Editor's Page

The problems of terminology are all too familiar to us in the struggles of classification. The desire for precision *or* alternatively for increased latitude of definition may be the concern of a single individual at different times. Within this context there are at least two conflicting ideals. First, the goal of conveying an unequivocable multiword description (definition) utilizing the economy of fewer specialized words (jargon), and second, the goal of limiting specialized words particular to any one discipline. The existence of a specialized vocabulary diminishes the sphere of communication and unity within science, but should increase the precision of communication.

Practitioners of *the scientific method*[1] use terms such as law, theory, hypothesis and model as if these terms can have identical meanings throughout the domain of science. We believe they can not. Geology is an historical science which differs basically from the fundamental or theoretical sciences such as physics and chemistry. Geology is concerned with the documentation of earth-bound events – the theoretical sciences with the establishment of universal laws[2]. Perhaps the distinctiveness of geology can most readily be appreciated through a brief examination of its methodology[3].

Geological methodology is a complex interplay of description and interpretation – the latter implicitly or explicitly utilizing the laws of the fundamental sciences[4,5]. The causes of an earth-bound event, which produced a documentable and describable effect, can only be interpreted by reference to some assumption of the applicability of present day causes and processes into the distant past. Geologists *must assume* that the fundamental laws and presently documentable processes were applicable in some way in ancient times, and only then proceed to utilize this knowledge in their interpretation of ancient causes[6]. No such concept is a requisite in the theoretical sciences because the validity of their laws can be reaffirmed at any time. All geological explanations contain two elements– a) those which involve historical data, and b) those which involve data, generalizations, and laws derived from the systematic knowledge of present processes. The theoretical sciences, in contrast, are wholly systematic and non-historical. Further, ancient events in earth-bound systems can never be completely defined, whereas the methodology of theoretical sciences necessitates the definition of the boundary conditions of a system. No amount of *experimental or theoretical studies* carried out under geological auspices will change the relationship between geology and the theoretical sciences, for *these studies* are intrinsically extensions of the methodology of the theoretical sciences.

Can we then expect to establish "geological laws" that involve those exact elements of laws and law-making that exist in the theoretical sciences? The answer is no! Generalizations, however, can be derived from geological knowledge through the recognition, for example, of repeated and repeatable events[7]. These geological generalizations[8] occupy the same rank of generalized conclusions as do laws in the theoretical sciences, but this comparison of rank is not meant to imply that they are *formulated or expressed in the same way*. This distinction has been recognized by the contributors and editors of The Glossary of Geology (Bates and Jackson, 1980) wherein those entries pertaining to the laws of the fundamental sciences begin with "The statement ...", whereas many of those pertinent to geology begin with "A general law of geology...". Since in the fundamental sciences, the degree of increasing universal certainty of generalizations is expressed in the order: hypothesis (hypothetical model) → theory (theoretical model) → law, we note a genetic relationship between these terms. A parallel sequence in geological terminology could be geological hypothesis (model) → geological theory (model) → geological law, *or* geological inference → geological generalization[9,10].

We propose that a specialized terminology with respect to geological generalizations is necessary to convey that its aim and methodology is basically different to that of the theoretical sciences. We recognize that this proposal adds to the expansion of jargon, but we believe that the explicit recognition of the distinctive character of geological methodology and knowledge *must be understood by all* so that mere semantic arguments do not arise to cloud the practice of geology[11].

NOTES

[1] — "Scientific method, once considered to be a rigourous procedure that included the study of scientific hypotheses induction, theories, laws, and methods of explanation; now regarded as a family of methods each of which differs according to the subject matter involved. The core of scientific method, however it is defined, is related to measurement of phenomena and experimentation or repeated observations." [Encyclopaedia Britannica, 15th edition]
— A definition which would likely include all readers of this editorial.

[2] — "Law ... a correct statement of invariable sequence between specified conditions and specified phenomenon". [The Concise Oxford Dictionary, 6th edition]

[3] — In the distinction between historical and theoretical sciences, we are following detailed arguments presented by Simpson (1970) and Kitt (1977), and others referenced by them.

[4] – A more forceful statement on this relationship was made by Kitt (1977, p. 112; *cf.* p. 110):

> "It is clear then that the theories of physics and chemistry are explicitly, obviously, and directly applied to problems in geology."

[5] – From the text sentence it follows that the body of geological practitioners needs to possess a knowledge of the fundamental sciences, the competency to identify and describe earth-systems, as well as the ability to meld these attributes. Now, if we had a few quantities to throw into this statement, it would represent a quantitative formulation of the "theory" of geological education, or of the efficiency of geologic practice or, ... Perhaps we will take up the subject another time!

[6] – The assumptions comprise a number of possible postulates. A common one is that of uniformitarianism as stated by Hooykaas (1970, p. 274):

> "The geological forces of the past *differ neither in kind, nor in energy* from those now in operation."

A lesser assumption is contained in the specific "actualistic" postulate (Hooykaas, 1970, p. 273):

> "The causes of geological changes in the past *differ not in kind,* though they may sometimes *differ in energy,* from those now in operation."

[7] – This example is that of strict "uniformitarianism (see note 6). Geologic generalizations may also be stated within the postulate of "evolutionism" for example (see Hooykaas, 1970, pp. 307-308).

[8] – See Kitt (1977) for a more complete discussion of geologic generalizations, especially pp. 49-68.

[9] – The first of these sequences uses terminology consistent with the Glossary of Geology (Bates and Jackson, 1980) usage of "general law of geology". The second abbreviated sequence utilizes terms used by Kitt (1977).

[10] – To further illustrate the distinction between geology and the fundamental sciences, try stating the "theory" of plate tectonics in the same form as the theories of the fundamental sciences. Note that other sciences have similar problems – for example that of astronomy with the big-bang "theory".

[11] – We have presented an argument using the theoretical or fundamental sciences as a foil. Equilvalent arguments have been presented in paleontology (*cf.* Simpson, 1970). Therefore this argument is of first order with respect to geology irrespective of its choice of foils. Any discussion of components of the argument are but of secondary or lower order.

BATES, R.L., and JACKSON, J.A., *Editors*. 1980. Glossary of Geology. American Geological Institute, Falls Church, Virginia, 2nd Edition, 749p.

*HOOYKAAS, R. 1970. Catastrophism in geology, its scientific character in relation to actualism and uniformitarianism. Koninklijke (Nederlandse Akademie van Wetenschappen, afd. Letterkunde, Med. (n.r.), 33(7), pp. 271-361.

KITT, D.B. 1977. The structure of geology. Southern Methodist University Press, Dallas, Texas, 180p.

*SIMPSON, G.G. 1970. Uniformitarianism. An inquiry into principle, theory and method in geohistory and biohistory. *In* Essays in evolution and genetics in honour of Theodosius Dobzhansky. *Edited by* M.K. Hecht and W.C. Steele. Appleton-Century-Crofts, New York, pp. 43-96.

* These papers have been reprinted in:
ALBRITTON, C.C., Jr. *Editor*. 1975. Philosophy of geohistory. Benchmark Papers in Geology. Dawden, Hutchinson & Ross, Stroudsburg, PN, 386p.

— *The Editors*

ERRATUM

On page (iv) of the editorial in the April 1981 issue (Vol. 17, No. 1), the first sentence of the second paragraph should read:

The second major and immediately noticeable change is that the journal has now become refereed, the adopted system being akin to that employed by 'Geology'.