at hand indicate that nearly one-half of that number are taking advantage of this opportunity to get the forecasts in their homes within a few minutes after their preparation at the district center. Officials of telephone companies operating lines in other States are rapidly signifying their desire to cooperate in this work, and it may be safely stated that the close of another fiscal year will show a gratuitous distribution of daily forecasts over the greater proportion of all independent telephone lines between the Atlantic seaboard and the western borders of Kansas, and as far south in the Middle West as the northern portion of Texas. The general manager of one of the largest independent lines in the State of Ohio stated in a circular letter to the managers of his exchanges that "intelligent handling of these reports will do much to make your service attractive, and whenever your service is attractive it is popular, and whenever popular it is a revenue producer." As these independent lines are merged with the long-distance companies the necessity for telegraphic forecasts to individual exchanges will cease to exist, making it possible to further extend the distribution over rural free-delivery lines into agricultural sections not now supplied with the forecasts.

The following statement shows the distribution by States and Territories and the changes, as compared with work of the previous year:

Distribution of daily forecasts and special and emergency warnings.

State or Territory.	At Government expense.			Without expense to United States by—				
	Forecasts and special warnings.	Special warnings only.	Emergency warning.	Mail.	Rural free delivery.	Telephone.	Railroad telegraph.	Railroad train service.
Alabama	23	4	139	1,175	257	107	83	12
Arizona	3	1	0	0	0	1	0	0
Arkansas	19	8	102	541	249	97	5	0
California	128	10	0	2,549	2,218	35	0	0
Colorado	17	67	39	980	1,016	1,889	0	7
Connecticut	11	3	49	1,074	100	0	15	151
Delaware	9	0	0	36	520	0	41	0
District of Columbia	0	0	0	1,199	0	0	0	0
Florida	27	127	61	917	0	42	91	0
Georgia	39	39	241	1,527	1,532	30	222	41
Idaho	10	1	0	371	0	4	0	17
Illinois	109	24	468	3,082	6,783	7,962	115	459
Indiana	93	16	208	1,913	5,488	6,658	68	287
Indian Territory	7	0	4	194	0	630	0	0
Iowa	168	30	400	1,730	7,667	51,083	13	0
Kansas	69	9	186	889	4,187	1,164	15	15
Kentucky	41	34	96	2,095	75	3,606	18	0
Louisiana	26	45	61	921	0	28	0	0
Maine	21	4	40	1,107	920	4	0	77
Maryland	26	4	42	1,778	1,384	15	101	0
Massachusetts	24	20	63	3,040	10,025	12	1	331
Michigan	115	21	379	4,894	4,888	4,208	253	457
Minnesota	62	18	196	1,961	2,342	1,744	13	0
Mississippi	55	6	118	703	0	49	6	0
Missouri	84	10	240	5,254	6,581	1,505	25	0
Montana	15	20	18	499	0	5	0	0
Nebraska	63	9	221	1,110	1,227	1,133	0	0
Nevada	3	0	0	205	0	0	0	0
New Hampshire	18	1	34	1,184	1,205	0	0	31
New Jersey	23	25	45	1,219	255	3	189	0
New Mexico	3	3	0	15	0	84	7	0
New York	106	68	365	7,549	9,359	3,467	363	168
North Carolina	56	20	189	1,131	268	24	1	16
North Dakota	16	9	99	0	258	74	0	0
Ohio	136	89	437	7,951	6,693	46,328	37	17
Oklahoma	7	2	13	214	0	2,596	9	0
Oregon	16	2	0	689	600	0	0	104
Pennsylvania	59	18	367	4,299	485	1,525	660	0
Rhode Island	4	0	12	105	0	1	0	28
South Carolina	34	5	109	1,123	456	193	30	23
South Dakota	33	19	77	800	195	2,981	0	0
Tennessee	43	11	291	1,534	1,370	217	23	2
Texas	57	66	240	1,769	1,583	259	154	0
Utah	14	62	0	372	290	6	0	0
Vermont	10	1	46	547	100	0	8	13
Virginia	43	9	96	1,572	228	118	60	96
Washington	21	5	0	737	876	8	0	29
West Virginia	18	11	55	987	232	1,619	18	26
Wisconsin	85	24	298	1,952	1,687	10,787	0	16
Wyoming	7	3	8	112	40	1	11	0
Total June 30, 1904	2,076	983	6,152	77,605	83,639	152,302	2,655	2,423
Total June 30, 1903	2,015	926	7,096	78,164	97,648	28,251	3,087	2,423
Changes	+61	+57	−944	−559	−14,009	+124,051	−432	0

THE MOUNT WEATHER METEOROLOGICAL RESEARCH OBSERVATORY.

