

But why should not meteorology now be regarded as a science sufficiently mature to be able to stand upon its own feet, and why should not school teachers be encouraged to take a course of study in meteorology as complete as is now usual in the case of botany or physiology? Teachers would then have a real acquaintance with the subject, and would be able to impart their knowledge satisfactorily to their pupils; and without doubt both teachers and taught would find the subject at once interesting and useful.

There are teachers who have already made this discovery and have profited by it. Of course in some schools, such as those for young seamen, or those for students of agriculture, meteorology naturally secures a prominent place; but in some "public elementary" schools the subject is also taught so far as first principals are concerned, and the interest of the pupils is further secured by getting them to observe instruments which have been provided as part of the school equipment.

In this country we, as a rule, move slowly, and although the inclusion of meteorology in the ordinary curriculum of school instruction has been advocated for many years, very little has yet been done to bring it about. But the growth of general interest in the subject to which we have drawn attention should we think aid materially in its accomplishment, and with the further development of that interest the time when meteorology shall form a common subject in schools of all grades should not be very distant.

#### ON "ABSOLUTE" VALUES.

In looking over the files of the section reports we notice a growing use of the word "absolute" that seems to be without official authority and that should be stopt, as it is objectionable for several reasons. The terms "absolute maximum" and "absolute minimum" frequently occur in climatology to express the highest maximum and lowest minimum that have occurred in a long series of observations at a given place. The difference between these extremes is the "absolute range" for that long period, and the term "absolute" is applicable only to a series of observations that is so long that the extreme temperatures and ranges may be supposed to approximate what would be given by a century or more of observation.

We use the expressions "maximum", "minimum", "extremes" for any given month or year, or for a short series of months or years, and always specify what that special period is.

In his translation of Hann's "Climatology" Prof. R. De C. Ward, on page 18, seems to apply the term "absolute" to a short series, but he does not intend this, as may be seen from the fact that he states that these data have very little value unless they are based on a long series of observations; and he illustrates the meaning and use of the word "absolute" on the next page by applying it to a series of ten years, while in the table on page 33 the term is applied by Hann only to a record of forty-six years. In the circular letter sent out by Prof. A. J. Henry, when gathering data for his Bulletin Q,<sup>1</sup> he called for "absolute maximum and minimum" in his temperature tables, but only expected these data from stations having long records.

As the use of the word "absolute" is liable to convey wrong impressions it has been strongly recommended that the simple expressions "maximum", "minimum", "range" for the month or the year, or a given number of years, be adopted for general use, and that the term "absolute" be left for special memoirs on climatology, where distinctions must be made between the periodic and nonperiodic features of climate.

In the best usage the word "absolute" refers to a single station and the oscillations thereat during a long period of time, but we notice a remarkable innovation in many of our

<sup>1</sup> "The Climatology of the United States", not "A Climatological Dictionary", as some erroneously call it.

section reports, where the term "absolute" is applied to variations over a large area, as over a State or section; thus, "the absolute maximum temperature for the State is 101° and the absolute minimum 45°". But a section rarely has more than a hundred stations, and no one can be sure that there are not many points in the State at which our extremes are exceeded. The term "absolute" is as inappropriate to our State sections as it is to our short records. One should simply say "highest recorded", "lowest recorded" in the State, without using the word "absolute", and should give the station and date as well as the temperature.

We note other peculiar phrases that are also objectionable; for instance, one section director instead of saying the "absolute highest" or "absolute maximum" writes the "highest absolute temperature" or the "lowest absolute temperature". Now the "absolute temperature" is a term long since pre-empted both by physicists and by meteorologists, and means the temperature counted upward from the absolute zero, as distinguished from the temperature centigrade, which is counted upward or downward from the freezing point, or as distinguished from the Fahrenheit scale where the temperature is counted upward or downward from the zero point chosen by Fahrenheit. The absolute temperature is usually found by adding 273 to the centigrade temperature; it would come to the same thing if we should add 459 to the Fahrenheit temperature. As the term "absolute temperature" is everywhere in common use it would be foolish to allow a new and loose usage to prevail in meteorological literature.

