Nebraska. — There are thirty-one observers, from whose reports it is found that the temperature and rainfall were about normal. The average mean temperature was 75°.4; average rainfall, 3.43 inches. The highest of the maximum temperatures was 93°; the lowest of the minimum, 47°. A violent hailstorm occurred on the 8th, at Lincoln; and a wind of forty four miles per hour, from the east, was noted at North Platte.

Ohio. — The barometric pressure was unusually steady, the small range of 0.542 inches being noted. The mean temperature, 68°.2, is more than four degrees below the average. A minimum of 39° was noted. Rain fell on seven days only. The average rainfall was only 1.88 inches, the usual amount being 3.47 inches. At Lebanon 4.60 inches fell, and at Granville 0.70 inch. A violent storm of wind and hail visited Wooster and vicinity on the 28th.

Tennessee. — The reports are from thirty-five stations. The highest of the maximum temperatures noted was 94°, and the lowest of the minimum 43°. The ranges of temperature were generally uniform throughout the state; but the precipitation, which ranged from 1.03 to 6.38 inches, was quite unevenly distributed. The weather presented no remarkable features. There was a marked absence of high winds or severe electrical disturbances. The crop reports are excellent, but the average condition is a little below that of last year.

THE GEOGRAPHIC CONTROL OF MARINE SEDIMENTS.

M. A. RUTOT, conservator in the Royal museum of natural history of Belgium, who, in connection with M. E. Van den Broeck, has been studying the tertiary strata of his country, has lately taken up (*Bull. mus. roy. hist. nat. Belg.*, ii. 1883, 41) the fruitful subject of the immediate dependence of fragmental marine deposits on geographic conditions, such as distance and form of shore-line, depth of water, currents, etc., and the consequent changes in these deposits following changes in the controlling geographic surroundings. The matter is properly treated deductively, and so far as concerns vertical oscillations of the earth's crust, which determine advance and retreat of the shore-line, it is examined with much detail. The conclusion is reached, that the frequent changes from gravels, through sands to clays, and back again to gravels, that characterize the Belgian tertiaries, can be fully explained by simple, assignable, and slow geographic causes. We have only to regret, that, in the forty pages devoted to the subject, more room was not found for mention of what others have done in the same direction. The method of investigation may be outlined as follows: —

There is first given the familiar illustration of the varied deposits forming off shore at any single time, showing that the texture, and, in part, the composition of the deposits, are functions of the distance from the shore-line, as in fig. 1. Now, let a general depression slowly take place, by which the sea will advance over the land: the whole set of deposits shifts with the shore, until sands, and at last clays, are laid down over the first gravels, as in fig. 2. Then, if elevation replace the depression, the set of strata shifts seaward, and the sands, and at last the shore-gravels, lie above the clays, as in fig. 3. It is generally noted that the upper gravels are finer than the lower, as the later deposits are made, in part, by working over the older during the time of emergence.

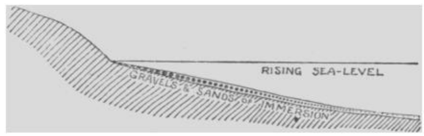

FIG. 1.

The complete set of deposits formed during such a double oscillation of sea-level is to be considered in two ways, — first, with regard to the vertical sequence of the strata; second, with regard to their horizontal equivalence. The vertical sequence is seen in fig. 4: it is made up of the gravels and sands of immersion, the central layer of clay, and the sands and gravels

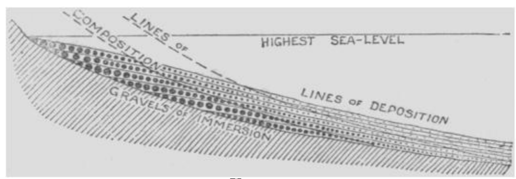

FIG. 2.

of emersion, each stratum having its appropriate fossils. Such 'circles of deposition,' enlarged by the addition of a limestone at the time of greatest distance of the old shore-line, occur several times in our Appalachian sections; and the recognition of their meaning, especially in Professor Newberry's luminous writings, has thrown much light on the evolution of our country. M. Rutot gives the accompanying figure (5) to illustrate the succession of unequal or incomplete oscillations: it shows, I., a large and complete

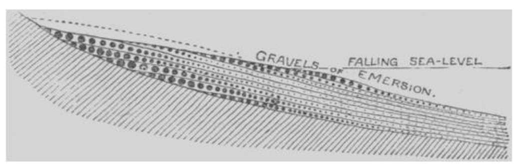

FIG. 3.

oscillation, partly eroded before II., a second depression, from which the elevation was incomplete; III., a great depression and complete elevation; IV., a moderate depression and elevation. This complicated succession represents perfectly the type of the Belgian tertiaries; and the deductions from its physical features are fully confirmed by the evidence from its fossils.

