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REPORT OF THE CHIEF OF THE WEATHER BUREAU

UNITED STATES DEPARTMENT OF AGRICULTURE,
WEATHER BUREAU,
Washington, September 12, 1924.

SIR: I have the honor to submit herewith a report of the operations of the Weather Bureau during the fiscal year ended June 30, 1924.

Respectfully,

C. F. MARVIN,
Chief of Bureau.

Hon. HENRY C. WALLACE,
Secretary of Agriculture.

Following the final enactment of legislation "for the classification of civilian positions within the District of Columbia and in the field services," and the now thoroughly formulated program of the President for the highest economies with efficiency in the conduct of the business of the executive departments, it seems appropriate to comment briefly upon these topics as they bear upon the personnel, duties, and responsibilities of the Weather Bureau.

By a peculiar course of history, with some other incidental causes, the rate of pay of Weather Bureau men has always been among the lowest in the Government departments. Organized more than 50 years ago as a branch of the Signal Corps of the Army, the rate of pay began with the soldier's standard of $13 per month, with allowances. Twenty years later the service was transferred to the Department of Agriculture with rates of pay fixed for the rank and file, thus bodily transferred to civil life, but slightly, if any, above the low pay then received in the military service. Despite numerous efforts to remove the great disparity in the old Weather Bureau scales of pay and those of many other and newer branches of the Government performing like service, little was accomplished until the new classification went into effect on July 1, 1924. This indeed marks an epoch in Weather Bureau history and creates a measure of status and opportunity of employment for young educated men that will permit recruiting the service, as necessities require, with that kind and standard of talent so necessary to the advancement of the difficult science of meteorology and its practical application to the benefits of agriculture, commerce, and navigation.

While there is no disposition to express other than gratification at the benefits which classification has conferred upon the Weather Bureau as a whole and the removal to a large degree of the great disparities which previously existed in rates of pay, nevertheless dissatisfaction still remains in a number of cases where, from the very complexity of the vast problem of classification, ideal justice is unattainable or not to be expected at the outset of its operation. Indeed, this is almost wholly caused by a provision of the law itself which, in the case of the Weather Bureau, has operated to fix the compensation of employees at the minimum salary rate of the grade in which their duties fall. In the case of the Weather Bureau, at least 90 per cent of its personnel are at the minimum or below the

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

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average salary of the grades to which they have been allocated.

The appropriations made for the Weather Bureau to introduce classification required the dropping of statutory places to the extent of slightly over $21,000 (about 18 places in number). This was carried out as of July 1, but necessitated in certain cases the discontinuance of some lines of work and in others the distribution of duties to employees already quite fully occupied. This operation still further lowers the total number of paid employees of the bureau, notwithstanding that the number for several years past has been held at a very low minimum, necessitated by both the amount and the form of its salary appropriation.

In the matter of promptitude, efficiency, and economy the administration and personnel of the Weather Bureau entertain a just pride in their accomplishments. The weather, like the proverbial "time and tide," waits for no man. All the operations of the bureau are organized around meteorological observations at certain exact hours and minutes, followed in general by telegraphic reports. Forgetfulness, neglect, inattention to duty, tardiness, etc., are attended with immediate serious consequences, and all the exactions of the bureau's work inculcate habits of industry, promptitude, and the policy of "do it now," which naturally go far beyond the exacting necessities of making observations and the preparation and issue of maps, forecasts, warnings, bulletins, etc., and embrace the entire service of the bureau to the public.

Owing to a peculiarity in the form of the Weather Bureau appropriations for salaries for the past 10 years, it has always been necessary to keep the total number of its employees at the lowest minimum necessary to perform the work effectively. Money to pay necessary additional employees could be obtained only by withholding deserved and well-earned compensation from men already in the service. Accordingly the present organization of the Weather Bureau personnel already represents a high type of industry and economy with efficiency.

The bureau's staff as a whole is literally on duty 365 days of the year, Sundays and holidays alike. Its personnel are the sentries always on guard to warn of the approach of storms, floods, hurricanes, cold waves, etc. They serve the Nation in a thousand beneficial ways, and for many long years with a civil patriotism and loyalty deserving of the fullest possible Federal consideration and recognition.

These comments are submitted on this occasion in hearty sympathy for and with cordial cooperation in the program of the President to reduce the costs of conducting Government business, because it is believed that in the matter of the number of and pay for Federal employees the principle and policy of the highest economy are already in full operation in the Weather Bureau.

A program of economy in the operations of our service is being constantly impressed upon and practiced by all the leaders of our work, both in and out of Washington, and scarcely a week passes without some minor change that accomplishes better results without increase of funds.

In some activities curtailments have been made to the danger point in order that funds might be made available for important needs in other directions. For instance, the period of obtaining observations during the hurricane season from parts of the West Indies and Caribbean Sea has been shortened by six weeks; several valuable reporting stations in Alaska have been closed; the quality of paper used in the printing of weather maps and bulletins has been lowered; and the distribution by circuits of daily weather observations to field stations has been curtailed to a stage scarcely sufficient for forecasting purposes.

There is necessarily a sharp limitation upon possible reductions, however, because almost the entire program of the bureau is one of a daily service to the public everywhere, and especially in the several hundred cities where certain field activities are centered. Curtailment of seemingly the least important of these is immediately followed by objections, protests, and pressure for restorations. In contrast to curtailments and reductions we must recognize that the Nation is steadily growing, cities are increasing in population, and the urban and rural public alike are awakening to the great economic value of Weather Bureau service, thus leading to new demands upon the bureau. These are expressed in many ways, and a few are mentioned, as follows:

A wider distribution of weather reports by telegraph; the locating of special stations for the purpose of securing and telegraphing weather conditions from areas which are inade-

quately represented by reports now received, the organization of special services in sections where fruits, vegetables, and other products are grown and where intensive and direct service and advices regarding weather and frosts are essential to the fighting of insects and fungi and the cultivation and protection of crops; and the telegraphing of the forecasts daily to small towns and communities which can not obtain them in any other way in time to be of service; the establishment of stations for investigating free-air conditions for the benefit of the navigation of the air; and finally, the general betterment of the river and flood work, including the determination of water available in the form of snow on extended regions of the West, needs increased appropriations. The conditions in the Ohio Valley present a distinct problem. The great engineering project of an extensive system of locks and dams in aid of navigation on the Ohio River is approaching completion. The successful operation of these locks and dams depends primarily upon accurate daily, and sometimes hourly, information as to precipitation and river stages throughout the entire drainage area of the Ohio River, covering as it does portions of nine States. This information is particularly valuable during the low water season, when precipitation is frequently very local in character, and when there is but little water in the pools, causing the necessity at times for the creation of artificial pools between dams in order that sufficient water may be had to float the boats. The Weather Bureau is expected to supply this information to those in charge of the locks and dams, but with its present facilities it can do so only in part. Many more stations are needed, a few for additional river gaging, but more for the measurement and reporting of precipitation.

Requests like these are legitimate and represent service which the Weather Bureau is charged by law to perform; in fact, is like that already extended to others earlier in the field. In the aggregate it would require increased appropriations to meet these needs. In urgent cases efforts are made to supply some service, but a process of further attenuation when the spread already is extremely thin is not effective. It is unsatisfactory to deny to one, as must be done, benefits and service that another is receiving, and the one denied has no hesitation in approving the small increases in appropriations his case at least calls for.

While a friendly attitude, which is deeply appreciated, has been shown toward the Weather Bureau estimates by both Congress and the Bureau of the Budget, nevertheless its increases in appropriations for extensions of its work have not fairly kept pace with the legitimate needs which arise entirely because of the natural and steady expansion of agriculture, commerce, and the industries of the Nation.

