develops the thesis that this relationship is reciprocal, *i.e.*, environment influences man and man modifies his environment and both are subject to continual change. The following chapter headings give an idea of the contents: Nature and Classification of Geography; Man's Distribution and Activities; Man's Environment; Location; Maps and their Interpretation; Major Climatic Regions of the Earth; The Seasons as Geographical Influences; Weather and Man; Lands and their Utilization; Utilization of Forest, Agricultural, and Urban Land; Minerals and Industries; Water and its Utilization; Biological Environmental Elements; Social Factors; Geography of Civilization.

It is a well presented book, teeming with information, and one that should be in every library.

ALAN BATEMAN.

Petrography of the Pioche District, Lincoln County, Nevada. By JOSEPH L. GILLSON. U. S. Geol. Survey Prof. Paper No. 158D, 1929.

This "contribution to general geology" is one of a series of short papers that the Survey has now been issuing for seventeen years. It describes two phases of a cupola of a batholith in Nevada, intruding some formations from the Cambrian to the Miocene(?) It seems likely that the late residual magma produced considerable changes in the early crystals that grew in the magma. These changes are so striking as to indicate that the residual magma or some other magmatic product of this Pioche intrusive moved farther, or moved in greater volume, or had effects more in contrast with that of the early magma, than is commonly the case. Dr. Gillson credits Dr. Fenner with this idea, and concludes that emanations from the magma not only produced contact metamorphism in the Miocene(?) lavas, but also made a difference in the magma itself and in the igneous rocks formed from it at several stages of its evolution. He calls special attention to the attack of the residual magma on the early solidified border phase of the same magma. If such an attack is to be classed as an igneous rather than a metamorphic process (as the reviewer is willing to agree), it may be included with processes of igneous differentiation, or at least as a feature modifying differentiation. All credit should be given to Dr. Gillson for calling attention to the matter, and it may be worthy of further elaboration than this incidental statement in the summary of a ten-page paper. It seems to be a process that should be distinguished from the gaseous transfer in a liquid magma described by Dr. Fenner.

The comments that follow are, therefore, in no sense to be taken as discounting the merit of the description of an occurrence where such processes seem to furnish a satisfactory explanation. The reviewer is

not sure that Dr. Gillson has proved his case,—what sort of field or laboratory evidences could prove that gas acted on a solid, rather than a liquid acting on a semi-solid mass? Nevertheless, as a presentation of Dr. Gillson's conclusions rather than a statement of fact, the process seems to be a good explanation for the Pioche occurrence.

The changes that occur in the early phases of the intrusive bring up a difficulty in terminology. We are accustomed to speak of the result of reaction between a crystal and a residual magma from which it had not been much separated as a deuteric effect; but in this case a large body of rock is supposed to have become solid—though probably still very hot—and then been attacked by the still fluid parts of the intrusive from some distance away. Possibly the process is comparable with that producing luxullianite or greisen, with which petrographers have long been familiar but about the origin of which there has been some disagreement. Should such rocks be classed as (1) igneous rocks, (2) contact metamorphic rocks, (3) endomorphosed rocks, (4) metamorphic rocks, (5) igneous rocks with deuteric alteration, (6) pneumatolytic rocks, (7) hydrothermal rocks, or (8) autometamorphic rocks? Dr. Gillson uses several of these terms for the Pioche occurrence,—uses them separately and in combinations that leave the reader in some doubt as to whether all refer to one process, or to several distinguishable processes.

A discussion of terminology or criticism of words comes dangerously near to quibbling. The reviewer believes it should be attempted in this case, however, because the ideas presented refer to magmatic differentiation, a process which is of major interest to petrographers, and about which there should be as little ambiguity of statement as possible. In the paper in hand there are passages that required a very careful reading and a study of the context before the outline given above could be formulated. Before criticizing particular features of the paper, the reviewer hastens to plead guilty, himself, of having written carelessly at times. Criticism seems to be needed in this case because loose statements appear to be more numerous than in Dr. Gillson's earlier papers or in other "contributions" of the Survey series.

On page 80 there is a statement that "the only way in which potash could have been introduced into the magma, as it was" also "in the solid rock after consolidation, was by means of volatile emanations." These words are not an exceptional accidental mis-statement but are repeated at several places in the paper. On careful study it appears that when Dr. Gillson says "introduction into the magma" he means moving from one place to another in the magma. It can not be that he has confused the magma and an early phase of rock (as he does elsewhere in the paper, pp. 83, 84 and 86), for he includes both magma and rock in the quotation given. "Introduction into the magma" is clearly an error. Things may

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have been introduced into the stock or into the cupola, or into one part of the magma; but they were no more introduced into the magma than fat is introduced into milk when the cream rises to the top of a milk bottle.

