Second Bibliography and Index for the Philosophy of Geology

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INTRODUCTION AND ACKNOWLEDGMENTS

The body of writings on the philosophy and history of geology has grown in a remarkable way since the end of the Second World War. There is no obvious explanation for this quickening of interest in what are surely the most academic aspects of a science best known for its practical applications. Influences arising both from within and from outside the geological profession have probably been responsible.

It is a matter of record that many departments of geology, upon resuming full-time operations after the war, decided not to go on moving in the old curricular ruts. The new courses, even those in the classical geological disciplines, became more analytical, relying less and less upon the memorization of factual material. This trend has called for a rethinking of the basic principles of geology. There has even been some pecking and scraping around that mossy Victorian cornerstone of historical geology, the principle of the uniformity of nature—and some of us have been astonished to find that the shape of the moss is not the shape of the stone.

Meanwhile philosophers and historians of science have discovered geology. C. C. Gillispie’s *Genesis and Geology* and W. F. Cannon’s articles on uniformitarianism and catastrophism are examples of historical writings that have disclosed something of the interplay between the geological thought and the social opinion of the last century. The volumes of writings on evolutionary thought attending the centennial celebration of Darwin’s *Origin of Species* likewise have focused attention upon geology, not only because of Darwin’s own substantial contributions to geologic thought, but also because of the bearing of fossils and geologic time upon evolutionary theory. One of the most glowing appreciations of James Hutton’s work, for example, is found in Loren Eisley’s popular *Darwin’s Century*.

Most philosophers of our century have taken little notice of geology, preferring to draw their illustrations from mathematics and

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physics. Hugh Miller was one of the earlier exceptions; his *History and Science*, published in 1939, made a strong case for the synthesis of historical and theoretical principles through historical sciences such as geology and paleontology. More recent support for this view is given in T. A. Goudge’s writings on causal and genetic explanations. In one of his two works cited in this bibliography, S. E. Toulmin actually argues that geology was the first of the natural sciences to demonstrate how its subject matter has evolved down through the ages, and hence was the first science to “grow up.”

There is little evidence, however, that the geologists, philosophers, historians and others who are writing about the philosophy of geology are in close communication with one another. In any case the literature on the subject is widely scattered through books and professional journals addressed to very different audiences. One purpose of my first bibliography for the philosophy of geology was to bring many different scholarly and scientific viewpoints to bear upon the subject. The inevitable misunderstandings and disagreements that appear in such a collection point the way to an array of problems, some of which have philosophic substance.

This supplementary bibliography cites 125 works, most of which were published after 1959 by British or American authors. Mrs. Robert R. Wheeler graciously assisted with the searching for titles. Through the Reference Department of The Science Information Center in Dallas, Mrs. Nadine George was able to obtain microfilm and photocopy of writings that are not in our collections. Mrs. Jacquelyn Newbury typed the manuscript and assisted with the proofreading.

**CONTENT OF THE BIBLIOGRAPHY**

The writings cited in the bibliography fall into one or more of the categories listed in the following table.

**A. STUDIES OF GEOLOGY AND CLOSELY RELATED DISCIPLINES, WITH REGARD TO:**

1. *Principles, laws, and maxims.*—Includes: (1) Studies of the content, logical status and application of the principles of uniformity, indeterminacy, association, etc.; (2) considera-

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3 Published in *The Fabric of Geology* (C. C. Albritton, Jr., ed.), Addison-Wesley Publishing Co., 1963; Reissued in 1964 by Freeman, Cooper & Company of Stanford, California.
tions of the validity and usefulness of propositions that have been called geological laws or historical laws; and (3) analyses of the meanings of maxims such as, "The present is the key to the past."

2. **Methodology.**—Includes: (1) evaluations of the use and misuse of natural, theoretical and mathematical models in attacking geological problems; (2) analyses or examples of the use of multiple working hypotheses; and (3) comparisons of the rational and empirical methods of investigation.

3. **Theory.**—Includes: (1) analyses of the formal characteristics of theoretical propositions; (2) comparisons of strengths and weaknesses of rival theories offered as explanations of geologic phenomena whose origin remains uncertain, and (3) investigations of the role played by theory in the development of certain geological sciences.

4. **Systems of classification.**—Includes: (1) discussions of various procedures for ordering and classifying strata, faults, fossils and other geologic phenomena, and (2) comparisons of relative merits of descriptive and genetic schemes of classification.

5. **Explications of terms and concepts.**—Includes analyses of the meanings of geologic and paleontologic terms such as "unconformity" and "species."

6. **Symbols and the communication of information.**—Includes analyses of the tools of geologic communication, and of the geologic map as a vehicle for conveying geologic fact and interpretation.

7. **Psychological impediments to development.**—Includes discussions of the difficulties in forming concepts of the length of geological time; and of the tendency to find in nature whatever one is looking for.

8. **Scientific philosophies of individual geologists or schools of geologists.**—Includes analyses of the scientific methods and habits of thought of James Hutton, Charles Lyell, Charles Darwin and G. K. Gilbert.

9. **Evolution of ideas.**—Includes discourses on the sequence of events leading to the formulation of the hypothesis of continental glaciation, the Huttonian theory of the Earth, and the theory of organic evolution.
10. Current trends in development.—Includes discussions of trends toward quantification, empiricism, authoritarianism, vitalism, determinism, indeterminism, etc.

11. Major intellectual contributions.—Includes appraisals of geologic contributions to general thought—as, for example, the idea of the antiquity of the Earth, the idea of incessant change in the configurational aspects of nature through time, and the idea that the courses of physical and organic evolution may be deciphered from the spatial relationships of rocks and fossils.

12. Scope, interrelations and distinguishing characteristics.—Includes: (1) identifications of the various geological specialties (physical, historical and applied), and their relationships to each other and to non-geological sciences; (2) analyses of the scope, method, and contributions of special fields, such as forensic mineralogy; and (3) identifications of the distinguishing features of geology as an historical science.

B. Studies of natural science that have a particular bearing upon geology.—Includes selected writings on general principles, methods, and problems of science—e.g., discussions of the principles of simplicity, microreduction, connectivity and verification; studies of the structure of scientific theories and of the nature of scientific explanation; and analyses of the problems of induction, prediction and retrodiction.

BIBLIOGRAPHY

Ager, Derek Victor, 1963, Principles of paleoecology; an introduction to the study of how and where animals and plants lived in the past: New York, McGraw-Hill, ix and 371 pp. "... uniformitarianism has its limitations when applied to the fossil record."


PHILOSOPHY OF GEOLOGY

tains references, with brief annotations, to some four hundred writings which reflect upon the scope, methods, and contributions of the geological sciences.

