barometric depression in the west of France, its path being recognized from Vendir to Ardennes.

The tornado at St. Claude, on the 19th, was studied by M. Cadenat. The giratory movement was recognized by prostrate trees, by pieces of board, *débris* of roofs, etc. On the right of the track many trees were blown down toward the north-east. On the left less trees were uprooted, and some lay in an opposite direction. In some places trees were blown down at right angles to the track, their roots invariably to the right. At some places bunches of trees were left intact in the centre of the tornado's track. The whirl was counter-clock-wise. "This trombe-cyclone in its narrowness furnishes the character of a *trombe* or tornado, and in its whirling, of a cyclone. I give the following secondary phenomena in the order of importance: —

"(1) The liberation of considerable electricity.
"(2) The straight currents.
"(3) The division of the principal branch.
"(4) The funnel-shaped cloud.
"(5) The aspiration.
"(6) The lateral wind."

"At 8 P.M. the sky is like a vast conflagration; the air is calm. Some great drops of rain, some few hail-stones, very great (40 grams), formed of agglomerated grains, preceded the disaster. A lightning stroke fired a house at Bois d'Amont (Jura). At the Swiss frontier the people saw fire on all sides. At another place globular lightning was seen. Some people were killed by lightning strokes. On all sides was a smell of ozone. Walls were prostrated, holes bored in window-panes, stoves destroyed, keys and bars of iron twisted, etc. On all sides thunder-bolts were very evident from their mechanical effects.

"We see on the left and right of the track through a forest, and in front of each point struck by a thunder-bolt, trees thrown down in great number, the top directed against (*contre*) the point struck. The direction of some fir-trees was perpendicular to the path.

"The funnel-cloud, thanks to numerous and intense lightnings, was seen by an observer at Aigh, some 35 miles from the tornado. The aspiration produced by the whirl was shown by the transport to 300 and more yards of great and solid *vachers*, by the removal of roofs, by the plucking up of a heavy boundary-stone weighing a hundred pounds, by the transport of objects 31 miles, mostly to the north. Hail fell at more than two miles to the north-west."

M. Faye also received a private report from M. Cadenat, and remarks: "It is very remarkable that in the United States tornadoes are rarely accompanied by electric balls similar to those at Dreux or at St. Claude, or at the ancient tornadoes of Assonval (1822) and of Chatenay (1835)." He thinks this is because they occur here mostly in daylight. He also suggests that the mechanical action of tornadoes is well understood to-day.

I note (1) there seems to be an enormous variety of terms which are applied in France to phenomena of this kind. In the four reports, covering eleven pages, the following are noted: *coup de vent*, used 6 times; *cyclone*, 6; *meteor*, 11; *orage*, 13; *ouragan*, 9; *tempete*, 4; *tourbillon*, 12; *tourmente*, 1; *tornado*, 19; *trombe*, 13; *trombe-cyclone*, 2. The fact that "tornado" heads the list in frequency is significant.

(2) It is hardly probable that there was a diminution in the gas pressure at Dreux through a diminished air pressure. A similar fact was noted at Cleveland, O., when there was no tornado, and at Louisville, Ky., during the tornado last year. An investigation of this question has shown that the diminished pressure is due to the forcing of the gas-holder at the works, by the wind, against the upright posts (see "The Tornado," p. 136).

(3) It is hardly probable that the absence of the observation of fire-balls in the tornadoes in this country is due to the light of day hiding the appearance. At such a time the sky is black, and the light is sufficiently diminished to show any bright, fiery object. The lack of this observation is due, partly to its not having been investigated, partly to the fact that most every one seeks safety in a cellar or dug-out, where it cannot be observed, but mostly, I think, because in the severer tornadoes the electric action, while abundant, does not manifest itself in this way. We are but just beginning to learn about unusual manifestations of electricity in storm phenomena. One of the most recent utterances is this, regarding the action of a lightning flash: "The seat of the electrical energy is, and must be, not in the cloud or in the earth, just preceding a flash of lightning, but in the air column between cloud and earth" (*American Meteorological Journal*, April, 1891, p. 599). If it can be once proved that it is possible to intensely electrify a column of air, we shall have gone a long way toward determining the cause of our funnel-clouds and the destructiveness of the tornado. It should be noted that fire-balls were observed at Louisville ("The Tornado," p. 134).

(4) I think we have hardly made a beginning in a determination of the causes of the mechanical effects noted either in our general storms or tornadoes. I can do no better than close with a quotation from "Bay of Bengal Cyclone Memoirs, Part III.," just received in this country.

The author, Mr. Eliot, himself an ardent supporter of the ordinary condensation theory of storms and tornadoes, by a course of reasoning almost identical with that previously adopted in this country, has arrived at the following conclusion, on page 285: —

"A cyclonic circulation cannot be resolved into the translation of a rotating disk or mass of air. The fact that the main supply of the energy is applied in front of the cyclone suggests that it is perpetually renewed in front, and that in fact its motion and transmission are hence rather to be explained by some process analogous to the transmission of a wave." This may be regarded as a noteworthy corroboration of views seriously antagonistic to present theories, and seems to indicate a significant advance in theories of storm generation. (See also in this connection this journal, No. 423, p. 150, and *Scientific American Supplement*, Jan. 18, 1890.)

(The following journals have been consulted in making up the above paper: *Comptes Reudus*, Aug. 20, 1890; Sept. 15, 1890; Oct. 6, 1890; Dec. 22, 1890; *Das Wetter*, December, 1890; April, 1891; and *American Meteorological Journal*, April, 1891.)

H. A. HAZEN.

Washington, D.C., May 22.

BOOK-REVIEWS.

Our Common Birds, and How to Know Them. By JOHN B. GRANT. New York, Scribner. Oblong 12°. $1.50.

THIS is an attractive little volume which cannot fail to interest any one who loves nature and to be helpful to him who wishes to become intelligent upon our common birds.

To quote from the modest introduction: "The author desires to disclaim great scientific knowledge of birds and their ways, his object being not so much to impart information as to point his readers to the way of acquiring it for themselves." It becomes quite evident, however, that Mr. Grant can tell us much more than he does, when we have mastered the first steps.

Some seventy portraits of birds on separate plates are given; the significant characteristics of each are so closely brought out, that, in connection with the text, it makes identification of the real object a comparatively simple matter.

The writer succeeded, during one hour spent in a small thicket a few hundred feet from his house, in New Jersey, in matching bird and picture of about a dozen specimens.

The book is of convenient size for carrying about, and would be as valuable an addition to the library of every school boy and girl as it is interesting to any one who, in his love of nature, "holds communion with her visible forms."

Appletons' School Physics. By JOHN D. QUACKENBOS, literary editor; ALFRED M. MAYER; FRANCIS E. NIPHER; SILAS W. HOLMAN; FRANCIS B. CROCKER. New York, Cincinnati, Chicago, American Book Company, 1891. $1.20.

THE title of this book shows what place it is intended to fill, and the list of authors shows how earnestly the publishers have attempted to make a book that shall fill that place with satisfaction. The literary editor, Dr. Quackenbos, is a professor of English at Columbia College, and is a member of the New York Academy of Sciences and a fellow of the New York Academy of Medicine. To each of the four scientific men whose names follow that of Dr. Quackenbos on the title-page has been assigned a special department of physics. Professor Mayer of the Stevens Institute,