Without the establishment of some base, any system of numbers is impossible. A binary system is characteristic of Australia, but it occurs elsewhere; instances of quaternary numeration are less rare than are those of ternary, and there is reason to believe that this method of counting has been practised more extensively than any other, except the binary and the three natural methods—the quinary, the decimal, and the vigesimal. There is probably no recorded instance of a number system formed on 6, 7, 8, or 9 as a base.

In its ordinary development the quinary system is almost sure to merge into either the decimal or the vigesimal system, and to form with one or the other, or both of these, a mixed system of counting. Whether or not the principal number base of any tribe is to be 20, seems to depend entirely upon a single consideration—are the fingers alone used as an aid to counting, or are both fingers and toes used? If the former, the resulting scale must become decimal. The quinary is never the principal base in any extended system. The Celtic races showed a preference for counting by twenties, which is almost as decided as that manifested by the Teutonic races for counting by tens.

With such a vast field from which to collect materials for his study, it is inevitable that Prof. Conant should have overlooked some authors who might have furnished him with additional examples, and that he should have made a few slips. Among the omissions may be noted Dr. Von den Steinen's discussion on the numeration of the Bakairi in his "Unter den Naturvölkern Zentral-Brasiliens," Mr. Ray's studies in the languages of New Guinea, Mr. H. Clifford's account of the Negritos of the Malay Peninsula (*J. Roy. As. Soc. Straits Br.*, 1892), Dr. S. Günther's study on numerical systems (*Beitr. Anth. Urgesch. Bayerns*, 1890, ix.). On p. 96 the Torres Islands in the New Hebrides are confused with Torres Straits, and the languages of Darnley Island (p. 24) and Warrior Island (p. 107) are Papuan (Torres Straits), and not Australian dialects. Anthropologists would have been thankful if the ethnological aspect of the question had been dwelt upon a little more fully; for example, the ethnologist is not at a loss to account for the superior development of the number sense in the Nicobarese as compared with that of the neighbouring Andamanese. The book is admirably printed, and is packed with valuable information clearly and logically arranged.

A. C. HADDON.

GEOMORPHOGENY.

Leçons de Géographie physique. Par Albert de Lapparent. Pp. xvi. + 590. Illustrations. (Paris: Masson et Cie., 1896.)

IF Prof. de Lapparent had been writing in America, he would have introduced the word *Geomorphogeny* in the title of his latest book; but in Europe, he observes in the preface, there is some risk of frightening those whom he would wish to instruct if they are confronted by an unfamiliar term at the outset. The title "Lessons in Physical Geography," although quite without terror, is not fairly descriptive, for this fine volume is no ordinary treatise of physical geography in the usual

vague sense. "Lessons on the Genesis of Geographical Forms" would, in the author's view, and in ours, be more descriptive; but the full scope of the work would, perhaps, hardly be suggested even by such a title.

Whatever he may call it, a book by Prof. de Lapparent is sure of a cordial reception by students and men of science in all parts of the world, for he combines the traditional grace and charm of French scientific writers with a temperateness of judgment and width of view which, rightly or wrongly, foreigners do not always associate with the writings of his countrymen. The avowed object of the work is to furnish a body of doctrines, logically linked together, which shall help to place geography on a truly rational basis. This basis is, in Prof. de Lapparent's opinion, a geological one, for he argues that the knowledge of no geographical form can be complete unless its antecedent conditions are known, and in geology alone can the clue to these be found. We might perhaps demand an even deeper foundation than geology, by taking into account the relations of form and position and the means of determining these mathematical conditions by astronomical observations; but geology may be freely accepted as the layer in the pyramid of geographical science which comes immediately below physical geography, and is most indissolubly connected with it.

The volume takes the form of twenty-five "lessons" or chapters; but it may be divided into two parts, approximately equal in bulk—the enunciation of the general principles of geomorphogeny, and the application of these to the configuration and structure of each of the continents. The great lines of terrestrial relief are first outlined, and the conditions of land-modelling are then discussed in fuller detail and with a more comprehensive grasp than in any other book of the kind with which we are acquainted. The various agencies at work on the land-surface are treated in turn, and their action illustrated by a great wealth of instances. The normal course of erosion in a region is first explained, and the various complications introduced by structural conditions, classed as genetic and tectonic, are then introduced. Genetic conditions are those produced by the original formation of the portion of land under consideration, e.g. whether sedimentary, igneous, or glacial; tectonic are those subsequently produced by movements of the crust. Considering the predominant part played in the modelling of the land by running water, it is natural that several lessons should be devoted to this agency, in the discussion of which a prominent place is given to the view of the cycle of erosion so vigorously set forth of recent years by Prof. W. M. Davis, of Harvard. One can hardly say of any part of this theory that it is new. Geologists have worked so long at the phenomena of erosion, that it is now difficult to fit each stage of the process with the name of the first observer or theoriser. But there is no doubt that, however universally the knowledge of the processes of the origin of scenery by denudation were known, the credit for expressing the nett result of them in terse and appropriate language is due to Prof. Davis, and his mode of statement is accepted by Prof. de Lapparent with full acknowledgment. The conception of the origin of surface features through a process of evolution, a continuous succession