At Mount Weather, Va., it is proposed to make and send out the apparatus for the exploring of the atmosphere to altitudes of 3 to 10 miles. In this work it is probable that many balloons will be simultaneously liberated from different stations, so as to get records of storms and of cold waves from their four quadrants. With the knowledge thus gained of vertical gradients of pressure and temperature, it will doubtless be possible to gain a better understanding of the mechanics of storms. This exploration will be useful in determining how near right are those who believe that change in temperature other than seasonal is mainly a function of the mechanics of the lower atmosphere—that portion lying below the 10-mile level; that in the study of those aberrations of climate called "weather" investigators need concern themselves only with the atmosphere near the earth; and that variations in the condition and in the intensity of the many forms of solar radiation are inappreciable in their effect on the weather of the earth.

With observations from the magnetic, the electric, and the solar physics observatories which the Department is now building, and which will be equipped with the most approved appliances, opportunity will be given to those who believe that the cyclonic or anticyclonic whirls that constitute storms or cold waves are mainly the result of changes in the amount or intensity of some form of solar radiation. It is the opinion of the writer that the synchronism of changes in the activity of the chromosphere of the sun and the weather of the earth has not yet been established with sufficient definiteness to be of benefit to the forecaster, but a working hypothesis has been formulated which stimulates thought, study, and investigation. This fact must be credited to the patient work of Prof. Frank H. Bigelow. Even those who differ from him in their conclusions relative to the association between astrophysics and meteorology must admit that the fertility of his thought and his earnest seeking after the problems which, when solved, shall raise meteorology from empiricism to a closer approach to an exact science have been highly beneficial. The study of storms has too long been made from a single view point. Daring minds are needed, even those that are willing to take a considerable hazard in the hypotheses which they are willing to lay down and attempt to demonstrate: for to doubt is to investigate. New truths are usually discovered by working inductively along conventional lines, but some of the greatest principles in nature have been made known to the world by deductive reasoning and by the assumption of a hypothesis that could not at the time be demonstrated. Due deference must be given to each other's opinions, and all must strive earnestly for the elucidation of the many difficult problems that now confront the meteorologist.

LINES OF PROPOSED INVESTIGATIONS.

It is proposed to make the research at Mount Weather catholic in its broadness; to look for the truth, and not to despise its source or the means of its conveyance; to discuss meteorological observations from the point of view of their relations to solar physics; to select meteorologic and magnetic elements and compare them with solar observations; to carry on research in the allied subjects of radiation, atmospheric electricity, ionization of gases, radioactivity, etc. Progress in knowledge of the effects of the sun's actions upon weather conditions depends upon introducing more refined processes than have generally been assigned to meteorology. It is hoped to determine the nature of the alliance between meteorology and solar physics. The atmosphere of the sun and of the earth, together with the connecting radiations, will be studied as one branch of science having common interests, which may be designated as cosmical meteorology.

In the seven buildings at Mount Weather the Weather Bureau will have the most approved apparatus for measuring

atmospheric electricity and magnetism, for measuring the solar radiation in the spectrum, for registering the sun-spot areas, the prominence output, and the extent of the faculæ. These are all valuable as registers of the solar energy, which, falling upon the earth, may play a part in stirring up the atmosphere and producing our weather.

INTERPRETING THE LANGUAGE OF THE SUN.

