46° and 82° distant from it. There is a third paranthelion at 38° and a fourth one at 60°, the latter being white.

Tangent arcs. These may be tangent at the top and bottom of the halo circle of 22°. When perfect they have two branches, one pair running off indefinitely and the other circumscribing the halo of 22°.

Circumzenithal parhelic circle. A horizontal circle tangent or quasi-tangent to the halo of 46°.

Lateral tangential arcs. These are arcs tangent to the lower part of the halo of 46° at points considerably to the right or left of the vertical circle from the zenith through the sun. Corresponding supra-lateral tangent arcs may also occur tangent to the same circle on the right and left hand sides of its summit; in fact, in one position only, the upper and lower lateral arcs may become continuous and inclose the halo of 46°.

Lateral arcs tangent to the halo of 22°. They are known as the arcs of Lowitz; they are of short extent and only clearly disengaged from the halo when the sun is quite high above the horizon.

Columns of light. Bright white columns passing vertically through the sun.

Solar cross. The intersection of a bright vertical column and a bright horizontal bar with the sun or the anti-sun at the center.

Oblique parhelic circle. This is analogous to the horizontal parhelic circle, except for its inclination.

Oblique arcs through the anthelion or through the sun. These are usually inclined about 30° to the vertical, or 60° to each other.

St. Andrew's cross. Two oblique arcs passing through the sun incline to each other at 60°.

As all these phenomena are due to the reflection and refraction of sunlight by crystals of ice floating in the air, the frequency of the phenomena will depend, other things being equal, upon the relative frequency with which crystals of the proper form and position occur in the sky. European observations gave Bravais the following results. (See Mascart, Optique, Vol. III, p. 518.) Let all the halo phenomena be divided into four classes, as follows:

I.—When the axes and facets of the ice crystals are distributed by chance, which is the great majority of cases, we perceive then only the two principal halos of 22° and 46°, and sometimes the halos due to prisms whose angles differ from the 60° or 90° that occur in the normal prisms of ice.

II.—When the prisms have a vertical axis they produce the parhelia of 22°, the quasi-tangential arcs to the halo of 46°, the parhelic circle, the para-anthelia of 60°, and the vertical columns or bright bands of light passing through the sun.

III.—When the plates of the ice crystals are vertical they produce the halos of 22° (the upper and lower parts of which are by far the brightest portions), the upper and lower arcs tangential to this halo, the lateral arcs tangential to the halo of 46°, and the parhelic circle.

IV.—When the lamellar crystals are unsymmetrically developed, so as to cause one of their diagonals to be vertical as they slowly fall through the air, they produce the extraordinary arcs tangential to the halo of 22°, the parhelia of 46°, the anthelia, the oblique arcs passing through the anthelia, and the similar arcs passing through the sun itself.

The relative frequency of these groups of phenomena, as indicated by the number of cases observed by Bravais, is:

I.—The great majority of cases.
II.—Two or three hundred times, or very frequent.
III.—Eighteen times.
IV.—Eight times.
II and III simultaneously.—Forty-five times.
II and IV simultaneously.—Three times.
III and IV simultaneously.—Once.
II, III, and IV simultaneously.—Six times.

THERMOMETER EXPOSURE.

It is frequently complained of the Weather Bureau temperatures that they relate to points in the atmosphere too high above the ground, and some remarks on this subject from our esteemed voluntary observer, Dr. A. C. Simonton, of San Jose, Cal., suggests the question, "What part of the atmosphere is of interest to man so far as temperature is concerned?" He answers this from the physician's point of view and says, "Evidently that part in which he lives." But to this we must add that man is also interested in a much wider range of temperature than this. We might even ask, "*Where* does man live? Does he wish the temperature at 5 or 6 feet above ground or at the surface itself? Does he wish it in the house or in the street; in the plowed field or in the forest; in the lowlands and ravines or on the highlands and plateaus; in the cool ocean breeze on the seashore or in the stifling hot air half a mile inland?" Evidently, there can be no restriction. The temperature of any special locality is of interest, but only when we are studying the phenomena of that locality. Even the reflected heat from a sandbank in the sunshine becomes of importance when we are studying the human life and the plant life that are subjected to it.

