eters and thermometers of Richard's construction, and in March, 1893, records were obtained 49,000 feet above the earth. In 1894 the Berlin Aëronautical Society began similar explorations in connection with manned balloons, and in September the exploring balloon *Cirrus* rose 60,000 feet and recorded photographically a temperature 90° Fahrenheit below zero. In December of the same year Berson, of Berlin, ascended alone 30,000 feet, and, at the highest level ever reached by man, observed a temperature 54° Fahrenheit below zero.

Efforts were now made to secure international cooperation, and the International Meteorological Conference which was held at Paris in September, 1896, furnished the opportunity to M. de Fonvielle. As stated in SCIENCE of January 1, 1897, simultaneous flights of manned and exploring balloons were recommended, and in consequence of the successful experiments with kites lifting self-recording instruments at Blue Hill this method of studying the lower air was advised. A commission was appointed to execute these resolutions, consisting of Messrs. Hergesell (President), of Strassburg; de Fonvielle (Secretary) and Hermite, of Paris; Pomortzeff, of St. Petersburg; Erk, of Munich; Assmann, of Berlin, and Rotch, of Boston. In the first international flight of 'ballons-sondes' on November 14, 1896, balloons were despatched from Paris, Strassburg, Berlin and St. Petersburg, but only the *Aërophile* from Paris reached a great altitude. Three simultaneous flights were made the past year, and the results of these and subsequent ones will certainly elucidate the conditions prevailing through a large extent of the upper air at much greater heights than can be reached by human beings. With these balloons only the barometric pressure and the air temperature are recorded, but after several attempts to obtain samples of the air at great heights this was finally accomplished with the apparatus of Cailletet carried by the *Aërophile*.

The chapter on the theory of a ballon-sonde, and the effect of temperature on the height to which one will rise, presents simply and clearly some important facts and formulæ. In closing this review it may be well to point out a few typographical errors. On pages 16 and 17 the words 'en papier' evidently should be omitted from the heading of the table, since balloons of goldbeaters' skin are included; in the same table the date 1862 should be 1892 and 'température maxima' should be 'température minima;' in the heading of the table on pages 88 and 89 the words 'en soie spéciale' should be omitted for the reason stated above.

It is proposed to hold a meeting of the International Aëronautical Commission next February, to consider plans for a more extended exploration of the atmosphere. As yet exploring balloons have not been employed in the United States, but the development of the kite in this country has proved it to be the best agent for studying the meteorological conditions of the lower ten thousand feet of free air at definitely determined heights. In fact, the records of temperature and humidity obtained with kites 11,086 feet above Blue Hill probably exceed in altitude any balloon observations on this side of the Atlantic, while the proposed use of kites by the Weather Bureau to obtain data for daily synoptic charts of the conditions a mile above the earth's surface may result in improving the weather forecasts.

A. LAWRENCE ROTCH.

*Volcanoes of North America:* A Reading Lesson for Students of Geography and Geology. By ISRAEL C. RUSSELL, Professor of Geology, University of Michigan; author of 'Lakes of North America,' 'Glaciers of North America,' etc. New York, The Macmillan Co. 1897. 8vo. Pp. xiv + 346. Price, $4.00.

In giving to the world a companion volume to his Lakes, and Glaciers, of North America, Professor Russell has laid under renewed obligation both the geological student and the general reader. He is eminently fitted for the discussion of his present theme. His own travels and explorations have made him familiar with the eruptive phenomena of North America, through a wide range of latitude and longitude, and in manifold variety of type—from the Mesozoic trap sheets of New Jersey, to the majestic snow-clad cone of Rainier; from the craters of the Mono valley, to the widespread stratum of volcanic dust in the valley of the Yukon. To the knowledge gained by personal

observation he has added an extensive and critical acquaintance with the varied literature of the subject.

The book opens with a general discussion of the characteristics of volcanoes, in which the various types of eruption are illustrated by the classical examples of Stromboli, Vesuvius, Krakatoa, the Hawaiian volcanoes and the colossal lava sheets of the Deccan and the Columbia valley. A description of the gaseous, liquid and solid ejecta of volcanoes is followed by a discussion of the form and structure of volcanic cones and necks. Next are described the characteristic types of subterranean intrusions —dikes, sheets, plugs, laccolites and subtuberant mountains. The opening chapter closes with a brief discussion of the characteristics of igneous rocks. A brief and popular petrological section is by no means an easy thing to write. The requirement of perfect accuracy in brief and non-technical language is somewhat like the pious old woman's order on her bookseller for a very small Bible with very coarse print. The following statements are inaccurate and confusing: "If fused slag is cooled quickly, crystals are not developed, but the mass has a glassy or stony structure" (p. 68); "if solidification takes place at this stage [after formation of minute crystals floating in the still fused material], the ground mass becomes a glass or felsite" (p. 112); "if the cooling is rapid, a crystalline glass is produced" (p. 114). The application of the name basalt to the coarsely crystalline rock of the Palisades involves an extension of the meaning of the word unwarrantable even in a brief and popular discussion. The statement that trachyte is normally dark colored is certainly misleading. With Dana and others, Professor Russell holds that some granites are truly metamorphic rocks. The tendency at the present time is to derive gneisses from granites rather than granites from gneisses; but we believe there is truth in both views.

