

universities or the establishment of monetary systems. If we wait for them to speak out we must wait indefinitely. If the introduction of the metric system be accomplished in America we must act in the light of experience already acquired in Europe, which is far more valuable than any amount of theorizing about the apprehended effect upon poorer classes who have not yet tried it.

The suggestion that an International Commission should be appointed to secure unity of action between the United States and Great Britain is eminently worthy of adoption. Any system of metrology adopted by one of these two nations must necessarily be adopted nearly, if not quite, simultaneously by the other. It is very much to be desired that this proposition shall be brought before Congress as soon as the Committee on Coinage, Weights and Measures is again ready to act.

W. LE CONTE STEVENS.

TWO EROSION EPOCHS—ANOTHER SUGGESTION.

HERSHEY's recent suggestion (*SCIENCE*, Vol. III., pp. 620-622) that a specific designation be given to the epoch of post-Lafayette erosion in the eastern United States is an excellent one. The epoch is one of the most clearly defined in the physical history of the continent; its record has already been interpreted over a vast area, and a specific designation will tend at once to crystallize knowledge and to aid in its diffusion. So the suggestion marks an advance in systematizing American geology.

To the writer the name selected seems hardly a happy one, partly because 'Ozark' is already in so general use in geologic nomenclature as perhaps to occasion confusion, partly because there is a certain incongruity in applying the name of a mountain region to a degradation period; but this question of fitness in name gives no occa-

sion for hesitating to adopt the suggestion.

There is a graver question concerning the age of the epoch. Hershey intimates, without argument, that there is 'general agreement * * * that the post-Lafayette period of erosion is early Quaternary in age;' but, so far as the writer is aware, most students have connected the degradation period with the preceding aggradation period—those geologists who have examined the formation and its degradation record (with perhaps two exceptions) regarding both as pre-Quaternary, and those who have written voluminously on the formation without seeing it regarding it as Quaternary. It seems worth while to direct attention to this question of age, partly for the purpose of pointing out that there is no less need for the term even if the epoch does not belong to the Pleistocene, and thus to the period so well classified by Chamberlin; it is not absolutely necessary to decide whether the Ozarkian epoch be classified as Pleistocene or Neocene, since each student can arrange his pigeon holes and their contents as he pleases, and since increasing knowledge is constantly making toward better arrangements; but it is important that this well-marked erosion epoch should bear a denotive label. It is also important to remember that, if erosion be regarded as yielding a time measure, the reference of the Ozarkian to the Pleistocene multiplies many times the commonly recognized duration of that period.

Hershey adequately recognizes the extent of the erosion affected during the Ozarkian epoch in (a) the Coastal plain of the Atlantic and Gulf, and (b) the broad area extending thence to the glacial margin; but it seems desirable to recognize (hypothetically perhaps, but with constantly increasing evidence), the record of the epoch in (c) the glaciated region: In the Coastal plain this epoch of profound erosion is recorded in estuaries hundreds of miles in length and

scores in breadth, and scores or hundreds of feet in depth to the bottom of later linings, excavated chiefly in nonlithified deposits; in the interior area it is recorded in steep-bluffed canyons carrying all the rivers and all but the smallest streamlets, excavated in hard rocks; and the two records are not only consistent in kind and amount, but intergrade in such manner as to establish substantial identity. In the glaciated area the drift mantles a surface, which, so far as outcrops and borings indicate, is the counterpart of that found in the extra-glacial region, *e. g.*, in Ohio and western Pennsylvania numerous ancient drift-filled channels have long been known; in Indiana and Illinois many such canyons have been revealed by borings; in Iowa several have been recognized for years and others have recently been brought to light through the researches of the State Survey; indeed throughout most of the glaciated region such buried canyons are known. Now it is noteworthy that all of these drift-filled gorges thus far brought to light are consistent in depth and width among each other, and also with the gorges of the Mississippi, Missouri and Ohio, not only inside the glacial boundary, but outside that limit where they form trustworthy records of the Ozarkian epoch. It is no less noteworthy that Salisbury and others have detected remnant gravel deposits, presumptively representing the Lafayette, far within the glacial boundary; and the combined records of aggradation and degradation indicate with considerable clearness that the continental oscillations of the Lafayette-Ozarkian time affected most or all of what is now the eastern half of the United States. This correlation of degradation records without and within the glacial boundary explains simply and readily the peculiar configuration of the pre-glacial surface which has puzzled many students; and at the same time it emphasizes the strong distinction between agen-

cies and conditions of the two periods—the Ozarkian epoch of high level and rapid degradation, and the Kansan and succeeding epochs of low altitude and aggradation or feeble degradation.