Allison, A. C., 1962, Natural selection in human populations: Univ. Kansas Sci. B., Supp., vol. 42, pp. 5-32. "... natural selection has in fact continued in human populations with only slightly reduced intensity to the present day, when its effects can still very easily be demonstrated."

Alonso del Real, Carlos, 1962, Comments on "Epistemology and archaeological theory," by Gordon R. Lowther: Current Anthropology, vol. 3, no. 5, p. 502. "... an understanding of the past as a function of the present and the problem of going from the better known to the lesser does not seem to me only important in a didactic sense but moreover ... in an epistemological or gnoseological sense . . . ."


Ardley, Gavin, 1950, Aquinas and Kant, the foundations of the modern sciences: London, New York, Toronto; Longmans, Green and Co., vii and 256 pp. "The exact science of physics belongs to the 'stern judge' class. A descriptive science like geology or botany . . . belongs predominantly to the 'receptive pupil' class. To find a common method in these two is a hopeless task."

Bailey, Sir Edward, 1962, Charles Lyell: London, Thomas Nelson and Sons, x and 214 pp. Lyell "consistently taught that all geological events, but not the origin of species, have been governed by laws of nature which are open to investigation at the present day."

Barth, Paul, ed., 1907, Raum und Zeit in Geographie und Geologie; naturphilosophische Betrachtungen von Dr. Friedrich Ratzel: Leipzig, Johann Ambrosius Barth, Natur- und kulturphilosoph-

Bernal, J. D., 1961, Origin of life on the shores of the ocean; physical and chemical conditions determining first appearance of biological processes, pp. 95-118 in Sears, Mary, ed., Oceanography: Am. Assoc. Adv. Sci., Pub. 67, xi and 654 pp. "The general principles I have tried to use in working out the origin of life are those which have been used with success in all the previous attempts at establishing origins at different levels of organization from galaxies to human societies. The first of these is essentially the same as the uniformitarian principle used . . . by Lyell . . ."

Betz, Frederick, Jr., 1963, Geologic communication, pp. 193-217 in Albritton, Claude C. Jr., ed., The fabric of geology: Reading, Mass., Addison-Wesley, x and 372 pp. "Perhaps the best way for scientists to attack the 'information problem' is to become more expert with the tools of communication, which we often use indiscriminately and badly."

Bradley, Wilmot Hyde, 1963, Geologic laws, pp. 12-23 in Albritton, Claude C., Jr., ed., The fabric of geology: Reading, Mass., Addison-Wesley, x and 372 pp. "Some day we may grow old and have more laws; right now we are busy exploring, experimenting, and trying to understand more of the 'how' of those processes that have produced the features of the earth, its crust beneath, and all it contains."

Chemie, Physik und Mathematik—spielt für die Geologie ... eine besondere Rolle."

Brouwer, Aart, 1962, Past and present in sedimentology: Sedimentology, vol. 1, no. 1, pp. 2-6. "There is no apparent reason to suppose that ancient causes differed from present ones, but the tectonical and morphological state of the earth, in short its whole physiognomy, is constantly changing."


Brown, G. Burniston, 1956, Have we abandoned the physical theory of Nature?: Science Progress, vol. 44, no. 176, pp. 619-634. "... a recent philosopher of science has declared (that) it is no use even beginning to look at things until you know exactly what you are looking for. ... The result of this attitude is a great temptation to find what you are looking for."


Cardwell, D. S. L., 1962, Science and technology in the eighteenth century, pp. 30-43 in Crombie, A. C. and Hoskin, M. A., eds. History of science; an annual review of literature, research and teaching, vol. 1; Cambridge, W. Heffer and Sons, vii and 133 pp. "... we meet with another instance of the cross-fertilization between technology and science in the work of William Smith, the civil engineer whose observations during the course of his professional work led him to make fundamental contributions to the science of palaeontology."

Charlesworth, John Kaye, 1957, The Quaternary Era, with special reference to its glaciation: London, Edward Arnold, 2 vols., 1700 pp. "... much of Quaternary geology is still in the stage
of multiple hypotheses, and the fate that has overtaken so many
geological fictions awaits some which are widely current or held
to be impregnable at the present day."

Chenoweth, Philip Andrew, 1962, Comparison of the ocean floor
"There are two principal theories of origin of the lunar fea-
tures—volcanic and meteoritic. Both theories lead to the con-
clusion that the agent which produced the structures was more
active in the past and may have been essentially dormant since
the Archeozoic era."

Chorley, Richard J., 1962, Geomorphology and general systems
theory: U.S. Geol. Survey, Prof. Paper 500-B, 10 pp. To "operate
within an appropriate general systematic framework" is to "in-
crease the scope of the study, make possible correlations and
associations which would otherwise be impossible, generally lib-
eralize the whole approach to the subject and, in addition, allow
an integration into a wider general conceptual framework."

2. 1963, Diastrophic background to Twentieth Century geomor-
"In the earth sciences ... the most notable advances are almost
invariably associated with the construction of a theoretical model
which, in a particularly symmetrical and harmonious manner,
seems to embrace a large part of observed reality."

Cloud, Preston Ercelle, Jr., 1961, Paleobiogeography of the marine
not to be confused with gradualism, or thought of as properly
incorporating purely static analogy, a misconception that has led
to uncritical rejection of this fundamental operational principle,
without which geology cannot be thought of in scientific terms.
It does not exclude catastrophic processes or unusual events, but
only ad hoc reasoning."

53, pp. 325-338. "Perhaps Darwin himself gained his first
acquaintance with the principle of selection, although not, of
course, selection as a creative process, from reading Lyell . . . "
Conant, James Bryant, 1951, The study of the past, Chapt. 10, pp. 258-259, in Science and common sense: New Haven, Yale Univ. Press, xii and 371 pp. “Geology expounded as earth history almost invariably takes on a dogmatic cast.”


Durham, John Wyatt, 1959, Palaeoclimates, pp. 1-16 in Ahrens, L. H.; Press, Frank; Rankama, Kalervo; and Runcorn, S. K., eds., Physics and chemistry of the earth, vol. 3: New York, Pergamon Press, viii and 464 pp. “Inferences about past climates are based on certain assumptions and limitations. The first and most significant of these assumptions is of course the ‘Principle of Uniformitarianism’ . . .”

Edelman, Nils, 1962, Mathematics and geology: Geol. Fören. Stockholm, Förh., vol. 84, no. 4, pp. 344-349. “Mathematics should be used neither for hiding defects in the primary field observations nor as a loose ornament to give the investigation the appearance of being more exact and more scientific than it really is.”

