very valuable work has been done with a considerably less sum. The State weather services of California, Indiana, Kansas, Missouri, Nebraska, North Carolina, and Virginia, and the New England weather service have received aid from State and other institutions for printing monthly reports in creditable form, but the legislatures in these States as yet have made no provision for the support of their local weather services. In a number of States the State weather services receive no assistance other than that extended by the Weather Bureau, but through zealous and energetic work on the part of the Weather Bureau officials, some excellent reports are being issued as private publications, the expense of issue being borne by funds derived from the insertion of a limited number of advertisements. In Illinois, Louisiana, Minnesota, and Wisconsin, highly creditable publications are issued by the means referred to, and it is expected that other services will adopt this plan during the ensuing year.

THE DISTRIBUTION OF FORECASTS, AND OF FROST, COLD-WAVE, INLAND STORM, RAIN, AND EMERGENCY WARNINGS.

While all lines of State weather service work have been greatly extended during the fiscal year ended June 30, 1895, the most important has been in connection with the distribution of weather forecasts and special warnings. For years the distribution of weather

forecasts has been a most important question with the Bureau. To reach all classes with this information in time to make it of practical value in the government of their daily transactions has been a difficult problem. When it is considered that the forecasts are true at least eight times out of ten, the great advantage of having such information from twenty-four to thirty-six hours in advance is so apparent as to need no argument to prove its value. It is the agriculturist to whom it has been most difficult in former years to give the benefit of this information, but a great deal has been accomplished in the past year in placing the forecasts at the disposal of the farmer. At no time during the existence of the Weather Bureau has the system of distributing the daily weather forecasts and special warnings been so complete and satisfactory as at present, and no system that has ever been tried for the dissemination of this important information has proved so economical and effective as the logotype plan, which was put into operation during the latter part of the preceding year. By this plan alone the number of places receiving the weather forecasts has been increased by more than 7,000 at a nominal expense, not exceeding 25 cents per year for each place supplied, and this trifling cost per station will be lessened during the coming year by the reduced cost of the supplies furnished under contracts for the year 1895-'96; and, with the extensive preparations now in hand, in a comparatively short time no important community in the United States will be without the daily predictions of coming weather changes. In the dissemination of weather forecasts, the Bureau has received the voluntary aid of public-spirited citizens, especially postmasters, throughout the country. Through the hearty aid of the latter, and the special advantages they have for convenient and rapid communication with adjacent communities, it has been possible to give widespread publicity to the weather forecasts, cold-wave, frost, and emergency warnings issued by the Bureau.

An addition of 142 in the number of places receiving forecasts and special warnings by telegraph or telephone, at Government expense, has been made, but a large proportion of this number are centers of distribution, from which the information is mailed daily to five or more suboffices, the remainder being forecast display stations at which flags are displayed or whistles sounded, indicating the forecasts, for the benefit of the general public.

In May, 1895, the Secretary of Agriculture called the attention of the Honorable the Postmaster-General to the value of cooperation on the part of postmasters in the distribution of weather forecasts, and he readily approved and acted upon the suggestion made by the Secretary of Agriculture that postmasters throughout the country be requested to render the Weather Bureau assistance in its efforts to give the public the best possible service in the dissemination of weather forecasts. Accordingly, in the Official Postal Guide of June, 1895, was published a letter from the Postmaster-General inviting postmasters to take interest in and cooperate in the work of giving the public of their respective communities the advantage of the weather predictions. As a result of the publication of this letter many offers from postmasters to assist in the work have been received, and during the coming year this work will be greatly extended. At the close of the year for which this report is made, over 22,500 places were receiving the daily forecasts and special warnings of the Bureau, this number being over 100 per cent

While the Bureau has for a number of years felt the necessity for a special system by which warnings of exceptional weather conditions, such as tropical hurricanes, cold waves, and storms of unusual severity, might be given out, it was not until the early part of the fiscal year to which this report applies that a plan was carried into effect by which the Bureau could distribute by telegraph what have been designated "emergency warnings." Arrangements have been made by which about 3,500 towns, in addition to the regular forecast display stations, now receive emergency warnings. When the weather conditions are such as to justify the issue of emergency warnings, the messages to the telegraphic distributing centers terminate with the words "notify postmasters," to indicate the urgent character of the information, and to distinguish the message from that containing the ordinary forecasts.

On February 17, 1895, the logotype system of forecast distribution was inaugurated in this division for the benefit of local interests and the agricultural and other interests of the States of Maryland, Virginia, and West Virginia, at such points as could be reached with the cards before 6 p. m., and at the present time over 600 addresses are being supplied daily (except Sunday) with the a. m. forecasts by this division. By means of a special messenger service the cards are delivered to the outgoing trains at both railroad stations, so that the a. m. forecasts are furnished to postoffices in southern and western Virginia and eastern West Virginia early in the afternoon of the day of issue.

The distribution of forecasts over railroad wires without expense to this Bureau has also been extended, an increase of 292 places being noted over the number of stations recorded one year ago.

There has been a slight falling off in the number of stations receiving weather information by railroad train service, this means of disseminating forecasts not being as popular, as it is attended by enforced cooperation on the part of railroad employees, who do not give the work the required attention to make this mode of distribution a success. On some roads, however, notably the Old Colony of New England, the railroad train service, as a means of forecast distribution, is a marked feature, and the officials of the roads exact from their employees a strict compliance with instructions regarding the prompt and proper handling of the bulletins.

COTTON-REGION SERVICE.

The cotton-region service has been continued and the interests for which this system of observations and reports was inaugurated have been well served. The good effects of inspection of these stations, which was made during the preceding year, have been apparent in the general improvement in character of work on the part of observers. Especial efforts have been made to improve this branch of the service since it was put in charge of the State Weather Service Division, and that efforts in that direction have been successful is indicated by the following resolution adopted by the board of directors of the Montgomery, Ala., Commercial and Industrial Association at its meeting held December 3, 1894:

Resolved, That the directors of the Commercial and Industrial Association hereby tender their thanks to Mr. F. P. Chaffee, chief of the United States

Local Weather Bureau, at Montgomery, for the valuable services he has rendered this association in furnishing it with daily reports of the weather, temperature, and rainfall in the cotton belt during the season just closing. This important information is greatly appreciated, not only by our immediate community, but by our people throughout the State.

We trust the Federal Government will maintain or increase the appropriation made for the continuation of this valuable branch of the Government service in this section.

