

Prof. F. H. Bigelow: "Studies on the circulation of the atmospheres of the sun and of the earth." (1) The circulation of the sun's atmosphere (October, 1903); (2) The synchronism of the variations of the solar prominences with the terrestrial barometric pressures and temperatures (November, 1903); (3) The problem of the general circulation of the atmosphere of the earth (January, 1904); (4) Values of certain meteorological quantities for the sun (February, 1904); (5) Results of the nephoscope observations in the West Indies during the years 1899-1903 (April, 1904); (6) Circulation in cyclones and anticyclones (May, 1904); (7) Average monthly vectors of the general circulation in the United States (June, 1904).

This long series of papers by Professor Bigelow presents the results of several years of work. It is the opinion of Professor Abbe that the most important conclusion to the meteorologist is the presentation of the facts that in certain portions of the globe the oscillations of temperature are similar to those of the solar phenomena, such as sun spots and prominences, while in other parts of the globe they are opposite, and about an equal number of regions show no decided agreement or opposition. He is of the opinion that terrestrial weather phenomena are the direct result of changes in the pressure and circulation of the earth's atmosphere, and it is not yet certain that these have any connection with the sun. Some are inclined to believe that changes in the sun are the direct or indirect cause of these terrestrial changes. Others believe that the latter would exist even if the sun's radiation were absolutely uniform, and that they represent hydrodynamic and thermodynamic phenomena confined to the atmosphere itself.

Another interesting result of Professor Bigelow's work is presented in his article on the nephoscope work in the West Indies, in which he shows the variation from month to month in the directions of motions of the winds and clouds. The season of hurricanes is distinguished by a special disturbance of the atmospheric circulation. The level of the maximum horizontal velocity changes systematically throughout the year. The mean altitude at which the westward drift reverses to the eastward drift is apparently above six miles in the summer months. The strata from four to six miles high are those chiefly concerned in causing the formation of hurricanes.

Alexander G. McAdie: "Mount Whitney as a site for a meteorological observatory" (November, 1903). This is a report of an expedition by Professor McAdie to the summit of Mount Whitney. The altitude of the mountain has been determined barometrically by a number of observers. Professor McAdie's result is 14,515 feet, but the levelings reported by Prof. Joseph N. LeConte since Professor McAdie's work give 14,434 feet.

Prof. Dr. J. M. Pernter: "Methods of forecasting the weather" (December, 1903); "Promotion of meteorology" (May, 1904). These two articles present an excellent summary of the arguments against the so-called long-range forecasts by means of planetary meteorology, and will do much to stem the tide of popular ignorance and superstition on this subject.

Oliver L. Fassig: "Kite flying in the Tropics" (December, 1903). This summarizes the results of meteorological work by Doctor Fassig on an expedition to the Bahamas under the auspices of the Geographical Society of Baltimore. A number of successful kite ascensions were made from both the land and water, and the temperature, moisture, and wind were determined at various heights up to 4000 feet.

G. C. Abbot: "Recent studies on the solar constant of radiation" (December, 1903). This is a most important publication in which for the first time meteorologists have been favored with quite reliable determinations of the absorbing power of the atmosphere for a number of specific wave lengths, ranging from the visible portion of the spectrum far down into the infra-red. A similar work by Professor Langley has been offered for publication, and a summary will appear in some future number of the WEATHER REVIEW.

Prof. James Dewar: "Problems of the atmosphere" (January, 1904). The author computes the relative quantity of oxygen and nitrogen, carbonic-acid gas, and possible hydrogen up to the outer limit of the atmosphere, and gives important suggestions as to the origin of the aurora and its spectrum.

Gen. H. L. Abbot: "Disposition of rainfall in the basin of the Chagres River" (February, 1904); "Panama meteorology" (June, 1904). These form the conclusion of an important series of papers in which the meteorological data collected by the engineers of the New Panama Canal Company are subjected to discussion by one of the most prominent officers of the Engineer Corps of the United States Army. The great work of Humphreys and Abbot on the Mississippi River has been a standard for fifty years, and his work on the Chagres promises to hold an analogous position as regards that river.

Rev. Marc Dechevrens, S. J.: "Vertical component of the wind" (March, 1904). This article presents the results of observations for several years on the vertical movements of the atmosphere as recorded on the island of Jersey by the use of a special anemometer. The observations are very instructive, although it may be doubted whether they have anything but an extremely local application.

W. B. Stockman: "The winter of 1903-1904." In this article Mr. Stockman gives a detailed record of departures from normal temperatures during the past winter. From New England westward to the Missouri Valley and southwest to the east Gulf States temperatures

were generally below the normal. On the Rocky Mountain slope, the Plateau, and middle Pacific districts temperatures were above normal.