Engel, Albert Edward John, 1963, Geologic evolution of North America: Science, vol. 140, no. 3563, pp. 143-152. “The classic view—that geologic events of the past may be explained by observable, contemporary earth processes and products—requires some modification. The formation of the earth 4.5 billion years ago was a cataclysmic event. So in lesser degree may have been the formation of a first granitic crust.”

Fairbridge, Rhodes Whitmore, 1961, Eustatic changes in sea level, pp. 99-185 in Ahrens, L. H.; Press, Frank; Rankama, Kalervo; and Runcorn, S. K., eds., Physics and chemistry of the earth,
... since for geologists the Lyellian philosophy that the present is the key to the past is one of the fundamental tenets, it is highly desirable to study such contemporary processes as sedimentation and erosion.

Feuer, Lewis Samuel, 1963, The scientific intellectual; the psychological and sociological origins of modern science: New York and London, Basic Books, Inc., xii and 441 pp. "A new species of young scientist is said to be arising in America. He has no use for the hopes of the 'new philosophy' of the seventeenth century. He has no philosophy; a few scraps of managerial ideology suffice for him."

Gilluly, James, 1963, The scientific philosophy of G. K. Gilbert, pp. 218-224 in Albritton, Claude C. Jr., ed., The fabric of geology: Reading, Mass., Addison-Wesley, x and 372 pp. "... in the nature of geologic evidence, a geologic concept, even if it survives enough tests to have the rank of theory, can never be proved. On the other hand, a single definite negation is enough to disqualify it."


Goodman, Nelson, ———, Uniformity and simplicity: Geol. Soc. Am., Spec. Paper (in press) "... the Principle of Uniformity dissolves into a principle of simplicity that is not peculiar to geology but pervades all science and even daily life."


Gruber, Howard Ernest and Gruber, Valmai, 1962, The eye of reason; Darwin's development during the Beagle voyage: Isis,
vol. 53, pp. 186-200. "As a theoretical model... Darwin's theory of the formation of coral reefs displays formal characteristics strikingly similar to the theory of evolution through natural selection."


Hagner, Arthur Feodor, 1963, Philosophical aspects of the geological sciences, pp. 233-241 in Albritton, Claude C. Jr., ed., The fabric of geology: Reading, Mass., Addison-Wesley, x and 372 pp. "Because geology rests in part on physics, chemistry, and biology, in addition to being a science in its own right, the geologist is in an excellent position to appreciate attempts to unify science and to contribute to them."

Haldane, John Burdon Sanderson, 1956, Time in biology: Science Progress, vol. 44, no. 175, pp. 385-402. "Only the Hindus among pre-scientific thinkers had dared to postulate stretches of time comparable to those revealed by geology, and for this reason... the emotional attitude to the universe resulting from... an acceptance (of the length of geologic time) will in some respects resemble the Hindu attitude."


Hanson, Norwood Russell, 1963, Some philosophical aspects of contemporary cosmologies, pp. 465-482 in Baumrin, Bernard, ed., Philosophy of science; Delaware Seminar, vol. 2 (1962-63): New York, Interscience Publishers, xviii and 551 pp. "The creation of the universe is, in any physically intelligible context, tantamount to the creation of Time—since in the absence of physical processes there is (simply and dogmatically) no such thing as Time."
Harrison, James Merritt, 1963, Nature and significance of geological maps, pp. 225-232 *in* Albritton, Claude C., Jr., ed., The fabric of geology: Reading, Mass., Addison-Wesley, x and 372 pp. "... the geological map, although in part objective and a record of actual facts, is also to a very large degree subjective, because it also presents the geologist's *interpretation* of these facts and his observations."


Hedberg, Hollis Dow, 1961, The stratigraphic panorama; an inquiry into the bases for age determination and age classification of the Earth's rock strata: Geol. Soc. Am., B., vol. 72, pp. 499-518. "... when we fully know the crust of our earth, both on the continents and under the oceans, the chances are that in one place or another the gaps in the rock record will be filled."

Hill, Mason Lowell, 1963, Role of classification in geology, pp. 164-174 *in* Albritton, Claude C., Jr., ed., The fabric of geology: Reading, Mass., Addison-Wesley, x and 372 pp. "To stimulate advancements in their science, geologists must be as willing to revise their classifications as they are to make new observations and new interpretations."

Hölder, Helmut, 1962, Geologie als historische Naturwissenschaft: Geologische Mitteilungen (Aachen), vol. 3, no. 1, pp. 11-21. "Wenn wir ... heute, wie vermutlich in langen Zeiten der Erdgeschichte, kein irdisches Eis hätten, so wäre auch die Enträtselung der glazialen Erscheinungen des Quartärs auf dem üblichen aktualistischen Wege nicht möglich."

Hubbert, Marion King, 1963, Are we retrogressing in science?: Geol. Soc. Am., B., vol. 74, pp. 365-378. "... we appear to have lost sight of our intellectual foundations and to have reverted to authoritarianism."

Hull, Lewis William Halsey, 1959, History and philosophy of science; an introduction: London; Longmans, Green, xi and 340 pp. "The really reliable evidence of great change in the past is geological: we can only shrewdly guess that the Galaxy was
once a cloud of incandescent gas; but we can scarcely doubt that the earth itself is very different from what it was once.”

Hutchison, Eric, 1964, Science and responsibility: Am. Scientist, vol. 52, no. 1, pp. 40A-50A. “Only the most bigoted scientists would assert . . . that the natural historian and the field naturalist do not carry out perfectly scientific activities, even though these latter scientists have little to do with pointer readings.”

Hutten, Ernest Hirschlaff, 1962, The origins of science; an inquiry into the foundations of western thought: London, George Allen and Unwin, 238 pp. “Every theory must contain some error if it is to be true. If it did not, it would be impossible to correct it by later experience and more advanced theories. Such a theory would . . . belong to a closed system. It would be a pseudotheory, constructed as a defense against paranoid anxieties.”


Huxley, Thomas Henry, 1897, Geological reform, Chapt. 10, pp. 305-339 in Discourses biological and geological, vol. 8: New York, D. Appleton and Co., xv and 388 pp. “The attempt to limit, at a particular point, the progress of inductive and deductive reasoning from the things which are, to those which were—this faithlessness to its own logic, seems to me to have cost Uniformitarianism the place, as the permanent form of geological speculation, which it might otherwise have held.”