As further evidence of the value of the cotton-region service may be quoted the following communication of November 22, 1894, addressed to Mr. F. P. Chaffee, Weather Bureau official in charge of the Montgomery cotton-region center, and signed by Lehman, Durr & Co., cotton factors, and twelve other prominent cotton factors and firms directly interested in the cotton crop:

We, the undersigned cotton factors and brokers of Montgomery, desire to acknowledge to you, and through you to the Chief of the Weather Bureau at Washington, our high appreciation of the great benefit and aid the Weather Bureau reports of temperature and rainfall in the cotton belt during the season just closing have been to the cotton industry of this section, and the very courteous, thorough, and business-like manner in which such reports have always been furnished the public by yourself and the competent and courteous assistants in your employ, and beg that you will use your kind offices in influencing such appropriation as will insure ample funds for this valuable branch of the Government service in this section.

Provision was made in the appropriation for the fiscal year 1895-'96 for the establishment of 10 additional stations. All necessary arrangements were made for opening these stations on July 1, 1895, and in selecting points at which the observations were to be made, the interests to be served were carefully weighed and the stations located at the most eligible points having proper telegraphic facilities. These 10 additional stations make a total of 127 places in the cotton, sugar, and rice regions of the South, from which daily observations of temperature and rainfall are telegraphed to district centers and published in bulletin form.

SNOW AND ICE CHARTS.

The snow and ice charts published during the winter of 1892-'93 were resumed during the winter of 1894-'95. This publication, which is issued weekly, on Tuesdays, shows the depth of snow on the ground at 8 p. m. on Monday, and the thickness of ice in rivers and harbors. Many manufacturers and wholesale dealers in rubber goods or in fabrics suited to the rigors of winter, now closely consult these charts, so that they may send their agents or ship their goods advantageously into the district north of the snow line.

STATE WEATHER SERVICE CONVENTION.

The American Association of State Weather Services, which was organized at Rochester, N. Y., in 1892, for the purpose of advancing the work of the Weather Bureau on State weather service lines, held its third annual convention in Brooklyn, in conjunction with the American Association for the Advancement of Science, which met in that city August 15-24, 1894. The meeting, while not so largely attended as some of the previous conventions, was a very successful one. A report of its proceedings was published as Bulletin No. 14 of the Weather Bureau, U. S. Department of Agriculture, and 12,000 copies

were printed and distributed to the voluntary observers and weather crop correspondents of the Bureau. Much good has resulted from these State weather service conventions, at which the various methods of work in the several States are fully discussed and views exchanged as to the most desirable and effective means of increasing the value of the Weather Bureau to people throughout the country. The fourth annual convention of this association, to be held at Indianapolis, Ind., October 16-17, 1895, promises to be the largest held since the organization of the association.

WEATHER CROP BULLETINS.

The weather crop feature of State weather service work has continued most popular and useful. The excellent system under which this work is now operated is the result of practical experience of a number of years, and it is doubtful whether it can be further improved with present facilities. The circulation of both national and local bulletins has grown steadily during the year, and it would be difficult to overestimate the extent to which the information they contain is published through the press of the country. At the close of the year, of the forty-one services publishing weather crop bulletins, all but six issue their bulletins in printed form, which is a marked improvement over the work of previous years, when most of the bulletins were issued by milliograph process.

VOLUNTARY METEOROLOGICAL STATIONS.

During the year 410 voluntary meteorological stations were established, the total number of such stations now in existence being somewhat over 3,100. The rapid increase in the number of these voluntary meteorological stations in recent years leaves but few counties in the entire country without a record of temperature and rainfall observations made with instruments of standard pattern.

METEOROLOGICAL RECORDS AND DATA.

The Division of Records and Meteorological Data has for its purpose the care and preservation of the meteorological records of the Bureau, the examination of the observational work of station employees, and the preparation of statistical matter for the use of the public officials of the Bureau, and also for publication in the MONTHLY WEATHER REVIEW.

Nearly 300,000 meteorological reports of one form or another, including the daily and weekly instrumental register sheets, are received in this division annually. From this vast collection of material charts and tables appropriate to subjects of special inquiry are made, and the data are systematically arranged for reference and publication.

The records of meteorological observations made by the station force are carefully examined in this division, since it is quite necessary that any tendency to careless and inaccurate work should be quickly corrected.

In addition to the meteorological reports of Weather Bureau observers, about 2,400 voluntary observers make monthly returns to the various State centers, and through the latter to the central office. The climatological data furnished by the voluntary observer supple-

ment to a very great extent the information contained in the reports of regular Weather Bureau stations, particularly as to rainfall and temperature, the two climatic elements of the greatest importance to all conditions of life.

It affords me very great pleasure to acknowledge the fidelity and public spiritedness of these observers.

The statistics of temperature and rainfall extending back to the beginning of meteorological observations in the United States, compiled in the division above named, if well distributed, would be of no inconsiderable value to the people of the United States. It is proposed, therefore, to copy from time to time and send to the directors of the various State services so much of the compilations of this division as will aid them in their current work, and also enable them to supply the public with information heretofore obtainable only by application to the central office.

The meteorological observations made by the Signal Service and Weather Bureau now cover a period of twenty-five years. The facts accumulated by these observations constantly find application in the development of new industries and in the growth and expansion of diversified interests. The central office, as well as the numerous outlying stations, has kept apace with the demand for information of a statistical nature, and at times, when very great interests were involved, considerable time has been devoted to compiling the necessary data. Free use of our data may be had at all times, subject to such restrictions only as may be necessary to preserve the integrity of the records.

PROPERTY.

During the past year this division has, by direction of the Secretary of Agriculture, made a full and complete inventory of all property in the central office and at stations, together with an itemized statement of all purchases, receipts, and shipments from July 1, 1894, to February 1, 1895.

Since July 1, 1895, more accurate and expeditious methods of handling Government property and receipting for and recording its transfer from the central office to stations have been introduced. Under present regulations each item of a shipment must be invoiced within three days after the shipment, so that a prompt comparison may be made at stations between the invoice and the property received, receipt at once returned, if the property reaches its destination, and proper report made if it does not.

The business of the division is being handled in a satisfactory manner.

LIBRARY.

During the year 785 books and 381 pamphlets were added to the library, making a total in the library at this date of 15,896 books and 5,741 pamphlets. Of the 785 books added, 262 were purchased, while 523 were received as gifts or in exchange for publications of the Bureau. Of 381 pamphlets added, 81 were purchased and 300 were secured by gift and exchange.