Dr. Edgar Buckingham: "The amount of energy in a unit of light" (April, 1904). This is a very thoughtful paper, revising our knowledge of radiant energy, and showing that to a certain extent we may calculate the temperature of a flame from its radiant energy, but the temperature of an ordinary body can scarcely be thus determined without involving undesirable assumptions.

E. L. Mosely: "The meteor of September 17, 1902" (April, 1904). The author collects the observations and calculates the path of this meteor. The sounds which emanated from it are, however, not explained by him.

R. Assmann: "The temperature of the air above Berlin" (April, 1904). The text and charts illustrate the results of the highest balloon and kite work, and give sections of the atmosphere showing the temperature day by day for fifteen months from October, 1902, to December 31, 1903. These are apparently the most accurate temperatures yet observed in the upper air, and show that at the height of 5000 meters, or over three miles, the changes in temperature from day to day are surprisingly large—but very little less than at sea level. The so-called diurnal variation of temperature is of course very small, but the irregular oscillations, due to the passage of masses of warm air and cold air, are as large in summer as in winter. On the average there is a general inversion of the vertical temperature gradient; that is to say, the stratum between 500 and 2000 meters has an average temperature a little higher than the strata above and below it. The level of freezing point varies between 3000 meters and the ground. The international high balloon ascensions now being carried on in Europe on specified days promise to add more to our knowledge of the atmosphere than was obtainable by the use of high mountain stations; but both of these methods of investigation, as well as the kite work, have become of great importance. Each is specifically adapted to the investigation of some special problem.

S. A. Mitchell: "Pressure of light" (May, 1904). This is an exposition of the latest views accepted by experimental physicists as to the consequences of the well demonstrated fact that a beam of light, or any other form of radiant energy, exerts a pressure in the direction of the propagation. This pressure is inappreciable when the body is large, in comparison with the attraction of gravitation, but becomes the most important item when the body is very small. By virtue of this pressure the finest dust of gaseous particles are repelled from the sun toward the earth and in all directions. When they impinge upon the outer boundary of the earth's atmosphere they may enter it temporarily and influence atmospheric and electric phenomena. These views have received their fullest development at the hands of J. J. Thomson, and at present the subject belongs to molecular and solar physics rather than to meteorology.

W. F. Tyler: "Sensation of discomfort" (May, 1904). The author has attempted to draw curves based upon personal observation showing under what conditions of temperature, wind, and moisture he experienced the greatest discomfort. His idea is quite analogous to that proposed by the editor some years since in which curves of perfect comfort were recommended. Either method seems to offer a convenient way of expressing something analogous to the so-called sensible temperature, and without involving the observer in any unsatisfactory theory.

The cooperation of so many physicists at home and abroad is gratefully acknowledged, and has contributed in an important degree in making the MONTHLY WEATHER REVIEW of increased value to the service as well as to meteorology in general.

THE TEACHING OF METEOROLOGY BY WEATHER BUREAU OFFICIALS.

Meteorologists gratefully recognize the personal interest of the honorable Secretary of Agriculture in the general introduction of meteorology into the courses of study provided by the universities and higher technical institutions of the country. At his suggestion the mode of teaching and the results obtained were made an important part of the work of the convention of Weather Bureau officials at Peoria, Ill., in September, 1904. At fourteen educational institutions Weather Bureau officials, in addition to their regular duties and mainly outside of office hours, deliver courses of lectures on meteorology. The discussion at the convention brought to light the fact that a large amount of work is being done by Weather Bureau men in an educational way. The methods employed are determined by the different needs of the institutions receiving the cooperation of the Bureau, and range from impromptu talks to elaborately prepared lectures with suitable illustrations. The audiences included school classes, teachers' institutes, science associations, and business men's meetings.

At many places regular and systematic courses are being given by Weather Bureau men, and at some of the leading universities a professor makes a specialty of the teaching of meteorology. We are anxious that it should be incorporated as a part of the science course in every university. I am of the opinion that some general study of meteorology should be required of persons who are fitting themselves to fill the position of civil engineer, mechanical engineer, geologist, or biologist, and that an elementary knowledge of meteorology and climatology is of prime importance in the study and cure of disease.

LECTURES BY PROFESSOR ABBE.

In addition to his work on the MONTHLY WEATHER REVIEW, the editor, Professor Abbe, has delivered a course of lectures on meteorology to students who come to the Weather Bureau. These lectures should, perhaps, properly be considered as preliminary or introductory to those that may be given in future years at Mount Weather. One lecture of two hours' duration was given on consecutive Fridays from January to May, inclusive. The preparation of these lectures required much more time than was originally contemplated, and as the subjects were treated from a mathematical point of view it may be doubted whether they can properly be called popular. However, they presented the latest results of work done by some of the ablest meteorologists in the world. If they could be published they would perhaps be recognized as an extension of the knowledge collected by Hann in his *Lehrbuch der Meteorologie*. The publication of an English edition of this *Lehrbuch* is still greatly to be desired, but as the work is a herculean task it may perhaps be postponed until Professor Hann himself publishes a condensed edition of his volume.

