

The meeting, which consisted of a morning and afternoon session, offered many points of interest to mathematical teachers. After President Butler of Columbia University had delivered the address of welcome, papers on various phases of mathematical teaching were read by Mr. Harry English, of Washington, D. C., Mr. Isaac N. Faylor, of Richmond Hill, Mr. Arthur Schultze, of New York City, and Mr. J. L. Patterson, of Philadelphia.

A mathematical exhibition of models, calculating machines, teaching devices, rare mathematical books, portraits of famous mathematicians, etc., in the museum of Teachers College, greatly added to the interest of the occasion.

The next meeting of the association will be held at Columbia University, New York City, about Easter time, and applications for membership and other communications may be addressed to Arthur Schultze, secretary, No. 4 West 81st Street, New York City.

In addition to the officers, the following were elected as council of the association: Professor John S. French, Jacob Tome Institute, Port Deposit, Md.; A. M. Curtis, State Normal School, Oneonta, N. Y.; Harry English, Director of Mathematics, Washington high schools, Washington, D. C.; John R. Gardner, Irving School, New York City; W. Z. Morrison, Shadyside Academy, Pittsburgh, Pa.; Mary V. Shea, Commercial High School for Girls, Philadelphia, Pa.

SHORTER ARTICLES.

THE PELÉ OBELISK.

THE most remarkable phase of the still continuing eruption of Monte Pelé is the appearance on the summit of the mountain of a column of solid rock which is a conspicuous feature even when seen from a distance of fifty or more miles. The nature of this 'obelisk,' the changes it has undergone, its rate of ascent, etc., have been faithfully reported by Professor A. Lacroix, Professor Angelo Heilprin, Major W. M. Hodder, Dr. E. O. Hovey and others,* but a more compre-

hensive statement than I believe has yet appeared in print, as to the place to be assigned it in the sequence of events normal to volcanoes, may be of interest to the general reader.

The earlier of the recent eruptions of Monte Pelé and all of those of La Soufrière of St. Vincent since early in May, 1902, as will be remembered, were explosive. Neither volcano has as yet discharged a stream of liquid lava. During the explosive eruptions referred to, vast quantities of angular rock-fragments were blown into the air, and fell on the adjacent land and sea. The material thus showered on Martinique and St. Vincent consists for the most part of fresh lava, but contains also large quantities of fragments of rock of older date, which were torn from the inner walls of the conduits through which the explosive discharges took place, and in addition on the sides of each volcano there are many 'bread-crust bombs' as they are termed, or masses of lava frequently two feet or more in diameter, that were blown out of the craters in a plastic condition and assumed rudely spherical forms during their aerial flights. A large portion of the fragmental material, but more especially that composed of fresh lava, is in the condition of fine dust-like particles.

The nature and explanation of the explosions referred to may be readily appreciated by picturing in fancy, as may be done from the evidence in hand, the sequence of events during the eruptions.

A volcano, it will be remembered, is a tube or *conduit* leading from the earth's surface sufficiently deep into its interior to reach a region of intense heat. In the case of the Antillean volcanoes under consideration, the conduits may be considered as rudely circular in cross section and approximating five or six hundred feet in diameter, and of great but unknown depth. Through the conduits rock material so hot that it was molten or rather as is more probable, because of the great pressure present, in a plastic and viscous condition, or a *magma*, as it is convenient to term it, was forced upward from a depth and reached or made a near approach to the bottoms of the craters from which the products of the explosions were blown out. The magma

* SCIENCE, November 13, 1903, Vol. XVII., pp. 633-634. *American Journal of Science*, October, 1903, Vol. XVI., pp. 269-281.

as it rose lost some of its heat, principally on account of the cooling effect of the water which gained access to it, and as it approached the summit of the mountain, changed to a solid and rigid condition. Steam explosions occurred in the congealed portion, of such intensity that it was shattered, much of it being reduced to dust, and the fragments produced blown heavenward. During the greatest of the explosions the projected fragments were hurled to a height of four or five miles.

In the manner briefly outlined above, the rigid summit portion of the rising columns within the craters of the volcanoes was removed and fresh material was forced upward from a depth to take its place, and the process repeated. There was thus a transfer of material from deep within the earth to its surface just as truly as if an overflow of molten rock had occurred. In fact the material blown out by Pelé or by La Soufrière would in each instance, if melted and run together, form an extensive lava flow, or one, I venture to say, exceeding in volume all of the lava discharged by Vesuvius during the eruptions of 1872.

