earth's rotation, which should in this present example increase the extent of those changes in accordance with the law above given, at first deduced in all its generality by Ferril.

2. The friction of the earth's surface has a greater influence upon strong than upon feeble winds, and thus does more to retard the tangential than the centripetal motion of the air in the neighborhood of an area of low pressure. Consequently, in severe storms on land the wind is found to be directed more nearly toward the central area of the disturbance than in oceanic storms. Thus in tornadoes the inward and upward motions predominate over the tangential.

Precisely as the velocity over water is greater than over land, so is the velocity far above the earth's surface greater than lower down. Balloon voyages show occasional velocities of one hundred miles per hour. The severest gales on the earth's surface rarely exceed eighty-five miles, though doubtless this has been exceeded in certain tornados and momentary gusts, etc. The currents only a few hundred feet above the earth have frequently twice the velocity of those observed on the surface, as shown by observations of the velocity of passing cloud shadows.

The destructive power of a wind, or its power to overthrow or move any body, is the difference in the pressure on opposite sides of the body. In steady winds this difference depends not only upon the velocity of the wind, but equally on the shape of the resisting body. Those bodies offer least resistance in which (as in fishes, the hulls of ships, bridge piers, etc.) the hinder portion receives the backward pressure of the fluid that presses up against it, thus permitting as little approach to a vacuum as possible. In the case of sudden gusts the resisting body receives the whole force of the impulse precisely as a blow. The atmosphere, though so light, is not devoid of mass and inertia. Air in motion at the rate of one hundred miles per hour strikes obstacles with a force equal to that which the same volume of water would exert if moving at the rate of three and one half miles hourly.

The Temperature.

The thermometric changes over all parts of the earth's surface are mainly dependent upon the apparent annual and daily motions of the sun and the grand atmospheric currents.

As fluids and gasses are both bad conductors of heat, the distribution of heat in the atmosphere is effected most largely by the winds or by convection, just as in the ocean it is effected by means of the grand aqueous currents.

Aqueous vapor visibly suspended in the air, as haze or cloud, serves as an effectual and double shield against the radiation of heat from the earth, and also against the sun's rays themselves. Even the invisible particles of vapor floating in the atmosphere, however rare, present an obstruction to the free passage of heat of low intensity, or obscure heat much in the same way as haze and smoke obstruct the light, or as stones in the bed of a water-course retard the flow of that fluid. On the most Alpine situations, where, on account of their loftiness, much less aqueous vapor is interposed between them and the cold stellar regions, radiation is less impeded, and, consequently, when exposed to the direct rays of a serene midday sun the heat is intolerable, while at night the unimpeded radiation produces a corresponding extreme of cold. The temperature observed is the difference between the heat given out and that received in a definite interval of time.

The temperature of the lower air depends primarily, indeed, upon the amount of heat poured down upon the earth by the sun, and the amount absorbed by the air, as the earth radiates its heat back into space; but, in addition to this, the heat held latent in the vapor diffused through the air is at times liberated by the condensation of the vapor into fog, rain or snow, and then it becomes sensible to the thermometer. During the day a moist atmosphere will become warmer than one that is dry, and during the night the radiation of heat through a moist atmosphere will be less than that through a dry one. During cloudy or hazy weather the radiation is almost wholly cut off, so that a very uniform temperature prevails between the earth and the bottom of the lowest layer of clouds. On the other hand, sufficient heat is absorbed (*i.e.* becomes latent) in the process of evaporation to materially reduce the temperature of the air; thus it is that drying winds are also "cooling." An increase of barometric pressure, by increasing the capacity of the air for moisture, serves to stimulate evaporation and temporarily reduce the temperature. A diminution of pressure and consequent expansion of confined air produces a lower temperature and diminished capacity or moisture, until the condensing vapor gives forth its latent heat.

Examination of the weather-charts will show that the temperature varies much less over cloudy than over clear districts; that it varies less in low than in elevated regions; that it is warmer on one side of an area of low or high pressure than the other, and generally *warmer in advance of any storm-centre and colder in the rear.*

The Moisture (RELATIVE HUMIDITY).

In all localities of the globe, and at all times, moisture, in greater or smaller quantities, exists in the atmosphere, which is, consequently, never absolutely dry. Intervals or interstices occur between the particles of the dry air, which are partially filled with this ever-present aqueous vapor. The more numerous such intervals are, the greater is the *capacity* of the air for moisture; and when these intervals are so full of vapor that the air is incapable of containing or holding any more it is said to be *saturated.*

An increase of heat increases the capacity of the air for moisture; while, on the contrary, a fall of temperature is the occasion of a corresponding diminution of the capacity for vaporous matter.

The important element of moisture is given in the Signal Service Bulletins, not in the absolute quantity in which it is found at any given place, but as a percentage of full saturation, or what, in the language of meteorologists, is expressed by the term *Relative Humidity.* This must not be confounded with absolute humidity, which is a very different thing. For, supposing the temperature of the air at a given place to be 40° and fully saturated with aqueous vapor, and then to be suddenly raised to 50° without any addition being made to its store of vapor, its absolute humidity would in each case be exactly the same, but in the former case the weather would, in popular language, be very damp, and in the latter case, very dry. In the former case the relative humidity (or *humidity*, as it is so often simply called) would be very high—*i. e.*, 100 per cent.; in the latter very low—*i. e.*, 50 per cent.

Watery vapor dissolves in air very much as salt dissolves in water, and as the salt is deposited in cystals whenever the water becomes fully saturated with vapor, the latter is deposited on the earth in the form of mist, dew, and rain if the temperature be high, or as frost, hail, or snow-crystals if the temperature be low.

One cubic foot of air, having a temperature of 50°, and under a uniform barometric pressure of 30.00 inches, and *fully saturated,* will hold 4.28 grains of water according to Glashier's tables. If, under these conditions, the temperature or pressure of the air is lowered, there will result a deposition of a portion of the water, and that either in the form of a fog, dew, rain, frost, or snow and hail. On the other hand, if there be an increase in the temperature or the pressure, the air becomes capable of holding a larger quantity of vapor, and ceases to be fully saturated. Relative humidity expresses the proportion of vapor actually contained in the air compared with what the air could contain.

Certain winds will be found to be moister than others. The west and north-west are generally the driest in the Mississippi Valley. Dry air almost always predominates on the leeward side of mountain-chains, and is the characteristic of the plains and plateaus west of the Mississippi Valley. Dampness or a large increase of relative humidity accompanies threatening weather as an almost invariable premonition. Ascending currents of air also increase in dampness; descending currents grow drier.

The smoky haze which spreads to a great distance when extensive forest fires prevail is composed of minute atoms of charcoal, which possess the singular property of attracting moisture to themselves, and thus perpetuating dry weather.

The Clouds and their Indications.

By entering graphically on the map the general features of the weather and sky, we complete the detailed representation of the atmospheric condition. The clouds by their kinds and changes are indices to the relative temperature, moisture, and pressure existing at high altitudes; by their motions they indicate the nature of the prevailing current of air, showing whether it is from the tropics, and