Imbrie, John, 1956, Biometrical methods in the study of invertebrate fossils: Am. Mus. Nat. Hist., B., vol. 108, art. 2, pp. 211-252. “. . . every species description is an act of faith based on the assumption that from the characteristics of the specimens actually at hand it is possible to draw useful inferences concerning the original population.”

phomena of the established order, science has discovered monuments of the past, hitherto unknown or misunderstood, and . . . has begun to reconstruct the series of events which have succeeded each other on the earth, ascending from monuments to monuments, until it has reached the limits of a beginning and a creation, as taught à priori by the cosmogonic annals of all nations."

Jourdain, Philip Edward Bertrand, 1919, The logical significance of "Ockham's Razor": Monist, vol. 29, pp. 450-451. " . . . the principle of parsimony appears . . . to be simply the maxim that logical analysis is to be carried as far as possible; and this is no more than Dedekind's maxim that what can be proved is to be proved."


Kirk, Edwin, 1928, Fossil marine faunas as indicators of climatic conditions: Smithsonian Inst., Ann. Rept., 1927, pp. 299-307. "We may now fairly ask the question whether marine animals are dependable indicators of the climates of the past. I think this can safely be answered in the negative."


Kuhn, Thomas Samuel, 1962, The structure of scientific revolutions: Chicago, Univ. Chicago Press, xv and 172 pp. "Scientific education makes use of no equivalent for the art museum or the library of classics, and the result is a sometimes drastic distortion in the scientist's perception of his discipline's past."

Legget, Robert Ferguson, 1963, Geology in the service of man, pp.
242-261 in Albritton, Claude C., Jr., ed., The fabric of geology: Reading, Mass., Addison-Wesley, x and 372 pp. "It is exceedingly clear . . . that geology will be applied in the works of the engineer in steadily increasing measure as far into the future as the mind can foresee."


Lindsay, Robert Bruce, 1963, The role of science in civilization: New York, Harper and Row, ix and 318 pp. "... if history as a whole is an ingredient of culture in our civilization, the story of the evolution of science is an essential component and its absence necessarily leads to distortion."

Lowther, Gordon R., 1962, Epistemology and archaeological theory (with discussion): Current Anthropology, vol. 3, no. 5, pp. 495-509. "Now, 'explanation' can only be explanations of relations; phenomena, if discretely identified, are not 'explained.' It would be invalid to ask that, for example, an artifact be explained."

Lyell, Sir Charles, 1881, Life letters and journals of Sir Charles Lyell, Bart. (Edited by his sister-in-law, Mrs. Lyell): London, John Murray, 2 vols. "The difficulty which men have of conceiving the aggregate effects of causes which have operated throughout millions of years, far exceeds all other sources of prejudice in geology, and is yet the most unphilosophical of all." (Lyell to Whewell, March 7, 1837.)

"Analogy of microcosm and macrocosm, analogy of celestial spheres and atmosphere, analogy of heart and sun, analogy of blood and rain: this is the heredity of Hutton's Theory—of our theory."

2. 1963, Precision and resolution in geochronometry, Op. cit., pp. 112-134. "Geology is rapidly becoming quantitative and it seems worth while to draw attention to the importance of presenting data so that the precision of measurement is clear, for it is this precision that determines the resolving power and hence, in large measure, the utility of the method."

McKelvey, Vincent Ellis, 1963, Geology as the study of complex natural experiments, pp. 69-74 in Albritton, Claude C., Jr., ed., The fabric of geology: Reading, Mass., Addison-Wesley, x and 372 pp. "Geology offers almost unique opportunity to observe the results of processes that not only involve interplay of more variables and larger masses than can be handled in the laboratory, but that also extend over much greater periods of time and hence reveal the effects of reactions too slow to observe under ordinary conditions."

McKenzie, Arthur Edward Ellard, 1960, The major achievements of science: Cambridge, Cambridge Univ. Press, vol. 1, xvi and 368 pp. "Geological facts were beginning to outrun theory, and the time was ripe for some comprehensive principle to co-ordinate them. Hutton provided the principle, whose importance in geology is comparable with that of evolution in biology: 'the present is the key to the past'."

Mackin, Joseph Hoover, 1963, Rational and empirical methods of investigations in geology, pp. 135-163 in Albritton, Claude C., Jr., ed., The fabric of geology: Reading, Mass., Addison-Wesley, x and 372 pp. "... if the objective is an understanding of the system investigated, and if that system is complex, then the empirical method is apt to be less efficient than the rational method."

about the past is used to justify another; but still there are no independent means of justifying them all.”

Mantell, Gideon Algernon, 1839, The wonders of geology, 1st American ed: New Haven, A. H. Maltby; London, Relfe and Fletcher, 2 vols. “What, then, is the result of our inquiry into the ancient state of our globe?—That, so far as our present knowledge extends, all the changes produced by mechanical, chemical, or vital agency . . . have been taking place from the earliest periods revealed by geological research; and, as like causes must produce like effects, will continue to take place so long as the present material system shall endure.”

Mead, Hunter, 1958, Science and society, pp. 214-221 in Hutchings, Edward, Jr., Frontiers in science: New York, Basic Books, vi and 362 pp. “. . . the narrow, strictly technical view of the philosophy of science will be broadened, or else a new field will come into existence (perhaps called 'Science and Society,' or 'The Sociology of Science').”

Merrill, George Perkins, 1924, The development of the glacial hypothesis, Chapt. 13, pp. 615-642 in Merrill, George Perkins, The first one hundred years of American geology: New Haven, Yale Univ. Press, xxi and 773 pp. “His (Louis Agassiz's) method of procedure . . . consisted in applying what one of our prominent geologists has slightly referred to as the principle of prolonging the harmless and undestructive rate of geological change of today backward into the deep past.”

Moore, John Alexander, 1962, The development of evolutionary thought: Univ. Kansas Sci. B., Supp., vol. 42, pp. 33-43. “. . . Darwin was much closer to the truth than he had any right to be . . . only a genius could have analyzed in so penetrating a manner the meager amount of data available in 1858.”

Moore, Leslie Rowsell, 1950, Geology and man (Inaugural Lecture delivered May 3, 1950): Sheffield Univ., 17 pp. “The human mind shows an instinctive parsimony in matters where time is concerned, and it is doubtful whether any other simple fact has so retarded the acceptance of the results of geological science.”


2. ———, Revolutions in the history of life: Geol. Soc. Am., Spec. Paper (in press). “There is nothing in the record to give support to catastrophism, as Cuvier understood it, nor to the uniformitarianism of Lyell which emphasized slow and uniform instead of episodic changes. Yet the record of past revolutions in the animal kingdom is understandable by application of basic principles of modern science. In this sense, the present is the key to the past.”