of adaptations to environment, is clearly stated; and the view of a land-surface modelled by the action of its rivers, and passing through the consecutive stages of adolescence, maturity, old age, and decrepitude, with a possible rejuvenescence by partial upheaval during the later stages, is set forth in an attractive manner. This is perhaps the nearest approach to a theory of physical geography which has yet been advanced, and the results of applying it serve to invest with fresh interest the monotonous topography of regions which, having run their course of natural life, await in the condition of a "peneplain" the revivifying tectonic power which will start their old sluggish rivers into fresh activity, throwing them out of harmony with their surroundings, and setting them to work to dig, carry, and build until they have created a new land, and, as is the way of the world, again destroyed it.

Looking on a river as an individual, or rather as a living system, any change in one part is shown to affect the whole. For example, the slow cutting down of the outlet of a lake, the surface of which serving as a base-level has dictated the configuration of the country above, lowers the level, accentuates the upper slopes, quickens the tributaries one by one, causing them to erode their valleys more vigorously, and in time perhaps to work back and tap the affluents of some other system, reversing their flow and extending the sphere of the power of the main river. The continual adaptation of river to land may in large measure be taken as the key to the origin of scenery in regions of normal drainage.

Prof. de Lapparent does not view aqueous erosion as all-powerful; he gives great weight to tectonic changes in preparing the way and laying down the lines along which erosion is to act, as, for example, in outlining the depressions of fjord and lake valleys. To glaciers he assigns a comparatively humble place: they cannot dig, but they are excellent polishers, and inexhaustible carriers; while if they cannot make valleys, they may at least preserve them unfilled for future occupation by lakes. The treatment of regions of internal drainage with their arid climates and characteristic æolian land-forms is particularly good.

We cannot, of course, attempt to summarise here a volume of six hundred pages, in which there is a steady unfolding of a definite plan supported by innumerable examples. It is only possible to allude to the chief contents. After the geomorphogenic introduction, two lessons are given to geological principles and their application in palæogeography, or the reconstruction of the map of the world in past ages. This introduces the systematic description of Europe, and of the other continents in less detail, from the point of view of the origin of their land-forms. Although necessarily in general terms, the description is sufficiently full to give a fair idea of the origin of all the more striking features of mountain and plain, and the general hydrographic system. There are points which might be criticised in detail; for example, one of the most important features in the existing geography of Scotland—the 25-foot raised beach which forms the sites of almost all the coast towns, both on the east and west—is not mentioned, but the larger features are very clearly described.

The work of M. de Lapparent builds largely upon the

foundations of Suess, Penck, Richthofen, and numerous British and American geologists whose contributions to knowledge are carefully acknowledged. It is emphatically a book for teachers and for students of geography; a model of strong and clear reasoning in the elaboration of a theory where no theory was generally recognised before, and a rich storehouse of facts and references full of suggestiveness, and affording evidence of the widest reading and the most careful thought.

HUGH ROBERT MILL.

THE RESEARCHES OF NEWELL MARTIN UPON THE HEART AND RESPIRATION.

Physiological Papers. By H. Newell Martin. Reprinted as Memoirs from the Biological Laboratory of the Johns Hopkins University. III. 4to. Pp. 264. (Baltimore: Johns Hopkins Press, 1895.)

THE Johns Hopkins University at Baltimore was founded in the year 1876, and Newell Martin left Cambridge, to the personal regret of all his English friends, to become the first occupant of the chair of Biology. This he held during seventeen years, in the course of which the department over which he presided grew from small beginnings to large and extensive laboratories fully furnished with apparatus, animals and privat-docents in the most up-to-date Teutonic style. In the summer of 1893, Prof. Martin was compelled by ill-health to resign his professorship, and in recognition of the value of his work, and as a token of their affection and esteem for him, his American friends and pupils have republished the scientific papers and some of the public addresses which were written and delivered by him during his tenure of the chair.

Most of the work done by Prof. Martin during this period is upon the action of the mammalian heart, and the papers upon this subject occupy nearly one half of the volume. As all physiologists know, Martin was the first to carry out with success experiments upon the action of the isolated heart of the mammal, most of our knowledge regarding the isolated heart having been derived from experiments upon cold-blooded animals. It was not to be expected that there would be any serious divergences in the mode of action of the heart in the two cases, and in fact the results which Martin and his pupils obtained regarding the effects of pressure of temperature and of drugs were such as might probably have been anticipated. Nevertheless it marked a distinct advance in what the Royal Society officially terms "natural knowledge" to have succeeded in determining these points in the mammal, and that Society set the stamp of its recognition upon the work by selecting one of the most important of these papers as the Croonian lecture for 1883.

The other researches relate exclusively to the mechanism of respiration in the frog and in the mammal. The peculiar character of the respiration in the former animal has always excited the interest of physiologists, and in more recent years it had been studied graphically by Paul Bert and Burdon-Sanderson. Martin subjected the normal respiratory movements in the frog to a careful examination and arrived at con-