ENCOURAGEMENT AND INCREASE OF EDUCATIONAL WORK.

The general subject of instruction in meteorology given by Weather Bureau men in the form of public lectures or college class work has been kept faithfully in mind. Every case worth mentioning has been noted in the MONTHLY WEATHER REVIEW. Inspectors have been instructed to report fully as to the amount and character of the work and the possibility of increasing it. There is an increasing demand for class work in high schools and colleges. It is not likely that the Weather Bureau employees can fully respond to this demand, partly because of their want of training as teachers, but principally because of the absorption of their time in regular office work. It is to be hoped that our colleges and universities will establish proper positions for teachers of meteorology, and that some of our best men may fill such places when retired from active service in the Weather Bureau. Meanwhile they are doing their best to respond to the demand made upon them.

LIBRARY.

The work of the library has been conducted on the same general lines as in recent years. On June 1, 1904, Dr. W. F. R. Phillips was succeeded by Mr. H. H. Kimball as librarian, climatologist, and supervising examiner.

The library is being used more and more as the work of the Bureau expands. Employees detailed to special lines of research need first of all to become familiar with the methods and results of others doing similar work. The library, therefore, becomes their starting point, and hence the necessity for having the books and pamphlets so arranged and indexed that all that relates to any given subject may be readily found.

As set forth in former reports, it has been the aim of the librarian to supplement the author index of books and pamphlets with a subject index, and this in turn with a bibliography of meteorological and allied topics made up from papers that appear in the periodicals of this and other countries. The bibliography is kept up to date, and most of the titles that are added to it are also published month by month in the MONTHLY WEATHER REVIEW for the benefit of students. The subject in-

dex of books and pamphlets is still incomplete, however, and work upon it will be pushed during the coming year as fast as the resources of the library will permit.

The accessions during last year amount to 550 titles, of which 82 were by purchase and the remainder by exchange or gift. The total number of accessions now amounts to 24,680 books and 4430 pamphlets, besides a number of miscellaneous works not catalogued.

Accessions are now limited to books and pamphlets bearing directly upon the science of meteorology. Many of these are the periodical publications of foreign governments and of scientific societies in all parts of the world; they contain so much that is of interest and value to meteorological students that it is plainly our duty to preserve them carefully.

A small collection of text-books, such as are required by observers in preparing for examinations for promotion, and also a few meteorological works of a more advanced character, is maintained at stations. Under the supervision of the library this collection of books is added to year by year as funds will permit. So many station officials are engaged in educational work in connection with high schools and colleges that a small library of this kind is necessary, although books are loaned to these officials from the central office library when practicable.

EXAMINATIONS FOR PROMOTION.

During the year 55 requests for examination were received by the supervising examiner and favorably acted upon. The subjects in which examinations are now given are arranged as follows:

1. For eligibility for promotion to the \$1000 grade: Arithmetic, English grammar, elementary meteorology.
2. For eligibility for promotion to the \$1200 grade: Algebra, elementary physics, plane trigonometry.
3. For eligibility for promotion to the \$1400 grade: Astronomy, plant physiology, advanced meteorology.

As a rule, all the subjects in a group are given at one examination. Of the 55 examinations held during the year 25 were on subjects in the first group, 21 in the second group, and 9 in the third group. Only five persons received less than the passing grade (70 per cent) on any subject.

Since one of the primary objects of these examinations is to elevate the educational standard among Weather Bureau employees, it is gratifying to note that the number of those who pass the examinations in the higher grades is increasing.

INSTRUMENTS AND EXHIBITIONS.

The Instrument Division is charged with the duties of providing, testing, adjusting, and supervising the installation of all meteorological instruments and storm-warning towers. During the past year the exhibits of the Weather Bureau at the Louisiana Purchase Exposition, St. Louis, were prepared and installed by the professor in charge of the division.

PRESENT STATUS OF STATION EQUIPMENTS.

The status of the instrumental equipment of stations at the close of business, June 30, 1904, was as follows:

One hundred and fifty-eight stations were completely equipped—that is, were supplied with instruments by means of which automatic records are made of the direction and the velocity of the wind, the duration of sunshine, the amount and the time of beginning and ending of rainfall, and, finally, the temperature and the pressure of the air. Of these stations the following were newly equipped with complete sets of apparatus, namely: Birmingham, Ala.; Modena, Utah (old station reequipped); Yellowstone Park, Wyo.; Maritime Exchange, New York; Brooklyn Eagle Building, Brooklyn, N. Y.; and Honolulu, Oahu, Hawaii. The number of completely equipped stations has been increased by twenty during the past year.

The following table shows the total number of the principal instruments in actual service: