SCIENTIFIC LITERATURE.

The Ancient Volcanoes of Great Britain. By Sir Archibald Geikie. London, Macmillan & Co., Limited. New York, The Macmillan Company. 1897. 2 vols., Imperial 8vo, with seven maps and many illustrations.

The title of this work is hardly commensurate with the scope of its subject-matter. Since the author's characteristic modesty has restrained him from giving it a name adequately expressing its magnitude and importance, he may kindly permit his readers to name it for him in full and call it more justly: A treatise on vulcanology exemplified chiefly by the ancient volcanoes of Great Britain. Such a treatise is needed. The time is come when the cumulative gains of our knowledge of volcanoes acquired during the last twenty years should be reckoned up and an account of stock taken, when bad assets should be sponged out and doubtful ones appraised at reasonable estimates. Nearly every branch of science needs a periodic overhauling and a revised statement of its general facts and principles in the light of its most recent advances. It is long since volcanic geology has had a satisfactory one. But it has one now at the hands of a master. The method of treatment, the logical order of the constituent parts, the arrangement of its wealth of material, are such as to enable the reader to see, as clearly as the present state of the science permits, the relations of parts to the whole and of facts to principles. The broader generalizations which have thus far been reached concerning the nature of volcanic action, its products and their modes of occurrence, are first stated. They are put forward briefly and conservatively, and no words are wasted in needless discussion. This presentation of the subject of vulcanism in general is the object of the first seven chapters, or Book I. The remainder of the work is a detailed discussion of the volcanic phenomena of the British Islands. The arrangement or plan of this discussion is doubtless the best one that could be selected. It begins with the most ancient, advances through the succeeding geological ages in their regular order, and ends with the most recent. The broader and more general facts laid down in Book I. are the guiding principles of this discussion, and the vast array of concrete facts becomes the foundation upon which the principles and generalizations repose. It will be interesting to glance, necessarily in the briefest manner, at the special points of interest in this work.

The first chapter is in the nature of a prelude or exordium preparatory for what is to follow. It points out what geologists of other countries might otherwise fail to realize, that the British Islands have peculiar advantages for this study because of the remarkable completeness of the geological record, the exceptionally full development of volcanic activity in nearly all geological ages, and the advantageous manner in which its results are exposed to view by denudation. American geologists may find difficulty at first in realizing this, but the author makes it certain. And so this little island, which would be buried half a mile deep in a fraction of the lava which swamps our northwestern States, proves to be as fruitful in material for the edification of vulcanology as it has been for the advancement of civil liberty and civilization. In the work at large we find such a wide range and variety of volcanic phenomena that the rest of the world is not likely to furnish many that are much more valuable, or that would materially affect the inductions drawn from those of Britain, though other regions may furnish occurrences which seem to be absent there.

The second chapter speaks of the causes of volcanic action. It is, therefore, a very short one, for alas! how little we know of those causes. Just here we are fortunately not concerned with the discussion of them, but merely with the way in which the author treats them. He says just enough to indicate his acquiescence in the contractional hypothesis, of which the extrusion of molten magmas within the earth is regarded as a concomitant. Conjoined with this is the intense elastic or explosive force of the vapors occluded in those magmas and which we see escaping from them during the act of eruption. The causes of volcanic action constitute the darkest and most discouraging problem in physical geology, with the exception of the causes of regional elevations, which may perhaps be only another phase of the same mystery.

To a wise and prudent man no chapter could be more embarrassing and disagreeable to write than this one. In truth, the science has no newly established inductions to record which help to solve this mystery. It is just where it stood twenty years ago.

