divided into any multitude of parts whatsoever —or if we replace this by an equivalent definition in purely logical terms—we find it lends itself at once to mathematical demonstrations, and enables us to work with ease in topical geometry.

3. Professor Royce wants to know how I could, in a passage which he cites, attribute to Cantor the above opinion about infinitesimals. My intention in that passage was simply to acknowledge myself, in a general way, to be no more than a follower of Cantor in regard to infinity, not to make him responsible for any particular opinion of my own. However, Cantor proposed, if I remember rightly, so far to modify the kinetical theory of gases as to make the multitude of ordinary atoms equal to that of the integral numbers, and that of the atoms of ether equal to the multitude of possible collections of such numbers. Now, since it is essential to that theory that encounters shall take place, and that promiscuously, it would seem to follow that each atom has, in the random distribution, certain next neighbors, so that if there are an infinite multitude in a finite space, the infinitesimals must be actual real distances, and not the mere mathematical conceptions, like $\sqrt{-1}$, which is all that I contend for.

C. S. PEIRCE.

MILFORD, PA., Feb. 18, 1900.

CURRENT NOTES ON PHYSIOGRAPHY.

DEFLECTION OF RIVERS BY SAND-REEFS.

AN article on 'The effect of sea barriers upon ultimate drainage' by J. F. Newsom (*Journ. Geol.*, vii, 445–451), describes several examples of rivers whose discharge is deflected to the right or left by the formation of an offshore sand-reef in front of their mouths, and suggests that such deflection may explain the course of rivers that now flow parallel to preexistent coast lines; for example, the Delaware below Bordentown, N. J.

This suggestion is evidently valid as a possibility, but it is not accompanied by tests that sufficiently distinguish deflections thus caused from deflections that arise from the spontaneous adjustment of streams to the weak strata that underlie the cuesta-makers of coastal plains having longitudinal relief. The lower Delaware cannot be a normal example of the latter class, because as the master river of its region it is the very one that should not be deflected by adjustment; on the other hand, it may truly fall under the former class because its deflection is in the sense of the dominant sand-drift along our Atlantic Coast. Examples of sand-reef deflections ought to follow the strike of strong or weak rocks, indifferently; while normal deflections by adjustment can only follow belts of weak rocks.

DEVELOPMENT OF THE SEVERN.

THE systematic development of rivers seldom finds better illustration than in the interaction of the 'waxing Severn and the waning Thames,' concerning which a number of new details and suggestions are given by S. S. Buckman (*Nat. Science*, xiv, 1899, 273–289). The growth of the Severn by headward erosion along the weaker strata that underlie the firmer oölites of the Cotteswold hills is advocated on good evidence, and a restoration of the original consequent headwaters that have now been diverted from the Thames system is attempted. The growth of obsequent branches of the subsequent Severn on the line of the beheaded consequent branches of the Thames is well presented as the reason for the peculiar unsymmetrical arrangement of the Severn tributaries in the neighborhood of Gloucester. The Frome, a branch of the Severn, is shown to have captured several of the westernmost headwaters of the Thames in the Cotteswold hills between Chalford and Edgeworth. The progressive diminution of the Coln, a branch of the Thames, by the successive diversion to the Severn of the two large branches that once came from Wales is offered in explanation of the very curious features of the present Coln valley in the upland east of Cheltenham: a valley of large-curve meanders is taken as the work of the original river; a narrower valley of small meanders, cut in the floor of the larger valley, is the work of the river after one of its upper branches was captured by the Severn; the wriggling course of the present stream on the floor of these smaller meanders is due to the further loss of volume after the second upper branch was captured.

Some further account of the Cotteswold streams and of their homologues in the Swabian Alp of southern Germany may be found in a paper by the undersigned on the 'Drainage of Cuestas' (Proc. Geol. Assoc., London, xvi, 1899, 75–93). The failure of even the obsequent streams fully to occupy their meandering valleys suggests that all the streams of the region have diminished in volume on account of climatic change or of deforesting and cultivation; beheading is therefore not alone the cause of the misfit of the Coln and its neighbors in the upper Thames system.

LANDQUART AND LANDWASSER.

HEIM'S explanation of the diversion of the upper waters that once belonged to the Landwasser by the headward growth of the Landquart in the Alps of eastern Switzerland has been made familiar in Lubbock's 'Scenery of Switzerland.' A serious difficulty that stands in the way of this explanation is presented by A. V. Jennings (*Geol. Mag.*, London, 1899, 259–270); namely, that the growth of the Landquart before its capture of the upper Landwasser would have had to be through a belt of resistant rocks, which usually rise high in ridges and peaks. If the capture really took place, it seems to have been long ago, for the divide at the head of the Landwasser appears to be formed not of bed rock as Heim implies, but of heavy morainic deposits by which certain streams, once captured by the Landquart, are now returned to the Landwasser.

Certain lines of evidence that might be found in connection with the form and attitude of the valley floors before the time of capture are not mentioned.

RIVER GORGES OPPOSITE LATERAL FANS.