Some needs, of course, are more pressing than others, and the officers of the bureau mean to press at this time only those extensions which are most urgent. Furthermore, they are convinced that a state of stagnation or, still worse, of reduction in Weather Bureau appropriations under a program of reduction of public expenditures is in itself harmful to the best interests of the Nation, because the service performed by the bureau is so distinctly of direct economic benefit.

FORECAST SERVICE

DISTRIBUTION OF FORECASTS AND WEATHER INFORMATION

The activities of the Weather Bureau which come within the purview of the Forecast Division include the procuring of weather reports by telegraph from land stations and vessels at sea for forecasting purposes and the dissemination of forecasts, warnings, and current weather information to the public, and especially to interests concerned with agriculture, commerce, and navigation. These functions represent a large volume of work and a high percentage of the duties of the employees at over 230 field stations, and a number of distinctive projects which are fixed forms of service. Many of these projects have been described in previous reports. However, changing conditions require modifications in methods and procedures which in many cases present new and interesting features and frequently inject problems which, with existing means and facilities, are difficult or impossible to meet. One of these activities which seems to justify special comment relates to the dissemination of forecasts, warnings, and current weather informations.

Weather forecasts and warnings are perishable news products. Unless they can be delivered to the reader within a few hours after they are issued they lose much of their value and shortly

become worthless except as past history. Prompt and thorough distribution is a problem that has confronted the Weather Bureau since its beginning. No great difficulties had to be overcome in cities and in immediately surrounding rural communities. They were reached with reasonable promptness by means of telegraph, telephone, mails, newspapers, and signal devices. Ships out of sight of land, farmers, cattlemen, and others beyond the range of these facilities and to whom the forecasts and warnings would be of incalculable value were reached with difficulty or not at all; and so it remained for a long time.

The rural mail service seemed a promising medium for extending the benefits of the Weather Bureau to farmers. It helped, but not to the extent that was anticipated, because, as a rule, carriers start on their routes in the early morning and before the forecasts could be made available to them. However, all morning newspapers publish the forecasts issued the previous evening. Large numbers of farmers subscribe to newspapers, but unfortunately a considerable part of the period covered by the forecasts published in the morning papers has expired by the time the papers are delivered.

The construction of rural telephone systems was the first marked advance in the solution of the problem. They grew rapidly and weather information service to farmers increased proportionately. Just as soon as a rural telephone line was completed arrangements were made to telegraph the forecasts and warnings to designated central stations thereon. Each subscriber is privileged to call central and to ask for the forecasts. In some instances a prearranged and significant ring is given by central at a designated hour, the forecasts are repeated by the operator and everyone desiring to do so listens in. The forecasts are now made available daily before noon to over 7,500,000 rural telephone subscribers.

The most effective method of furnishing farmers with weather forecasts and warnings at the present is by means of rural telephone systems, but this bids fair to be excelled in a short time by radiophone broadcasting. Developments in the latter since January, 1921, when the first regular radiophone broadcasts were begun from the plant operated by the University of Wisconsin at Madison, have been rapid. There are now about 120 broadcasting stations cooperating with the Weather Bureau and nearly all parts of the United States are within their range. The forecasts radiocast from each station are those appropriate to the sections in which it is located; that is, the forecasts for its own State and in some instances those for several surrounding States in addition. Therefore, the potentiality of radiocasting for excelling all other methods in the dissemination of weather information does not depend on either a material increase in the number of broadcasting stations or in the power and range of such stations. It depends on the installing of receiving sets by farmers and residents of rural districts. The splendid entertainment features provided by broadcasting stations perhaps is doing more to encourage such installations than the utilitarian portions of the programs, but, whatever the inducement may be, thousands of receiving sets are being added monthly and in course of time farmers and business men in every remote section will be on equal terms with city residents in obtaining promptly and directly weather forecasts and warnings, which, if used advantageously, will add largely to national economies. Commenting on this point the radio editor of the National Stockman and Farmer, under whose auspices forecasts for eight States are broadcast from the radio station (KDKA) operated by the Westinghouse Electric and Manufacturing Co., at Pittsburgh, Pa., said in a recent letter:

> The report as it is now constituted is certainly a beneficial report for this section of the country, and we have received any number of favorable comments on the value of the weather report. Personally, I believe that the time signals and the weather report, in themselves, are worth the price of a radio-receiving set to any farmer.

By these and other means the time seems near at hand when the most remote sections will be able to receive the very latest weather information with the same promptitude as the city dweller.

FIRE-WEATHER WARNINGS

For a number of years the Weather Bureau has been cooperating with the Forest Service and with State and private forestry organizations in the furnishing of forecasts of weather favorable to the inception and spread of forest fires and of the coming of rains in sufficient volume to extinguish fires under way. For the most part this work has been conducted in the Western States and has been referred to

in previous reports. The forecasts have been of great value in the preservation of the forests, but it is recognized that the systems of observations from widely separated stations (practically none of them located in the forests) on which the forecasts necessarily have been based, are not sufficiently localized and are therefore inadequate to anywhere near as efficient service as could and should be rendered. Funds have not been available for placing this project on an effective basis, involving as it does more or less complete meteorological surveys of forested terrains and a study of topographic peculiarities which have a direct bearing on the weather conditions therein. The problem can not be approached satisfactorily except by installing meteorological instruments appropriately scattered in the forests and the obtaining of records and reports not only for purposes of study but to provide current data whereby the forecasters may issue advices of a specialized character and applicable to the limited areas for which they are intended.

The situation in the forests of the Pacific Coast States early in the year indicated that a serious condition was likely to exist during the fire-danger season of 1924, and appeal was made to the Weather Bureau for assistance. It was known that the funds of the bureau were far insufficient to provide the service that was necessary and certain forestry associations agreed to bear the cost of instruments, travel, and other incidental expenses if the Weather Bureau would assign one or two of its meteorological experts to the project. In view of the emergency that seemed to exist and which later events fully justified, the proposal was accepted and two trained meteorologists were assigned to the work. These experts were located at Seattle, Wash., and Portland, Oreg., and they were directed to devote themselves exclusively to the problem. As this work was started practically at the end of the fiscal year encompassed by this report details of results must be reserved for discussion at some future time.

VESSEL WEATHER SERVICE

This service in connection with the obtaining of weather reports from vessels at sea was carried forward on the same general lines as heretofore, but special efforts were made to secure more reports from ships in the Pacific Ocean. Considerable improvement was accomplished and more reports were obtained than in any previous year. This was due to more direct and closer cooperation on the part of shipping interests and in large measure to the very active interest of the officials of the United States Shipping Board. During the year new directions were issued by that organization to its ship masters whereby observations from vessels of that fleet are now forwarded twice daily instead of once a day as before. This order also applies to ships plying the Atlantic and other waters from which observations are desired.

A number of changes were made in the schedules of radio broadcasts of weather bulletins, forecasts, and storm warnings for the benefit of ships at sea. Effective announcements of such changes were made in the usual channels and need not be reviewed here.

AIDS TO AVIATION

For several years forecasts and bulletins have been prepared and issued daily for the benefit of aviators, especially those connected with the services of the Army and Navy. A description of this service was contained in the annual report for the fiscal year ended June 30, 1922. When the transcontinental air-mail service was extended across the continent in the early summer of 1924 and to include night flying, arrangements were made at the request of the Second Assistant Postmaster General to provide special weather forecasts therefor. These forecasts, issued from the district forecast center at Chicago, are made in two sections, one covering the route from Bryan, Ohio, to Omaha, Nebr., and the other from Omaha to Rock Springs, Wyo. In formulating the forecasts the forecaster has in mind conditions at the surface and between 1,000 and 5,000 feet aloft. The predictions are prepared each morning and are made available to both eastbound and westbound fliers at the air mail field at Omaha, Nebr. An additional forecast is furnished in the evening whenever, in the judgment of the forecaster, decided changes are in prospect.