The phrases, "highest absolute maximum" and "lowest absolute minimum", are redundant and should be replaced by the simple expression "highest" or "lowest", omitting the word "absolute" as improper, and the words "maximum" or "minimum" as unnecessary. It is much clearer and more definite to say, "the highest temperature of the month at the station", or "the highest temperature recorded in the State" or "the maximum temperature for the State".

In another report we read, "the absolute minimum, 29°, at ———, is the lowest in fifteen years". It would be shorter and just as well to say, "29°, at ———, is the lowest recorded in fifteen years", omitting the words "absolute minimum".

Again, we read "the absolute maximum temperature for 1906", as tho the absolute maximum could occur, not merely once in a century, but once every year. The proper expression is "the highest temperature in 1906", or "the maximum temperature during 1906".

In another line occurs the expression "the highest absolute temperature for November, 1906, in the State of ———", as tho absolute temperatures could occur at every station, but the highest absolute could characterize some one point in the State. It would be a great deal better to say, "the highest temperature in the State during November, 1906".

From another report we quote an "absolute range of 100° in temperature for the month of February". The writer of this line evidently intends to say that the range of temperature for the month between the lowest at one station and the highest at another station somewhere within his section was 100°, and that this was the largest of all similar records for that month. His word "absolute", therefore, includes both the idea of time and geographical extension—not either one alone, but both. Now such a combined chronological and geographical range of temperature has no local climatological value. The figures are not comparable with those for any other section because everything depends upon the sizes of the sections and their orography, whether mountainous or flat, and their shape, whether elongated north and south, or east and west. The climatologist wants the range of temperature for each individual station; by comparing these ranges among themselves he may be able to discern the differences in the climate over different parts of the section. To be sure one might imagine

that taking the State or section as a whole the maximum and minimum occurring within it and the general range for the section might be comparable with similar numbers for other sections, and that thus we might study the relative climatology of the different sections, but this has not yet been done to any great extent. We can take the average of the departures of all the stations from their respective normals, and thus obtain an average departure for the whole section, but even this has no value in climatology when the stations have a wide range in altitude, latitude, or longitude. The study of climatology is coming down more and more into details, and these so-called absolute maxima and minima by sections cover up the very details that we wish to study.

Finally we note "The absolute maximum of 95° was, with two exceptions, the lowest of record for the month, while the absolute minimum was the highest with one exception". We think that the writer was endeavoring to communicate something that had impressed him as peculiar and perhaps remarkable, as to the weather in his section during September, 1906, but we do not ourselves get any clear idea from this paragraph and we think it should be rewritten, omitting the word "absolute", and mentioning the names of the stations.—*C. A.*

#### ADAM PAULSEN (1833-1907).

Prof. Adam F. W. Paulsen, director of the Danish Meteorological Institute—the national weather service of Denmark—died January 11, 1907, at the age of 74.

In addition to his many other activities as the head of the Danish meteorological service and as a member of the International Meteorological Committee, Professor Paulsen was especially interested in two important projects—the study of the aurora, and the establishment of telegraphic communication between Europe and Iceland, for meteorological purposes. The cable to Iceland became an accomplished fact shortly before his death, and is a lasting monument to his memory. The discouraging financial difficulties that he had to overcome in achieving this result have been set forth in his reports to the International Meteorological Committee.

Paulsen's investigations of the aurora date from the international polar expeditions of 1882-1883, in which he took part as leader of the Danish expedition to the west coast of Greenland. In 1899-1900 he led an expedition to northern Iceland for the special purpose of studying the aurora. The results of the latter expedition included some remarkable photographs of auroral spectra, and new measurements of the altitude of the rayless auroral arch, indicating that it occurred at not less than four or five hundred kilometers from the earth's surface. At this height the atmosphere must be so rarified that ordinary electrical discharges would be impossible. In a paper<sup>1</sup> published a few months before his death Paulsen reaches the conclusion that the cause of the aurora is to be sought in an immense ionization and negative electrification of the upper layers of the atmosphere, produced by cathode rays emitted from the sun.