Newmark, Philip, 1962, Biochemical evolution: Univ. Kansas Sci. B., Supp. vol. 42, pp. 99-111. “It would appear that—at least during the billion or two years of the fossil record—nature has been obtaining all the diverse proteins from the same group of 20 to 25 amino acids.”

Nicol, David, 1958, Taxonomy versus stratigraphy: J. Washington Acad. Sci., vol. 48, no. 4 pp. 113-114. “Nomenclatural designations should serve to clarify, not obscure, taxonomic relationships, and the practical needs of stratigraphers should in no way hinder this goal.”

Oakeshott, Michael Joseph, 1933, Experience and its modes: London, Cambridge Univ. Press, viii and 359 pp. “The ‘uniformity of nature’ is not established by observation, it is not even an hypothesis to be verified, it is, for scientific experience, a postulate, a conditio sine qua non of scientific thought. Uniformity is secured to nature by definition.”

Pompeckj, Josef Felix, 1928, Is the earth growing old?: Smithsonian Inst., Ann. Rept., 1927, pp. 255-270. “Into whatever class of geological activity we probe, in no case are we led to the conclusion that evidence from the expressed movements indicates an on-coming senility of the earth.”

Pospelov, G. L., 1960, O kharaktere geologii kak nauki i ee meste v estestvoznanii (Geology as a science and its position among other sciences): Akad. Nauk, Isv., S.S.S.R., Geol. Ser., 11, pp. 3-19. To the criticisms that geologic generalizations are temporally and geographically limited (making geology more historical and descriptive than mathematical and logical), and that the twentieth century has added nothing to geological principles, the author counters that information originating in the more exact sciences of physics and chemistry must be interpreted geologically before it can be applied to geological problems, and that in the twentieth century the method of actualism has been supplemented by a new historic concept—the principle of spiralling evolution.

Prestwich, Joseph, 1895, Collected papers on some controverted questions of geology: London and New York, Macmillan, xi and 279 pp. “... we would not for a moment contend that the forces of erosion, the modes of sedimentation, and the methods of motion, are not the same in kind as they have ever been, but we can never admit that they have always been the same in degree. The physical laws are permanent; but the effects are conditional and changing, in accordance with the conditions under which the law is exhibited.”

Quine, Willard van Orman, 1963, On simple theories of a complex world: Synthese, vol. 15, no. 1, pp. 103-106. “... the maxim of the uniformity of nature is of a piece with” the maxim of the simplicity of nature, “uniformity being a species of simplicity.”

Rodgers, John, 1950, The nomenclature and classification of sedimentary rocks: Am. J. Sci., vol. 248, pp. 297-311. “Classifications of sedimentary rocks serve a number of purposes, and no one can serve all; we need both descriptive and genetic classifications, but the need for the former is at present the greater.”
Roller, Duane Henry Du Bose, 1963, Galileo and modern science: Texas J. Sci., vol. 15, no. 4, pp. 365-380. "Modern historical studies seem to be steadily denying the importance of the accumulation of data by scientists who engage in significant scientific work. In case after case ... vast amounts of data have failed to produce scientific advances, in case after case major discoveries have been produced with nearly no data collecting."


Rudwick, M. J. S., 1962, The principle of uniformity (essay review of "Natural law and divine miracle," by Reijer Hooykaas), pp. 82-86 in Crombie, A. C. and Hoskin, M. A., eds., History of science; an annual review of literature, research and teaching, vol. 1: Cambridge, W. Heffer and Sons, vii and 133 pp. "It is generally acknowledged that geology provided an essential background to evolutionary theory, and that the enormously lengthened time-scale which it postulated has had a profound effect on thought in general. Yet most books on the history of science give it the most perfunctory treatment ..."


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INDEX

Abnormalities, geologic
   present time: Rutten 1
Accuracy
   distinguished from precision: McIntyre 2
Actualism, See Uniformity, principle of
Agassiz, Louis
   glacial hypothesis: Merrill
   method: Merrill
Anagenesis
   illustrated: Huxley, J. S.
Analogies
   importance in reasoning: Bradley; McIntyre 2; Wilson, E. B.
Analyses, geologic
   sources of errors: Edelman
Analysis
   geologic: Bemmelen
Applied geology: Conant; Legget; Moore, L. R.; Sidorenko
   branches: Breddin
Archeology
   philosophy of: Lowther, Malik
Association, principle of
   examples: Leopold
Astronomy
   and eschatology: Wilson, A. G.
Authoritarianism
   in science: Hubbert
Avicenna
   contributions to philosophy: Brown, B. W.
Bacon, Francis
   inductive method: Brown, B. W.
Biblical geology: Toulmin 1
Biochemical evolution: Newmark
Biology
   center of all science: Simpson 2
evolutionary: Simpson 2
scope: Simpson 2
time scales: Haldane
Biometrical methods
applied to invertebrate paleontology: Imbrie
Biospecies: Young
Biostratigraphy
aims: Young
basic concepts: Young
history: Young
Biostratonomy
scope: Kaiser
Cataclysms
in early history of the earth: Engel
Catastrophies
cosmic: Wilson, A. B.
natural: Newell 1
Catastrophism
compared with evolutionism and uniformitarianism: Huxley, T. H.
Cuvier's: de Beer; Newell 2
defined: Huxley, T. H.
d'Orbigny's views: Young
influence upon taxonomy: Young
neocatastrophism: Tikhomirov
reasons for early popularity: Hull
source of error: Simpson 1
vs. uniformitarianism: Bailey
Cause and effect relationships
in geology: Mackin
Chronostratigraphy
chronostratigraphic classification: Hedberg
chronostratigraphic units: Hedberg
principles: Hedberg
Cladogenesis
illustrated: Huxley, J. S.
Classification
chronostratigraphic: Hedberg
compared with ordering: Hill
descriptive versus genetic schemes: Rodgers
faults: Hill
importance to progress in geology: Hill
rules of: Hill
sedimentary rocks: Rodgers
Coherence, theory of: Lowther
Communication, scientific
barriers: Betz
difficulties: Cloud
scientific ideas: Lindsay
tools: Betz
Configurational aspects of nature
basis of historical science: Simpson 1
opposed to immanent aspects: Simpson 1
Connectivity, principle of
analyzed: Schlesinger
Control of natural phenomena
aim of scientific explanations: Weaver; Wilson, E. B.
Convergence, phenomenon of
time correlation vs. homotaxis: Woodford
Correspondence, theory of: Lowther
Cosmology
perfect cosmological principle: Toulmin 1
theories: Toulmin 1
Crises
history of life: Newell 1
Cycles
orogenic: Rutten 4

