be handled rather frequently by many of its owners.

Edwin B. Frost.

Yerkes Observatory.

La Montagne Pelée et ses Eruptions. Par A. Lacroix. Ouvrage Publié par l'Académie des Sciences sous les Auspices des Ministères de l'Instruction publique et des Colonies, Paris. 1904. Pp. xxii + 662. 30 plates and numerous text figures.

The most complete report on Martinique yet published is that of Professor Lacroix, which embodies the results of his researches during two extended sojourns in the West Indies. Few geologists were better qualified to undertake the task and unusual facilities were offered him to make as exhaustive an examination as the conditions would permit of the volcano Pelée.

Professor Lacroix was sent, at the suggestion of the Académie des Sciences, by the Minister of the Colonies at the head of a scientific commission to study the effects of the eruption of Pelée and to examine into its causes. The commission consisted, in addition to Professor Lacroix, of M. Rollet de l'Isle and M. Giraud. After a preliminary visit of little more than a month in June and July, 1902, the party returned to France to arrange for a longer visit in the dry season. The eruption of the thirty-first of August hastened Professor Lacroix's departure and he arrived a second time at Fort de France on the first of October alone, the other members of the mission being unable to accompany him. During this second visit, which lasted nearly six months, the greater part of the material was gathered upon which the present report is based.

Two observatories were established from which the volcano could be watched day and night, and at these posts were cameras and various instruments for the purpose of recording with as minute detail as possible all events, or changes in the form of the mountain. The results of these observations were correlated by Professor Lacroix, who devoted a greater part of his own time to an examination of the volcano, the collection of specimens, and to obtaining, if one may judge from the illustrations of the book, a large number of very remarkable photographs.

In presenting his results Lacroix has arranged them under three heads: The first part, which is by far the longest, deals with the geological and physical problems involved in the eruptions, and contains detailed descriptions of the more violent outbreaks. The second part is devoted to a petrographical study of the actual products of the eruption and to a comparison of these with rocks from the other islands of the Lesser Antilles. In the third part, the various products resulting from the conflagration of Saint Pierre are discussed, particular attention being paid to the secondary minerals developed and the effect of intense heat on the old andesite of which most of the houses were built.

Much of the information contained in the first part will be familiar to those who have followed Lacroix's earlier reports and the descriptions of the American observers, but certain chapters are of unusual interest to geologists, especially those which deal with the processes involved in the formation of the famous 'dome' and 'spine,' the theory of the 'burning clouds' (nuées ardentes) of the more violent eruptions, the deposits of fragmental materials, and the various secondary phenomena. After summarizing in chapter I. of the first part the geology of Martinique and the other Antillean islands, and describing earlier eruptions, the author calls attention in chapter II. to the single center of eruption and the absence of secondary vents. A study of the modifications in topography resulting directly from the great eruptions shows them to have been relatively slight, from a geological point of view, when compared with the devastation wrought. Judging from the records of cable repair ships no marked changes in submarine topography occurred and the breaking of the cables is attributed to the shelving of deltas at the mouths of streams descending from the flanks of Pelée.

In chapter III. Lacroix describes the evolution of the 'dome' and offers an explanation of the processes involved in its development. Briefly, the 'dome' is the eminence which has

appeared within the old crater (Etang Sec) since the eruption of May 8, 1902, and which was considered by some of the American observers as merely a secondary cinder cone, or an accumulation of fragmental ejected material about the actual vent. Lacroix denies that it is of fragmental nature and states that it is, in fact, a homogeneous mass of viscous lava surrounded by an envelope of the same substance cooled and consolidated. The explanation of this phenomenon and of the remarkable spine of solid rock which has from time to time risen above the dome itself is essentially as follows:

The viscous magma on reaching the surface through the throat of the volcano and forming a protuberant mass is quickly surrounded by a solid shell or envelope which protects the still pasty interior from a too rapid cooling. This envelope becomes fissured, under the influence of progressive solidification, and the increase in volume of the mass itself, and through the clefts thus formed fresh molten material is exuded. In this way a homogeneous rocky mass increases in height and volume, bristling with jagged points, glowing like a 'charcoal-burner's fire' at night, and bounded by abrupt walls which rise from the debris accumulating at its base from incessant superficial crumbling. Projected materials resulting from violent eruptions play but a small part in the constitution of such a dome. A dome so constructed is not characterized by any permanent vent or crater, but violent eruptions determine such openings, which are of a temporary nature and rapidly closed. When the envelope has become sufficiently resistant to permit no longer a growth in all directions, the action of the pressure is localized at certain points and results in the extrusion of solid rocky masses issuing as from a mold and producing needles or spines which may attain an elevation of several hundred meters. In the course of a single eruption the point at which the pressure concentrates itself may be displaced, and successive spines may result of diverse forms, dimensions and positions, and often of an ephemeral existence, for continual crumbling tends to modify or totally destroy them. This process, which has been unrecognized up to the present, and which Lacroix is the first to describe, explains, in his opinion, the origin of the many peculiarities of structure of 'domes' in volcanic regions where activity no longer is manifest, and which have often been assumed to be the cores of dissected volcanoes.