It was never supposed that the so-called regulation or standard instrument shelter would give us the temperature of the air at any of these special localities; thermometers placed therein give us very little idea of the nocturnal minimum temperature of the surface of leaves of grass and low tender garden vegetables, nor yet of the midday maximum temperatures of the surface of the soil. Special thermometers must be placed in special localities if we wish to know accurately these local temperatures. Thermometers whose bulbs are free to give and take radiant heat give us very little idea of the temperature of the air in contact with them because radiant heat passes through the air without affecting it very much, but it does affect the temperature of the bulb of a thermometer by nearly its full amount. It is, therefore, very nearly correct to say that a thermometer in the air indicates the average temperature due to the radiation between it and its material inclosure. If it is entirely surrounded by a shelter it gives the average temperature of the inside surface of that shelter. If its inclosure consists of grass or soil below it, trees and houses around it, clouds and blue sky above it, then the radiation between it and each of these affects it in proportion to their temperatures and the solid angles they subtend at its center. It would require a very strong wind or a violent whirling of the thermometer to produce enough convection of heat between it and the air to enable it to indicate a temperature that is even approximately close to that of the air. The so-called *ventilation of the thermometer* is the *first essential* in getting the temperature of the air and the *cutting off of all noxious radiation is the next essential.* As was explained in the Editor's "Treatise on Meteorological Apparatus and Methods," page 80, "The thermometer should neither give heat to nor receive heat from any object that has a temperature differing from that of the external air. When the thermometer is surrounded by a screen and fresh air is drawn into the screen, or blown in by the wind, it should show no change in temperature. When a thermometer is whirled rapidly in the free air, near the shelter, and at the same time protected from noxious radiations, it should give the same temperature as the thermometer within the screen." There are but two practicable ways of getting the temperature of the air at any given spot, viz, (1) let the thermometer be screened from radiation by placing it within one or two thin metallic tubes, and then whirling the whole combination rapidly, or (2) let the thermometer and screens be stationary and the air drawn rapidly over its surface and through the screens.

The temperature of the air is a very different matter from the temperature of a surface, whether it be a surface of soil, rock, water, leaves, the human skin, or the outside surface of the clothing. The temperature shown by an accurate thermometer is always the average temperature of its bulb, but we are ourselves liable to make a mistake in assuming that this is also the temperature of the object that we wish to measure.

It is claimed that the nocturnal minimum temperature, as recorded within a shelter, is always higher than the real minimum temperature of the air, because the shelter retains the heat that it acquired during the day, and that therefore, the minimum thermometer should be placed outside the shelter, with a mere canopy above to prevent radiation to the clear sky. But if the shelter is properly made the heat of its top and sides, warming the cold air in contact with them, will cause the latter to rise, drawing in fresh air from all sides; if this indraft is strong enough it will keep the thermometers down to the temperature of the air, if it is not strong enough it must be increased by artificial aspiration or by whirling the thermometer; therefore, the Weather Bureau shelter, like that of all other modern meteorological offices, combines ventilation with screens that shelter from noxious radiations.

We regret very much that these modern improvements are too expensive to be provided for every important voluntary station. In this respect, however, all the world is on the same plane, and observers everywhere have to content themselves with the reflection that, although the maximum temperatures may be too low and the minimum too high, yet the average temperatures of the day, the month, and the year will not be very erroneous. Meteorology and climatology have not yet attained to that development as exact sciences that they can afford to dispense with the faithful work of an honest observer, even if there be small systematic errors in his work. Of course, those who can give us some idea of the amount of these errors, in their own individual cases, will contribute by so much to the advancement of exact knowledge.

FAKE STORMS.

Mr. John F. Smith, Jr., voluntary observer at Jasper, Hamilton County, Fla., reports that no storm occurred in that neighborhood during the current month corresponding to the one described in a special telegraphic dispatch published in a Cincinnati paper of July 19. Something like Farmer Harvey's race with a tornado may have occurred at some other time and place, but as it stands the record seems to be a hoax.

Meteorology is peculiarly liable to be troubled by the inevitable errors of observers, but it is greatly to be regretted that any one, in seeking to hoax the public, should not also send the Weather Bureau at least a word of caution. We rely so implicitly on the good faith of the press and of both regular and voluntary observers, that it troubles us to realize that we are liable to be taken in by such unblushing deception. Mr. Smith kindly suggests that the tornado in question may have happened in the neighborhood of Jasper, Walker County, Ala. (or, possibly, Jasper, Pickens County, Ga.), but we fear that it is not worth our while to make further search after this will-o'-the-wisp.