Data, scientific
relation to important discoveries: Roller
Davis, W. M.
cycle of erosion: Chorley 2
Darwin, Charles
contributions to knowledge: Simpson 2
theoretical models: Gruber
Darwinism
impact upon biostratigraphy: Young
Dedekind’s maxim: Jourdain
Descriptive classification
sedimentary rocks: Rodgers
Determinism
in evolution: Simpson 2
in geology: Guntau
in paleontology: Daber
Diastrophism
influence upon geomorphic theory: Chorley 2
Dictionaries, geologic
classified and compared: Betz
Doctrine of fixed species in chemistry: Toulmin 1

Empirical method of investigation
time correlation vs. homotaxis: Woodford
history: Legget
increasing importance: Legget

Epeirogenic theory
- G. K. Gilbert's: Chorley
- Epistemology and archeological theory: Lowther
- Eschatology and astronomy: Wilson, A. G.
- Eustatic theory
  - in geomorphology: Chorley

Evidence
- paleobiogeographic: Cloud

Evolution, cosmic: Huxley, J. S.; Sandage; Simpson

Evolution, general
- importance to social opinion: Simpson
- supreme principle in Nature: Hawkins
- whole of reality: Huxley, J. S.

Evolution, organic
- biochemical: Newmark
- biological: Huxley, J. S.
- crises in history of life: Newell
- determinism in: Simpson
- development of thought: Moore, J. A.
- evidence: Romer; Wilson, R. W.
- evolutionary determinism: Simpson
- evolutionary theology: Simpson
- extinctions: Newell
- future: Simpson
- G. G. Simpson's contributions: de Beer
- geologic contributions: Moore, L. R.
- human: Allison; Simpson
- laws: Huxley, J. S.
- nineteenth century approaches: Simpson
- paleontologic contributions: de Beer
- paleontological evidence: Romer; Wilson, R. W.
- problem of purpose: Simpson
- role of natural selection: Sokal
- spiralling: Pospelov
- synthetic theory: de Beer

Evolution, psychosocial: Huxley, J. S.

Evolutionary humanism: Huxley, J. S.

Experiments
- "natural": McKelvey

Explanation, scientific
- anthropological: Lowther
- anthropomorphic features: Weaver
- geological: Kitts; White, W. S.
- nonpredictive: Simpson
- varieties: Simpson
- vertical vs. horizontal: Weaver

Faults
- classifications: Hill
PHILOSOPHY OF GEOLOGY

Faunal sequence, principle of
importance: McKelvey

Forensic mineralogy
scope and methods: Liebenberg

Fossils
and men: Hawkins
biostratigraphic units: Woodford
marine fossils as paleoclimatic indicators: Kirk
use in correlation: Woodford

Functional theory of Nature: Brown, G. B.

Generalizations, geologic
biostratigraphic: Woodford
imprecision: Kitts
origin: Kitts
relation to normic statements: Kitts

Genetic classification
sedimentary rocks: Rodgers

Genetic sciences
concern with time: Barth

Geochronology
late Quaternary events: Fairbridge

Geochronometry
precision and resolution: McIntyre 2
radiometric methods: McIntyre 2
statistical inference: McIntyre 2

Geognosy
forerunner of various geological sciences: Tikhomirov

Geology: See also Geomorphology, Mineralogy, Stratigraphy, Structural Geology and Tectonics

academic isolation: Legget
aims: Conant
applied: Breddin; Conant; Legget; Moore, L. R.; Sidorenko
Biblical: Toulmin 1
characteristics: Conant
communication of findings: Betz
complexity: Simpson 1
conference on philosophy: Albritton 1
contrasted with physics: Ardley
contributions to other sciences: McKelvey; Shantser
descriptive: Bemmelen; Kitts
determinism in: Guntau
development, 1800-1850: Tikhomirov
distinctive qualities: Bradley
engineering geology: Legget
exploratory and analytical science: McKelvey
fallacies: Semper
geologic generalizations: Kitts
geologic terms: Betz; Kitts
historical: Breddin; Conant; Guntau; Moore, L. R.; Simpson 2; Toulmin 1
historical and non-historical aspects: Simpson 1
historical science: Hölder
history: Hölder; Shantser; Tomkeieff
influence of principle of simplicity: Anderson
influence upon philosophy: Brown, B. W.
in Kant's classification: Ardley
intellectual contributions: Albritton 2; Hagner; McKelvey; Moore, L. R.; Rudwick
Kant's contributions: Huxley, T. H.
laws: Bradley; Guntau; Kitts; Shantser
logic and method of investigation: Semper
loss of prestige among sciences: Hagner
Lyell's contributions: Bailey
main branches: Breddin
mathematical: Edelman
methods: Albritton 2; Conant; Hagner; Pospelov
model for cosmology: Toulmin 1
models: Green; Rutten 2
19th century American: Gilluly
petroleum: Hubbert
philosophy: Albritton 2; Hagner; Hölder
physical: Breddin
postulates: Conant
prediction in: Bemmelen; Wilson, E. B.
problems: White, J. F.
Quaternary: Charlesworth; Fairbridge
regional: Breddin
relation to other sciences: Bradley; Shantser; Tikhomirov; White, J. F.
relation to selenology: Green
scope: Albritton 2; Huxley, T. H.; Moore, L. R.; White, J. F.
source of evolutionary ideas: Hull
specialization: Hubbert; Tikhomirov
stratigraphic: Breddin
study of complex natural experiments: McKelvey
terminology: Betz; Kitts
theoretical and applied: Sidorenko
theory: Gilluly; Kitts
trend toward quantification: Hagner; Mackin
writings: Betz

Geomorphology
association and indeterminacy principles: Leopold
historical: Fairbridge
influence upon diastrophic theory: Chorley 2
laws: Leopold
methodology: Leopold
problems: Leopold
relation to tectonics: Goguel
stochastic relationships: Leopold
trend toward quantification: Leopold
PHILOSOPHY OF GEOLOGY

Geophysics
   experimental science: Conant
Gilbert, G. K.
   analogical reasoning: McIntyre 1
   influence on geology: Gilluly
   scientific philosophy: Gilluly
Glacial hypothesis
   history: Merrill
Glacial theory
   history: Charlesworth
Goethe
   geological studies: Semper
Guide fossils
   use in correlation: Woodford
Harvey, William
   influence on Hutton: McIntyre 1
Hindu estimates of time: Haldane
Historical geology
   climatic history: Schwarzbach
   core of geological science: Moore, L. R.
   nucleus of geological sciences: Breddin
Historical science: Simpson 2; Toulmin 2
   defined: Simpson 1
   laws: Simpson 1
   postdictive character: Simpson 1
   strategy: Simpson 1
History
   evidence in: Oakeshott
   inferential nature: Oakeshott
   relationship to science: Lindsay
History of geology
   neglect: Rudwick
History of science
   importance: Lindsay
   importance in geology: Tomkeieff
Homotaxis
   Mesozoic systems: Woodford
   vs. synchronism: Woodford
Hooykaas, R.
   views on principles of geology: Rudwick
Humanist revolution: Huxley, J. S.
Humanities: relationship to science: Lindsay
Hutton, James
   intellectual characteristics: McIntyre 1
   intellectual contributions: Toulmin 2
   interest in applied geology: Legget
   origins of geologic theory: McIntyre 1
   philosophy of geology: McIntyre 1
   providential views: Bailey
Hypotheses, scientific
origin in analogies: McIntyre 1; Wilson, E. B.
glacial: Merrill
multiple working hypotheses: Charlesworth; Gilluly; Mackin
probability: Kitts
testing: Wilson, E. B.