The climate and crop conditions from year to year depend largely upon the invisible and subtle solar radiations, known to exist as waves, like those used in wireless telegraphy. The space between the sun and the earth—that is, the cosmical ether—is filled with wireless messages which science is laboriously learning to interpret. Its votaries do not understand the solar code very well, and the process of deciphering it is like that of learning to read Babylonian inscriptions, namely, by putting this and that together, learning to read a bit here and there, by intercomparisons, trial and failure, till at length the language of the sun shall be understood. The time may come when it may be possible to interpret the seasonal weather from year to year in advance. It has not yet arrived. The sun moves leisurely through its cycles and the terrestrial conditions seem to follow loosely. At present all available information concerning these matters comes in scattered form from observatories, in reports two or three years old. It is necessary, therefore, to have instruments, trained research observers and computers, and a discussion of results, subject to the direct control of the Weather Bureau.

BUILDINGS COMPLETED AND PROJECTED.

During the past year the main building of the Weather Bureau observatory has been completed, the power plant and the building from which balloon ascensions and kite flights are to be made have been erected, and the magnetic buildings started. It has been found that the rocks are entirely free from magnetism, and that the field is uniform, so that it is a suitable place on which to locate a magnetic observatory. A physical laboratory for electrical and radioactive effects is being planned, and its erection will take place during another year. Finally, a comprehensive physical observatory for photographing the sun directly and through the spectrum, for measuring the radiation energy by actinometry and bolometry, with their allied equipment, will be required. This complex institution must grow up slowly; as plans can be matured along the best modern lines, our assistants must be trained to work in several lines on a harmonious general plan, and the results must be carefully studied as the science progresses.

CONVENTION OF WEATHER BUREAU OFFICIALS.

Under the authority of the Secretary of Agriculture, a convention of Weather Bureau officials was held at Peoria, Ill., in the audience room of the Bradley Institute of Technology, on September 20, 21, and 22, 1904. It is the custom to hold similar conventions once each three years. The character of the papers read and the discussions that followed were of an unusually high order. Particular effort was made to contribute to the science of meteorology, as well as to discuss methods of utility. Several important results were obtained which will, without doubt, contribute both to the science of meteorology and to the efficiency of the weather service.

Synopses of the papers read follow. A full report of the convention, including all of the papers in full and the discussions relative thereto, will be issued as soon as the work can be edited.

LABORATORY WORK IN METEOROLOGY, by Prof. A. G. McAdie: Laboratories essential in all courses of the applied sciences.—Meteorology to be the most important of the applied sciences.—Equipment of laboratory a measure of the standing of the university.—A laboratory containing only first-order station instruments does not meet the demand of the day.—Less routine work and more individual contributions.—Necessity of expressing clearly results obtained.—Teachers of science not familiar with meteorology.—Out-of-door work.—Movements of air on large scale and on small scale.—Arousing an interest in the students.—More important to understand the physical processes at work and to have clear conceptions of a few things than to maintain elaborate records or attempt long courses in reading.—Problems awaiting investigation.

THE MOUNT WEATHER RESEARCH OBSERVATORY, by Prof. F. H. Bigelow: Need of a modern research observatory for meteorology in the United States.—Recent advances in physics which concern meteorological problems.—Equipment of the proposed observatory at Mount Weather.—Problems and observations which can be undertaken.—Relation of the data to processes in forecasting the action of cyclones and anticyclones.—Problem of long-range forecasts of the seasons and the synchronism between solar and terrestrial actions.

ERRORS OF METEOROLOGICAL INSTRUMENTS AND LINES ALONG WHICH IMPROVEMENT SHOULD BE SOUGHT, by Prof. C. F. Marvin: Three general classes of errors mentioned.—Accuracy of mercurial barometers and thermometers.—Clock errors in automatic instruments.—Discussion of effects of thermometer errors on the psychrometer at certain temperatures.—Construction of rain gages, errors of exposure, action of wind, etc., considered.—Difficult problems in snow measurements.—Errors of anemometers at high and unusual velocities.—Measurement of sunshine.—Lines of improvement discussed.

LONG-RANGE FORECASTS, by Prof. E. B. Garriott: Refers to theories regarding weather periodicities dependent upon lunar or planetary influences, and pronounces them theories of faith and not of practise.—Summarizes results obtained by comparisons of maximum and minimum sunspot periods with the phenomena of the earth's atmosphere, and states that the next advance in meteorological science must result from extensive research in solar physics and terrestrial magnetism and comparison of solar and terrestrial phenomena.—Mentions means proposed to accomplish world-wide plan of observation permitting systematic study of the problem.