PROTECTION OF BANANAS IN TRANSIT

Bananas are consumed in great quantities by the people of the United States, the annual imports amounting to approximately 45,000,000 bunches. The distribution of this fruit from the ports of entry to all parts of the country is a highly organized service.

The product is very susceptible to weather damage, especially by cold, and protective measures must be employed. Shipments are made in ventilator cars which in some cases are accompanied by attendants or else they are looked after by messengers at designated points en route who adjust the ventilators according to weather conditions expected to occur before the next messenger station is reached. The manager of the southern division of the Fruit Dispatch Co., with headquarters at New Orleans, reported that serious losses occur from sudden drops in temperature because the agent at the previous station did not have knowledge of the approaching cold and failed to properly adjust the ventilators. Appeal was made to the Weather Bureau for assistance, and arrangements for providing special services were made. The company furnished a chart showing the various shipping routes and the location and names of their agents. The entire area was divided in zones and the duty of rendering service in designated zones was assigned to the officials in charge of Weather Bureau offices best situated to render prompt and efficient service. Wherever a drop to or below freezing temperature is expected within the ensuing 24 to 36 hours a telegram is sent at the expense of the company to the fruit company messengers in the area to be affected. This service was inaugurated in the late fall of 1923 and the results during the past winter were highly beneficial.

SERVICE TO BEEKEEPERS

There are certain weather conditions which are of great importance to the honey industry and beekeepers often have difficulty in anticipating them. This is true particularly in the sections where winters are severe and housing during the cold months is necessary. Bees should have a cleansing flight before being placed in winter quarters and it is often a serious problem to determine when this should be allowed. Keepers frequently defer action too long in the hope that mild weather will continue and too often snow or severe cold comes on and finds the bees where they can ill stand the cold weather.

Service in furnishing special forecasts to beekeepers in some of the Northern States, especially in New York, which enables them to avoid hazard and still allow the bees to have the benefit of as long a stay in open weather as is possible, has been given by the Weather Bureau for a number of years, but in the fall of 1923 a special service was inaugurated at the request of the Honey Producers League whereby the Weather Bureau will wire any beekeeper north of the Ohio River between Ohio and Michigan on the east and Wyoming and Montana on the west whenever in November a day or two with temperatures of over 50° F. and clear weather to be followed by cloudy and colder weather is expected. The keepers who desire the service register their requests at the Weather Bureau office from which the weather forecasts for his particular State are issued and the telegrams are sent at the expense of the recipient. Announcement of the plan was made in the bulletin issued by the Honey Producers League and a coupon was provided for use in registering request for the service. Unfortunately the project was not begun in time to fairly test the service in a large portion of the area where bees are protected in the winter, but enough to indicate the great value and success of the plan. It will be continued the coming winter and it is probable that eventually it will be nearly nation-wide in its scope.

In New York the service is conducted in cooperation with the State College of Agriculture at Cornell University. It is of a similar character, the particular exception being that the weather forecasts are supplied to the officials of the college in charge of agriculture and they telegraph the advices to key men who distribute them to beekeepers in their communities, and that it also includes springtime service as a guide in removing the bees from cellars under favorable conditions.

A project of the same kind is conducted by the British meteorological service for the benefit of beekeepers in the Britsh Isles. There, however, a fee is charged the keepers for the forecasts, but the United States Weather Bureau makes no charge. The only cost to them is that of a telegram if sent direct, or nothing when obtained from key men.

COMBATING MEDITERRANEAN FLOUR MOTH IN FLOUR MILLS

The Mediterranean flour moth is a pest which causes much damage in flour and feed mills. An effective method of combat is to freeze out the moths and larvæ by temperatures from −10° to −20° F., if possible. This can be done at mills located in very cold climates by closing down, draw-

ing furnace fires, draining all water pipes and opening the building, so that the whole interior of the mill may cool to the lowest temperature possible. Obviously the mill owners must have accurate and timely notice of cold waves of the required severity in order that preparations may be made and shut-downs be confined to as brief periods as possible. Successful service of the sort was rendered during the past winter to several large flour mills. The Duluth-Superior Milling Co., Superior, Wis., a large concern having a daily capacity of about 5,500 barrels of flour products and 160 tons of mill feed, in a letter to the official in charge of the Weather Bureau at Duluth, said:

We have just completed our annual freeze-out to check the growth of the millers' pest—the Mediterranean flour moth—and, thanks to the advance information received through your office, we met with very favorable weather conditions. For the past 12 years we have used this method of keeping down the propagation of this moth and have always depended upon the bureau to furnish us with the right kind of weather. You have never failed us, and we recall especially a few open winters in that period had we not taken advantage of the advice given us we would have been unable to get the proper results. This would have meant a rather serious condition during the summer and fall months in the manufacture of our product.

SERVICE BY NEWSPAPERS

It is considered pertinent to refer briefly to the extremely important service performed by the newspapers of the country in their relation to Weather Bureau work. Approximately 2,400 daily newspapers are printed in the United States. The weather forecasts are published by practically all of them, the only exceptions being those having only local circulation without telegraphic news or press association affiliations. Generally the forecasts appear in a prominent way on the first page and usually near the title line. In addition, many papers devote considerable column space to the publishing of detailed local weather data, tables showing weather conditions in other cities, special articles, weather stories, news paragraphs, and almost daily comments on current weather.

It would be most ungracious to think of this spontaneous press service in terms of sordid space value, and the press of the Nation is assured that the Weather Bureau esteems its friendly and cordial cooperation of priceless value in the dissemination of its weather advices and indeed indispensable to its efficient functioning.

STUDY OF HURRICANES

During the year an exhaustive study of West Indian hurricanes and other revolving tropical storms of the North Atlantic Ocean was completed by one of the forecasters at the central office. The results of the study are included in Supplement No. 24, of the Monthly Weather Review, now in course of publication.

All available data from ships as reported to the Hydrographic Office of the Navy and to the marine division of the Weather Bureau for a period of 37 years from 1887 to 1923, inclusive, including the daily weather maps of the Weather Bureau and the publications of various foreign meteorological services, were used in the work of replotting the tracks of all storms of tropical origin.

One of the most important results of the study is the establishment of the fact that there are two principal regions where conditions are most favorable for the development of cyclonic storms in the Tropics, one in the region immediately south and southwest of the Cape Verde Islands in the eastern Atlantic Ocean and the other in the western third of the Caribbean Sea. It was found that no storms of this character developed over the eastern two-thirds of the Caribbean Sea during the entire period of 37 years.

Another important conclusion reached is that a tropical cyclone will recurve to the northward and northeastward at the first favorable opportunity, irrespective of longitude or time of year. That so many of these storms travel far to the westward before recurving is because of the influence of the semi-permanent area of high pressure which extends from the vicinity of the Azores west-southwestward to the coast of the South Atlantic States. Whenever there is a temporary breaking down of this area of high pressure to the northward of a hurricane it will immediately start to recurve.