Whenever similar inventions appear in the daily press, we should be glad to have the local voluntary observer communicate directly to us a refutation of the misleading statement, in order that such romances may not unwittingly be quoted as belonging to the annals of science.

THE PRACTICAL UTILIZATION OF LIGHTNING.

If the study of atmospheric electricity is of general interest to meteorologists, then they must take an equal interest in its practical application to the wants of man. Franklin wrested the thunderbolts from the heavens, but no one has yet harnessed them to useful work. The telegraph and the telephone, the electric light and electric motors, illustrate our control of artificially manufactured electricity, but the natural article in its native state is still a terror to man, or an annoyance. For a generation past there have been innumerable schemes for the use of ground currents in telegraphy and aerial currents in telephony. The daily press announces that quite recently an inventor at Worcester, Mass., has perfected mechanism by which he can actually discharge a bolt of artificial lightning and control its direction, and again, we are told that "several experimentors are already employed in devising a plan for gathering and storing atmospheric electricity which may be employed for lighting, heating, and motor power."

A still more hardy inventor of the highest scientific attainments has arranged a trap to catch electro-magnetic waves from the sun, or other heavenly bodies, and although he has caught nothing, yet the idea is still held to be scientifically correct.

The fact is, however, that the natural electric and magnetic forces at the earth's surface are so vastly inferior to the forces of gravitation and solar heat, wind pressure, waterfalls, and even tidal rise and fall, that man can not profitably experiment with natural electricity while these greater forces are running to waste.

MOUNTAIN STORMS.

Referring to Mr. Struble's article on "Peculiar Mountain Storms," in the MONTHLY WEATHER REVIEW for May, 1897 (Vol. XXV, p. 212), Mr. A. D. Elmer, voluntary observer at Northfield, Mass., states, under date of July 31, 1897, that—

In the American Meteorological Journal for August, 1895, Vol. XII, p. 127, there will be found reprinted from the New York Tribune an account of local winds and clouds at New Lebanon, N. Y., which also may be considered as a perfectly reliable description of what obtains also at Northfield, Mass., under the same conditions, except that as the decline from the ridge of the eastern hills, over 1,500 feet above sea level, to the Connecticut River Valley, 200 feet above the sea, is less than the Taconic decline or the Laurel Hill decline in Pennsylvania, therefore the gale is not noticeable a mile from the mountain base, except in occasional gusts, and is not so strong at the base as to attract serious attention, not breaking limbs from trees, but manifesting itself from westward by a loud roar; otherwise the conditions in the three cases are practically identical, except, I think, by the "storm rarely reaching 6 miles west," Mr. Struble means the gale, etc., for the other manifestations of the general cyclone must present themselves there. As to explanation, it seems to me that as the chinook manifests itself in the same descending tendency, likewise the great guns of a West Indian hurricane, it may be assumed that all winds preceding a storm center, with falling barometer, represent air that is being forced down; therefore they flow down hill with accelerated velocity, similar to liquids, as water, etc. (Exception: When the increased temperature and lessened specific gravity of the storm current is sufficient to offset the pressure from above.) It is to be hoped that observations taken in the meteorological region—which is, strictly speaking, not less than the general height of clouds—will reveal the present mysteries in major part.

LANDSLIDE IN VERMONT.

We have received from Mr. W. A. Shaw, of Northfield, Vt., Weather Bureau Observer, an excellent manuscript map by E. J. Hatch, of Warren, Vt., showing the characteristics of the great landslide that occurred Wednesday, July 14. The previous landslide on record in this region is that of June 3, 1827, when about 100 acres slid from Fayston Mountain down to the valley beneath. The worst flood in the history of the valley was in July, 1830, and again July, 1850, and October, 1869. The landslide of the present month had been preceded by heavy rains, but it seems to have been started by the fall of an immense boulder near the top of the mountain in the northwest corner of Warren township at an altitude of about 3,890 feet. Simultaneously, another slide began at a point a little south of this boulder; the two slides joined together after a path of about 100 rods, and the com-