but the instrument was little known to physiologists. Since 1890, however, it has in its improved form, with a wax cylinder, engaged the attention of Professor Hermann, of Königsberg, and more recently of Dr. Boeke, of Alkmaar, and of Professor M'Kendrick, of Glasgow. By an ingenious method of photographically recording the vibrations of the marker that runs over the impressions produced by sounds on the wax cylinder of the phonograph, and which, by acting on a thin glass plate, reproduces the sounds, Hermann has obtained the curves corresponding to the tones of the vowels, and he has shown that the vowels are true musical tones, each having its own proper pitch, and not, as Von Helmholtz supposed, the pitch of a harmonic tone corresponding to the shape of the oral cavity when the vowel sound is uttered. When one considers that the phonograph can faithfully reproduce human speech, the sounds of a musical instrument, of a quartette or chorus of human voices, or the sounds of an orchestra, and that all these sounds and tones are imprinted on the wax cylinder of the phonograph in the form of a more or less complicated wave, it is manifestly of great importance to determine the wave form for any particular sound. If this could be done, not only would it be of great scientific interest to submit the curve to harmonic analysis (as was done by Jenkin and Ewing), and thus determine the component waves, but it might be possible to cut the curves on the margin of a wheel, or other appropriate device, and thus construct a speaking or singing machine. Speech and song and orchestral effects might be multiplied mechanically. The grooves on the wax cylinder vary in depth from the 1–1000th to the 1–2000th of an inch, and, thus, as the curve is in the bottom of the groove, it is a difficult matter to trace its form. Boeke has measured the transverse diameters of the grooves at different points, and from these measurements he has calculated the depths, and thus he has endeavoured, as it were, to construct the curve. M'Kendrick has taken direct photographs of the marks on the wax cylinder, and has thus been able to demonstrate vibrations (or 'dabs' on the wax cylinder traveling with great velocity) made at the rate of 1,500 to 1,800 per second. He has also shown that there is a definite form of these markings for pure tones, for the simpler chords, and for very complex tones, such as those of the organ, piano, or a quartette or chorus of human voices. By adapting large resonators to the phonograph, M'Kendrick has also made it possible to so increase the volume of tone as to make it audible even in a hall of considerable size. Edison and others have frequently used large resonators, but M'Kendrick has gone further in this direction. Recognizing, however, that resonance cannot increase the volume of tone beyond a certain limit, he has made use, with much success, of Mr. Alfred Graham's ingenious loud-speaking telephone, along with a transmitter of variable resistance, as supplied by Messrs. Muirhead and Co., of Westminster. In this way the tones of the phonograph are much amplified in volume and improved in quality. To physiologists the interest of these researches lies in the mode of action of the vibrating plate of the phonograph. This acts like the drumhead of the ear. Consequently the better the modes of movement of such a plate are understood the better can we explain the mechanism of the drumhead of the ear—a drumhead, however, infinitely more sensitive than the phonograph plate.—*London Times.*

CURRENT NOTES ON PHYSIOGRAPHY (XIII.).

THE CATOCTIN BELT OF MARYLAND AND VIRGINIA.

THE Blue ridge, dwindling from the Carolina highlands, extends a few miles north of the Potomac at Harper's Ferry, there overlapping the southern extension of South Mountain from Pennsylvania. Five or ten miles to the east, on both sides of the Potomac, Catoctin Mountain repeats in many respects the structural and geographical features of Blue Ridge and South Mountain. The geographical features of this region are described and explained in a valuable essay on the 'Geology of the Catoctin Belt' by Arthur Keith (14th Ann. Rep., U. S. G. S., 1895, 293–395). The Tertiary 'baselevel' is the most extended surface of the region. Catoctin and various other residuals of hard rocks rise above it, and numerous valleys are entrenched beneath it. Three stages of post-Tertiary denudation (two Pleistocene and one recent) are indicated by the 'baselevels' observable in the valleys. The even summits of Catoctin and the other residuals above the Tertiary plain indicate two stages of pre-Tertiary denudation; but these older 'baselevels' are now so greatly consumed that they are referred only in a general way to Cretaceous time. Judging by the volume of denuded rocks, the ratios of Tertiary, early Pleistocene, later Pleistocene and recent time are as 134, 1, $\frac{6}{5}$, and a 'small fraction.' The small consideration of marine erosion marks the essay as distinctly belonging to the American school.

