

by the writer, recently published by the National Geographic Society.

This series of papers from time to time will embody researches in diverse fields of science resulting from National Geographic Society expeditions. Notices of their appearance will be sent to all who desire such notification. The papers themselves will be distributed only to those who specifically request them.

An abstract of Dr. Fenner's paper follows:

The valley of ten thousand smokes is filled with a thick deposit of fragmental material, which was extruded during the great eruption of 1912. Although similar in composition to the ashfall from Katmai, this material evidently flowed down the valley under gravity like a liquid. At the time of its extrusion it was highly heated, for all vegetable matter which it touched was completely reduced to charcoal.

Several lines of evidence indicate that this tuff could not have come from the crater of Katmai: (1) The slopes down which it would have flowed are covered with a large glacier whose surface bears no indication that an avalanche of hot material passed over it. (2) The topographic relations of the several parts of the deposit make it practically impossible that Katmai crater or any other single source (either outside the valley or within its borders) could have supplied the material to all areas that it covers.

It is concluded, therefore, that the tuff must have come from a number of vents, and further inquiry reveals no other probable source than the fissures that have disrupted the valley floor (and to a less degree, the floor of Katmai Pass and the lower slopes of Trident) and are now marked by lines of fumaroles.

At the time of its extrusion the temperature of the material was sufficiently high not only to carbonize tree trunks but probably to produce secondary explosions where it came into contact with streams of water.

The extrusion of this material preceded the explosion of Katmai, as its surface is, in general, covered by the ashfall.

Most of the material is a highly silicious glass, inflated into pumice or shattered to fine dust, but mingled with this is a considerable amount of basic pumice and scoria, together with fragments of old andesites, sandstone and

shale. The old basic rocks have been much digested by the new magma, producing great quantities of banded pumice in which both old and new components are easily distinguishable. The sediments are attributable to the Jurassic strata that underlie the valley everywhere, but the source of the old volcanics is more of a problem.

Something of the conditions of digestion of the old lavas can be learned from a study of Novarupta volcano, the largest vent in the valley, which is now plugged by a "dome" of highly viscous lava. A large amount of old basic lava evidently became involved in the newly rising silicious magna and was melted down by it. The author believes that the source of this old basic material was derived from the morainal deposits rather than from bed rock below the vent.

It is thought that the best explanation of the practical restriction of fissures to the valley floor is that a sill-like wedge of magma was intruded between the horizontal strata underlying the valley and produced by its upheaving action a block-like fragmentation of the roof where thinnest. The fractures then served as orifices of extrusion for portions of the magma.

The surface outburst seems to have behaved very much like the *nuées ardentes* of Pelée and La Soufrière and to have spread as a hot sandflow through the valley. A surprising feature is the extremely low angle of repose (little more than 1 degree) finally assumed. This and other features seem best explained by supposing that evolution of gas from the magma continued during the movement of the sandflow and was the central feature of it. The characteristics of this form of eruption and the factors to which they are due are discussed in some detail.

SPECIAL ARTICLES

THE PRECIPITATION OF METALS BY HYDROGEN SULFIDE

IN connection with Professor Neuhausen's¹ appreciative discussion of a note of mine² on the precipitation of metals by hydrogen sulfide, I desire at this time to call attention to a newly

¹ SCIENCE, Vol. LVII, No. 1462, p. 26, (1923).

² J. Am. Chemical Soc., 44, 1500 (1922).

discovered instance which appears to have a significant bearing on the subject. This, of course, is merely a preliminary notice; the details of an extensive investigation concerning the interaction of hydrogen sulfide and metallic salt solutions, which is being carried on in collaboration with Mr. Waldo L. Semon, will, it is hoped, be ready for publication within the next year or two.

As a starting point, the reader is requested to call to mind the white precipitate, whose intermediate formation is always observed when hydrogen sulfide is passed into a solution of mercuric chloride strongly acidified with hydrochloric acid; and which may also be prepared by treating freshly precipitated mercuric sulfide with a solution of mercuric chloride. The composition of this white substance is represented by the formula, $\text{HgCl}_2 \cdot 2 \text{HgS}$; and the analogous double nitrate, $\text{Hg}(\text{NO}_3)_2 \cdot 2 \text{HgS}$, is a familiar substance, as well. Formally, at least, these compounds are analogous to the addition products of mercuric chloride with organic sulfides, as $\text{HgCl}_2 \cdot 2 \text{S}(\text{C}_2\text{H}_5)_2$.

In the writer's opinion, all these compounds are complexes, more or less analogous to the well-known platinum complexes, $[\text{Cl}_2\text{Pt}(\text{SR}_2)_2]$, $[\text{Pt}(\text{SR}_2)_4]\text{Cl}_2$, etc.; and it is thought probable that their formation may be a consequence of the previous formation and decomposition of unstable addition products of mercuric salts with hydrogen sulfide itself, or of the intermediate ions of such salts with hydrosulfide-ion, or both. But, unfortunately, the transitional mercuric double salts in question are insoluble, or else very unstable, and therefore they do not readily yield to investigation. For that reason, we have sought in many ways to prepare soluble inorganic compounds of this nature.

Apparently, we have met with some success in working with mercuric perchlorate, $\text{Hg}(\text{ClO}_4)_2 \cdot 4\text{H}_2\text{O}$. This salt was prepared by dissolving mercuric oxide in an appreciable excess of perchloric acid, followed by evaporation to a small volume, and crystallization. It should be noted that mercuric perchlorate in its reactions resembles mercuric nitrate rather than the chloride, and that perchloric acid and hydrogen sulfide do not interact in aqueous solution.