RIVERS AND FLOODS

One of the severe floods of the present fiscal year occurred in the Canadian River of Oklahoma in October, 1923. This flood was caused by two periods of phenomenally heavy rains that began on September 29 and ended about the middle of October. In the valley of the North Fork of the Canadian River the flood was the greatest and most destructive in the history of the valley, and, notwithstanding the ample and timely warn-

ings given by the Weather Bureau, the unpreventable losses reported were over $15,000,000. A large proportion of the season's crops had not been harvested, and 600,000 acres of rich farm lands were overflowed. It will be remembered that a great flood had occurred in the North Canadian River during June, of last fiscal year, causing losses amounting to between $5,000,000 and $10,000,000, and another flood of similar proportions in the Arkansas River and its tributaries other than the Canadian, with resulting damage in southeastern Kansas and Oklahoma amounting to over $18,000,000, of which about $5,000,000 occurred in Oklahoma. These figures summarized show that the losses by flood in Oklahoma during the calendar year of 1923 were between $25,000,000 and $30,000,000, almost entirely in growing and matured crops, and therefore unpreventable.

Another flood of very destructive character during the year was that in the Pittsburgh district of the Ohio River in March, 1924. In this flood rapidly melting snows and high temperatures played an important part. There were no crops endangered and the timely and accurate flood warnings kept the losses down to about $1,000,000, while the reported value of property saved through the warnings was $10,000,000.

The third great flood of the year was the Potomac River flood that occurred coincidently with the upper Ohio River flood, and under the same causative influences. This flood caused unavoidable damage to the extent of about $6,000,000.

Other floods of the year were relatively unimportant, yet they were sufficiently numerous to bring the aggregate of reported flood losses during the year to $29,519,522, while the reported value of property saved through the flood warnings issued by the bureau was $11,942,370, the latter amount being sufficient to maintain the entire Weather Bureau on its present basis for a period of about five years. Obviously all figures must be incomplete, but always on the side of understatement.

AGRICULTURAL METEOROLOGY

Owing to the protracted illness of Prof. J. Warren Smith, the former efficient chief of this division, there has been a material suspension in the research work in the field of agricultural meteorology in which he was a distinguished pioneer. Notwithstanding this handicap and a very limited force the division has accomplished a notable amount of important work under the direction of the efficient assistant chief, J. B. Kincer.

WEATHER AND CROP SERVICES

Beginning as of January 7 the summaries of weekly weather and crop conditions were again printed at the Weather Bureau under the title of "Weekly Weather and Crop Bulletin." Some further reference to this matter is made below under printing. The publication of the weekly Corn and Wheat Region Bulletin at Chicago, the Cotton Region Bulletin at New Orleans, the weekly weather and crop summaries at the several section centers, and the daily Cotton and Corn and Wheat Region Bulletin at a number of points in the principal agricultural districts, as well as weekly Cattle Region Bulletins for the western grazing section was continued as in previous years.

FRUIT FROST WORK

The fruit frost service was maintained in the western fruit districts on about the same basis as during the preceding year. Eight special representatives of the bureau were assigned to duty in the citrus and deciduous fruit districts of the Pacific Coast States during the winter and spring months. This service was unusually successful during the year and was fully appreciated by the fruit interests, who contributed approximately half of the expense.

Other fruit frost activities were conducted during the year in the vicinity of Roswell, N. Mex.; Yuma, Ariz.; Delta and Grand Junction, Colo.; Wichita, Kans.; Peoria, Ill.; St. Joseph and Springfield, Mo.; Pensacola and Tampa, Fla.; Mobile, Ala.; East Wareham, Mass.; and New Lisbon, N. J. Some extension of service was made at Mobile, where the Satsuma orange industry is becoming of much importance.

ATLAS OF AMERICAN AGRICULTURE

Early in the year authority was obtained from the Congressional Joint Committee on Printing for publishing the Temperature Section of the Atlas of American Agriculture. As eight years of additional data had accumulated since the charts and graphs were

prepared for this publication, it was decided to revise such charts as needed revision to represent records practically up to the time of publication. A careful examination of the hundred or more charts and diagrams comprising the temperature section showed that 24 needed revision. The necessary compilation of data for and the revision of these were accomplished in the division without additional assistance, and copy for the section resubmitted to the department for publication.

THE 1924 YEARBOOK

The 1924 Yearbook committee assigned a section of that publication, 100 to 125 pages, to the Weather Bureau. The acting chief of division was assigned two subjects for this section, namely, "The Adjustment of Agriculture to Climate, Soil Conditions, and Topography," and "The Influence of Weather on Farm Work and Crop Yields." Copy of the text matter, graphs, and charts were prepared to occupy 65 to 70 pages of the section.

THE 1925 YEARBOOK

The 1925 Yearbook committee decided to devote that publication to fruits and vegetables. Two subcommittees were appointed, one on fruits and the other vegetables, the acting chief of division being a member of each. Several committee meetings have been held and a general outline for the Yearbook agreed upon.

COOPERATION

Charts, tabular data, and other material were completed during the year in cooperation with the Spring-Wheat Council in a general survey of land utilization in the Northwest. A publication on the geography of the area was decided upon, a separate of which was assigned to the Weather Bureau, to be entitled "The Climate of the Spring Wheat Region and the Northwestern Great Plains." The acting chief of division attended a meeting of the Spring-Wheat Council at St. Paul, Minn., in November in connection with the prosecution of its program.

EXTENSION HANDBOOK

The question of the preparation of a comprehensive departmental Extension Handbook, which had previously been under consideration, was crystallized during the year, with the appointment of a representative from each of the bureaus to form a central committee, for the preparation of material for the publication. The acting chief of division represented the Weather Bureau on this central committee, and supervised the preparation of, and coordinated and indexed data furnished by the several divisions of the central office for this publication. Copy was furnished for 12 printed pages of the Handbook.

RANGE COMMITTEE

A department committee to consider range problems in cooperation with representatives from the agricultural colleges and extension services of the western grazing States, including the acting chief of division, who attended a range conference at Fort Collins, Colo., in November. Among other things agreed upon was the preparation of a range teaching manual, Weather Bureau material for which has been supplied.

OTHER COMMITTEES

The acting chief served also on the Ozark committee, appointed to consider an agricultural program for the Ozark region, and data were submitted on the climatic characteristics and Weather Bureau work in this connection. Other committee services included motion pictures and exhibits.

EDUCATIONAL WORK

The acting chief of division was assigned by the department committee on educational work to substitute for Dr. H. L. Shantz in lectures on plant geography during December and part of January, two lectures each week of one hour each being given. These dealt with the general subject of meteorology and the influence of climate on the geographic distribution of vegetation in general, and different varieties of plants in particular.

STATIONS AND ACCOUNTS DIVISION

WEATHER BUREAU QUARTERS IN THE FIELD

The maintenance of office quarters in the field during the year has been carried out efficiently despite difficulties encountered through the very general demand for increased rentals for quarters by lessors and the limited funds available for this purpose.

Removals to cheaper rented quarters have been made in a few cases and space reduced wherever possible. By these means demands for increased rentals of $2,388.64, at the beginning of the fiscal year, were avoided. During the year quarters were moved at Knoxville, Tenn., and Louisville, Ky.,

and space reduced at the Reading, Pa., and Tonopah, Nev., stations, with resulting additional saving of $1,195. This procedure, however, has been carried so far in the last several years that little more can be hoped for along this line. Change of quarters is made especially difficult because of the necessity of securing offices only where suitable exposure may be had for instrumental equipment and because of the desirability of maintaining the continuity of instrumental records. Unavoidable increases in rentals at seven stations resulted in a net increase of $3,498.