The second consideration, involving the horizontal equivalence of the different strata, is perhaps the most suggestive part of the paper. It is of much importance, and is seldom sufficiently treated. It involves the further examination of the dependence of a set of phenomena on their distance from some controlling condition, which can be called the directrix, and which may change its position. This is worthy of illustration. We find a simple case, in which the directrix is motionless, in the escape of

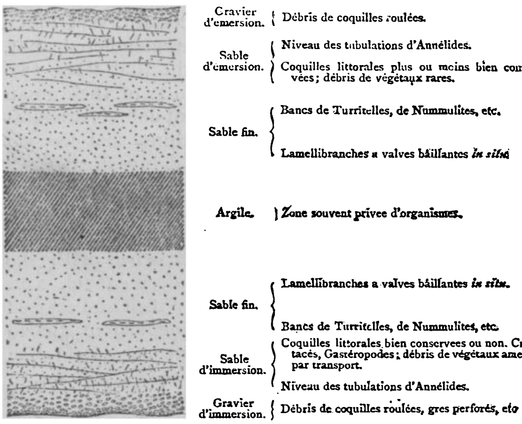

FIG. 4.

gases during a volcanic eruption. The eruptive vent is the directrix, and the various gases are successively given off from the lava when its temperature falls to that below which they cannot be occluded, the temperature depending largely on the distance of flow from the crater. An example in which the directrix moves continually in one direction is seen in the dependence of terrestrial day and night, with all their attendant changes, from warmth to cold, activity to rest, on the position of the sun. One in which the directrix moved for a time in one direction is seen in the relation of our drift-deposits to the

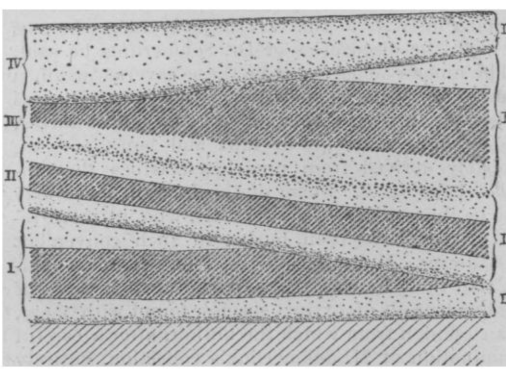

FIG. 5.

'retreating' margin of the continental ice. Far to the northward of the margin, where the ice was thickest and moved fastest, erosion was most active; at a less distance, the ground-moraine was accumulated at favorable points; at the margin, the Kame gravels were deposited; and farther south, the brick-clays settled where they found quiet water: hence all these may be chronologically equivalent in passing from south to north, although at a given point we should find a vertical sequence from scratched rock, through ground-moraine and Kame gravels to brick-clay. An effect of irregular motion of the directrix will be seen in the shifting of all those physical and chemical actions going on within the earth, and dependent for their proper temperatures and pressures on their depth below the surface; for this depth, or the distance from their directrix, is continually, though very slowly and irregularly, changing, — decreasing, while the superincumbent mass culminates in a land-surface that is losing ground by erosion; increasing, while it is receiving new material below the sea. A regular oscillation of the directrix is presented in the swinging of the sun north and south of the equator, carrying the seasons, the wind-systems, and the length of the day, in its train. Finally, the case in point shows us an irregular shifting of the shore-line directrix as the land slowly rises and falls. As a first result of the dependence of deposits on their distance from the shore-line, we shall find that those formations which are at any given moment contemporaneous, or horizontally equivalent, are the very ones already seen at any given point in vertical sequence. Secondly, when we view a broad set of deposits accumulated during a shifting of the shore-line, it will be seen, that while the band of conglomerate or sandstone is continuous for considerable distances, and apparently of contemporaneous formation throughout, it is not so in reality; for the lines of composition are not lines of deposition, and one part of the conglomerate is distinctly of later date than another, and really contemporaneous with the clay overlying the latter. This is illustrated in fig. 2, and shows the complete abandonment of the old ideas concerning universal formations. Instead of supposing that contemporaneous deposits are of uniform composition throughout, we must now admit that they necessarily vary.

M. Rutot's paper was prepared especially for the explanation of Belgian geology. Before it could serve as a guide to the meaning of our broad paleozoic strata, there should be added a consideration of the geographic conditions of limestone-making, and of the former greater strength of transporting agencies required by our old conglomerates. It would have been well to consider Phillips's suggestion concerning continuous subsidence at irregular rates, in which the shallowing is produced by deposition instead of by elevation; for, although this is quite inadequate to explain the changes in the heavy Appalachian sediments, where shallow-water sandstones sometimes quickly follow deep-water limestones or shales, it may serve in certain cases of smaller measure, which M. Rutot has interpreted as the effects of oscillations. On the other hand, the occurrence of elevation after and in spite of deposition might be emphasized to show the rather one-sided aspect of the conclusions lately discussed by the English geologists, who too often consider erosion and deposition as almost the chief causes of change of level.