The Interaction of Mercuric Perchlorate and

Hydrogen Sulfide, and of Mercuric Perchlorate and Mercuric Sulfide.—Freshly prepared (approx. 0.08 molal) hydrogen sulfide solution was slowly run from a burette into a solution of 2.0 g. of crystalline mercuric perchlorate in 25 cc. of water. Each drop produced locally a flocculent black precipitate, *which quickly redissolved on shaking*. The reagent was run in with shaking, in 1 cc. portions, as long as the precipitate continued to redissolve. The clear, colorless liquid soon acquired a brownish opalescence, but nevertheless it continued to redissolve the precipitate, more and more slowly, as produced, until in all about 32 cc. of the hydrogen sulfide solution had been added. The further addition of the reagent yielded a permanent precipitate, which however showed no tendency to settle until the further addition amounted to 26 cc.; even then, the clear supernatant liquid gave no test for hydrogen sulfide until the further addition amounted in all to 28 cc. It is seen, therefore, that about 60 cc. of the reagent was required for the complete precipitation, and that of this quantity about one half was consumed in each phase of the reaction. The latter observation was confirmed by the following experiment.

The black precipitate, obtained as above from 2.0 g. of mercuric perchlorate, was freed as far as possible from the supernatant liquid by decantation, after which it was washed twice by decantation with water. It was then treated with a solution of 2.0 g. of mercuric perchlorate in 30 cc. of water, added in small portions, with shaking; the whole quantity was required in order to just redissolve the black precipitate. The resulting solution was transparently clear, with a brownish opalescence, and left only a trace of residue upon filtration. The behavior of the solution thus formed is of considerable interest, especially in connection with the formation of the well-known white precipitate, $\text{HgCl}_2 \cdot 2 \text{HgS}$, which is observed as a transition product in the precipitation of mercury by hydrogen sulfide in the presence of chlorides.

Small portions of the freshly prepared solution were found to give white precipitates with sodium chloride or hydrochloric acid, nitric acid and sulfuric acid—all containing mercury and sulfur, and presumably of the compositions represented by $\text{HgCl}_2 \cdot 2 \text{HgS}$,

$\text{Hg}(\text{NO}_3)_2 \cdot 2 \text{HgS}$, and $\text{HgSO}_4 \cdot 2 \text{HgS}$. The bulk of the solution, upon standing overnight in a small stoppered flask, deposited an almost white precipitate, and the supernatant liquid contained only mercuric perchlorate and perchloric acid. This precipitate, which can readily be obtained pure and white, was found to correspond in composition to the formula, $\text{Hg}(\text{ClO}_4)_2 \cdot 2 \text{HgS}$. It will be more fully described in a future publication.

In conclusion, it is desired to emphasize that the solution obtained by the interaction of 2 mols of mercuric perchlorate and 1 mol of hydrogen sulfide, or of one mol each of mercuric perchloride and sulfide, contains a complex salt which on the one hand reacts with soluble chlorides, nitrates and sulfates to yield more or less insoluble precipitates, and on the other hand spontaneously decomposes in accordance with the equation, $2[\text{Hg}(\text{ClO}_4)_2 \cdot \text{HgS}] = \text{Hg}(\text{ClO}_4)_2 \cdot 2 \text{HgS} + \text{Hg}(\text{ClO}_4)_2$.

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EFFERENT CHARACTERISTICS OF RECEPTION CENTERS

THE peripheral efferent nerves of mammals arise as axones of cells having a definite type of structure, a structure characterized by the arrangement of the Nissl substance within the cell in large sharply defined granules. Other efferent cells closely related to the peripheral efferent neurones have been shown by Jacobsohn to present much the same type of structure, and in a previous article I have described the location of these cells in various regions of the brain; such cells may be termed pre-motor to express their functional and structural relation to the peripheral motor cells.

Further study convinced me that due to the complex relations within the central nervous system a rigid classification of nerve cells into types would offer little hope of elucidating the functional significance of cell structure. We do not know what determines the structure of a nerve cell, but it must be related at least partly to the stimuli which the cell receives. Since the activity of the central nervous system consists essentially of diffusion of impulses through diverse paths and recombination into new paths it is evident that, while in some cases

the total stimulus to two nerve cells may be practically identical or else very different, in many cases two cells may receive stimuli which are similar in some respects but different in others. I consider cell activity (function) and cell structure (together with size and form) as complexes and have attempted partially to analyze each of them, observing under what functional conditions a certain character of cell structure constantly appears in cells otherwise structurally different. Thus the structural characteristic of efferent cells is the presence of relatively large and discrete Nissl granules, while the large size and polygonal form which such cells often exhibit are not directly related to their efferent function but to other aspects of cell activity.

Having isolated from the complex of cell structure the element corresponding to the efferent tendency it was then possible to identify this structural character in cells known to be more remotely related to the musculature than are the peripheral efferent cells or those pre-motor cells closely related to them; and as the relation of the cell to the peripheral efferent neurones became more remote the cell showed a corresponding change in the efferent character of its structure, the Nissl granules becoming smaller and often less sharply defined. In studying the more remote efferent cells I was finally confronted with the fact that many so-called sensory centers contain at least some cells with a structure as characteristically efferent or even more efferent than that of certain undoubted efferent cells. This efferent character of cell structure as revealed in reception centers of the human brain and cord will now be considered.

Our knowledge of reception centers for general proprioceptive sense is limited largely to those related to the spinal nerves. The peripheral efferent column of gray matter is a reception center for general proprioceptive impulses involving the simpler reactions, and the failure formally to include it among the proprioceptive reception centers has tended to obscure the relation between afferent and efferent nerve centers. Another proprioceptive center is Clarke's column, whose cells are structurally related to the efferent type; these cells send their axones to the cerebellum, and the significance of this connection will appear later. The