The residual hills of this region are so characteristically developed that in 1891 McGee suggested the use of Catoctin as a generic name for such topographic forms (5th session, Internat. Geol. Congress, 249), in the same way that I have used Monadnock in New England (Nat. Geogr. Mag., V., 1893, 70). Recent practical experience has shown me that it is convenient to use both these terms; Monadnoch to apply to residual eminences that surmount peneplains of Cretaceous denudation, such as are common in the highlands of New England and Carolina, and Catoctic to apply to the residuals that surmount Tertiary peneplains, such as are common over the inner piedmont belt of Virginia. Whether so special a terminology will commend itself to general usage remains to be seen. It may be noted that Keith employs 'baselevel' in a topographic sense to which strong objection may be urged. (See Science, February 15, 1895, 175.)

RECENT TOPOGRAPHICAL MAPS.

Recent topographical sheets issued by the United States Geological Survey represent a number of areas of particular interest. Those for New York, the joint product of State and National funds, are especially welcome. The Oriskany, Oneida, Chittenango and Syracuse sheets portray the northern margin of the Alleghany plateau where it descends to the lowland of central New York; the eastern sheet includes Rome, where the Mohawk enters the broad valley that, according to Gilbert, once served as the outlet of the expanded Lake Ontario. The Syracuse sheet includes the beginning of a remarkable area of drumloidal drift hills, and also shows some of those curious abandoned channels near the margin of the plateau that seem to have been cut by temporary streams, constrained into peculiar courses by the melting ice sheet. Elmira and Rochester are included on other sheets of interest in connection with recent papers of Fairchild (see Science II., p. 11.; Amer. Geologist, xvi., 39–51). The Ithaca sheet illustrates the general dissection of the plateau and the morainic obstruction of some of its valleys, referred to by Chamberlin (3d Ann. Rept. U. S. G. S., 357). The Catskill and Rhinebeck sheets make the series for the Hudson almost complete from New York City to Albany. A large part of the Ausable basin in the Adirondacks is included in the Mt. Marcy, Ausable and Plattsburg sheets, offering interesting problems about lakes and gorges for attentive study. The Pulaski sheet at the eastern end of Lake Ontario exhibits the simplification of an originally irregular shore line by cutting off headlands and throwing bars across bays.

In other States, the Bath (Maine) sheet is a remarkably effective illustration of a ragged coast line; it includes the northward deflection—presumably by drift barriers—of the Androscoggin at Brunswick to the expansion of the Kennebec in Merrymeeting bay. Wood River, Grand Island, Minden and Kearny sheets, Nebraska, show how the overburdened Platte sprawls across the Plains in its many channels. The shore line on the Seattle (Wash.) sheet has a number of low cuspate points, apparently small-scale examples of the action of eddying currents. For the most of us who cannot see the country itself, these maps are highly illuminating and suggestive.

THE DELAWARE WATER GAP.

THE plunging Medina sandstones that form Kittatinny mountain, the wall on the northern side of the Great Appalacian valley in Pennsylvania, are trenched across by a number of streams, all flowing from the region of the inner Alleghany ridges southeast towards the sea. It may be plausibly suggested that the ancestors of these streams originally ran to the northwest, as the New-Kanawha of Virginia still does; but that in Pennsylvania the drainage was afterwards turned to the present direction of discharge in some manner not now well defined but probably dependent on moderate deformation and the associated shifting of divides. The date of this change is not settled, but it is supposed to have been before the post-Cretaceous elevation of the region. This would imply that the Tertiary excavation of the broad longitudinal and the narrow transverse valleys or water gaps was accomplished by rivers running as a whole in their present courses.

A recent article by Emma Walters (Does the Delaware water gap consist of two river gorges? Proc. Acad. Nat. Sci., Phila., March, 1895) takes another view in suggesting that the most noted of the water gaps is the work of a river that ran northward for most of the time while it was cutting down the gap, and that it assumed its present direction in comparatively recent time. The local and immediate evidence quoted to indicate a northward flow is a pool, fifty to seventy feet deep, on the northern side of the hard sandstone sill of the gap; but the excavation of such a pool seems to be within the power of a strong river flowing in a narrow, curved channel. Collateral evidence of northward flow is found in the favorable interpretation of a number of indecisive observations made by various geologists, but the value of this kind of evidence is very uncertain.

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PSYCHOLOGICAL NOTES.

THE SENSE OF EQUILIBRIUM.

DR. A. CRUM BROWN, in a lecture on 'The Relation between the Movements of the Eyes and the Movements of the Head' (printed in *The Lancet*, May 25th, and in *Nature*, June 20th), reviews the evidence that has led to the assumption that the semi-circular canals (together with the utricle and sacule) of the inner ear are sense-organs, giving us our information concerning position and equilibrium of the body. This view is now universally accepted, although the evidence is only circumstantial and not altogether conclusive to the present writer. There is no doubt but that injuries to the semi-circular canals cause corresponding disturbances in equilibrium, but dizziness and sickness are also caused by visual sensations. We may become dizzy from watching a waterfall, and when whirled about grow dizzy much more quickly when the eyes are open than when they are closed. It would seem that