SEASONAL FORECASTS, by Prof. A. G. McAdie: Improvement of daily forecasts.—Experience at San Francisco; rain falling on typical fair-weather maps; map classifications insufficient.—Seasonal types of pressure distribution.—The individual disturbance in its relation to the seasonal condition.—Permanent pressure areas and their relation to the season's character.—Typical wet winters on the Pacific coast.—Individual disturbances are by-products of the larger air movements; therefore the character of the individual high or low will vary more or less with the swinging of the larger pressure areas.—True normal conditions rare.—Ability to forecast the abnormal condition is the real test of the forecaster.

AMPLIFICATION OF FORECASTS FOR BENEFIT OF SHIPPERS OF PERISHABLE PRODUCTS, by Dr. W. M. Wilson: Importance of amplified forecast to large industrial and commercial enterprises.—Extent to which their needs are met at present, and practicability of specializing for their benefit.—Necessity of a definite view on the part of the forecaster regarding the interests to be thus served.—Terms proper to such forecasts.—Review of other special services now in operation.—Suggested methods of amplification.

AN AID IN FORECASTING, by Mr. F. H. Brandenburg: Disadvantages of a district forecaster under present methods through lack of convenient means of studying local weather signs at outlying stations.—Recommends compilations of prevailing wind directions, temperature changes, clouds, and pressure changes for twelve and twenty-four hour periods before and after precipitation.—Advantages of such compilation.

FORECASTING FOGS ON THE GULF COAST, by Mr. B. Bunnemeyer: Periods of and areas covered by dense formation.—Diurnal periods of maximum and minimum density.—Temperature, air pressure, and wind direction in connection with fogs.

A POPULAR ACCOUNT OF THE COUNTERCURRENT THEORY OF STORMS, by Prof. F. H. Bigelow: Leading meteorological theories and their defects.—Observations which have contributed to the new theory.—Cause of the countercurrents in the general circulation of the atmosphere.—Local circulation in cyclones and anticyclones.—Equilibrium of temperature.—Interchange of inertia.—Relation of the theory to forecasts.

VARIATIONS IN INSOLATION AND IN THE POLARIZATION OF BLUE SKY LIGHT DURING 1903 AND 1904, by Mr. H. H. Kimball: Observations in Washington and their comparison with those in other cities.—Cause of diminution of solar insolation in 1903.—Effect of variation of solar energy on climatic conditions and plant life.—Value of solar investigations at Mount Weather.

A POSSIBLE METHOD FOR DETERMINING THE DIRECTIONS AND VELOCITY OF STORM MOVEMENT, by Mr. E. H. Bowie: Variations from the average direction and velocity of movement of cyclonic areas responsible for a large percentage of errors in forecasting.—General statement that storms follow lines of least resistance of small practical value without definite rules for determining such lines.—Brief summary of views of leading authorities as to the main laws of control of cyclonic movement.—Studies of erratic storm movement by the writer, disclosing the influence exerted by unequal pressure distribution surrounding the area of low pressure, and the presentation of a working basis for determining the value of such control upon the future movement of the storm.

TEMPERATURE FORECASTS AND IRON ORE SHIPMENTS, by Mr. H. W. Richardson: Temperature an important consideration in the shipment of iron ore.—When iron ore is frozen, it can not be economically trans-

ferred from cars to boats; thawing by steam expensive, also causes delays, which can be averted by advance information of freezing temperature.—Practical application at Duluth.

DISTRIBUTION OF FORECASTS BY TELEPHONE. by Dr. G. M. Chappel: List of telephone companies in Iowa.—Plan of cooperation.—Practical results.

PRACTICAL RULES FOR FORECASTING FLOOD-CREST STAGES FOR CAIRO, ILL., by Mr. P. H. Smyth: Difficulty of crest-stage forecasting.—Character of the data upon which forecasts are based.—Possibility of predicting the intensity of floods two or three months in advance of their occurrence.—Method of applying the tabulated data.—Brief history of the flood at Cairo in the spring of 1897.—Time of flood crests from Cincinnati, Chattanooga, Nashville, and St. Louis to Cairo.