REPAIRS TO WEATHER BUREAU BUILDINGS

Repairs to buildings owned by the bureau have been restricted, owing to the urgent need for economy, to the minimum required to prevent serious deterioration of property values, except in one case. The assistants' quarters at the isolated station at Cape Henry, Va., were remodeled and repaired at a cost of $3,727.95. This action was taken in conjunction with, and to conform to, general improvements being made by the Bureau of Lighthouses to the Government reservation at Cape Henry.

STATUS OF WEATHER BUREAU OFFICES AT STATIONS OUTSIDE OF WASHINGTON

Free quarters and accommodations:	
Observatory buildings (owned and controlled by the Weather Bureau)	46
State university buildings	5
Federal buildings	79
Total free of rental	130
Rented buildings, etc., owned by individuals or corporations:	
Office buildings	87
Buildings with kite-flying fields, aerological	6
Total number rented buildings partly or wholly occupied	93
Total	223

ACCOUNTING PROCEDURE

At the beginning of the fiscal year, a very efficient accounting system was installed to adequately care for a complete ledger record of expenditures in classified form in accordance with Bulletin 1 of the Bureau of the Budget.

Toward the close of the year provision was made to place the expenditure of Weather Bureau appropriations on a budgetary basis. This has not previously been practicable, except in part, owing to the language of the 1924 and prior appropriation acts, peculiar to this bureau, setting forth certain "not-to-exceed" subappropriations which required the transfer of various amounts during the year with consequent uncertainty as to the available funds for particular projects. This sort of faulty legislation was happily corrected in the appropriations for 1925, and, as a result of the budget system set in operation, it is confidently believed that the various activity leaders will be enabled to effect a more efficient utilization and control of the funds under their supervision.

SURPLUS BUILDINGS AND PROPERTY

Weather Bureau buildings and grounds at Narragansett Pier, R. I., and Mount Weather, Va., remain surplus and unoccupied, in charge of caretakers. The sale, disposition, or rental of this valuable Government property has not yet been authorized and should be done without further delay. Cost of only the most urgent repairs and upkeep amounts to about $2,500 per annum, which expense is necessary in order to keep the property from being rendered wholly worthless.

TELEGRAPH

The normal existence and functioning of the Weather Bureau is dependent in an extreme degree upon telegraphic and other electrical agencies for the collection and the issue of observations and reports and it is gratifying to speak of the very cordial relations of friendship and cooperation which characterize the service performed by the great commercial agencies handling our work. Generally satisfactory conditions have attended transmission of the circuit report and message business throughout the year. A contributing factor has been a smaller number than usual of disastrous storms which interfere so seriously with wire maintenance. Another which has had its influence is the gradual improvement in transmission by mechanical apparatus. Complaints from this cause have been reduced in number and seriousness, although there remains some dissatisfaction. A full force of operators at the central office has been continuous, no vacancies having occurred, although expected because of complaints of inadequate salaries. The hope of better pay upon reclassification has sustained most of the employees in their work, and realization has been provocative of a renewed interest in and application to their tasks.

Contracts for telegraph, telephone, cable, and wireless service for 1925 were renewed upon former advantageous terms, with the exception of one company operating on the Pacific coast.

Audit of bills for all telegraph, telephone, cable, and wireless service performed for the Weather Bureau throughout the country, including services of special operators, wire rentals, pole tax, and Weather Bureau telephone and telegraph line accounts, was efficiently and expeditiously accomplished by the local telegraph force. Amount expended for above was approximatey $240,000.

Advantage was taken during the spring of fairly satisfactory personnel conditions and opportunity afforded by reason of the good audit work situation to improve and bring up to date some important division records mentioned in the last annual report as lying dormant. Other work of like character, however, is awaiting further opportunity, execution of which is impracticable during the hurricane season when telegraph duties consume most of the time of the employees, auditing of accounts demanding the remainder.

The list below represents the several wire and cable lines operated by the bureau, and as conditions over these lines have been generally satisfactory throughout the year and are similar to details reported in previous annual reports, repetitions thereof will be omitted this year:

Block Island and Matunuck Beach, R. I.: Telegraph line, two-wire, leased to commercial company for telephone communication.

Norfolk-Cape Henry, Va., and Hatteras, N. C.: Telegraph line.

Whitefish Point and Vermilion Point, Mich.: Telephone line.

Beaver Island and Charlevoix, Mich.: Telephone.

North and South Manitou and Sleeping Bear Point, Mich.: Telephone.

Alpena, Middle Island, and Thunder Bay Island, Mich.: Telephone.

Point Reyes and San Anselmo, Calif.: Telephone.

North Head and Fort Canby, Wash.: Telegraph.

Tatoosh Island and Port Angeles, Wash.: Telegraph.

AEROLOGICAL INVESTIGATIONS

The only expansion of aerological observations effected during the year consisted of the establishment of a regular pilot balloon station at Memphis, Tenn., and at Curaçao, Danish West Indies, the latter through cooperation with the Dutch Government.

KITE STATIONS

Observations with kites were made regularly at Broken Arrow, Okla., Drexel, Nebr., Due West, S. C., Ellendale, N. Dak., Groesbeck, Tex., Royal Center, Ind. Kite flights are made daily whenever possible and in addition when conditions are favorable continuous series of flights are made for periods of 24 to 36 hours. The average altitude reached is 3,000 meters above sea-level, but a large proportion of the flights extends to 5,000 meters or higher. Records of air pressure, temperature, humidity, and wind are thus obtained.

PILOT-BALLOON STATIONS

Morning and afternoon observations by means of pilot balloons were made at the six kite stations listed above, and at Key West, Fla., and Washington, D. C. Afternoon observations were made at Burlington, Vt., Denver, Colo., Ithaca, N. Y., Lansing, Mich., Madison, Wis., Memphis, Tenn., San Francisco, Calif., and San Juan, P. R. From these observations the wind conditions at various heights are telegraphed to district forecast centers at Washington, Chicago, and San Francisco, where they form the basis for "flying weather" forecasts issued to the military, naval, and postal aviation services.

Special observations were made and telegraphed when requested for use in connection with long-distance airplane flights, free-balloon races, etc.

Continued efforts and progress have been made in securing numerous two-theodolite observations to determine to what extent the balloon is affected by convection and to study its behavior at high altitudes, especially above 10,000 meters. A detailed analysis of these results has been made and a number of important conclusions reached.

COOPERATION

Active cooperation between the Army and Navy meteorological services has been continued during the year. Each of these services maintains a number of pilot-balloon stations, whose primary purpose is to furnish wind data of immediate local interest to aviators at flying fields. These observations are regularly telegraphed to district forecast centers of the Weather Bureau, where, supplemented with our own, they are used in issuing "flying weather" forecasts.

In addition to the stations in the United States proper, the Navy maintains one at Santo Domingo, Dominican Republic, one at Coco Solo, Canal Zone, which, together with those of the Weather Bureau at San Juan, P. R., and Key West, Fla., and the cooperative station at Curaçao, Danish West Indies, furnish information of value in connection with the development and movement of hurricanes. Additional stations in this region are necessary, however, to make this service properly effective. As yet only a single pilot-balloon station is maintained in the Pacific, this being at Pearl Harbor, Hawaii, under the Navy's supervision.

In cooperation with a representative of the United States Air Service, the air mail records for the second year were analyzed and studied. These were combined with a similar analysis made last year and the results published in the Monthly Weather Review and a number of aeronautical journals.

The official in charge of the aerological investigations continued to serve as the Weather Bureau representative on a sectional committee that is preparing an aeronautical safety code. The committee is composed of representatives of the Departments of War, Navy, Commerce, Post Office, the Society of Automotive Engineers, the National Aeronautical Association, and aircraft manufacturers. The code when completed will provide regulations for the design and manufacture of aircrafts, qualifications of pilots, establishment of airdromes and airways, and dissemination of meteorological forecasts and warnings, etc.

CENTRAL OFFICE

All kite and pilot balloon observations made at the Weather Bureau stations as well as the pilot balloon observations made by the Army and Navy are forwarded to the central office of the Weather Bureau for final reduction and study. Numerous inquiries are received for these data not only from Government departments but from commercial aviation concerns as well.

A meteorologist who devotes his entire time to the study of these records with reference to scientific problems of meteorology and their practical application has been assigned to central office staff during the year.

A summary entitled "An Aerological Survey of the United States" has been brought practically to completion and publication of it is expected shortly. This will contain the results of *all* free-air observations made in this country.

The publication of monthly summaries of the free-air conditions in current issues of the Monthly Weather Review was contined during the year.

SPECIAL PROJECTS

In cooperation with the United States Air Service, plans were completed during the year relative to an investigation of certain meteorological problems with the use of a manned free balloon. The program included, primarily, a series of constant elevation flights for the purpose of tracing the path of air currents, obtaining thereby first-hand information concerning the free movement of portions of the atmosphere under certain pressure distributions. In addition, observations were made of the amount of dust in the air, sky brightness, size of cloud droplets, visibility, etc. The flights were made from the Army post at Scott Field, Ill. On the fateful tenth flight the two participants, Dr. C. Le Roy Meisinger, Weather Bureau representative, and Lieut. James T. Neely, Army Air Service, pilot, met their tragic deaths. The Army board of inquiry concluded that either induction from a distant lightning discharge or a direct lightning stroke attracted by their radio equipment caused the balloon to catch fire and fall to the earth. The results obtained during their previous flights will unquestionably yield information of meteorological value, although as yet it has been impracticable to study the records.

CLIMATOLOGICAL

COOPERATIVE OBSERVERS

The large corps of men and women making daily observation of weather conditions on a nonpay basis continued their excellent cooperation, and too much praise can not be given these faithful workers, whose reports form such a substantial basis for all the weather information gathered and placed before the public.

In the main the country is now so well covered by these observers that few new stations were established at Government expense during the year, though in a number of instances the business needs of individuals or companies were so closely associated with weather conditions that they were willing to cooperate in securing the necessary data by furnishing their own

equipment, the bureau to cooperate by supervising the work and publishing the data so gathered.

The policy of insuring against loss on account of rain or other adverse weather conditions, now becoming so prevalent, has resulted in much annoyance to our cooperative observers, who are frequently called upon to make measurements for periods other than those usually observed. Permission to make a reasonable charge for such service will probably result in a reduction in the number of these requests, or at least in making them less of a hardship in view of the prospective remuneration.

INSPECTION OF COOPERATIVE OBSERVERS

The program of inspecting these stations once in three years has fallen much in arrears due to insufficient funds, and little work of this character was accomplished during the year, despite the urgent need therefor and the direct benefits these men and woman receive in bettering their work through personal contact with the supervising official.

PUBLICATIONS

The material for the statistical portions of the annual report of the Chief of Weather Bureau, 1922–23, was assembled and the volume issued at the usual time. Likewise tabular matter, charts, and discussions of the main weather factors were prepared as usual for the Monthly Weather Review.

The publication of the Monthly and Annual Climatological Data for the several States and outlying areas proceeded as usual, and no important lapses in the regular and prompt issue of these and their distribution to the public occurred.

No important changes in the manner of presenting the data, or in their character, were suggested from any source, and it may be safely assumed they satisfactorily meet the public needs. They are in constant demand for use in local affairs, and are used with increasing numbers and over greater areas by all classes of business or other interests.

The special snowfall bulletins issued for the information of irrigation and water-power interests in the several western Mountain States were continued as usual during the winter months, though there is a general tendency to the belief that one or two issues at the close of the snow season would sufficiently serve all needs, and several of the State directors have adopted the plan, making special effort at that time to secure the fullest information possible concerning the depth and condition of the snow in the mountains, to enable satisfactory estimates of the probable amount and time of the principal run-off to be made.

A few additional stations have taken up during the year the printing of the new and enlarged Form 1030, meteorological, which gives a detailed summary of all the observations made at the station for the month just closed, and includes comparative data for the same month in previous years. These are now published at sufficient stations to give a good representation for the entire country and are much sought by the public.

The printing of the separate parts of Bulletin W of the Weather Bureau, which summarizes all past records at all stations, was at a standstill for many months, but was again taken up and some 25 of the parts most desired were printed and distributed, furnishing a much-needed medium for answering inquiries as to prevailing weather conditions. Ten more of the parts were prepared during the latter part of the year and submitted to the Government Printing Office, leaving only about a dozen constituting the remainder of the 106 parts which are practically ready for publication and will be submitted shortly for completion of the set, the printing of which it is hoped can be accomplished during the present fiscal year.

The policy inaugurated during the preceding year of printing annual summaries for the stations having long records was continued, and such reports for 1923 were published at nearly all the stations issuing similar reports for 1922.

Two extensive new tables, embracing the mean monthly and annual maximum temperatures and similar data for the station pressures were added. With the publication of these special tables and in combination with the tables of mean monthly and annual temperature and monthly and annual amounts of precipitation appearing in the annuals for 1922, there is now available in printed form practically all the data required for study of the main climatic facts over periods extending back in some cases 100 or more years. These should prove especially valuable in the study of problems of possible climatic changes or of supposed recurrences of weather conditions.

The increasing need for insurance protection from damage by hail and wind storms has made necessary the collection and publication of more details concerning the occurrence of these storms and their distribution to enable the insurance companies to arrive at equable rates for the different sections. Special efforts are now being made to collect the necessary data and they are being printed in a special table monthly in the Monthly Weather Review.

SPECIAL WORK ACCOMPLISHED DURING THE YEAR

The preparation of new daily normals of temperature covering the 46-year period July, 1875, to June, 1921, was practically completed during the year and the final values forwarded to the various stations for current use. The reduction of these to a uniform period of years has been accomplished, and the tables for all stations having such normals, together with a brief description of the manner by which they were determined, have been prepared for printing.

Further progress was made in collecting climatic data for important foreign countries, and data for several sections are now practically completed and ready for printing. Much assistance has been given by W. W. Reed, who is in charge of this work, in extracting foreign data upon written or oral requests, and he has translated a number of important papers for publication in the Monthly Weather Review.

On account of several long periods of illness and frequent and in some cases long details of clerks to other divisions, the effective force of the climatological division has been somewhat diminished as compared with previous years. All routine work has, however, been carried forward as usual.

Due to increasing work along all lines, the clerical force of the division is scarcely equal to the demands made upon it, and in order that more care can be given the preparation of material for distribution to the public it is again urged that an additional well-trained meteorologist be assigned to the division.

Much credit is due each employee for the conscientious efforts made to carry forward the various lines of work.

MARINE

The advent of radio telegraphy has had the effect of materially modifying and developing the ocean meteorological work of the bureau. In the days when reports of observations made at sea could be transmitted only by mail their use was restricted to such purposes as the determination of average, or normal, weather conditions over the oceans and the general study of atmospheric phenomena. With the development of radio telegraphy the collection of such reports for forecasting purposes was made possible and has become of primary importance. This is a distinct branch of ocean meteorology and is attached to the forecast work. Reference to it will therefore be found under that head.

The collection by mail of vessel weather reports continued as usual during the past year. The number of reports received was somewhat in excess of that of the preceding year. The volume of reports reaching the bureau varies with the state of ocean shipping, rising or falling as the number of vessels in commission increases or decreases. The number and the character of the reports received indicate the continued interest of seamen in the work as well as a satisfactory administration of the work on the part of the bureau.

For several years past the bureau has desired to cooperate in the compilation of international ocean weather data under a resolution of the Commission on Maritime Meteorology adopted at Rome in 1913. During the past year it was possible to begin such cooperation by the assignment of an additional employee to the marine work.

An important part of the marine work is the supplying of meteorological data for publication on the pilot charts. These charts, as generally known, are issued by the Hydrographic Office of the Navy Department, the Weather Bureau and Hydrographic Office cooperating in their publication under an act of Congress. The furnishing of material for the pilot charts proceeded as usual during the year.

The time has now come when a general revision of the meteorological data published on the pilot charts is necessary, and recommendation to that end has already been made. In order to undertake such a revision, which involves the compilation of a large amount of accumulated data, it will be necessary to augment the force of the marine division.

Recenty there has been a revival of interest in the subject of ocean surface water temperatures and their in-

fluence as a factor in weather causation. The compilation of data necessary to the revision of normals for the pilot charts will render available for study in this connection a large number of water temperature observations.

During the year about the usual amount of ocean weather data were furnished for use in Admiralty cases. This routine feature of the marine meteorological work is one that brings to the bureau numerous expressions of appreciation from recipients of data.

SOLAR RADIATION INVESTIGATIONS

During the year the weather bureau observatories at the University of Chicago and in Central Park, New York City, have been equipped with the new weather bureau thermoelectric recording pyrheliometers, and the pyrheliometric equipment at Washington, D. C.; Madison, Wis.; and Lincoln, Nebr., has been maintained as in past years. These five stations now obtain continuous records of the intensity of the total radiation, or heat energy, received on a horizontal surface directly from the sun and diffusely from the sky, and a weekly summary of the results is given in each number of the Monthly Weather Review. At the same time a summary is given of the measurements of the intensity of direct solar radiation at normal incidence, made with a Marvin pyrheliometer at Washington, Madison, and Lincoln.

The recording pyrheliometers installed at Chicago and New York, and also one belonging to the Thompson Research Laboratory, Yonkers, N. Y., were standardized by the solar radiation section; and, in cooperation with the instrument division, investigations were conducted looking to an improvement in this type of instrument.

During the visit to Washington of Dr. Ladislas Gorczyński, director of the Central Meterological Institute of Poland, comparisons were obtained between weather bureau pyrheliometers, a pyrheliometer that he will use in the Desert of Sahara, and also one that will be installed at the magnetic and meterological observatory of Samoa. These comparisons make it possible to express the important radiation measurements that will be obtained in equatorial Africa, and near the Equator in the Pacific, in units of the Smithsonian pyrheliometric scale.

The quantity of heat received from the sun on a horizontal surface is recognized as an important climatic factor, especially in its relation to plant growth. In large cities, however, not so much importance attaches to the *heat energy* in solar radiation as to the *light intensity*. Therefore, in response to the request of the Illuminating Engineering Society of America, the relation between pyrheliometric records of radiation intensity and photometric cloudless day if the radiation intensity has been the subject of an investigation. The results show that on a cloudless day if the radiation intensity on a horizontal surface, expressed in gram-calories per minute per square centimeter, be multiplied by 6,700, we obtain the daylight intensity on the same surface, expressed in foot-candles, with a probable error of 5 per cent. With a cloudy sky the factor is about 7,000.

This result is important, since in some of the larger cities methods involving a measurement of the total or heat energy of solar radiation are employed to measure variations in the intensity of daylight.

As stated in the last annual report, the Weather Bureau is cooperating in an international investigation of the dust content of the atmosphere. Each day a count is made by means of a high-power microscope of the number of dust particles collected from a known volume of air by the Owens jet dust counter. Most of the records have been made at the American University, which is situated in the outskirts of Washington, at some distance from the Weather Bureau; but during the winter of 1923–24 they were made at both the university and the Weather Bureau. A few records were also obtained in Chicago during September and October, 1923.

Through cooperation with the Army Air Service, records of the dust content of the atmosphere were obtained during airplane flights up to a height of 10,000 feet, in the late summer and fall of 1923, and in the spring of 1924 during balloon flights up to heights of 7,000 feet.

A summary of the results obtained between December, 1921, and March, 1924, has been published in the Monthly Weather Review for March, 1924. Briefly, the surface measurements even at the American University clearly showed increased dustiness in winter, due to smoke. The increase was especially marked at Washington during the winter of 1922–23, when, on account of a coal shortage, the burning of a certain percentage of bituminous coal in heating dwellings was obligatory. The maximum number of dust

particles collected per cubic centimeter is 7,180, at Chicago, under average conditions. At the Weather Bureau in Washington the maximum is 6,046 on an unusually smoky day.

In summer, convection carries considerable dust as high as 7,000 feet, it being more noticeable in the afternoon than before noon. In the late fall there was little dust above 5,000 feet. Some few dust particles—from 30 to 50 per cubic centimeter—were always found, even at the 10,000-foot level. At this height their diameter averaged about one-fourth as great as at the surface.

A close relation exists between the dust content of the atmosphere and the limit of visibility, although the atmospheric humidity is also an important factor.

Rain or snowfall cleanses the air of much of its dust. Light winds favor the accumulation of dust, especially in the cities.

Besides dust particles due to smoke and loess and finely-divided mineral particles taken up by the wind from the ground, spores and pollen in small quantities have been found even at the 10,000-foot level.

EDITOR'S OFFICE

The Monthly Weather Review, now in the fifty-second year of publication, serves several useful purposes, chief among which are the following:

(1) It enables the United States as a member of the family of nations to carry out that spirit of comity whereby each member furnishes to every other member a comprehensive summary of the meteorological observations made under its direction, receiving in return a like courtesy from the others. Progress in meteorology can be advanced only by the fullest cooperation on the part of all organized services and institutions; it is through the publication of the Monthly Weather Review that cooperation on the part of the United States is brought about.

(2) The Review also serves as a medium through which students and investigators both in this country and abroad may become acquainted with investigations made in any field of meteorological inquiry. Weather Bureau officials are thus enabled the better to correlate the results of their studies with the work of others in the same or related fields; and, finally:

(3) The Review forms the permanent printed record of the weather in the United States and adjacent land and water surfaces month by month, with discussions of the weather influence upon agriculture, commerce, and industry.

The trend of inquiry among meteorologists, as indicated by contributions offered to the Review, has been toward determining the characteristics of the free air with greater precision than heretofore has been possible. The most important studies have dealt with the strength and direction of dominating air currents up to altitudes of 2 to 2½ miles (3 to 4 kilometers). It has been possible in some of these studies through the cooperation of the Air Mail Service to compare the flying conditions as deduced from a consideration of the data of kites and pilot balloons with those actually experienced by air mail pilots over the cross-continent route, New York to San Francisco. The close agreement between these two sets of conditions strengthens the confidence that has been placed in the practical utility of free air observations conducted by the Weather Bureau.

A second line of inquiry that has proceeded so far as to justify the publication of the results is that which deals with the protection of citrus fruit from frost and freezing temperature. Many other climatological subjects have been treated in the current numbers of the Review.

INVESTIGATIONS IN SEISMOLOGY

The important work of collecting and publishing earthquake data, begun December 1, 1914, has been continued during the year.

Instrumental records have been obtained by instruments owned and operated by the Weather Bureau at Washington, D. C., Northfield, Vt., and Chicago, Ill. Similar data have been secured for publication from various seismic observatories distributed from Panama to Canada and from the Hawaiian Islands to Porto Rico.