Immanent aspects of nature
basis of non-historical science: Simpson 1
opposed to configurational aspects: Simpson 1

Indeterminacy
in geology: Kitts
Indeterminacy, principle of
in geomorphology: Leopold
Indeterminism
in paleontology: Daber

Induction
hypocrisy of 19th century science: Williams
inductive arguments: Malik
inductive reasoning: Bradley

Inference
historical inference in science: Toulmin 1
statistical: Kitts

Information problem
in geology: Betz

Involvement paradox: Cloud

Jurassic System
zonation and boundaries: Woodford

Kant, Immanuel
classification of sciences: Ardley

Lacunas
European Jurassic: Woodford
recognition and naming: Woodford

Laws, scientific
defined: Bradley; Simpson 1
evolution: Daber; Huxley, J. S.
geologic: Bradley; Guntau; Kitts; Shantser
geomorphic: Leopold
"historical": Simpson 1
law of superposition: Shoemaker, Young
paleontologic: Daber
permanence: Hawkins; Prestwich

Life
history: Simpson 2
origin: Bernal; Oparin
ultimate destruction: Sandage

Linnéan species: Young

Lithostratigraphy
scope: Breddin

Lyell, Charles
PHILOSOPHY OF GEOLOGY

concept of species: Coleman
contributions to geology: Bailey
evolutionary views: Scott
intellectual contributions: Toulmin 2
methodology: Scott
philosophy: Lyell
sources of uniformitarian views: Wilson, L. G.
uniformitarian views: Bailey; Lyell; Scott; Toulmin 2

Mathematical theory of Nature: Brown, G. B.
Mathematics
use in geology: Edelman
Man
biologic specialization: Hawkins
evolution: Allison
Maps, geologic
as instruments of communication: Betz
nature and significance: Harrison
preparation: Harrison
Maxims
Dedekind's: Jourdain
principle of simplicity: Quine
Measurements
geologic: Edelman
Methodology, scientific: Ardley; Hutten; Wilson, E. B.
geologic: Albritton 2; Conant; Hagner; Pospelov
geomorphic: Leopold
Lyell's: Scott
rational and empirical methods: Mackin; Roller
strategy in historical science: Simpson 1
Micro-reduction, principle of
unjustifiable: Schlesinger
Mineralogy
forensic: Liebenberg
Models, theoretical
Darwin's: Gruber
Davis' cycle of erosion: Chorley 2
geologic: Green; Rutten 2
Suess' eustatic theory: Chorley 2
Moon
geosciences applied to study of: Green
origin of lunar features: Chenoweth
stratigraphy: Shoemaker
Mysticism
evolutionary theology: Simpson 2
Natural experiments
McKelvey
Natural selection: See Selection, natural
Nature
plan and purpose in: Simpson 2
Neocatastrophism
   present trends toward: Tikhomirov
Neptunism: Toulmin
Nineteenth century science:
   induction vs. speculation: Williams
Nomenclature
   faults: Hill
   rules of: Hill
   stratigraphic: Moore, R. C.
Nonpredictable phenomena
   discovery: McKelvey
Normic statements
   in geology: Kitts
Numerical taxonomy: Sokal

Occam's Razor, See Simplicity, principle of
Ocean basins
   origin of features: Chenoweth
Ordering
   compared with classification: Hill
Organisms
   humanoids: Simpson
   scarcity: Simpson
   study of: Simpson
Orogeny
   orogenetic cycles: Rutten
Paleobiogeography
   limitations of paleobiogeographic evidence: Cloud
   relationship to stratigraphy and paleoecology: Cloud
Paleoclimatology
   essentials: Cloud
   fossil marine faunas as climatic indicators: Kirk
   historical: Schwarzbach
   methods: Durham; Schwarzbach
   scope: Schwarzbach
Paleoecology
   applications of uniformity principle to: Ager; Scott
   basic assumptions: Scott
   principles: Ager
   relation to paleobiogeography: Cloud
Paleontology: See also Fossils
   applied: Conant
   Darwin's knowledge of: Romer
   determinism in: Daber
   early development: Tikhomirov
   evidence for evolution: Romer; Wilson, R. W.
   historical science: Simpson
   laws: Daber
   numerical taxonomy: Sokal
   relation to biology and geology: Simpson
PHILOSOPHY OF GEOLOGY

relationship to geology: Conant
statistical methods: Imbrie
vitalism in: Daber

Paradigms
importance in structure of scientific thought: Kuhn

Paradoxes
involvement paradox: Cloud

Parsimony, principle of; See Simplicity, principle of

Perfect cosmological principle: Toulmin 1

Philosophy
natural: Hutchinson
relationship to science: Lindsay

Philosophy, scientific
geological: Albritton 2
G. K. Gilbert's: Gilluly
James Hutton's: McIntyre 1
need for studies of philosophy of geology: Hagner
neglect of geology: Albritton 1
relationship to science: Lindsay
scope and present limitations: Mead
stratigraphic: Hamilton

Physical geology
relation to other sciences: Breddin
physical theory of Nature: Brown, G. B.

Physicalism: Oakeshott

Physics
authoritarian trends: Hubbert
contrasted with geology; Ardley

Pleistocene
abstraction: Roller

Politics
relationship to science: Lindsay

Positivism
liberal positivism defined: Spaulding

Postulates
geological: Conant

Precision
distinguished from accuracy: McIntyre 2
in geochronometry: McIntyre 2
lead-alpha method: McIntyre 2
potassium-argon method: McIntyre 2

Prediction
gologic: Bemmelen; Wilson, E. B.
importance in science: Wilson, E. B.
in historical science: Simpson 1
in structural geology: Anderson
limitations: Simpson 1
nonpredictable phenomena: McKelvey
testing: Simpson 1
test of explanations: Weaver
Present
geologic abnormalities: Rutten

Principles: See Association, Connectivity, Indeterminacy, Micro-reduction, Perfect Cosmological Principle, Simplicity, Spiralling Evolution, Superposition, Uniformity, and Verification

Probability
scientific hypotheses: Kitts

Processes, geologic
past vs. present: Chenoweth
rhythmic: Pompeckj

Prophesy
scientific: Wilson, A. G.