An allowance of \$1,000 was set aside from the contingent fund for the purchase of books for the fiscal year. Of this amount the sum of \$650 was expended. For the year 1895-'96 the sum of \$1,500 has been allowed.

The present force consists of a librarian and one assistant.

PACIFIC COAST SERVICE.

Two able forecasters are stationed on the Pacific coast, one at Portland and the other at San Francisco. The Portland forecast district comprises the States of Washington, Oregon, and Idaho; the San Francisco district, the States of California, Nevada, and the Territories of Arizona and Utah.

In August, 1894, the San Francisco official was promoted from local forecast official to the grade of forecast official, in consideration of having won second place in the competitive examination inaugurated a few months before for the purpose of selecting an official to fill a vacant professorship.

The weather conditions on the immediate Pacific coast are purely marine. In the plateau regions of the Rocky Mountains they are continental in character. Both conditions are quite distinct from the storm conditions of the country farther east. It has been found advisable to organize forecast districts separate from those east of the Rocky Mountains. While these regions are not often visited by such terrific storms as prevail east of the Rocky Mountains, there is still a fruitful field for the forecaster. Grazing interests are greatly dependent upon the rain warnings. Ranchmen move their flocks and herds as they learn that rain has fallen in other sections. In the fall, at the time of first rain, the information is of very great value. In the spring, after rain ceases, the grass cures on the ground, and still remains good feed for stock; but the first rain in fall rots the grass, and unless rain then falls at frequent intervals the stock is in danger of starvation; therefore, when information is received that rain is about to occur, or has occurred, owners of ranches who live in San Francisco, or other cities, arrange to ship the necessary hay and fodder to keep the stock until the new crop of grass has grown sufficiently to maintain them.

The morning weather map is now issued at San Francisco at 8.30 a. m., instead of at 11 a. m., as was the case before the present official took charge, thus making it available for use at the opening of business hours.

PUBLICATIONS.

The work in this division has steadily increased, as shown by the following statement:

No. of impressions on printing presses for the fiscal year ended June 30, 1895	2,959,914
Previous year	1,840,305
Increase	1,119,609
No. of impressions on lithograph presses for the fiscal year ended June 30, 1895	1,887,205
Previous year	1,024,238
Increase	862,967

The work in the drafting room, folding room, forms room, and mailing room of this division has also materially increased. The work is generally well executed mechanically.

OBSERVATION STATIONS.

On June 30, 1895, there were in operation 157 regular paid stations of the Bureau, at which observations are taken or work of State weather services performed, against 156 the year before. There have been discontinued: Southport, N. C.; Colorado Springs, Colo.; Pikes Peak, Colo.; and Tucson, Ariz. There have been established: San Luis Obispo, Cal.; Independence, Cal.; Phoenix, Ariz.; Lincoln, Nebr.; and Lansing, Mich.

Forty-eight stations were inspected.

INSTRUMENTS.

The work of the Instrument Room pertains to the maintenance of the instrumental equipment of stations installed for the purpose of securing meteorological observations. This includes the preparation of complete drawings and detailed specifications required for the purchase of instrumental supplies, accessories, etc.; the inspection, test, and adjustment of all new instruments; their issue to stations; the supervision by correspondence of their erection, exposure, and operation while on stations; and the monthly inspection of all automatic records, comparative readings, etc., for the purpose of detecting neglect or improper care, or the defective performance of instruments.

The following table exhibits the number of the more important instruments received and issued during the year ended June 30, 1895:

Name of instrument.	Acquired by purchase.	Received from stations.	Issued to stations.
Anemometers	* 100	94	83
Barographs	5	16	13
Barometers, aneroid	2	8	7
Barometers, mercurial	* 75	51	56
Gauges, weighing rain and snow	3	6	6
Gauges, rain recording		6	2
Machines, map circling	41		38
Recorders, sunshine	20	11	10
Registers, single	* 23	24	23
Registers, triple	4	16	15
Telethermographs		7	5
Thermographs	1	46	43
Thermometers, exposed	100	+ 145	127
Thermometers, maximum	400	+ 280	386
Thermometers, minimum	300	+ 239	324
Thermometers, soil	25		† 34
Thermometers, water	50	+ 24	17
Whirling apparatus		4	4
Wind vanes	5	3	7
Wind-vane supports, complete		2	13

* Repaired instruments.

† These amounts include 78 exposed, 227 maximum, 173 minimum, and 14 water thermometers, which were received broken and totally unserviceable.

‡ Turned over to Division of Agricultural Soils.

The forecasts of the Weather Bureau are much dependent upon the station instruments. A dozen bad barometers and thermometers in use at as many stations, giving erroneous measurements, might lead to an entire misrepresentation of existing meteorological conditions. It is plainly seen, therefore, that the purpose of the Instrument Room is, and should be, to preserve uniformly at all stations the greatest attainable accuracy in the observations from instruments,

not only as they relate to forecasts, but to all the great volume of data annually accumulated and published by the Bureau.

In the discharge of its duties during the past fiscal year the Instrument Room has prepared and mailed about 1,100 letters, and has inspected and examined 62,000 record sheets and forms from automatic instruments in operation at stations. In the aggregate, about 1,016 thermometers of all kinds have been compared with the standards, and correction cards furnished. Anemometers, barometers, and self-registering instruments frequently become impaired with ordinary station use, and are repaired, to a large extent, at the central office. As, however, the force and facilities available for doing this repair work are very limited (two small foot lathes, with bench tools, and two mechanics), some repairs must be done outside on contract, and the work in the machine shop is confined to that of the simplest character.

The subappropriation allotted for the purchase and repair of instruments for the fiscal year ended June 30, 1895, amounted to \$8,500. The aggregate expenditures from this amounted to \$8,440.37, leaving a balance of \$59.63.

The greater part of the instrumental supplies expended during the year was for the purpose of replacing the damaged, broken, or worn-out equipment of stations already in existence. A limited number of thermometer has been issued to new voluntary observers.

The official in charge of the Instrument Room was designated the agent representing the Weather Bureau at the Atlanta Exposition, and to him was assigned the important duty of making all the necessary preparations for the exhibit.

PLAN OF WORK FOR CURRENT YEAR.

