American Scientific Congress at Santiago, Chile, in January, 1909, with official delegates from twenty American governments present, not only took such action, but, in addition, adopted on January 4 the following resolution:

Considering, that a neutral auxiliary international language is necessary, and observing that the idiom Esperanto fulfils the requirements, that it is already sufficiently widespread throughout the world, and that official propaganda alone is lacking:

1. That the First Pan-American Scientific Congress decide to express to the American governments the pleasure with which it would view the call for a congress to which would come official representatives of all civilized countries, with the purpose of solving the problem of the adoption of a neutral international auxiliary idiom; and

2. It agrees to urge upon the government of the United States of North America that, under its grand auspices this desire of the Scientific Congress may be effected.

The next Congress of Applied Chemistry meets in America in 1912, the same year in which the next Pan-American Scientific Congress will gather in the same country. May we not hope that before that time the expressed desire of the latter will be realized, and that, led by the United States, as suggested, the governments of the nations will place in the possession of every man the instrument by which he can make himself understood by every other man?

At Washington, in the summer of 1910, will meet still another international body, the Sixth Annual Esperanto Congress, and if the experience of recent preceding years is duplicated, there will gather in attendance delegates from thirty or more nations, speaking as many languages; but, in great contrast to the congress, the report of which inspired these remarks, the proceedings will be in only one language—Esperanto. No time will be wasted in translation or repetition and *all* the members will understand *everything* that is done, *at the time,* and will be able to discuss freely all the matters presented. Every international gathering and association can do the same, if it will, instead of continuing to struggle with the archaic system now in vogue.

Surely all our scientific brethren will soon recognize this fact and a new step upward in human progress will have been achieved.

J. D. HAILMAN

PITTSBURGH,
September 22, 1909

THEORY AND HYPOTHESIS IN GEOLOGY

THE importance of hypothesis and of theory in geological research, as indeed in every other branch of learning, can not be over-estimated. Concrete facts are valuable, and their observation and accumulation are indispensable, but, in pure science, they are of worth chiefly in so far as they are available in explaining the cause of the phenomena for which they stand. The purpose of such science is to ascertain why and under what circumstances present effects were produced. Every hypothesis and every theory is therefore an attempt to expound the relations between cause, condition and effect.

Granting that observation, as far as pursued, has been correct, there are still many reasons for disagreement in theories. Scantiness and multiplicity of data may lead, respectively, to error of interpretation and to variety of inference. In both events, the personal equation is at a maximum. Again, lack of experience—that is, want of a thorough acquaintance with all the facts, not only in the specific case which serves as a foundation for the theory, but also in all similar occurrences—may result in diversity of opinion. Very common, too, has been the tendency to exaggerate the importance of some one particular factor or cause. Consider, for example, the numerous efforts to account for a glacial epoch. This fallacy is due partly to the personal equation, partly to a failure to discern all the premises, and partly to an innate desire for simplicity, a craving which induces the theorist to assign but one cause to a given phenomenon.

The misconception of the need for unity of cause may be an outgrowth from the doctrine of uniformity. But uniformity is not synonymous with simplicity, any more than complexity is synonymous with chaos. Nature is orderly; its realms are everywhere subject to

unchanging law; yet nature is intricate, profoundly intricate, and its processes interact beyond man's faculty of perception.

How the idea of complexity in nature is important may best be seen in its application to cause, condition and effect, the three essential topics of every theory. According to this conception, one effect may be the result of several causes. For instance, as Professor Crosby pointed out some years ago,[1] eskers may be partly of subglacial and partly of superglacial origin, and a single esker may be both in different portions of its course. The hydrocarbons, in their various occurrences, do not always satisfy the view entertained by some geologists, that they have had an organic source. Hence it is probable that they (the hydrocarbons) are like effects to be ascribed to different causes. Moreover, to say that, inasmuch as we observe a certain deposit to be forming to-day by a certain process, "it is therefore a legitimate theory that all similar deposits have the same origin,"[2] is unsafe reasoning. Because limestone is now in the making as an organic deposit, *all* limestone has not necessarily been so derived. Multiplicity of causes, then, must be taken into consideration by the theorist.

On the other hand, while the cause may be single, the conditions under which it acts may be so various that the effects are manifold. If the circumstances of origin are widely different, interpretation of the results is not so difficult as it is when these conditions are hard to discriminate. Thus, a theory of wind-worn sand should have regard for the composition of the sand; the size, weight, specific gravity, hardness and cleavage of the grains; and the prevailing wind velocity. So, too, any exposition of the origin of phenocrysts in igneous rocks should be developed with due heed for variations in the acidity and basicity of magma and of country rock. Consequently, multiplicity of conditions is also to be allowed for in elaborating a theory.

Thus, in the intricate system of nature, *similar* products may be the outcome of *different* causes, and *unlike* products may result from *one* cause, in each case the causes working under varied conditions. Although there are many other relations between cause, condition and effect, these two are especially emphasized here because they are most easily overlooked.

Summarizing—theory and hypothesis too often suffer from the mistake, first, of overrating the importance of some one particular cause or condition, and, second, of extending, more broadly than is legitimate, the application of this factor. These fallacies are in large part due to a failure to realize the extreme complexity of the relations between cause, condition and effect.

To avoid misunderstanding and to give a theory real value, we must assign to it definite limits, beyond which criticism should not reach. Be discreet in generalization, is good counsel.

Fred. H. Lahee
Harvard University,
January 4, 1909

[1] W. O. Crosby, "Origin of Eskers," *Am. Geol.*, XXX., p. 2.

[2] H. L. Fairchild, "Geology under the New Hypothesis of Earth-origin," *Am. Geol.*, XXXIII., p. 107.

THE BEHAVIOR OF A SNAKE

Several years ago, while Mr. Lester and I were sauntering along a country road near Newnan, Ga., a commotion was heard in the dry leaves along the side of the road. On quietly entering the underbush, it was noticed that the noise was caused by a struggle between a coach-whip snake (*Zamiens flagellum flagellum* Shaw) and a lizard that was unknown to me. The snake was about four feet long; the lizard less than a foot. They were not fighting; the snake was trying to make a meal of the unmanageable lizard. Frequently the lizard escaped from the snake. Then would follow a chase resulting in the recapture of the lizard. The snake invariably caught the lizard by the body. I knew that, if the snake were to capture the lizard by the tail, the lizard would break off the tail and escape. The snake, behaving as though aware of this, attracted my attention and caused me to remain and study its movements.