Professor Paulsen's successor as director of the Meteorological Institute is Capt. Carl Ryder, who has heretofore been known to science chiefly as an arctic explorer.—*C. F. T.*

#### WEATHER BUREAU MEN AS EDUCATORS.

The following lectures and addresses by Weather Bureau men have been reported:

Mr. S. S. Bassler, March 5, 1907, before the Cincinnati Society of Natural History, on "The weather map".

Mr. Ford A. Carpenter, March 9, 1907, before the Scholia

<sup>1</sup>Sur les récentes théories de l'aurore polaire. Résumé et critique des théories de MM. Birkeland, Arrhenius et Nordmann. Idées personnelles. (Académie royale des sciences et des lettres de Danemark. Extrait du bulletin de l'année, 1906. No. 2.)

Club, of San Diego, Cal., on "What makes the climate of San Diego"?

Mr. George M. Chappel, March 20, 1907, before the teachers and pupils of the North High School, Des Moines, Iowa, on "The work of the Weather Bureau".

Mr. David Cuthbertson, March 27, 1907, before the West Side Business Men's Association, of Buffalo, N. Y., on "The usefulness of the Weather Bureau to the commercial interests".

Mr. C. F. von Herrmann, March 23, 1907, before the Alpha Delta Epsilon Scientific Fraternity, of Johns Hopkins University, Baltimore, Md., on "The principles of forecasting the weather".

Mr. J. R. Weeks, March 18, 1907, before pupils of the Washington Street Public School, Binghamton, N. Y.; also March 21, before the successful scholarship contestants of the Binghamton Republican, on "The work of the Weather Bureau".

Classes from universities, academies, and schools have visited Weather Bureau offices, to study the instruments and equipment and receive informal instruction, as reported from the following offices:

Meridian, Miss., March 14, 1907, the physics class from Moffat-McLaurin Institute.

Mobile, Ala., March 22, 1907, a section of the physical geography class from Barton Academy.

Salt Lake City, Utah, during March, 1907, students from the Salt Lake High School and the Latter Day Saints' University.

#### BELLS AS BAROMETERS.

We find a misleading paragraph under the above heading going the rounds of the press to the effect that "about five miles from Lebekke, in Belgium, there are some small church bells known as the 'water bells'. When they are heard distinctly in the town rain is sure to follow". With this paragraph goes a so-called "plausible popular explanation of the phenomenon", about as follows:

"If bells sound very distinctly of an evening, this points to the probability of a wet day following, since air heavily charged with moisture conducts sound better than dry air. So, too, as dense air conducts better than light air, bells sound more clearly when the barometer is high than when it is low, other things being equal; and so, too, with hot and cold air".

There are several errors in this explanation. It may be acceptable to teachers and others if we add that the intensity and quality of a sound depends primarily on the bell, and the tower in which it is hung, but only to an infinitesimal degree, if at all, on the temperature of the air, or the quantity of aqueous vapor contained therein, or on the relative humidity of the air. On the other hand the intensity of sound, observed at a distance, does depend to a very large extent on the homogeneity of the air, while the distance to which a sound is heard depends on the direction of the wind. If the air is perfectly homogeneous then the effect of a horizontal wind, which is usually feeble near the ground and strong higher up, is to bend the rays of sound out of their straight line directions. If the observer is to windward of the bell, the sound that should come to him passes over his head, and if he is to leeward the sound that should pass over his head is brought down to him. If he is to leeward of a house or island the irregularities of the wind may bend the sound wave entirely away from him. If he is in a calm stratum, as in the early morning, with the wind blowing strong above him, then he may hear no sound if he is to windward of the bell, but a more intense sound if he is to leeward. Ordinarily the air is not homogeneous, but is a mixture of warm and cold, or dry and moist masses, that is to say, a mixture of rarer and denser portions that break up waves of sound. Especially during hot sunshine does the air become acoustically opaque, that is