THE COLUMBIA RIVER, by Mr. E. A. Beals: Its discovery and commercial importance.—Drainage basin, extent and character.—Precipitation over watershed.—River stages, including The Dalles Hydrograph.—Causes of floods, their frequency and duration.

SOME DIURNAL PERIODICITIES IN THE CLIMATIC FACTORS AT BALTIMORE, by Dr. O. L. Fassig; A diurnal period will be shown for temperature, pressure, humidity and vapor tension, rainfall (frequency and amount), wind velocity and direction, cloudiness and sunshine, and thunderstorms and atmospheric electricity.—Discussion based on series of ten years of hourly observations made at the Baltimore station.—Diurnal periods graphically shown by means of a system of "isopleths."

INSTRUCTION AND RESEARCH BY WEATHER BUREAU OFFICIALS, by Prof. Cleveland Abbe: In this address the author shows what has been done for meteorological education during the past thirty years by the Bureau or through its influence.—He examines the present condition of this subject in this country and considers its future prospects.—He shows that progress in forecasting means not only education in the physical sciences but research, and illustrates this by recent examples.—Finally, he shows what research means, how it is to be fostered, and especially how it can be carried on at a well-equipped central meteorological observatory like that at Mount Weather.

PHENOLOGICAL OBSERVATIONS AT WAUSEON, OHIO, by Mr. J. Warren Smith: Temperature and precipitation at Wauseon, Ohio, since 1876, and their relation to the blossoming of fruit trees.—Average yield per acre of principal farm fruits and crops. (This paper will be accompanied by charts.)

A STUDY OF THE RAINFALL ON THE WEST FLORIDA COAST, by Mr. B. Bunnemeyer: Summary of rainfall data for twenty-four years, with charts.—Ratio of day rainstorms to night rainstorms.—Hours of greatest and of least frequency of showers.

CLIMATOLOGY OF PORTO RICO, by Mr. W. H. Alexander: Topography.—Temperature.—Rainfall.—Humidity.—Prevailing winds, etc.

MONTHLY STATEMENT OF AVERAGES FOR RURAL PRESS, by Mr. W. S. Belden: Form similar to 1079-Meteorological, based on data from all observation stations within section, to be prepared at section centers.—Such data for ten years or more now available.—Data should be concise and plainly stated.—Extreme values for important agricultural districts to be stated.—Time of issue and use of by weekly newspapers and newspaper unions.—Result of experiments.

IRREGULARITIES IN FROST AND TEMPERATURE IN NEIGHBORING LOCALITIES, by Dr. I. M. Cline: Marked variations of temperature in different localities in immediate neighborhoods.—Occurrence of "frost patches," or the irregular effect where small areas scattered over fields have suffered much greater damage than other parts of the same field.—Character and color of soils and their influence on insolation and radiation have much to do with the occurrence of frost and explain the "frost patches."

FORMER CONVENTIONS OF WEATHER BUREAU OFFICIALS, by Mr. James Berry: Brief mention of former conventions and of the benefits resulting therefrom.

WIRELESS TELEGRAPHY.

The Department of Agriculture, through the Weather Bureau, was one of the first of the Government Departments to take up, systematically, experimentation in problems concerned with the development of wireless telegraphy. By this action research into the physical problems concerned in transmitting messages through the medium of ether waves was greatly stimulated in this country. Probably one of the best, if not the best, instruments anywhere made for the receiving of wireless messages had its inception in the experimental work of the Weather Bureau.

Recently a Board, to consider the whole problem of wireless telegraphy and the relation of the Government thereto, was appointed by the President. Its conclusions and recommendations follow:

CONCLUSIONS.

The conclusions of the Board are—

That the science of wireless telegraphy has been advanced by the able and persistent work of the Signal Corps of the Army and the Weather Bureau of the Department of Agriculture, as well as by the experimental work of the Navy Department.