Again, the "volatile emanations" which are credited with doing the work of differentiation probably never left the magma and are not properly called emanations according to any dictionary or geologic usage known to the reviewer. There are several better terms in use for such constituents,—mineralizers, easily volatile constituents, fugitive constituents, or even dissolved(?) gases.

Taken at their face value these statements in the report clearly give the impression that a new explanation is being proposed for differentiation, viz., by introduction; but they sound new only because they are inaccurately stated.

The reviewer would add a plea, not directed at Dr. Gillson more than at others, but none the less apropos, to use the term deuteric within the limits originally given it by Dr. Sederholm. "I think that it would be advisable to discriminate between such metasomatic changes which belong to a later period of metamorphism, *i.e.* are secondary in the strictest sense of the word, and those which have taken place in direct continuation of the consolidation of the magma of the rock itself. I propose to call the latter deuteric, as distinct from secondary changes." Effects of gases or residual magmas outside the intrusive are clearly secondary in the rocks affected, and not covered by his term deuteric. For reaction effects inside the igneous rock before it cooled, "deuteric" serves well when there is no sign that the reacting materials have moved far into any solid rock. For the effects of a late residue on an early solidified border phase such as here noted by Dr. Gillson, perhaps a new term is needed.

Dr. Gillson furthermore makes a number of assumptions that certain controversial matters are settled. The most striking of these is the assumption of gas emanations in and around an intrusive. The work of Dr. Morey of the Geophysical Laboratory, and of Dr. Niggli of Zurich, who formerly worked with Dr. Morey, has been very enlightening as to the relations of gases to magmas. Yet these two experts who apply their physical chemistry to geologic problems, *disagree* as to whether a residual pegmatitic emanation is above or below its critical temperature. Like Dr. Fenner, they are very cautious in their references to gas. They speak of the "streaming" of dissolved gases, and of gas bubbles rising and escaping from a magma. Most petrographers with less knowledge of physical chemistry are also cautious. Dr. Gillson writes as if the gaseous state of magmatic emanations were all settled. For example, he says (p. 83), "the gases passing upward from below . . . were rich in potash." If this was dissolved gas it would be better to describe it as a potash-bearing rest-magma rich in dissolved gases.

Again, there is the statement that "the potash feldspar . . . continued to grow after consolidation" (p. 80), which sounds as if a considerable mass of the rock was solid, whereas the evidence cited shows only that certain mineral grains were solid.

Several such assumptions need a more detailed statement of evidence before they are acceptable: "the magma stoped its way upward" (p. 83); "the replacement of quartz by orthoclase" (pp. 81 and 82); "the wide distribution of minute euhedral grains of augite . . . so nearly unique that it would probably not be found in different rock types" (p. 80); "this replacement was not a magmatic corrosion" (p. 82); and even the age of the "Miocene(?) lavas" (p. 77).

FRANK F. GROUT.

Geochemie in ausgewählten Kapiteln. By W. J. VERNADSKY. Authorized translation from the Russian by E. KORDES. Pp. xii + 370. Akademische Verlagsgesellschaft M.B.H. Leipzig, 1930. Price, $6.25.

The first edition of Vernadsky's work was printed in French in 1924. A revised edition was published in Russian. This German edition is translated from the Russian edition, but contains many additional items, not contained in the original.

The book differs from most of those dealing with geochemistry in that it discusses the effect of chemical changes in the Earth's crust brought about by organic as well as by inorganic substances. The first chapter gives a brief history of geochemical thought. The second treats of the chemical substances in the crust; the third of the geochemistry of manganese; the fourth of silica and the silicates; the fifth of carbon and organic substances, and the sixth of radioactive elements and their compounds. The literature is combed for information on all these phases of the subject and the conclusions reached by the various authors are abstracted and generalizations are built upon their conclusions. An annotated bibliography of 834 articles concludes the volume. The work appears to be very thorough. It contains many tables, and emphasizes the fact that the development of the earth is the result of processes due to the activities of organic as well as of inorganic bodies.

W. S. BAYLEY.

The Earth for Sam. The Story of Mountains, Rivers, Dinosaurs and Men. By W. MAXWELL REED. Illustrated. Harcourt, Brace & Co., New York. Pp. 390.

This is a readable account of the history of the Earth and of its life, written for a boy of grammar school age. The story of the development of animals and plants is told in a way that should interest any normal boy

of 14 or 15 years of age. It is i
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