ness, falling to 16 miles per hour by 10:30 p. m. Rain, accompanying a heavy thunderstorm, began at 9:10 p. m., and during the very high wind came down in a deluge, 0.06 of an inch falling in about two minutes. Although no hail fell at the Weather Bureau office, large, opaque hailstones, about half an inch in diameter, fell in the storm track immediately after the wind rush ceased.

Damage by the tornado amounted to about $15,000 and several persons were injured.

The tornado occurred at 10:05 p. m., which was the time of maximum wind velocity at the Weather Bureau station.

LOCAL COOPERATION IN FROST PREVENTION.

Mr. Richard H. Sullivan, Observer, in charge of the Weather Bureau station at Grand Junction, Colo., reports the result of his efforts to raise a healthy sentiment in that locality in favor of employing concerted artificial methods for the prevention of damage by frost. Having on all occasions advocated the use of smudges on a generous scale, he was finally able to bring about a practical illustration of the value of his idea of combined effort.

On April 21, a frost warning was issued by the district center through the local office, and this was in turn given the widest possible distribution. Consultation with the officers of the Fruit Growers' Association and other citizens resulted in a meeting at the office of the Daily Sentinel, where ways and means were discussed, the mayor of the city extending the influence of his office toward enlisting the efforts of the residents to assist in smudging the whole valley if necessary. Therefore, on account of the warning and also the comparatively low temperature prevailing, the mayor issued a proclamation calling on all citizens to prepare smudge piles. The local office was designated as the central point for information as to the fall in temperature during the ensuing night, and Messrs. Adams and Moore agreed to assist in the work of urging all fruit growers to make preparations. Arrangements were made with Mr. G. W. Peugh, Manager of the Colorado Telephone Company's exchange in this city, for extra night service. Mr. Peugh detailed two operators for the work, with instructions to call the observer should dangerous temperatures be reported before the agreed hour of 3 a. m., local time, the following morning. Under the mayor's instructions, the city employees under the street commissioner placed wagonloads of manure and rubbish in all the open lots of the city, and the residents very generally responded to the request of the mayor by placing smudge piles in their back yards. By midnight the work of placing 1000 large smudge piles in the city limits was completed. It was agreed that the time for lighting was to be determined after consultation with the orchardists by telephone at or before the appointed hour, all connections to be made with the line running to the Weather Bureau office, so that each individual could hear observed temperatures and discuss ways and means with his neighbors up and down the line. A continued fall in the temperature resulted in the decision to start the general smudge at 5 a. m., local time, April 22. By 5:30 a. m. the whole valley was covered with a sheet of dense smoke 50 to 75 feet deep, 8 to 10 miles wide, and about 40 miles long. The winds being light, the smoke seemed to settle well over everything, drifting slowly over the valley with changing currents, similar to a dense fog, and the first systematic smudge ever attempted in the valley was successfully in operation. A light frost was discovered, by careful examination, under tufts of alfalfa along the city ditches, but none on the walks or in the open. No damage resulted, due, many orchardists affirm, to the thorough manner in which smudging was carried out. By 10 a. m., local time, the smoke had almost entirely disappeared. On the night of the 23d–24th, preparations were made for a second combined effort, but the night passed without its being necessary to light the fires. At 3 a. m. of the 25th, local time, the Weather Bureau office was again opened, and temperature reports were received and compared. Toward daylight, the temperatures had fallen to 37° in the vicinity of Grand Junction and to 33° farther northwest. Smudge fires were started over a large area, and but slight damage was reported. At 4 a. m. of the 30th, the office was again opened for business, but comparison of temperatures showed that smudging was not necessary. The Chamber of Commerce united in an expression of appreciation of Mr. Sullivan's attention to the interests of the community and of gratification at the good results of the work.

THE TRIENNIAL MEETING, APRIL, 1904, OF THE GERMAN METEOROLOGICAL SOCIETY.