In considering the physical history of the southeastern quarter of the continent during neozoic time it should be borne in mind that there were two and only two great eons or cycles of earth movement. The first eon began with the profound oscillations attending the deposition and subsequent degradation of the Potomac formation, continued with ever-lessening amplitude of oscillation nearly to the end of the Tertiary, and closed with the remarkable epoch of stability in the earth crust antedating the Lafayette; the second eon began with the profound oscillation by which the deposition and subsequent degradation of the Lafayette were produced, continued with diminishing vigor and amplitude of movement to the end of glacial time, and is apparently not yet closed, *i. e.*, each cycle began with strong movement which gradually declined and died away, the first in a long epoch of quiescence, the second in the gentle oscillation apparently in progress to-day. It may be noted in passing that there is a certain logical symmetry and completeness in correlating these eons or cycles with the stratigraphic and paleontologic series, and thereby in referring the second wholly to Pleistocene; but it should not be forgotten that there is no indubitable evidence connecting the Lafayette with glacial action, and a vast body of trustworthy evidence pointing in the opposite direction, so that the logic of fact runs counter to the logic of idea; moreover such a correlation tends to deepen the slough of baseless speculation concerning the cause of glaciation which alone seems to connect the Lafayette with the glacial deposits. Now on considering in detail the oscillations of the two eons, it is found that they run in

pairs, each subsidence being followed by elevation of proportionate amount; * *e. g.*, the strong subsidence of the Potomac epoch was followed by a strong uplift, the slight subsidence of the Pamunkey by a slight uplift, and in the Lafayette and again in the Columbia epoch the same relation held, while the values of subsidence and elevation varied together in different latitudes, yet remained essentially equal at each. So uniform and so constant is this relation that it seems fitting to couple each degradation period with the immediately preceding aggradation period rather than with that which followed; in other words, each unconformity seems more closely related to the formation in which it is carved, than to the newer, perhaps much newer, formation overlying it. These considerations indicate the conditions of the erosion epochs preceding and succeeding the Lafayette; and incidentally they seem to afford additional grounds for classing the Ozarkian epoch with the Neocene rather than with the Pleistocene.

There is satisfactory evidence† that as the oscillating earth crust came to approximate rest in the earlier physical eon, the land surface throughout the Piedmont, Appalachian, Cumberland and contiguous provinces was extensively baseleveled and so far degraded that mechanical agency became feeble; this was the epoch of widespread planation by which character was given to the inter-stream surface outside the glacial margin, and presumptively to the inter-canyon surface in the glaciated area. As mechanical activity decreased chemical activity increased, and the less

obdurate rocks were decomposed into a thick mantle of residua, interrupted by occasional siliceous ledges and bodies, which were afterward gathered by the revived streams to form the Lafayette deposit. This epoch of baseleveling and rock decomposition was of exceeding importance in the geologic history of the southeastern part of the continent, since it was during its course that the chief topographic features of the provinces—the broad plateaus and inter-stream plains—were developed. Its earlier limit is indeed somewhat vague; the characteristic processes began with the waning post-Potomac oscillation, and were measurably interrupted by each throes of the earth crust up to and including the Chesapeake, in the middle Atlantic slope; but its later limit is clearly fixed by the Lafayette.

It seems desirable that this important degradation epoch should receive a distinctive appellation. The association of Hershey's designation would suggest Appalachian, or Piedmont, or Cumberland as a suitable term, since the configuration of these provinces was shaped during the epoch; but it would seem to the writer more fitting to borrow a name from one of the principal agents in the work of the epoch, viz: Tennessee river—a great waterway which then drained a large section of the Cumberland and Appalachian provinces directly into the Mississippi, which was of much greater importance in the earlier neozoic epochs than at present, and which assumed a new course in its lower part and lost much of its drainage area as the epoch ended.