The present chief took charge of the Bureau July 4, 1895, and at once undertook a careful review of its work, and a careful consideration of its scope and purposes, in the light fortunately afforded him by a long period of active service in the practical work of the Bureau. The close personal attention given to the administrative work of the Weather Bureau by the Secretary of Agriculture, with special reference to economy in expenditures and to efficiency in those lines of work having a practical bearing upon the needs of the public, fortunately marked out for the present Chief with unmistakable clearness certain lines in strict accordance with which he has undertaken the responsible duty of reorganizing, consolidating, and perfecting the administrative work of the Bureau in all its branches. As many steps in the work as thus mapped out have already been undertaken at this writing, it is unavoidable that this portion of the report, while designed to set forth the plans of work for the current year, should also serve to a certain extent as a report of work done during the first quarter of the present fiscal year.

REORGANIZATION.

The position left vacant by the promotion of a professor to be Chief was filled by the advancement of an official who had made the highest record in forecasting at Washington during the past year and he was assigned to duty at Chicago in charge of a large district. The vacancy caused by this promotion was filled by an official, who,

in a recent rigid competitive examination, gained the second place in forecasting, the one gaining first place having already been advanced.

Two chiefs of divisions were appointed, the positions being filled by the promotion of officials of long service whose sole recommendations were their abilities as officials and their integrity as men. Observers on station have similarly been promoted in deserving cases. A careful record is kept of all errors made by observers in taking and working out observations, and in making meteorological forms, of their failure to take observations on time, and other lapses from duty. This record, with the general reputation of each man, is the sole basis for promotion.

The policy of the Secretary of Agriculture in dispensing with superfluous officials, and filling all vacancies, even those outside the classified service, by the promotion of meritorious employees from the lower grades, has exercised a most salutary influence in every branch of the Bureau, and must greatly inure to the good of the public service.

The total number of observers and officials on stations outside of the city of Washington was—	
On June 30, 1895.....	301
On September 30, 1895.....	289
Decrease in force.....	12

The total number of messengers and laborers on stations outside of the city of Washington was—	
On June 30, 1895.....	68
On September 30, 1895.....	70
Increase.....	2

The total number of station employees promoted from July 1 to September 30, inclusive, including those to take effect on October 1, is..... 78

Reduction in per annum expense by the discharges, reductions, resignations, etc., which have been made in the station employees outside of the city of Washington from July 1 to September 30, inclusive..... \$17,485.00

Increase in per annum expense by the promotions, appointments, and transfers which have been made in the station force outside of the city of Washington from July 1 to September 30, inclusive, and including promotions made to take effect October 1..... 16,416.50

Being a reduction per annum in the expense for the payment of salaries to station employees of..... 1,068.50

By cutting off unnecessary work and dispensing with the services of those inefficient or inattentive to duty, it has been possible to give a material advance in salary to seventy-eight meritorious workers, as shown by the foregoing statement, and still to diminish expenditures of the public funds at the rate of \$1,068.50 per annum.

The total number of employees in the office of the Chief of the Weather Bureau promoted from July 1 to September 30, inclusive, was 12.

The total number of employees in the office of the Chief of the Bureau on June 30 last was 170, with salaries aggregating per annum. \$183,950.00

The total number of employees in the office of the Chief of the Weather Bureau on September 30 was 159, with salaries aggregating per annum..... 175,660.00

Being a decrease of 11 employees and a saving per annum of..... 8,290.00

Of this saving, however, \$6,840 is due to the separation from the Bureau of the Division of Soils, with its clerical force, which was provided for as an independent division in the Department of Agriculture on July 1, and the proper saving, therefore, to be credited to the Weather Bureau management since July 1 is.... \$1,450.00

An economical distribution of the work at this office has rendered it possible to promote twelve deserving employees without increasing the expense for salaries; in fact, there is a saving effected of \$1,450 per annum; and this, with the saving of \$1,068.50 effected on the salary roll of the station force, makes a total saving of \$2,518.50.

USELESS EXPENSE ELIMINATED.

Since July 1 the number of observers on stations has been considerably reduced. A thorough revision of all meteorological forms has been made during the past three months, simpler methods have been introduced, and unnecessary work has been discontinued. The saving thus accomplished is equivalent to the time of at least ten observers, and a consequent saving in expense of \$10,000 annually.

A careful redistribution of the working force on stations has been made. At some stations observers were on duty twelve to fourteen hours daily. These men cared for and collated the records of automatically working instruments, took the observations, and attended to the distribution of weather information for the benefit of their respective communities. At some places several men were found on duty where far less work was being performed than at some of the one-man stations. A redistribution of the force has been made, so as to equably adjust the duties, as far as possible, among the different stations. It is essential that the executive functions of the Bureau should be controlled by one familiar with the numerous details of the station work, and of the varying needs of the communities in different sections of the country. A thorough personal knowledge of these duties should be supplemented by frequent inspections by the Chief of the Bureau himself, so that he may keep closely in touch with the working force of the service, and be well informed as to the varying needs of the stations.

At fifty-eight stations the working up of the hourly temperature and pressure data was discontinued on September 1. Little or no use has ever been made of these data, and great volumes are now stored in the vaults of this office. Further accumulation is useless. It has required in the aggregate the time of four men annually to make these forms, and during the twenty-five years that the Bureau has existed probably \$100,000 has been spent on this work. These data have been continued at the twenty-eight stations from which the records are desired for use in the annual tabulated report of the Chief of the Weather Bureau, and these stations, being equidistantly placed throughout the United States, sufficiently preserve the record of the hourly temperature and pressure conditions of the country. At the fifty-eight stations where the working up of the data was discontinued the instruments are continued in operation, and the original record sheets are filed at the main office, so that the data may be worked up if at any time in the future it be found desirable to do so. This curtailment of work has therefore been accomplished without in any way impairing the efficiency of

the Bureau, or eliminating any portion of the work essential to the scientific investigation of meteorological problems.

A displayman was appointed during September, 1895, at one station, in place of the regular observer, and a more economical and equally efficient administration of the office secured; one station was opened and one abandoned, the result being a net saving of about \$1,000 per annum.

In August, 1895, a reorganization and redistribution was completed of the telegraphic reports of observations which are sent to the different Weather Bureau stations throughout the country for the purpose of issuing local weather maps and of enabling the officials in charge of stations to give proper information to the different industries in their vicinities. The stations from which reports were to be sent to given centers were selected so as to enable observers to have a clear and concise report of existing weather conditions throughout the country. At some stations too many reports were being received, and at others too few. In some instances the selection of stations from which telegraphic information was received showed bad judgment. As an illustration the case of the observer at Grand Haven may be cited. He was receiving many reports from remote points in the Rocky Mountain region, and from stations as far south as Atlanta and Vicksburg, while from many contiguous stations at lake ports, and from which mariners in his locality might need information, he received none. Effort has been made in rearranging the distribution of points of observation from which each Weather Bureau office shall receive its report, to adjust the situation so as to meet the various needs of each central office, that it may give to the people of its vicinity information really required, and so that this Department may at the same time dispense with all unnecessary reports and restrict the useless expenditure of public funds. This rearrangement of the telegraphic service will effect an annual saving of \$3,500.

Economy without detriment to the service has also been effected in the telegraphing of night observations to this office, confining them to such as are useful to the weather forecaster. In accordance with this policy the evening telegrams from 31 observation stations were discontinued to take effect September 30. The saving thus effected will result in an annual reduction of expenses of \$6,082, making a total saving possible on telegraphic expense during the coming year of \$9,582.

On September 30, 1895, the lithographing of the evening weather map was discontinued. The printing of this map was mainly for file. The mailing list was small, and is now supplied from the issue of the morning lithograph map. The public will not miss the evening chart. The files of this office do not require that it be printed, because the data which it contains are already worked up in an elaborate form on special charts constructed in a form better adapted for purposes of study and investigation than they possibly can be in the printed form. As a result the services of one lithographer and one printer have been dispensed with. The expenditure of money to do this work has never made adequate return, and its being continued for many years past can only be explained by a tendency to accumulate data which grew even to the length of duplicating those data, without sufficient regard to their practical use. This is a

heritage handed down from previous administrations. In the interest of economy and efficiency, and for the opening up of new lines of thought and investigation, it becomes necessary to discard precedents and to mark out the way anew, eliminating everything no longer needful and substituting whatever promises materially improved results.

DAILY FORECASTS TO AGRICULTURAL COMMUNITIES.

The total appropriation for the current fiscal year is \$885,610, which includes an increase over the preceding appropriation of \$25,000 for the purpose of telegraphing daily weather forecasts to small villages and farming communities, many of which are too remote from large cities to get the forecasts published in the daily papers. The public estimate of the value of the forecasts has so increased that from all sections of the country come numerous requests that the forecasts be telegraphed daily, instead of being sent only when rain or a material change in temperature is expected. The daily telegraphing of forecasts to display stations was begun July 9 and has proved highly satisfactory to the many and diversified interests so dependent upon coming weather conditions. The number of stations receiving daily forecasts October 1, 1895, will require an increase of about \$15,000 in expense for telegraphing over that of the preceding year.

HARMONIOUS WORK AND PROPER DISCIPLINE ESSENTIAL TO SUCCESS.

Harmonious cooperation between the practical worker and the scientific investigator is essential to success. Too often they have found themselves picking out diverging paths. In the future they will be required to work on parallel or converging lines.

In a system the ramifications of which extend into every State in the Union, success depends upon each worker being justly recognized for the merit that is in him, whether he be a skilled scientist or an able executive, and each should be given his proper place as an integral part of that great composite which constitutes the efficient bureau.

With observers at one hundred and twenty-one stations reporting their observations by telegraph at 8 a. m. and 8 p. m. each day of the year, and with the necessity for all observers to read their instruments at exactly the same moment of time, and to file with the telegraph company the complete and corrected result inside of twenty-five minutes, thorough discipline must be maintained in order to reduce to a minimum the number of cases where accident, sickness, or negligence causes the report to be missed. Such discipline is easily maintained without resorting to the harshness of military regulations, and it is safe to say that fewer observations are missed, and far fewer lapses from duty are recorded, than under any previous régime. The observers are, as a class, men of education and of a high standard of morality. The aim of the Chief is to encourage pride in good character.

CIVIL SERVICE.

Several discharges have been made for inefficiency. It is probable that the highest encomium that can be paid to the work of the Civil Service Commission is to say that, to the knowledge of the Chief,

no report of inefficiency ever has been made against an observer appointed upon certification by the Commission.

The method employed by the Civil Service Commission in selecting our observers, together with the supplementary examination provided by this office, can not well be improved on. The improvement in the public service due to this method of selecting employees was so patent that the Secretary of Agriculture, early in his administration, made use of the same system in the selection of employees whose rank and emoluments placed them above the civil service grades. These places have since been covered into the Civil Service by order of the President.

PERSONNEL.

It is the intention not only to maintain the high character of the personnel of the Bureau, but to improve it, and, with this purpose in view, the personal habits, as well as the official character, of its employees will be the subject of rigid inspection. Officials in charge of stations will be required to report as to the following conditions and qualifications of each subordinate: What is his general ability? What are his habits as to attention to duty? Do convivial habits in any way impair his efficiency? What is his standing in the community, officially and morally? Does he generally excel in all branches of work, or in some particular line? Is he married? How many depend on him for support? Does he live within his means?

INSPECTIONS.

While frequent inspections will be made by the Chief of the Bureau, any official of suitable rank may be detailed for this duty. A material saving in transportation may often be effected by making use of some official in the immediate vicinity to make the needed inspections. Officials so designated are admonished that if a dissolute or inefficient employee is passed by them without a proper report being rendered, they themselves will be held personally responsible.

NEW SERVICE.

On July 23 officials in charge of all stations were directed to prepare a list of the superintendents of street railways, general managers of railroads, superintendents of railroad telegraph lines, and managers of all other important interests in their vicinity, to whom should be sent, by such means as would secure the promptest transmission, warnings of cold waves, heavy snowstorms, or other information of special value to them. This system of specially warning transportation lines in the interest of the general public was put into operation at Chicago during the past winter by the present Chief of Bureau, and resulted in great saving of time to the traveling public and a curtailment of loss in revenue and property to the transportation lines.

NEW AND IMPROVED PUBLICATIONS.

On July 18 instructions were issued making such changes in the details of printing, editing, and issuing the MONTHLY WEATHER REVIEW as will shortly bring that publication up to date, instead of having it issued six months late, as has hitherto been the rule. This

publication contains the most complete compilation of meteorological data anywhere put forth, and it is intended to issue it not later than fifteen days after the expiration of the month for which it is a record. Special papers prepared by members of the scientific staff will, unless otherwise directed, first appear in this publication. The result of investigations now under way for the purpose of improving the official forecasts, and papers on future investigations into the philosophy of storms, will appear from time to time in its pages.