But if the second chapter is unsatisfactory by reason of the obduracy of the subject and the lack of progress to announce, the third and fourth chapters are the reverse. In these are described the materials brought by eruptions to the surface and their modes of occurrence. Along this line there has been great and rapid progress and our knowledge is fast taking shape. Since the time of Sorby the petrographer's microscope has yielded a world of knowledge of the constitution of rocks and opened the way to the solution of many questions. The field observation of erruptive material has also become more accurate and discriminating. The author's treatment of the whole subject, though brief and much condensed, is admirable. The field geologist of long experience among the volcanics will keenly realize the practical and accurate way in which every important feature is described and its significance interpreted. As we read it, it all seems simple enough. But it is that simplicity which is the result of great knowledge and experience, clarified by many years of laborious thought and frequently revised expression of it in writing. Especially gratifying is the broader or primary basis of his classification of the lavas. It is the strictly chemical one and there should be no other. In fact, most geologists have now adopted it by common consent. The classification by contained minerals and texture can only be secondary and subsidiary. In the earlier stages of microscopic petrography there was an apparent tendency on the part of many able investigators to make everything turn upon mineral contents and it proved to be a serious clog upon the results of their researches. New facts in extraordinary abundance, and many of them of high import, were brought to light, but the methods of grouping them often selected rendered them barren of generalizations. It is a matter of vast importance how we group volcanic rocks, for it profoundly influences the directions and limitations of our speculations concerning their genesis and primitive condition within the earth. The descriptions of the rock textures, their appearance to the naked eye and in the microscope, and the explanations of the terms which are commonly used to designate their many varieties, are all excellent and the examples well chosen. The descriptions of lava sheets follow. The clastic volcanic materials, conglomerates, agglomerates, tuffs and volcanic dust are given careful and accurate attention. The finer material is worthy of especial study in this country, where it has not hitherto been followed up with the diligence it deserves.

The fourth chapter is devoted to the especial consideration of materials errupted at the surface and to the types of volcanic piles, three types being taken, the Vesuvian, the Plateau or fissure and the Puy types.

The fifth chapter deals with the underground phenomena, the vents themselves and the necks or cores left in the passageways of the lavas to the surface being described with great fullness. It is a favorite theme of the author and he invests it with the liveliest interest.

The next, or sixth, chapter treats of dykes and the subterranean intrusive masses in the forms of laccolites and sheets of lava forced in between sedimentary beds. Finally he discusses those remarkable and singularly interesting intrusions named bosses, which are often so puzzling and hard to understand and which look as if a vast mass of relatively soft or plastic material had been trying to punch an immense hole or passageway upwards through hard, rocky strata and at the same time to preserve its identity and general shape with comparatively little deformation. This paradox is often seen in our Western mountains and is the problem of the so-called dome structure and eruptive granite of California and Colorado.

The remainder of the work, and much the greater part of its bulk, is a detailed description of the volcanic relics of the British Islands. It begins with the eruptions of the Archæan and ends with those of the Tertiary. The whole mass of material is arranged so as to constitute a geological history of vulcanism and also so as to show it in its relations to the geological evolution of the land. It is not light reading and is not a study for children. But to the ex-

perienced it is of profound interest from beginning to end. Each geological age is made a chapter, or series of chapters, by itself and is prefaced with a short, clear exposition of the general geology of that age as represented in the British formations, thus preparing the way to the easiest understanding of the relations of the volcanics to the geology at large. The first one will be of deep interest to all geologists, and to many it will be the most fascinating. For it treats of the pre-Cambrian rocks and the mystery of the 'fundamental complex.' In a few paragraphs he sketches in outline the state of knowledge of the rocks which underlie the oldest known sediments of Britain. Here, at the uttermost bounds of geological knowledge and in the dim light of the earliest known order of things, we find remnants of volcanic action. The admirable studies of Teall among the Lewisian or 'fundamental' gneisses of Murchison, exposed in the northwest of Scotland and in the Hebrides, leave little doubt that the great bulk of them are plutonic igneous rocks. They differ in no essential respect from those deeply buried bosses or intrusions of later ages which are known to be connected with surface eruptions and constitute the subterranean portions of the outflowing masses. But beds clearly contemporaneous and erupted at the surface have nowhere been identified, and interbedded clastic volcanic formations are also absent. On the other hand, the Archæan complex is traversed by innumerable dykes, which are certainly older than the oldest rocks which overlie the complex, and their volcanic nature is unmistakable. It is interesting to compare this with the conclusions reached by American geologists in the 'basement complex' of Canada and Lake Superior, where the facts are of the same nature and the conclusions are the same, except that surface eruptions both massive and clastic are recognized in abundance.

Sir Archibald still retains the name 'Lewisian gneiss' as originally given by Murchison. Why have our geologists been so shy of the good old name, Laurentian, given by Logan? Certainly a rose by any other name will smell as sweet, but what is the use of the other name? The extreme caution and candor of Irving (R. S.) were lovable, but they did not call for a new one. The old one would have misled nobody unless the true spirit of geology were not in him. All needful reservations geologists will make for themselves.