There was a considerable attendance at the triennial meeting of the German Meteorological Society, held at the Institut für Meereskunde in Berlin during Easter week, under the presidency of Professor von Bezold. Numerous papers were read and discussed, those on April 7 and 9 being mainly meteorological, and those on April 8 electrical and magnetical, the one which occasioned the most animated discussion being communicated by Professor Holdefleiss, Halle, "Ueber die meteorologischen Ursachen des Auswinterns des Getreides." On the afternoon of April 7 the members were conducted over the Meteorological Institute in the Schinkelplatz; that of April 8 was devoted to the Physical Observatory at Potsdam; that of April 9 to the meteorological and military balloon and kite flying establishments at Tegel, and the evening to the Geographical Society's meeting; and Sunday evening to the Astronomical Observatory at Treptow. At Tegel, the Luftschiff military section charged a balloon of 600 cubic meters within three minutes; within fifteen minutes it had been attached to its car, and with two officers aboard had disappeared beyond the clouds. The military authorities also carried out wireless telegraph experiments by means of kites. Dr. Assmann, in charge of the meteorological station, had observations taken at a considerable elevation by means of a kite, and also dispatched a small rubber free balloon with a set of instruments attached.—*From Nature, April 21, 1904, p. 587, vol. 69.*

THE METEOROLOGY OF THE UPPER AIR.

The international commission for scientific balloon ascensions has, as is well known, published during the past year in great detail the results of work with balloons and kites and on high mountain stations during the years 1901, 1902, and 1903. It proposes to continue this publication, but, according to a recent circular, there will be added thereto an appendix or series of papers, published at irregular intervals, containing special investigations on the results of the international balloon ascensions. It seems that the great mass of data now rapidly accumulating is likely to frighten individual students from undertaking the necessarily tedious investigations suggested thereby, and that many valuable results will remain hidden from the world unless the International Committee promptly supervises the discussion and publication of such results as can be attained. This will also be a valuable means of improving future work. The development of meteorology depends more upon the prompt discussion and publication of data obtained from the upper atmosphere than upon any other class of work that is now being carried on by observers as such. On the other hand, a still more important class of work is that which relates to the improvement of the mathematical methods of treating the mechanical and physical theories of the motions of the atmosphere, and this subject will undoubtedly be fully provided for by the international commission. Subscriptions for the proposed appendix to the international observations at great altitudes will be received by the firm of H. Trübner, Strassburg.

THE METEOROLOGY OF JAMAICA.

The Institute of Jamaica has just published a handy pamphlet by Maxwell Hall, esq., on the meteorology of that island. To this subject Mr. Hall has given especial attention during his long and active life, and is properly recognized as our highest authority. Besides describing the instruments, the stations, and the laws of storms for the West Indian cyclones, he also gives a list of the more important articles that have been published in the monthly weather reports compiled by him for the Weather Service of Jamaica since 1880. We quote the following from among the numerous interesting items relative to clouds:

1. *Cirrus.*—Cirrus clouds are often seen in the morning about sunrise during the summer and autumn months, but they rapidly disappear as the temperature of the day increases. Under these circumstances they are fine-weather clouds, and it is only when they increase in extent and develop into cirro-stratus that they can be connected with bad weather. There is a well-marked upper current from the east-northeast during the

autumnal months, as shown by the following table of percentages, based on observations at Kempshot Observatory.

Average drift from—	Relative number of cases.	
	Cirrus.	Cirro-stratus.
North	7	9
Northeast	26	25
East	28	27
Southeast	8	18
South	4	6
Southwest	7	6
West	13	5
Northwest	7	4
	100	100

This table shows that the highest wind from the west and northwest occurred less frequently than that from the northeast and east, or, in other words, that in about 27 per cent of cases the east and northeast currents reached from the lower clouds up to the highest cirrus and doubtless beyond, but probably the westerly wind prevailed above that, even during the autumnal months. Maxwell Hall adds:

The existence of this still higher current from the west has been confirmed at times by the drift of long continuing trails of shooting stars and by the drift of dust from volcanoes in eruption.

With regard to the strato-cirrus, Mr. Hall says:

When rain begins to fall from a large cumulus, a quantity of cloud is poured into the air from the top of the cumulus, as smoke from a factory chimney. This takes place in all parts of the world when rain falls from cumuli, but in the temperate zones only a little cirriform cloud is thrown off. In Jamaica the process is on a gigantic scale, and the cloud is spread out as a sheet far and wide, so as to shade the land for some hours from the direct rays of the afternoon sun. It is therefore a common cloud in the west-central district of Jamaica during the summer and autumn months. Its texture at first is thick and woolly, but as it spreads the sheet becomes thinner. It then settles down, often passing through different forms, and finally disappears, leaving the evening sky perfectly clear.

Now, by means of a sextant, some careful observations were made of the altitude of the tops of well-formed cumuli whose distances could be ascertained by their rain falling on mountain ranges or by the average interval between the thunder and lightning; and it was found that the average height of such well-formed cumuli was as much as 6 miles. At this elevation the temperature is below zero, and strato-cirrus, when spread out as described above, must be very fine snow, as distinguished from the very minute particles of ice which form cirrus and cirro-stratus. This fine snow then falls slowly by its own weight, and, melting, it often produces those quiet after-rains that follow the heavy rains and squalls of the cumulus.

