covering the north flank of the Kittatinny Mountain; and a bowlder of limestone perched on the summit, which, within a distance of three miles, had been carried up eight hundred feet of vertical distance.

Referring to a paper recently published by Mr. W. J. McGee, who found difficulties similar to those of Professor Heilprin in the assumption of a polar ice-cap of great thickness, and who imagined the glacier to increase by additions to its outer rim, Professor Lewis held, that the single fact of the transportation by the glacier of far-travelled bowlders to its terminal moraine was a fatal objection to any such hypothesis. Nor did he believe that the hypothesis adopted by Professor Dana and others, of a great elevation of land in the north, was a probable one. The facts now in the possession of geologists do not indicate such a great and local upheaval as required by that hypothesis.

An explanation therefore must still be sought for the southward flow of a continuous ice-sheet, — a flow in some regions up-hill. The action of gravity was certainly not sufficient. Even in the case of the downward flow of the steeply inclined Swiss glaciers, it had been shown that gravity was more than counterbalanced by friction of the sides and bottom, and those glaciers moved by reason of an inherent moving power of the molecules of the ice. It was probable that a similar action occurred in the great continental glacier. He suggested, therefore, a hypothesis which, while preserving the unity of the glacier, as indicated by observed facts, neither assumed an unreasonable land-elevation in polar regions, nor required a thickness of ice so great as to be open to the objections of the last speaker. He suggested that the ice-cap flowed south simply because it flowed toward a source of heat. Such flow does not depend upon gravity, but would occur in a flat field of ice, or possibly even up a slight incline toward a warmer temperature. Upon this hypothesis the ice need not to have been more than a few times its present thickness in Greenland to account for all existing phenomena.

AN EARLY STATEMENT OF THE DEFLECTIVE EFFECT OF THE EARTH'S ROTATION.

A CORRECT knowledge of the deflective effect of the earth's rotation on the motion of bodies on its surface is generally accounted the result of studies made within the last twenty-five years. First in 1856, and more fully in 1859, Mr. William Ferrel of Nashville, Tenn., now of Washington, made the general statement, that, "in whatever direction a body moves on the surface of the earth, there is a force arising from the earth's rotation which deflects it to the right in the northern hemisphere, but to the left in the southern" (*Math. monthly*, 1859, i. 307); and gave, by a rigorous analytical treatment of the question, a quantitative measure of this force, showing that it depended on the sine of the latitude of the body, but not at all on the direction of its motion. A similar but less comprehensive result was arrived at about the same time by Babinet and others (*Comptes rendus*, xlix. 1859); and since then the subject has been treated by many writers, among whom may be mentioned Buff, Finger, Guldberg and Mohn, and Sprung. It has, however, also been disputed by some authors, as Bertrand and Benoni, who erroneously hold to the old idea, first suggested by Hadley (1735), and recalled (it would seem independently) by De Luc (1779), Dalton (1793), and Dove (1835), that the deflective effect is greatest on motions in the meridian and nothing on east-and-west lines; and this incorrect view is but slowly disappearing from the text-books in general use.

It is the object of this note to call attention to an early statement of the law of deflection, that has never, so far as I can learn, received due credit. In 1843 Mr. Charles Tracy, now of New York, read a paper 'On the rotary action of storms' before the Utica (N. Y.) society of natural history; this was published in the American journal of science (xlv. 1843, 65–72), and the paragraphs quoted below are taken from it. It will readily be perceived that this explanation is far in advance of Dove's; although it lacks the consideration of the effect of centrifugal force and of the preservation of areas, to be a full statement of the matter. Mr. Tracy thought, in accordance with Espy's theories, that there must exist "a qualified central tendency of the air, in both the general storms and the smaller tornadoes" (p. 67); and in order to develop a uniform rotary movement in these centripetal winds, he looked to "the forces generated by the earth's diurnal revolution" (p. 66). In every storm, "the incoming air may be regarded as a succession of rings taken off the surrounding atmosphere, and moving slowly at first, but swifter as they proceed towards the centre." In virtue of the law of deviation, every ring "begins to revolve when far from the centre, turns more and more as it draws near it, and finally as it gathers about the central spot all its forces are resolved into a simple whirl" (p. 69). The law of deviation is illustrated by appropriate figures for the two hemispheres, and is explained as follows. (Its *direct* application to the tornado and water-spout is probably incorrect, as Mr. Ferrel has shown.) "The relative motions of the parts of a small circular space on the earth's surface, by reason of the diurnal revolution, are precisely what they would be if the same circular space revolved upon an axis passing through its centre parallel to the axis of the globe. If such space be regarded as a plane revolving about such supposed axis, then the relative motions of its parts are the same as if the plane revolved about its centre upon an axis perpendicular to the plane itself; with this modification, that an entire revolution on the axis perpendicular to the plane would not be accomplished in twenty-four hours. Such plane daily performs such part of a full revolution about such perpendicular axis as the sine of the latitude of its centre is of radius. The plane itself — the field over which a storm or a tornado or a water-spout is forming — is in the condition of a whirling table. Hence the tendency to rotary action in every quarter of the storm is equal, and all the forces which propel the air toward the centre co-operate in harmony to cause the revolution" (p. 72). The special value of this statement lies in the proof that motions in all directions are deflected equally; but on account of the omissions above named only one-half of the total deflective force is accounted for. W. M. DAVIS.

LETTERS TO THE EDITOR.

'Mother of petre' and 'mother of vinegar.'

CHEMISTS were not a little interested a few years since by the discovery, first announced by Alexander Muller in Germany, and afterwards by Schloesing and Muntz in France, that the formation of saltpetre in nature, and of other nitric compounds as well, is in some way connected with the presence and action of a living 'ferment,' much in the same way that the formation of alcohol in the brew-house or distil-