In December, 1893, the Secretary of Agriculture, in a communication to the Chief of the Weather Bureau, suggested that some method be devised whereby both the sanitary and the meteorological conditions existing throughout the various States of the Union might be regularly presented to the public through the Weather Bureau. He anticipated that an additional service of great value to the people of the United States might thus be rendered by the Weather Bureau. What had been done previous to the present Chief's assuming office was carefully reviewed by him, and, with some modifications in the original plan, the first publication of CLIMATE AND HEALTH was issued the latter part of September, 1895. It is presented to the medical and other professions, and to the public at large, as probably the most complete and comprehensive publication of contemporaneous meteorological and sanitary data so far put forth either by Government or private means. The object is to facilitate an intelligent investigation into the relations existing between meteorological conditions and disease. The publication will be monthly and the compilation of the data will be in weekly parts.

It may not be out of place to mention briefly what it is hoped may be accomplished by this publication. The practicability of utilizing the daily weather forecasts by the physician in his practice will be kept constantly before him, and it may reasonably be expected that something of value will thereby be added to our common stock of knowledge. It will present information in regard to climate and its relations to disease that are practically unobtainable from any other source. A knowledge of the relations existing between climatology and hygiene must precede the practical application of the one science to the other, and the facts must first be collected before this knowledge can be obtained.

Yet another good result will be the information developed concerning health resorts and climatic data of value to invalids. Immense sums of money are spent yearly by the invalids and valetudinarians of this country in seeking, by change of climate, alleviation or cure of their ills. Not infrequently these people find that they have abandoned the comforts of home, and undertaken long, tiresome, and expensive journeys to reach localities which they find totally unsuited to their needs. These migrations, in many instances, would never have been advised or undertaken had either physicians or patients possessed a full knowledge of the climatic conditions of many of these places.

An inquiry that naturally suggests itself is, "Will it be practicable to precisely forecast the appearance and progress of diseases?" To this a negative answer must for the present be given. It does, however, appear probable that by a diligent pursuance of this work some important conclusions as to the conditions favorable to the development of certain diseases may be arrived at.

IMPROVED COTTON-REGION SERVICE.

Beginning with September 1 the hour for taking observations at cotton-region, sugar, and rice stations was changed from 6 p. m. to 8 a. m., seventy-fifth meridian time. By making this change it has been possible to issue the cotton-region weather bulletins each morning for the twenty-four hours ending 8 a. m., and to issue it to the public and to the important cotton exchanges within two hours after the hour of observations, and to give the minimum temperature for the current morning and the rainfall for the past twenty-four hours. Heretofore the bulletins have been issued at 8 p. m., and as a rule they reached the public not earlier than the morning of the following day—from fourteen to sixteen hours after the time of observations—and the bulletins contained the minimum temperatures which occurred more than twenty-four hours before posting. The great advantage which will result from this change is obvious.

For several years it had been apparent that the service would be greatly improved by such a course, but the difficulties to be overcome in securing reports at so early an hour from stations in the western portion of the cotton region have heretofore been such as to deter the Bureau from ordering the change.

In the cotton, sugar, and rice growing regions of the South hundreds of millions of dollars are invested, and the state of the crop, as determined by weather conditions, is at all times a feature eagerly watched by the many interested in those staples.

The special service organized in the interest of the cotton, sugar, and rice interests is quite separate and distinct from the forecasting or storm-warning features of the Bureau, although the duty is performed with little additional expense. Briefly described, it may be said that each Weather Bureau station becomes a center to which, each morning, is telegraphed from a radius of 100 to 200 miles the temperature and rainfall from selected stations, these stations being manned by resident observers who receive for this service compensation at the rate of 20 cents per day. These reports are not needed specially for forecast purposes, and are gathered in order to show the current weather conditions, as affecting the staple products of the region, more minutely than can be done by the reports from the regular Weather Bureau stations, as they are, in many cases, 300 to 500 miles apart. From the reports received at the section centers the average rainfall and temperature is determined for each section, and this average is telegraphed to all other section centers. This information is strictly reliable and not subject to influences affecting those whose pecuniary interests might prompt them to disseminate erroneous information. The authenticity and reliability of these reports have never been questioned.

Since July 1 the pamphlet of instructions to cotton-region observers has been reprinted in a revised form, and an improved cipher code adopted. A new bulletin form (1045) also has been devised and will be put into use during the ensuing year. This bulletin provides for important weather information not heretofore given. It will contain a small outline map of the cotton belt, with location of district centers and all stations at which observations are taken. These maps will be used for illustrating graphically the daily temperature and rainfall conditions of the cotton region.

The cost of maintaining the cotton-region service, independent of the expense of telegraphing reports, for the seven and one-half months during which observations are made, is a little less than \$6,000 per annum.

WHEAT AND CORN SERVICE PROPOSED.

It is desirable that a service similar to the cotton-region service be organized in the principal wheat and corn sections during the coming year. In the estimates recently submitted for the year ending June 30, 1897, provision has been made for such service. Many interests, which in other ways are conflicting, are really unanimous in their desire for this detailed information, coming, as it does, from reliable sources, and being prepared by disinterested persons whose sole object is to render an accurate and impartial return. Chart I shows the cotton-region stations and the section centers.

It is thought that an efficient corn and wheat region service could be conducted with about ninety stations, grouped around nine or ten district centers, the latter to be regular Weather Bureau stations. The instrumental equipment for ninety stations would cost about \$1,600, the outfit for each station to be the same as that constituting the equipment of a cotton-region station, viz, a set of maximum and minimum thermometers, rain gauge, and thermometer shelter. At the same compensation as now paid cotton-region observers, viz, 20 cents per observation, the cost of maintaining ninety stations the year round would be about \$6,600 per annum. It is believed that it would be well to continue the observations throughout the year, as seeding of winter wheat begins shortly after the close of the spring-wheat harvest, leaving practically no interval during which these reports would not be of sufficient importance to justify their continuance.

ADDITION OF SENSIBLE TEMPERATURES.