The eruptions thus far considered may be termed fragmental-solid discharges, except that on both Martinique and St. Vincent a minor portion of the material extruded was in a plastic condition when blown into the air. This still plastic material probably came to the surface during the later stages of several of the eruptions which furnished the solid angular fragments.

La Soufrière has exhibited only the explosive phase of solid eruptions, but Monte Pelé has undergone another and much more novel variation of the same process. Succeeding the earlier and more intense explosions in the summit portion of the conduit of the volcano on Martinique, the solid lava in its throat was forced upward in a massive condition until, in spite of many losses, it stood at one time about 1,600 feet higher than the rim of the crater from within which it was protruded. Its rate of ascent for a period of eighteen days, as observed by Major Hodder, was forty-one feet per day. The massive tapering column, or 'obelisk,' was approximately 600 feet in di-

ameter near its base, and composed of solid or massive rock, and not of angular fragments or adhering cinder-like scoria, as in ordinary cones of eruption. Light was emitted from fissures in its sides, and steam escaping from it showed also that its interior was still hot. The fall of material from the summit and sides of the obelisk and at times its nearly complete destruction, may be accounted for by its structural weakness and by the occurrence of steam explosions owing to rain-water gaining access through fissures to its hot interior. A still more important agency leading to its diminution appears to have been furnished by steam explosions about its base. Then, too, as will be understood, a huge irregular plug of solid rock was being pushed out by pressure applied beneath, through an irregular opening in still more rigid rock, and many jars and tremors must have occurred which would tend to dislodge masses of material from the sides and summit of the ascending plug. Allowing for the losses due to these various causes, the elevation which the obelisk would have attained, had it suffered no loss in height, can reasonably be estimated at not less than three thousand feet.

The obelisk is evidence that the upward movement of the material in the conduit beneath it did not cease when explosions in its rigid summit portion failed to remove material as fast as it rose from a depth, but continued and was the cause of the forcing out of the summit of the plug in the manner described.

As the rock composing the obelisk was still hot even after rising high in the air, the decrease in the energy of the explosions which accompanied its growth can not be ascribed to the lack of the necessary heat to vaporize water. The only other alternative seems to be that the rate at which water gained access to the summit portion of the volcano's conduit diminished, or there was a marked decrease in the vapor content the rising magma brought from a depth.

Thus far, as may reasonably be claimed, the conclusions reached are a direct and legitimate deduction from the facts observed. We

can take still another step, but with less confidence, in the same direction.

In reference to the proximate source of the water which changed to steam, which is a conspicuous accompaniment of all volcanic eruptions, there are two leading hypotheses; one, to the effect that it is derived mainly from a deep source and was present in a state of solid solution in the magmas supplied to volcanoes before their migration outward from the earth's interior, and, also, that the steam thus occluded, or its component gases, is expelled as loss of heat occurs and the magmas change from a liquid or a plastic to a solid condition; and the other, that water descends from the earth's surface and meets the ascending magmas and becomes occluded in them and at the same time decreases their temperature.

To be sure, both of these hypotheses may be true, and both of the processes referred to be in action at the same time; but even if such were the case, it is to be presumed that one source of water supply or the other would be dominant and in control.

One of the most interesting questions in connection with the obelisk of Pelé is in reference to the evidence it furnishes favoring one or the other of the hypotheses referred to.

If the steam given off by the volcano was an original or primary constituent of the magma which rose in its conduit, it is reasonable to suppose that the distribution of vapor or gases in the magma before its upward migration would be essentially uniform in all parts of the 'reservoir' from which it was supplied. This assumption, as must be freely admitted, is not susceptible of direct proof, but the little which is known concerning the diffusion of gases in liquids seems to demand that the tension in all parts of a relatively restricted mass of the magma in the subcrustal portion of the earth shall be the same. It may be argued that such a conclusion is not permissible in view of our almost total ignorance of the condition of matter under the influence of pressures and temperatures such as exist at a depth in the earth, but as the volcanic problem now stands, it certainly does not seem reasonable to suppose that there can

be any conspicuous variations from place to place in the primary vapor content of the magma which supplies a single volcano. That is, we have no reason for concluding that the material which was forced upward in the conduit of Monte Pelé, while yet deep in the earth, was in a pronounced degree vapor-charged in one part more than another, and can not appeal to such a supposed variation to account for the diminution in the energy of the explosions in the summit portion of the conduit, or the accompanying change in the material extruded from a fragmental to a massive-solid condition.