The noninstrumental reports rendered by the regular and cooperative observers of the Weather Bureau recorded 76 separate earthquakes strong enough to be felt by the unaided senses in continental United States during the calendar year 1923. Although some of these were felt over wide areas, only three caused appreciable damage. No important earthquakes occurred in our outlying possessions.

VOLCANOLOGY

The activities in this connection have been confined to special investigations

of the behavior of the volcano at Kilauea in the Hawaiian Islands. More than a year ago it was deemed in the best interests of the logical organization of Government activities and the promotion of scientific investigations of this character to transfer this work to the Geological Survey of the Department of the Interior. In accordance with this idea, steps were taken to incorporate the necessary legislation in the appropriations for the conduct of Government work, and, consequently, at the close of the year this work in volcanology was transferred to the Geological Survey of the Interior Department.

The work throughout the year consisted of routine observations of lava behavior, including some special investigations by borings and other special studies supported partly by funds contributed by the Volcano Research Institution of Hawaii.

At the request of Japanese officials that the official in charge of the work be authorized to visit Japan in connection with the disastrous earthquake in that country on September 1, 1923, Dr. Thomas A. Jaggar spent several weeks in Japan. After his return he was detailed for temporary duty in Washington, and preparations were made for certain final reports and publications, which it is hoped will ultimately be available for general public use.

LIBRARY

During the fiscal year 979 books and other separate publications were added to the library, bringing the total strength of the collection up to about 43,000 volumes.

As in previous years, the library has catalogued, besides books separately accessioned, nearly the whole of the current literature of meterology and climatology appearing in scientific journals throughout the world; has maintained in efficient condition more than 200 station libraries; has handled most of the routine translating from foreign languages required by the bureau; and has supervised foreign mailing lists.

The official in charge of the library has prepared weekly notes and articles for use, by the press service of the department, in the Official Record and the department Clip Sheet; has served as a member of the Weather Bureau committee on scientific papers; and has continued work that has been in progress for many years in the collection of dictionary material relating to meteorological terminology and nomenclature.

PRINTING

The incident of chief importance in printing during the year was the resumption as of January 1, 1924, of the issue of the Weekly Weather and Crop Bulletin from the small Weather Bureau print shop. About two years prior thereto part of this weekly summary of weather conditions over the great agricultural districts was combined with a department publication known as Weather, Crops, and Markets. The restoration of the printing at the Weather Bureau accomplished at least three important results: (1) The total cost of printing was reduced; (2) the weather report, of great value to farmers and business in agriculture generally, reached destination within 24 to 36 hours after reports were closed and saved from 7 to 10 days' delay unavoidable in the issue of the combined bulletin; (3) finally, the present publication contains more details of information and is otherwise in better form.

The Snow and Ice Bulletin was issued weekly between December 11, 1923, and March 31, 1924, under approval of the Bureau of the Budget, dated December 22, 1922.

Among the regular publications issued annually at the Government Printing Office several new publications were printed under the following titles: Cloud Forms, with halftone plates, descriptive pamphlet, 22 pages; Monthly Weather Review Supplement No. 23, "Temperatures in Mexico," and Appendix 2, Circular D, Instrument Division, "Instructions for Wiring Meteorological Instruments."

The demand for Weather Bureau publications, especially for instruction purposes, by educational institutions throughout the country in meteorolgy and kindred subjects, continues to increase. It has been the policy to comply with these requests in such numbers as existing regulations and funds will permit.

The mailing lists of the Weather Bureau have been revised, with a view of expediting delivery of all publications to those particularly interested in meteorological data. Numerous paid subscribers for Weather Bureau publications are supplied. Subscriptions should be forwarded direct to the Superintendent of Documents, Government Printing Office, Washington, D. C.

Under the regulations prescribed by the Congressional Joint Committee on Printing, quarterly printing plant reports and annual inventory reports

from 96 field stations and the Printing Office, Washington, D. C., were rendered through the Office of Publications, Department of Agriculture, for transmittal to the committee. With the approval of the committee and in accordance with their regulations, several pieces of printing-plant equipment were procured for the maintenance and repair at field stations.

In accordance with existing regulations, the utmost economy was practiced in the issuance of publications and the purchase of paper, ink, and other printing materials.

INSTRUMENTS

MAINTENANCE

While it has been possible to maintain in operative condition the existing equipment of the various stations of the bureau out of funds substantially the same as were available in former years, much help has been given by station officials, many of whom have effected minor repairs such as painting of roof equipment at small expense. The general policy of the bureau to refrain from extensions of its observational program has permitted the devotion of the resources and funds of the division largely to maintenance.

EVAPORATION

The evaporation stations have been continued substantially as heretofore. Offers of cooperation in establishing new stations have been generally refused, because an increase in the number of stations means not only an increased expenditure for instruments but also a greater demand upon the resources of the bureau if the records are to be properly supervised, tabulated, and published.

ANEMOMETRY

Investigations in anemometry by Messrs. Fergusson and Covert have led to the final selection of a three-cup anemometer of the Robinson type whose indications run quite close to the actual velocity of the wind. Two models have been completed in our own shop, and bids have been invited for the construction of six. Funds will not be available this year for the general introduction of the new instrument, and it is intended to utilize the time in giving it a thorough trial under actual service conditions.

TELETHERMOGRAPH

A telethermograph that answers the purpose served by the present thermograph and telethermoscope is being introduced as funds permit. The recording portion of the instrument, operated in the office, is similar to the ordinary air thermograph. The thermal element is placed in the standard instrument shelter or in a special shelter provided for the purpose, and may be at maximum 65 feet from the recorder, to which it is connected by a capillary tube. In addition to the convenience of having a graphic record of air temperature in the office, the clock is protected from the severity of outdoor weather, and the cost is considerably less than the combined cost of the two instruments it displaces.

THERMOMETERS

Special effort has been directed to the question of thermometers, particularly maximum and minimum thermometers. That a correctly constructed maximum thermometer may subsequently become a "retreater" has long been known. Evidence is now at hand indicating that this change in form is due to stresses left in the glass by reason of too rapid cooling. As a result improvement in this respect is to be expected. There has been also a decided improvement in the quality of the minimum thermometers obtained.

THERMOMETER SPECIFICATIONS

Under the direction of the Federal Specifications Board a committee has been created to prepare specifications for all thermometers used by two or more Government departments or bureaus. The chief of the instrument division, who represents the Weather Bureau on the committee, has assembled and prepared for the use of the committee in the form of tentative specifications a description of the types of liquid in glass thermometers used in meteorological work.

PYRHELIOMETRY

Four new thermoelectric pyrheliometers have been constructed during the past year by H. E. Hobbs, cooperating with H. H. Kimball. Experimental work has been made on a low-resistance instrument to be used with small radiation values in the short-wave portion of the spectrum, which, in connection with a new sensitive recording microampere meter,

gives a full scale deflection with but 30 microamperes. This is now being tried out in service. A new sealed type of mounting is under construction, which it is expected will eliminate the trouble of moisture condensation on the interior surfaces of the instrument.

A comprehensive catalogue of meteorological instruments, upon which R. N. Covert has been engaged for several years as his time could be spared from regular duties, is now nearly completed. This catalogue, which is in loose-leaf form, contains a concise description of each instrument and of its interchangeable parts, and the price during representative years, together with brief historical notes, references to published descriptions, drawings, etc., and also photographs sufficient for identification. The catalogue is of assistance to the present administration of the division, but its greater value consists in recording for future years information that can best be obtained at this time, when employees who have been connected with the division from its early years may be consulted.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1924