From what has been said about the spreading out of this cloud, it might be supposed that it had no average drift; but if well-formed cumuli at considerable distances be watched it will be found that, while their average drift is from the southeast over the western half of Jamaica, the drift of the strato-cirrus issuing from them is generally northeast.

(From northeast?—ED.).

With regard to the origin of hurricanes, Mr. Hall says:

If we look at the pilot charts published each month by the U. S. Hydrographic Office, we shall see that when the region of equatorial heavy rains between South America and Africa reaches as far north as latitude 15° cyclones originate in about that latitude, but to the west of the region of heavy rains, and then move off on a westerly course. As the diverting effect of the earth's rotation upon currents of air is very important for the development and maintenance of cyclones, and as this effect varies as the sine of the latitude, there are no cyclones near the equator or within 12° of it; but, as we have seen, at 15° the effect is sufficient to give the currents the necessary divergence. Now, as the region of heavy rains advance as far north as latitude 15° in August, somewhat farther in September and October, but withdraws far to the south in November, and remains there until the following July, it is evident that August, September, and October are the months in which cyclones usually occur in the West Indies. Of course they may occur at other places and at other times if all the essentials are present and combine.

THE CURIOUS WORK OF THE WIND.

In the earlier years of the Weather Bureau it was not uncommon for an observer to send to the Central Office, for exhibition in its museum, some tree trunk studded with straws driven into it by a tornado wind, or twisted into shreds by the action of the wind, or split open by lightning. Lately we have received from Professor McAdie a most instructive illustration of wind work, namely, a Weather Bureau storm-warning flag that had been exposed at the Weather Bureau office, Southeast Farallon Island, Cal., during a recent high wind. Not only is this flag torn into shreds, but the shreds were so interlaced and knotted together as to preserve in permanent form many of the intricate movements of the wind as it whirled past the flagstaff. These movements are easily seen when one watches the fall of snowflakes. The actual path pursued by a particle of atmosphere is undoubtedly not only very complex, but much longer than the path registered by any form of anemometer. Therefore, the so-called internal energy of the wind is decidedly greater than would correspond to the measured velocity of the wind, just as the internal energy of a vortex ring is much greater than that of its linear movement as a whole, or just as the internal energy of a warm gas, as computed from its temperature, is much greater than the energy of the whole mass as computed from the linear movement of the mass as a whole.

INSTRUCTION IN METEOROLOGY.

Through the generosity of an unknown citizen, the city of Chattanooga has been enabled to provide its high school with a meteorological observatory, equipped with the following standard instruments: An anemometer with single register, a barometer and barometer box, hygrometer, maximum and minimum thermometers, rain and snow gage with support, and standard thermometer shelter. The instruments were presented to the school on condition that meteorology should be added to its curriculum as an optional study, and 20 copies of a text book on meteorology were given by the same person for the free use of students. The instruments were selected by Mr. L. M. Pindell, Observer at Chattanooga, and installed under his direction. Twenty-three students formed the first year's class. Mr. Pindell has assisted the teacher by occasional talks to the class and explanations of the care and use of the instruments. So far as the Editor knows, this is the first *high school* in the country to possess a meteorological laboratory, a laboratory scarcely inferior in educational value to the high school laboratories of chemistry and physics now universally recognized as indispensable in connection with thorough elementary instruction in those subjects.

HUMMING OF TELEGRAPH WIRES AND POLES.

The question is frequently asked: "What causes the humming of the telegraph wires and poles; what connection has it with the weather; can it be used for weather forecasting?" The telegraph pole merely transmits to the ear the humming of the wires over head. Its own vibrations are so slow that they make no audible sound. The wires strung from pole to pole are set into oscillation by the wind, somewhat as the strings of a violin are set into vibration by the bow. In skilful hands the violin bow can be made to bring forth from the string one powerful fundamental note and several overtones of higher pitch but in perfect harmony with the fundamental. But the wind is a very unskilful performer, and brings forth at the same time not only the deepest fundamental bass note of the wire, but a great variety of overtones, both harmonious and discordant. In fact, the many wires strung over head, from pole to pole, constitute splendid æolian harps. The slowest oscillations of the wires may be seen or felt, but are not audible. The bass notes and the higher tenor we hear but faintly when we stand midway between two poles. If the ear is pressed against a pole we hear more especially those notes to which the wooden