A JOURNEY in Bokhara by Rickmers (*Geogr. Journ.*, xiv, 1899, 596–620) led to the headwaters of the Oxus, where a great body of conglomerates is deeply dissected, producing bad lands on a gigantic scale well illustrated by figures from photographs. The relation of the conglomerates to the lofty snow mountains further east suggests that the former represent an ancient 'wash' from the latter, the whole region now being uplifted and trenched. The local stream in a branch valley of the Yakh river excited the curiosity of the traveller by alternately passing through open basins and narrow rock-walled gorges, and as Rickmers was 'unable to find any mention of a similar phenomenon in the literature on the subject,' especial description of these 'Dandushka barriers' is given. They appear to be examples of gorges produced by a stream that has been displaced from the axis of its valley by the growth of large lateral fans such as may be seen in the upper Engadine of Switzerland. They are, therefore, analogous to gorges due to local displacement and superposition of streams on rocky beds by the irregular distribution of glacial drift, but they are of peculiar interest from their spontaneous production by the interaction of different members of a single drainage system. Although such features of a valley are as well specialized as the thorns and galls of a twig, they are not likely to be given any conveniently designative name by British geographers, inasmuch as one of the honorary secretaries of the Royal Geographical Society recently takes occasion to say that "the invention of a new scientific word is always a positive evil, to be avoided if possible" (*Geogr. Journ.*, 1899, 658). On the supposition that nothing worth naming remains to be discovered in scientific geography, this dictum may have value; but a hundred years hence geographers will probably look on the geographical terminology of to-day as we do on that of our predecessors a hundred years ago, when atoll and caldera, mesa and canyon, moraine, drumlin, esker and kame had no place in the English language.

AN AVALANCHE TRACK ON MT. SHASTA.

AMONG many items of interest in the introductory pages of Merriam's 'Biological Survey of Mount Shasta' (U. S. Dept. Agric., *N. Amer. Fauna*, No. 16, 1899), is the account of the path formed by a recent avalanche that must have been of unusual size, through a forest of large firs. After gaining headway in descending from the upper slopes, the snow cut a broad swath through the huge trees, carrying their trunks forward over a gently sloping tract, and strewing hundreds of great logs 75 to 100 feet long and 3 or 4 feet in diameter, in confusion over the broad area where the

slide finally came to rest. Here a few trees that were left standing are deeply scarred 10 or 15 feet above the ground where they were struck by trunks that were carried forward over deep snow. A number of excellent heliotype views are given of the mountain, the frontispiece being particularly fine.

W. M. DAVIS.

ZOOLOGICAL NOTES.

REGENERATION AND LIABILITY TO INJURY.

IN a recent number of the *Anatomischer Anzeiger*, Professor T. H. Morgan gives an account of his later experiments on the regeneration of the appendages of the hermit-crab. It will be remembered that his first experiments, made at Woods Hole in 1898, showed that certain appendages, because of their protection within the mollusk shell in which the crab lives, regenerate after artificial amputation quite as readily as the more exposed appendages which in nature are constantly liable to injury, and which actually reveal a much higher percentage of injuries. This result was clearly at variance with the opinion of those who believe that there is a definite relation between the regenerative capacity of a part and its liability to injury.

Professor Weismann attempted to explain the phenomenon by attributing to the more or less protected appendages of the hermit-crab the inherited regenerative power of some remote ancestor—an ancestor which was not domiciled in a shell. Moreover, he thought the fact that the power of autotomy was possessed by the three anterior thoracic appendages—parts frequently subject to injury—and not possessed by the two protected posterior pairs, was evidence of the comparatively recent origin of autotomy, and the more remote origin of regeneration, Morgan having shown that the fourth and fifth pairs of legs do regenerate. In stating that "The adaptation for autotomy once gained, the power of regeneration had of necessity to become localized; that is to say, the apparatus necessary for it had to be transferred to those parts at which alone the breaking off of the the limb occurs," Professor Weismann gave, to use his form of expression, a new lead which Morgan has again followed in his series of experiments of the summer of 1899. These experiments show that the power of regeneration has *not* become localized, and that the first three thoracic legs can regenerate both when cut off proximal to, and when cut off distal to the breaking-point of autotomy. Moreover, the experiments of Morgan incidentally give additional reasons for his earlier conclusion that there is no relation between regeneration and liability to injury, for in removing the appendages, at a point proximal to the 'breaking-joint,' he laid bare a regenerative zone, which in a state of nature must almost never be called upon to exercise the function of repair.

Weismann's suggestion that in the last abdominal appendage the regenerated part would be renewed after the pattern of a tail-fin of the Macroura, rather than after the original pattern of a 'holdfast,' is shown not to be supported by the facts.

H. C. B.

COMFORT AND PRODUCTIVITY.

M. MAX GERARD, in the *Bulletin Scientifique*, of the University of Liege, January, 1900, shows the influence of the compensation of the workman upon the productivity of establishments, taking his data from Dechesne, Ansiaux, and Waxweiler. He places the values of services and products, as reported from the several countries, in certain cases, thus:

	Wages per diem.	Value of product: Labor per tonne.
United States	12.20 fr.	17.15 fr.
Great Britain	6.25 "	15.15 "
France	4.15 "	16.90 "
Belgium	3.20 "	10.50 "

It is thus found that the cost of the product is, as a rule, very slightly affected, in these different countries by the wages paid their workmen, and France, paying one third the wage given in the United States, finds the product to cost practically the same amount. Great Britain, paying one-half the wages paid in the United States, produces very little more cheaply. Belgium pays little more than one-fourth the wages ruling in similar establishments in America and the product costs two-thirds as much, and even this difference may be due, in some degree, to other conditions.

The author of the paper accounts for these facts by the interaction of wages and morale,