The main part of the book, as implied in the title, is occupied by the description of the active and recently extinct volcanoes of North America; and the reader cannot fail to be interested in the great variety of volcanic phenomena so clearly described in its attractive pages. The eruption of Coseguina in 1835 almost rivals in tremendous explosiveness that of Krakatoa in 1883. In Mount Taylor and its companions are seen beautiful examples of volcanic necks. The volcanoes of the Mono valley include a remarkable variety of volcanic phenomena; and the pages devoted to their description, bright with the vividness of personal observation, are among the most fascinating in the book. In Crater Lake we have a magnificent example of a caldera formed by the ingulfing of a volcanic cone. The reader will readily sympathize with the author's enthusiasm over the majestic beauty of the snowy cones that dominate the Cascade Range. In the Columbia lava sheet we have the result of colossal fissure eruptions rivaled only by those of the Deccan. The Spanish Peaks are beautiful examples of volcanoes dissected by erosion. In Shishaldin we see a volcanic cone, the symmetry of whose graceful, slightly concave lines rivals the beauty of Fusiyama. In Bogosloff we have apparently a shapeless mass formed by the sudden chilling of highly viscid lava erupted beneath the sea.

From the description of the volcanic phenomena shown in North America the author returns to the discussion of volcanoes in general. The reader who has become familiar with such widely varied details is in position to appreciate the inductions which may be drawn from them in regard to the mechanism of volcanic eruption. Professor Russell adopts the view that the interior of the earth is solid, but potentially liquid at no great depth below the surface—a view which seems to harmonize the teachings of geology with those of physics. In common with Reyer, the author attributes the relief of pressure, which is the condition of local liquefaction, and consequently of eruption, to the formation of fissures. We are inclined to believe that the principal cause of such relief of pressure and consequent liquefaction is found in crustal elevation, as suggested by Archibald Geikie.* Professor Russell rightly connects igneous intrusions with volcanic eruptions, as different phases of the same process. A true and comprehensive theory of vulcanism must include all phases of eruption and intrusion.

* Text-book of Geology, 3d edition, p. 268.

Incidentally, we remark that it may well be questioned whether the theory of protuberant mountains, so beautifully illustrated in the Sundance Hills, is not unduly stretched in attempting to make it cover the Front Range of the Rockies in Colorado and Wyoming. Finding the essential condition of eruption in liquefaction by means of relief of pressure, Professor Russell makes the rôle of steam merely incidental. The action of steam is conspicuous enough in volcanic eruptions of the explosive type, but it cannot account for the phenomena of great fissure eruptions; and the two extreme types of eruption are so connected by fine gradations that the general cause must be identical throughout the whole series. In criticising the special form of the steam theory proposed by Shaler, the author justly protests against the enormous thickness of sediments postulated by that theory. Professor Russell holds the steam contained in lavas to be exclusively of superficial origin. This is undoubtedly true of a part of it, and probably of much the larger part. But the fluid cavities of plutonic rocks are proof of the existence of water vapor in magmas at great depth, and it appears probable that somewhat of this vapor may have been occluded in the originally molten mass of the globe. Professor Russell holds that volcanic activity increased through geologic time until the Tertiary, and that it is now declining. This conclusion seems to us not supported by adequate evidence. According to modern views of the mode of solidification of the globe, the reaction of its heated interior upon its surface could not have been very different in Cambrian time from what it is now. The apparent rarity and insignificance of volcanic phenomena in the earlier geological periods may well be explained as due to the destruction of the evidence by erosion and metamorphism, or its concealment beneath masses of superincumbent strata.

The closing chapter, on the life history of a volcanic mountain, is an exquisite piece of scientific description, in which picturesque imagination gives vividness without detracting from scientific accuracy. One incidental point, however, we should be disposed to criticise. We would not, indeed, contradict the statement that it is *possible* that the aborigines, so artistically introduced to add a human interest to the pictures of natural scenery, were living in Tertiary time; but we do, nevertheless, consider such a supposition extremely improbable.

The book, so delightful and instructive, would have been made still better by more careful proof-reading. Several proper names are misspelled. We read *Atria del Cavallo*, instead of Atrio; *Mazana*, instead of Mazama; *Roichthofer*, instead of Richthofen; *Johnson-Lewis*, instead of Johnston-Lavis. In the note on page 74, in which the last name is thus misspelled, the reference to the *American Journal of Science* should be to Vol. 36. Typographical errors have rendered a few sentences ungrammatical or nearly unintelligible. The printers have also metamorphosed the young insects of Lake Mono into *lavæ*. The book is thoroughly attractive in its mechanical execution. Many of the pictures (mostly reproductions of photographs) are very beautiful.

Wm. North Rice.

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## *SOCIETIES AND ACADEMIES.*

### NEW YORK ACADEMY OF SCIENCES—SECTION OF GEOLOGY, DECEMBER 20, 1897.

The first paper of the evening was by Mr. Arthur Hollick, entitled 'Recent Explorations for Prehistoric Implements in the Trenton Gravels, Trenton, N. J.' Dr. Hollick gave in his paper a summary of the present understanding of the artifacts found in the Trenton gravels, a more complete statement of which has already been published in Science for November 5, 1897. The second paper of the evening was by Professor J. F. Kemp, entitled 'Some Eruptive Rocks from the Black Hills.' Professor Kemp summarized the geological features and history of the Black Hills, and gave a bibliography of the works concerning these deposits. He then mentioned the occurrence of some Leucite-bearing rocks, in the northern part of the hills, similar in character to those which occur in but few other places in this country, as in Wyoming, Montana, Lower California and New Jersey, near the Franklin Furnace.

Richard E. Dodge,
*Secretary.*