On September 20 was begun the telegraphing from observation stations of the readings of the wet-bulb thermometer, more popularly known as the "sensible temperature." This is about the temperature felt by animal life, and may be many degrees below the air temperature, the difference between the two temperatures depending upon the relative humidity of the air—the drier the atmosphere, the lower the sensible temperature when compared with the air temperature; the damper the air, the higher the sensible temperature. This will be better understood when it is stated that in case the air be saturated the readings of the dry and wet bulb thermometers will be the same and the sensible temperature and the air temperature equal. In the arid regions of the West cases can be cited where the sensible temperature was 38° less than the air temperature, due to the extreme dryness of the atmosphere. In the more humid regions of the eastern part of the country such extreme differences can not occur. Both the air temperature and sensible temperature are now published on the charts issued at Washington, and it is probable that at all stations of the service these two temperatures will hereafter be published. The relative importance given to each in the discussion of the matter of forecasting, and in the discussion of meteorological conditions in the daily weather report, has not been entirely determined. It is

apparent that no true measure of heat, as applied to animal life, has heretofore been systematically published, and it is believed that the United States Weather Bureau will be the first to make the innovation. Its application is so simple and so easily understood by all that in the future it will doubtless form one of the most important features of Weather Bureau work, and it will serve to correct some very erroneous ideas in regard to climate entertained by people who have never considered anything but the air temperature.

UPPER AIR OBSERVATIONS PROPOSED.

The main object of the existence and maintenance of this Bureau is to give warning of the approach of storms. Our synoptic charts, from which forecasts are made, are based entirely upon what may be considered surface readings of air conditions, and while the degree of accuracy attained by the most expert forecasters is such as to render the forecasting work of the Bureau of vast benefit to the agricultural, commercial, and maritime interests of the country, there is still an element of error amounting to about 20 per cent, and our present knowledge of the mechanism of storms will probably permit of but little further increase in accuracy.

It is, therefore, highly essential to push forward such lines of scientific investigation as give the greatest promise of fruition. For twenty-five years we have been making readings at the bottom of the great ocean of air, while many believe that the subtle forces which combine to initiate storms and the constant accretion of forces which augment their energy as they move eastward, or which at times cause them unexpectedly to be dissipated after having reached a great degree of storm intensity, may be operative at great elevations. It is therefore desirable that upper air readings should be accomplished by this Bureau to determine the accuracy of these theories, and that synoptic charts based upon readings taken at an elevation of not less than two miles should be prepared, showing the conditions prevailing at that altitude throughout a considerable portion of the country. The difficulty is to devise appliances, which, while captive, will carry automatically recording instruments to the proper elevation under all conditions of wind velocity and variable direction; but the obstacles do not seem to be formidable, and it is believed that they can be successfully overcome. While the expectations of many may not be realized in obtaining knowledge which will enable us more accurately to forecast the coming of storms, the field is certainly promising enough to justify a moderate expenditure in thoroughly exploring it. With so much property and so many lives often dependent upon storm forewarnings, any line of investigation which holds out reasonable hope of improvement should be followed until proved to be fallacious. By dispensing with such work at the observation stations as can not be shown to be immediately useful, it is believed that, with practically no increase in working force, the line of investigation herein outlined can be prosecuted, and that the expenditure necessary will be only for material and the time of one or two thoroughly skilled officials to move from station to station establishing the necessary appliances for upper air readings. These appliances, however, have yet to be devised, and the contemplated system is consequently still in embryo.

WEATHER BUREAU BUILDINGS AND GROUNDS.

The present Weather Bureau buildings and grounds, situated at the corner of Twenty-fourth and M streets, were purchased by the Government from Mr. David Fergusson for the use of the Signal Corps, under an act of Congress approved March 5, 1888, which appropriated \$150,000 for the purpose. Of this sum \$112,000 was paid to Mr. Fergusson for the site, including the large building standing thereon, and the extra \$38,000 was expended for the erection of additional structures required for use as storehouses, printing office, stable, machine shop, etc., these latter structures being constructed under the supervision of the Treasury Department.

The site has a frontage of about 230 feet on M street, and an area of about 54,000 square feet, and, with the buildings thereon, was transferred to the Department of Agriculture, for the use of the Weather Bureau, on July 1, 1891, under the terms of the act of Congress of October 1, 1890.

It is thought that the market value of the ground alone is not less than \$1.50 per square foot, making the total value of the ground about \$81,000, exclusive of the buildings, because, if thrown upon the market, the property would doubtless be bought for the purpose of erecting small residences, in which case the present buildings would be of no value except for old brick.

IMPROVEMENT IN INSTRUMENTAL EQUIPMENT.

The growth of the service from year to year develops increased demands for meteorological information in behalf of commercial, agricultural, and engineering interests, and as the public, students, and specialists become more and more familiar with the details of the work of the Weather Bureau, new ways are discovered of rendering the results of its observations useful and beneficial to all. At the same time students and others become more and more exacting and critical in respect to the accuracy of the observations. To retain the confidence and respect of the people, the Bureau must see to it that its instruments and its methods of making observations are accurate in the highest degree and abreast of modern thought and opinion in such matters. The Bureau must be able to defend itself against any criticisms respecting the quality of its work that the growing intelligence of the public in meteorological matters may be able to make. The duties of the official in charge of instruments are but badly administered unless stimulated by an intelligent interest in the development of more perfect instruments and methods of observation, and in the increase everywhere of the uniform accuracy of the observation work of the service. The observations supply the facts upon which the whole meteorological work of the Bureau rests. Their accuracy is, therefore, a matter of primary importance. Without a proper regard for these considerations, improvement and progress in the duties relating to instruments are not possible, and all such work is degraded to the level of mere perfunctory performance. It is clear, from the cursory view of the case here presented, that affairs relating to instruments merit, by virtue of their importance, a prominent place in the organization of the Bureau.

DANGERS OF TORNADES EXAGGERATED.

The popular ideas as to the destruction of life and property by tornadoes (often improperly called cyclones) are generally exaggerated. All the reports of violent local storms of all kinds and of deaths caused by them, as obtained from newspapers and observers of the Weather Bureau during the past five years, have been examined and are given in the accompanying table, together with the number of true tornadoes:

	1890.	1891.	1892.	1893.	1894.	Total.
Reports	347	297	563	661	625	2,493
Deaths	273	106	276	399	236	1,289
Tornadoes	33	8	28	51	80	150

We generally have an idea that when one of these tornadoes is reported it shows widespread destruction, but in reality a tornado's path is long and very narrow. The total area of destruction by the largest single tornado has never exceeded 10 square miles. The chance that any township 6 miles square will be visited by a tornado within a century is not one-half of 1 per cent.