Under the hypothesis that the steam given off by volcanoes has its chief source in the water supplied by downward percolation, or descends from the earth's surface through fissures, etc., and meets an ascending magma, the rate of such supply may reasonably be considered as variable and its depletion possible in case great demands are made upon it.

How surface water is enabled to reach a volcano's conduit, and the methods by which it is absorbed or passes into a state of solid solution, are again obscure, but these questions may well be left in abeyance, during the search for evidence as to the source or sources from which the water is derived.

In the instance before us, the evidence seems to show that the earlier explosions exhausted, or at least greatly depleted, the water within reach of the volcano's conduit, and in consequence the conspicuously violent eruptions ceased and the rigid although still hot plug of lava in its summit portion was forced upward by pressure beneath its base and rose far above the rim of its encircling crater. In this connection also it may be noted that the access of water to the summit portion of the conduit of the volcano seems essential to account for the observed cooling and hardening of the rising magma at that locality; on the other hand, the fact that the rigid lava was not shattered and blown to fragments suggests that water in considerable quantity did not gain access to it. In reference to these and many other questions bearing on the theory of volcanoes, the reports of the detailed observations that are being made on

the behavior of Pelé by the French commission, will be looked for with interest.

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CURRENT NOTES ON METEOROLOGY.

METEOROLOGICAL BIBLIOGRAPHIES.

It is likely that but few persons will be perfectly satisfied with any single volume of the 'International Catalogue of Scientific Literature,' but the help to be gained from the different volumes is so great that it seems rather ungrateful to make adverse comments. Any one who has endeavored to keep a complete card catalogue of the current literature in even one science will necessarily appreciate these volumes much more fully than he who has not spent many weary hours in the monotonous labor of copying titles from scientific journals. The writer has, since 1887, the date with which the 'Signal Service Bibliography of Meteorology' ended, kept for his own use, and that of his students, a fairly complete card catalogue of meteorological literature, not only of original articles, but also of notes, abstracts and reviews. To him, therefore, the publication of the 'International Catalogue,' unsatisfactory as it is in many respects, means the relief from cataloguing to which reference has just been made, and this means the addition of just so many more hours to constructive work.

The chief complaint which is to be made regarding the first volume on meteorology (1901) of the 'International Catalogue' is the entire omission of the *Meteorologische Zeitschrift*. The *Zeitschrift* is by far the most important of all meteorological journals, and no one can pretend to keep up with the progress of the science who does not see this publication regularly. It is evident, moreover, that Austrian publications as a whole were neglected, for we miss also the *Sitzungsberichte* and the *Denkschriften der Wiener Akademie der Wissenschaften*, which have always contained valuable contributions to meteorology. Furthermore, Dr. Hann, whose writings on meteorology are among the most important the world over, and who by common consent stands in the very front rank of

meteorologists and climatologists, appears in this volume only as the author of the 'Lehrbuch der Meteorologie' and of one article, of comparatively little note, published in the *Geographische Zeitschrift*. It is almost inconceivable that this volume should have been allowed to appear without any mention of the *Zeitschrift* and of the Vienna Academy publications. Doubtless the mistake will be rectified in the 1902 issue, and it certainly should be.

There are a number of misprints. Among them we have noted the spelling of Dr. Köppen's name as Koppen; of *Meteorologie* as *Meterologie*, etc. Nevertheless, with all its imperfections—and we do not propose to debate here the question of the classification which has been adopted by the International Council—the 1901 volume on meteorology of the catalogue will be received by many workers in meteorology, as it has been by the writer, with a grateful feeling of relief.

While considering meteorological bibliographies, it is to be hoped that an appropriation from the Carnegie fund may be made with a view to completing and printing the 'Signal Service Bibliography' above alluded to. The few copies of that publication which were sent out, in the very crude form which was alone possible at the time of its issue, but emphasized the importance of the work. It would be a very great help to meteorologists and other persons who have need to refer to meteorological literature, if the 'Signal Service Bibliography' could at last be completed and properly printed.

As regards current meteorological bibliographies, these are now published regularly in three journals, the *Meteorologische Zeitschrift*, the *Monthly Weather Review* and the *Quarterly Journal of the Royal Meteorological Society*. With these lists coming in from month to month, and with the annual list in the 'International Catalogue,' the lot of working meteorologists and climatologists, as well as of teachers and students of these branches of science, is made much easier than it was a year or so ago.

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