In the same chapter the reader is carried up into the vast pre-Cambrian formations which overlie the Lewisian, from which they are divided by the great unconformity, probably the greatest in all geological time, and to the first great series the name of Torridon sandstones is given. They abound in dykes, intrusive sheets (or 'sills') and bosses, but no surface eruptions have been proven. Higher still after another great unconformity is a vast succession of crystalline schists (provisionally named Dalradian) whose age is not yet determined, but which seem in part at least to be pre-Cambrian. They too abound in eruptives and their general character suggests our own Algonkian rocks. It is obviously impossible here to note in detail the substance of the long series of chapters which carry the reader from the Archæan to the close of the Palæozoic. Only the most general summary can be given. And yet to pass thus cursorily over the many chapters relating to the eruptive masses of the Cambrian, the Silurian, the Old Red Sandstone, and, above all, the long series of chapters devoted to the Carboniferous, with all their wealth of material wrought out in such a masterly way, seems unappreciative. We are presented with an immensely long vista of volcanic action, beginning with the earliest epoch of which we have any knowledge and extending down to the close of the Palæozoic, manifesting itself in all that succession of ages. But the more ancient they are the more profoundly have the erupted materials been changed or modified by metamorphic action and disturbed by repeated earth movements with dislocations and distortions of the strata, so that the determination of their true volcanic nature has required many years of labor by hundreds of earnest workers in the field and laboratory and with the microscope. The result of this labor now seems well assured, not only in Britian, but in all other countries where geologic research is diligently prosecuted. One grand result of it is the conclusion that volcanic action has been the same in all ages. And when our thoughts reach

back to the Archæan we find that even then the world was an old world. Nor are there any visible signs that the world was then any nearer the beginning than it is to-day. Geology has thus far found nothing to tell us about the beginning of mundane things, and our notions of a primordial state of the world must come wholly from outside the domain of geology.

With the close of the palæozoic came a long age of quiescence in volcanic action. No traces of it have been discovered in any part of the Mesozoic of Britain, and only trifling ones in the Mesozoic of all Europe. But though the fact is a wide one, it is not world-wide. The eruptive masses of our own Appalachians, New England and Nova Scotia are Jura-Trias, and the vast fields of the Deccan in India are assigned to the Cretaceous. That they should have slumbered so long in Europe is remarkable, but still more so is the fact that their fires should have been awakened again with full energy in the Cenozoic and often in the same old places.

The description of the Tertiary eruptions of Britain is the theme of the greater part of the second volume. It is of especial interest to American geologists whose labors have been most largely in the far West, where the main eruptive masses are distributed all the way from early Eocene down to a time which is surely post-Glacial. The chapters on these rocks are a veritable mine of information. Remarkable indeed are the two chapters on the Tertiary dykes not only on account of the extraordinary development of these features in the island of Great Britain, but equally so on account of the thorough manner in which they have been worked up in the field and in the laboratory. Of course, it represents the labor of many investigators for several generations, but among them we know that our author is preeminent. He draws an interesting inference from them. While accepting the physicist's view of the general solidity of the earth as a whole, he concludes that during the Tertiary volcanic period not less than 40,000 square miles of Britain were underlaid by one or more reservoirs of liquid lava. This state of affairs he puts into relation with a discussion as a pure mechanical problem by Hopkins, in 1835, where just such conditions were assumed. The inferred result was the formation of fissures similar in form and grouping to those which field observation discloses.

The chapters on basaltic plateaus constitute the most conspicuous subject connected with the Tertiary eruptions. Assuredly the grandest results of volcanic action the world over are the plateau eruptions. Great piles like Shasta and Ætna, however imposing, are after all secondary in importance. The plateau eruptions of Great Britain, their extension into the far North to the Faroe Islands, and their possible connection with those of Iceland, are a grand theme and the descriptions of them are worthy of the subject. In the author's mind these plateau eruptions often take the form of the so-called fissure type as distinguished from the centralized vent, and the dykes as described in preceding chapters are regarded as the relics of fissures supplying the lavas of plateaus which have been swept away by secular erosion. In view of the great importance attached to the massive eruptions from fissures he introduces an interesting sketch of the lava fields of Iceland, which are believed to furnish the most impressive examples of recent occurrence.