An examination of reports also shows that the number of deaths by lightning almost equals that by tornadoes.

It is not at all probable that the number of tornadoes is on the increase in this country, but as the number of towns and their inhabitants increase in the tornado regions, a dread of their visitation must correspondingly increase, and the ingenious will strive to provide means of protection.

It can not be too clearly stated that these terrific atmospheric disturbances nearly always move from west to east or southwest to northeast, and that persons endeavoring to escape from their line of progression should, as a rule, flee toward the northwest or southeast. In a paper recently prepared by Prof. H. A. Hazen of this office, the statement is made that—

So far as known no one has ever lost his life when in the ordinary cellar of a house, and this may be regarded as ample protection. In many parts of the West so great is the dread of a tornado that timid persons sometimes spend a half day at a time in a tornado cave when the sky has a greenish or peculiarly threatening appearance in the west. As a matter of fact, the genuine tornado always makes its presence known by an unmistakable and indescribable roar. Some have heard this roar a half hour before the storm struck, and the cases are rare where it has not been heard fifteen minutes before. This single fact should serve to allay the fears caused by ominous clouds on a hot summer afternoon.

In the sections where tornadoes are frequent the annual loss due to them is only about one-fourteenth that caused by fire.

VALUE OF RECENT HURRICANE, FROST, AND RAIN WARNINGS.

The season so far has been unusually free from those destructive storms which often, in the early fall, move from the West Indies northwestward into the Gulf of Mexico and thence recurve to the northeast and cause destruction on our Atlantic coast.

From August 24 to 29, inclusive, a hurricane moved from south of the Island of Cuba in a westerly direction and reached the extreme southern coast of Texas. No material damage was done, as all shipping was warned well in advance by telegraphic information sent from the central office to ports along the Gulf coast.

The Corpus Christi Caller says:

Last Monday the observer here gave notice of a storm entering the Gulf and cautioned all boats about going out. Still there was no sign of a storm at Corpus Christi, the weather being clear and beautiful. Tuesday further information was received from the Chief of the Weather Bureau giving notice that the storm in the Gulf was moving toward the central Gulf coast and notifying the shippers that it was not safe to leave port, and still the weather was clear at this place. Wednesday evening still further information was received of the approaching storm, with instructions to hold shipping until further notice. It was not long after this before our people commenced to hear the old Gulf roar and to notice their barometers falling and the wind increasing from the north-east. Yesterday morning it was evident that the blow was upon us, though not so severe as it was outside. One thing is sure, the Weather Bureau has done its duty in giving timely notice and warning of this storm from the high seas. The Bureau located the storm from its commencement, kept track of it, and reported it right along until it got here.

This emphasizes the importance of the West Indian cable-reporting stations of this Bureau. In the storm just reported the station at Merida, near the north coast of Yucatan, was especially useful as indicating the westerly direction of the hurricane and in rendering it possible for the Weather Bureau to locate the center of the hurricane as being northward in the Gulf of Mexico.

The abnormally hot weather prevailing east of the Rocky Mountains from early in September until the 20th of that month was broken in the West on that date by a marked cool wave, with frost, moving in from the Rocky Mountain plateau region. On Sunday morning, September 22, at a time when temperatures ranging from 85° to 95° prevailed throughout the greater part of the Mississippi and Ohio valleys and Lake region, over 2,000 telegrams were distributed by the Weather Bureau in the regions mentioned, giving warning that the temperature during the next twenty-four to thirty-six hours would fall not less than 30°. The prediction was of great benefit to the people, and was fully verified throughout the entire region. In some cases the change in temperature amounted to 40° inside of twenty-four hours. The advance of the cool wave eastward to the Atlantic Ocean in a modified form was also successfully forecast. Extensive and favorable comment was made on the work of the Bureau in this instance.

Frost, which did considerable damage to tobacco in the Ohio Valley on September 30, was successfully forecast the morning of the 29th and warnings distributed throughout the threatened districts, doubtless resulting in a considerable saving of this valuable crop by inducing growers to cut and house much of the plant. This frost was also successfully forecast twenty-four hours in advance until it reached the middle Atlantic coast States, although little or no damage was done farther eastward.

On Wednesday, September 11, the forecast official at San Francisco became convinced that the rain then prevailing in the northern portion of the State would, within a few hours, extend to fruit regions in the vicinity of Fresno, and sent rain warnings to the observer at

that place, by whom they were widely distributed to horticulturists. The official has been informed by extensive fruit growers that these warnings were worth probably many thousands of dollars, as they enabled the growers to gather the trays of drying fruit and stack them before the coming of the rain. The fruit industry of California is more extensive than that of any other State in the Union, and none, perhaps, is more dependent upon the Bureau for success. In early spring frosts frequently occur during the period when fruit is blossoming and setting. The people are well educated in regard to protecting fruit from frost when warnings are received, and many instances have occurred where orchards have been protected owing to the warnings of this Bureau. During the season from June 1 to October 1 many fruits are dried in immense quantities in trays exposed to the sun. The fruit thus dried is superior to that cured by artificial evaporation. It is liable to be injured by unexpected rain or by high winds blowing dust into the newly cut fruit. Protection can be had from both these conditions by stacking the trays one upon another.

From August 15 to December 15 large quantities of raisins are dried. Unexpected rains are especially injurious to this product, since the rain penetrates the bunches of partly dried fruit and seldom evaporates before mold sets in.

The warning of September 11, therefore, was of great benefit to the fruit industry.

The San Francisco Call of September 13 says :

As a result of the warnings of the Weather Bureau thousands of dollars were saved to the raisin growers to-night. Ample time was had for stacking the trays and protecting them from rain.

The Fresno Morning Republican of Thursday, September 12, says :

Rain, which began falling in this city last evening, did not come so suddenly or unexpectedly that the vineyardists had no time to prepare for it. The system of signals perfected by the Weather Bureau has been of much assistance to the people in getting ready for rain. By this arrangement flags are displayed in every important raisin district of the county, and there are very few vineyardists out of sight of one or more flags. Vineyardists had warning in time to stack their trays.

The San Francisco Chronicle says :

The threatening weather and warnings sent out by the Weather Bureau gave the vineyardists time enough to stack their trays, but considerable loss will result nevertheless.