So it may be suggested that *Tennessee* (or *Tennesseean*) epoch be added to the time nomenclature of American geology as a designation for the long period of planation and rock decomposition immediately preceding the Lafayette. Thus may we have convenient designations for the two chief erosion periods by which the lands of a vast area of our continent were finally shaped.

* The characteristics of the movements have been noted in the *Compte Rendu de la Congress Géologique International*, 5me. Session, Washington, 1891, p. 165.

† Noted in part in Twelfth Ann. Rep. U. S. Geol. Survey, 1891, pp. 494-6, 508; also in descriptive text of the *Nomini Atlas-folio* (now in press) of the *Geologic Atlas of the United States*.

The relations of the epochs, as conceived by the writer, are shown in the following scheme :

<i>Period.</i>	<i>Epoch.</i>	<i>Process.</i>
Pleistocene	Wisconsin . . .	Glaciation.
	Toronto ? . . .	Aqueous erosion, etc.
	Iowan	Glaciation.
	Aftonian	Aqueous erosion, forest growth, etc.
	Kansan	Glaciation.
Neocene	Ozarkian	Canyon cutting.
	Lafayette	Sedimentation.
	Tennessee . . .	Planation.

Save occasionally in the Appalachian and Piedmont provinces, where the normal land forms are locally dominated by structural mountains, monadnocks and catoctins, the topographic record of the two Neocene erosion epochs stands out in every typical landscape from the fall-line to the drift margin ; for the characteristic tabular or gently-rounded, residuum-mantled divides represent the earlier, and the no less characteristic steep-bluffed labyrinthine gorges represent the later epoch. The even-topped ranges and outlying monadnocks record earlier episodes in continental development, as Davis, Hayes, Campbell and others have shown; but the record found in the relatively modern plateaus and gorges is many times the more extensive and impressive.

Howsoever the Ozarkian be classified, it is evident that the erosion epochs of the Pleistocene and Neocene were long, especially in the earlier time. Recent researches, notably by Chamberlin and others in the interior and by Salisbury in New Jersey, indicate that the Toronto epoch was much longer than the post-glacial epoch ; and it has for some time been recognized by a number of glacialists that the interglacial epoch called Aftonian was much longer, as measured by erosion, than all those that have followed—or, at any rate, that the Kansan was many times more remote than the Wisconsin. Yet the erosion of the Toronto and Aftonian together is trifling in comparison with the profound and

widespread canyon-cutting of the Ozarkian, during which the streams and larger rivers of the southeastern sub-continent cut gorges averaging 250 feet in depth and ranging from a few rods to several miles in width ; and even this enormous erosion is slight in comparison with the widespread wasting of the Tennessee epoch.

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CURRENT NOTES ON PHYSIOGRAPHY.

GEOGRAPHICAL DESCRIPTION OF THE BRITISH ISLANDS.

DR. H. R. MILL gives in the April *Geographical Journal* an account of his plan for a series of memoirs, one for each sheet of the one-inch ordnance survey, describing the geography of the British Islands in a most comprehensive manner. Index of names and locations, mean elevations, hypsographical description, physiographical explanation, areas of woodland, moorland, cultivated land, etc., political and historical boundaries and events, geographical description proper, and bibliography, are to be duly considered. The plan was favorably commented on at a meeting of the Royal Geographical Society, and it does not seem impossible that it may be carried into execution.

The remark made under 'historical information' might be applied to all parts of the plan: It 'would be very stringently edited, so as to confine it strictly to those features and events of direct geographical importance,' for an inspection of current geographical literature shows how vague is the prevalent conception as to the essential quality of geographical discipline. Local floras and faunas, one of the proposed topics, are distinctly not geographical, but biological subjects. Treated with relation to the controls of their distribution, they gain geographical flavor. Treated as exhibiting geographical controls, they become as distinctly geographical as are any other means