American geologists will take a lively interest in the chapters which follow, describing the intrusive Tertiary rocks, especially the olivin-gabbros and the eruptive granites. We have them in this country and they have awakened warm discussions as to their real nature. Their true eruptive character is now beyond dispute, and their occurrence in Tertiary time is an important consideration in establishing the practical identity of volcanic action in the most ancient and most recent ages. The British examples are certainly admirable ones and are described with the author's usual precision and clearness.

It seems like trifling with a serious subject to merely notice in this fragmentary way a few points in this great work, which abounds in an unspeakable wealth of instructive and interesting material, all wrought out and delineated with a master hand. The arrangement is admirable. Everything is in logical order, and whatever precedes is a preparation for that which follows. The broad plan of the work is historic progression, and as we complete the

perusal we can look back through 'the corridors of time' and admire the perspective with everything in due proportion.

I regard this monograph as the greatest work on vulcanology ever written. Scrope's work on the volcanoes of central France was indeed a great one—almost an epoch-making one in its day. Nor is its force or usefulness yet spent. For it may be still read with great profit and instruction. But it was much more limited in its categories and discoursed upon the volcanoes of a single period. The work before us deals with vulcanism in all its aspects and with volcanoes of all time, and embraces a vast accumulation of knowledge, of which the world in Scrope's time knew little or nothing.

C. E. Dutton.

Catalogus Mammalium tam viventium quam fossilium. By Dr. E. L. Trouessart. Berlin, R. Friedländer & Sohn. January, 1897. 2d ed., fascic. I., Primates, Prosimiæ, Chiroptera, Insectivora. 8°, pp. 218.

The appearance of the first part of the new edition of Trouessart's 'Catalogue of Mammals, Living and Fossil,' will be welcomed by all students of mammals, for such compilations, in spite of their inherent imperfections, are a great practical convenience.

The present part contains 265 genera and 1,294 species, which numbers, contrasted with those of the first edition (1878–81), show a falling-off of 104 genera and an increase of 200 species. The decrease in genera seems to be due in the main to different limits assigned to the orders, chiefly from the shifting of fossil genera.

The work is apparently brought down to the end of 1896, as it includes *Nesopithecus* Forsyth Major (published in October, 1896) and recent species described by Thomas. For fossil forms Rogers's 'Verzeichniss' and Lydekker's 'Geographical History of Mammals' have been consulted. Five new generic and subgeneric names are proposed, as follows:

p. 17. *Rhinostictus*, based on Sclater's *Cercopitheci rhinosticti* 1893.

p. 19. *Erythrocebus*, based on Sclater's *C. erythronoti.*

p. 22. *Otopithecus*, based on Sclater's *C. auriculati.*

p. 68. *Prosinopa* for *Sinopa eximia.*

p. 204. *Scaptogale* for *Echinogale* Pomel 1848, preoccupied.

The usual sequence of forms is reversed, the Catalogue opening with the genus *Homo*, which, by the way, is given independent ordinal value ('Ordo I. Bimana') in accordance with the antiquated Cuvierian system. *Pithecanthropus* is recognized as a valid genus—the highest anthropoid—and is the first genus given under Primates. The Lemurs are raised to ordinal rank. The classification adopted is in the main that of Flower and Lydekker (except that it begins at the wrong end), but we regret to see that Lydekker's excellent division of the old order Edentata into *Edentata* (Armadillos, Anteaters and Sloths) and *Effodientia* (Pangolins and Aard-varks) is not followed.

The matter is so arranged that the specific names, references and synonymy form a broad column on the left-hand side of the page, while the geographic distribution occupies a narrower column on the right. Unfortunately, the type localities are not given at all. The specific names are numbered consecutively and are printed in black-face type; the subspecific names are not numbered and are in italics. 'Varieties' are preceded by '*Var.*' but the author neglects to state how he imagines a 'variety' to differ from a subspecies. Synonyms are indistinguishable from the recognized subspecies, except that they lack the letter and dash [a.—] which precede the former—a hardly sufficient distinction.

By this method of treatment the distinction between species and subspecies is greatly exaggerated—a common error among authors whose knowledge of the forms treated is derived mainly from books rather than from specimens. Whether the describer of a new form accords it specific or subspecific rank depends, according to present usage, on his belief as to the existence or non-existence of intergrades connecting it with other forms, and his views on this subject are pretty sure to vary with the material at hand and the time spent in its study, and sometimes with his mood and the particular day his manuscript goes to press. Hence it is not surprising that an author often changes his attitude with respect to the status