Four types of rock were recognized as constituting the dome and spine, the specimens being collected from the talus extending down the Rivière Blanche from the base of the dome, and from the edge of the old crater after violent eruptions. The four types are differentiated by the character of their ground-masses, the phenocrysts being the same; they are essentially hypersthene andesites. Rocks of the first two types are glassy, the first being obsidian, the ground-mass of the second containing a few microlites of an acid plagioclase in a glassy base. The third type is a porous or vesicular andesite containing greater or less amounts of plagioclase microlites in the ground-mass; the fourth type differs but little from the third except that the groundmass contains quartz in small crystals frequently abundant enough to make the rock micro-granular. Of these four types I. and II. are believed to have been derived from the shell or envelope of the dome, type I. probably representing the original crust, and type II. the material filling the cracks and fissures in the outer shell. Rocks of these types are abundant in the ejectamenta of violent eruptions. Specimens of types III. and IV. were obtained from the quiet crumbling or breaking down of the spine. The quartz-rich rocks are assumed to have come from the interior of the spine and are the result of a much slower cooling of the magma, while rocks of type III. represent a somewhat more rapid cooling. In commenting upon these quartzose andesites, Lacroix says: "* * * The actual production of quartz-bearing rocks, more or less completely microgranular, which I consider one of the most important observations that I had occasion to make, shows that the conditions necessary for the formation of quartz in a volcanic rock may be realized at slight depth under the solidified outer shell of a dome of acid rock in process of evolution" (page 157).

In part II., on petrography, this matter is taken up in greater detail and the conditions controlling the crystallization of quartz discussed. The microlites of feldspar and the metasilicates like the phenocrysts are essentially the products of igneous fusion, but the quartz is assumed to have crystallized under hydrothermal conditions acting at a lower temperature. These opinions are especially significant, coming as they do from one of the foremost French petrographers.

Chapter IV. deals with the most evident and apparent expressions of vulcanism—the great clouds of vapor ladened with fragmental material, the 'burning clouds' (nuées ardentes) which swept down the flanks of Pelée and annihilated Saint Pierre, mud-flows, etc. Several chapters follow in which the different violent eruptions are described and the theory of the 'burning clouds' is discussed. Chapter IX. is an important one on the character and distribution of the fragmental deposits and their subsequent erosion. The first part closes with an account of the various accessory phenomena, as atmospheric electricity, changes in atmospheric pressure, abnormal optical phenomena, etc.

Part II. consists of a systematic petrographical study of the recently erupted rocks in which, it is interesting to note, the author makes frequent use of the Quantitative System recently proposed by Cross, Iddings, Pirsson and Washington, finding it most convenient for purposes of comparison. The mineral composition and texture of the rocks are described, and the conditions already mentioned, which have influenced the consolidation of the magma, are discussed in detail. The older rocks of Martinique and a number from other islands of the Lesser Antilles are compared, and a consideration of their chemical composition leads to the recognition of a well-marked petrographic province.

In part III. Lacroix presents the results of his observations on the products resulting from the burning of Saint Pierre. The effect of intense heat on metals, glass, structural stone-work, etc., was often sufficient to cause complete fusion, leading to the formation of a considerable variety of secondary minerals.

The book bears evidence in places of hasty preparation and there is considerable needless repetition, but, on the whole, it must be recognized as the most complete and masterly presentation that has yet appeared of the facts and problems related to the West Indian eruptions of 1902–3. The promptness with which the final report was published after the close of the field work deserves praise in itself, and too much can not be said of the excellence of the numerous illustrations which, with very few exceptions, are from untouched photographs and are faithful records of the events from soon after the disaster of May 8, 1902, until the autumn of 1904.

Ernest Howe.

Washington, D. C.,
March 22, 1905.

SCIENTIFIC JOURNALS AND ARTICLES.

The February number (volume 11, number 5) of the *Bulletin of the American Mathematical Society* contains the following articles: Report of the Eleventh Annual Meeting of the American Mathematical Society, by F. N. Cole; 'Mathematical Progress in America' (Presidential Address), by T. S. Fiske; Report of the Sectional Meetings of the Heidelberg Congress (Continuation), by E. B. Wilson; Report of the Breslau Meeting of the Deutsche Mathematiker-Vereinigung, by R. E. Wilson; 'The Construction of Conics under Given Conditions,' by M. W. Haskell; Notes; New Publications.

The March number of the *Bulletin* contains the following articles: 'The Present Problems of Geometry,' by Edward Kasner; Report of the Fifty-fourth Annual Meeting of the American Association for the Advancement of Science, by L. G. Weld; 'A Calculus for Geometers' (Review of Humbert's Cours d'Analyse), by E. R. Hedrick; 'Halsted's Rational Geometry' (Review), by S. C. Davisson; 'Tchebychef's Theory of Congruences,' by André Markoff; Notes; New Publications.

The American Naturalist for February opens with an article by J. S. Kingsley, on 'The Bones of the Reptilian Lower Jaw,' showing the presence of an element, the derm-