That wireless telegraphy is of paramount interest to the Government through the Navy Department, and that its use by the Signal Corps of the Army for communication between military posts of the Army and other necessary links will be necessary both in peace and war, and that such use shall be unrestricted. When interference seems probable between stations of the Navy and War Departments, the question involved shall be mutually settled by representatives of the two Departments;

That coastwise wireless telegraphy is not a necessity for the work of the Weather Bureau of the Department of Agriculture, provided that the necessary meteorological data for that Department can be collected by the stations of the Navy Department from ships at sea and by them sent to the Weather Bureau of the Department of Agriculture;

That the maintenance of a complete coastwise system of wireless telegraphy by the Navy Department is necessary for the efficient and economical management of the fleets of the United States in time of peace and their efficient maneuvering in time of war;

That the best results can be obtained from stations under the jurisdiction of one Department of the Government only, and that representatives of more than one Department should not be quartered at any station;

And finally the Board concludes that the Government must take the necessary steps to regulate the establishment of commercial wireless-telegraph stations among the States and between nations.

RECOMMENDATIONS.

In order that the above conclusions may be carried into effect, the Board recommends—

That the Signal Corps of the Army be authorized under its chief to establish from time to time such wireless stations as he may deem necessary, and that they do not interfere with the coastwise wireless-telegraphy system of the Government under control of the Navy Department; and further, that the Chief Signal Officer be requested to inform the Navy Department what stations of its systems may be utilized to transmit messages for the Signal Corps or other bureaus of the War Department, and that representatives of the Signal Corps of the Army and Bureau of Equipment of the Navy Department be at once requested to draw up such rules as will insure the efficient and harmonious carrying into effect of the above recommendations.

That the necessary steps be taken to have the Weather Bureau of the Department of Agriculture turn over to the Navy Department all coastwise wireless-telegraph apparatus now under its control, and such material as it may have in its possession which can be utilized by the Bureau of Equipment of the Navy Department and that proper transfers of funds for this purpose be made;

That the Weather Bureau of the Department of Agriculture furnish to the Hydrographic Office of the Navy, and to the naval wireless-telegraph stations, or to other portions of the public service, such meteorological data as it or they may desire at no cost to them;

That the Department of Agriculture shall continue the work of its meteorological vessel-reporting and storm-warning stations, as now constituted and provided for by law, and continue the control of seacoast telegraph systems, except wireless systems;

That the necessary steps be taken that the Navy Department may equip and install a complete coastwise wireless-telegraph system covering the entire coasts of the United States, its insular possessions, and the Canal Zone in Panama;

That the Navy Department be directed to receive from the Signal Corps of the Army, at such points as may be requested by the Chief Signal Officer of the Army, all messages for army posts within their radii, and transmit them under such rules as may be agreed upon by the representatives of the Signal Corps and Bureau of Equipment, without cost to the Signal Corps of the Army;

That all meteorological reports from vessels of war or commerce or other sailing craft, now being forwarded direct to the Hydrographic Office of the Navy, shall be forwarded direct to the Weather Bureau, and the control of ocean meteorology be transferred to the Department of Agriculture, which already has ample law for doing this work;

That the estimates for the support of the Hydrographic Office of the Navy, or any other office of the Navy, for the next and succeeding fiscal years, do not contain any provision for the making of ocean forecasts, or for the publication of meteorological data, other than such as may be needed by the Hydrographer of the Navy for use on the pilot and other charts, which data shall be furnished by and credited to the Weather Bureau;

That it is the opinion of this Board that no meteorological work need or should be done by any portion of the Navy for the purpose of publication, or for the making of forecasts or storm warnings; that all such duties, being purely civil, should devolve upon the Weather Bureau of the Department of Agriculture in accordance with the organic act creating that Bureau;

That the wireless station of the Navy Department shall, without charge to the Agricultural Department, receive and promptly transmit to the ocean or to islands, or to other places where the information can be made useful, the storm warnings of the Weather Bureau;

That the Navy Department shall request all vessels having the use of its wireless stations for the receipt of messages, to take daily meteorological observations of the weather when within communicating range and to transmit such observations to the Weather Bureau, through naval wire-