Providentialism
Hutton's: Bailey
opposed to uniformitarianism: Jobert

Provincialism
Upper Jurassic faunas: Woodford

Pseudotheories: Hutten

Publications, scientific
growth: Hubbert

Quaternary geology
multiple hypotheses: Charlesworth
need for time scale: Fairbridge

Quantification in science
illustrated by Mohs scale of hardness: Wilson, F. B.
trend in geology: Hagner; Mackin
trend in geomorphology: Leopold

Rational method of investigation
in geology: Mackin

Reality
theories about: Hutchinson

Reasoning
inductive: Bradley

Regional geology
relation to other geo-sciences: Breddin

Research
academic: Hubbert
by teams: Hubbert
grants and contracts: Hubbert

Resolution
in geochronometry: McIntyre

Retrogression
in science: Hubbert

Revolutions
in history of life: Newell
intellectual: Toulmin
in scientific thought: Kuhn

Rhythm
in geologic history: Pompeckj
PHILOSOPHY OF GEOLOGY

Sampling
  geologic: Edelman

Science
  abstract mode of thought: Oakeshott
  authoritarianism: Hubbert
  communication of scientific ideas: Lindsay
  compared with technology: Hutchinson
  configurational vs. immanent aspects: Simpson 2
  defined: Lindsay
  evolution: Hubbert
  freedom: Hutten
  genetic sciences: Barth
  growth: Hubbert
  historical: Simpson 2; Toulmin 2
  historical vs. unhistorical aspects: Simpson 1
  intellectual contributions: Brown, H.
  in civilization: Lindsay
  Kant's classification of sciences: Ardley
  laws: Simpson 1
  methods: Ardley; Hutten
  metric vs. non-metric: Hutchinson
  nineteenth century: Williams
  origin of new ideas: Williams
  origins: Hutten
  philosophy of: Mead
  practices: Ardley
  psychological and social origins: Feuer
  publications: Hubbert
  "receptive pupil" sciences of Kant: Ardley
  relationship to history: Lindsay
  relationship to humanities: Lindsay
  relationship to philosophy: Lindsay
  relationship to politics: Lindsay
  relations to technology: Cardwell; Lindsay
  research grants: Hubbert
  retrogression: Hubbert
  sociology of: Mead
  specialization: Hubbert
  "stern judge" sciences of Kant: Ardley
  theories about reality: Hutchinson
  value judgments: Hutchinson

Scientists
  scientific intellectual: Feuer
  social obligations: Hutchinson

Sedimentology
  uniformitarian approach: Brouwer

Selection, natural
  development of concept: Sokal 1
  evidence for: Sokal 1
  human populations: Allison
Lyell's views: Coleman
natural vs psychosocial: Huxley, J. S.
Selenology: Chenoweth; Shoemaker
relation to geology: Green
Seventeenth century
scientific revolution: Feuer
Simplicity, principle of
analyzed: Schlesinger
applied to geologic problems: Anderson
equated with Dedekind's maxim: Jourdain
example of use in geology: White, W. S. 1
logical significance: Jobert
maxim: Quine
relation to principle of uniformity: Goodman; Quine
unrelated to credibility: White, W. S. 2
variants; Anderson
Simpson, George Gaylord
contributions to evolutionary theory: de Beer
Smith, William
accomplishments in applied geology: Legget
contributions: Toulmin 1
Sociology of Science
emerging discipline: Mead
Solar system
future of: Sandage
Space
geographic and geologic concepts: Barth
Specialization
in geology: Hubbert; Tikhomirov
in science generally: Hubbert
Species concept
biometric viewpoint: Imbrie
biospecies: Young
Linnéean: Young
Lyell's concept: Coleman
Spiralling evolution
principle of: Pospelov
Stages and substages
Paleozoic and Mesozoic: Woodford
use in time correlation: Woodford
Stasigenesis
defined: Huxley, J. S.
Statements
normic: Kitts
Statistical inference
in geochronometry: McIntyre 2
Stratigraphic nomenclature
rules for stabilizing: Moore, R. C.
Stratigraphy
biostratigraphy: Young
PHILOSOPHY OF GEOLOGY

cronostratigraphy: Hedberg
compared with anatomy: Huxley, T. H.
deep-sea: Hamilton
lithostratigraphy: Breddin
objectives: Hedberg
phases: Hamilton
philosophy of: Hamilton
relationship to paleobiogeography: Cloud
relationship to tectonics: Goguel
rules for stabilizing nomenclature: Moore, R. C.
scope: Breddin; Hedberg
versus taxonomy: Nicol
Stochastic relationships
in geomorphology: Leopold
Structural geology
classification of faults: Hill
prediction in: Anderson
principle of simplicity applied to: Anderson
Suess, E.
eustatic theory: Chorley 2
Sun
evolution: Sandage
Superposition, principle of
applied to lunar history: Shoemaker
law: Shoemaker; Young
Synchronism
vs. homotaxis: Woodford
Systems
closed and open: Chorley 1
Taxonomy
numerical, applied to paleontology: Sokal 2
vs. stratigraphy: Nicol
Technology
compared with science: Hutchinson; Lindsay
contributions to science: Cardwell
Tectonics
historical science: Goguel
relation to geomorphology and stratigraphy: Goguel
scope: Breddin
Terminology, geologic
dictionaries: Betz
faults: Hill
gaps: Betz
growth: Betz
origin of terms: Betz
Terms
geologic: Kitts
Theology
evolutionary: Simpson 2
Theory
archeological: Lowther
functional theory of Nature: Brown, G. B.
general systems theory in geomorphology: Chorley 1
geologic: Gilluly; Kitts
geomorphic: Chorley 1, 2
glacial: Charlesworth
Hutton's theory of the Earth: McIntyre 1
mathematical theory of Nature: Brown, G. B.
origin of lunar features: Chenoweth
physical theory of Nature: Brown, G. B.
time of coherence: Lowther
time of continental glaciation; historical development: Charlesworth
time of correspondence: Lowther

Thermodynamic imperative
defined with examples: Lindsay

Time
biologic: Haldane
difficulty in conceptualizing geologic time: Lyell; Moore, L. R.
geologic: Haldane; Moore, L. R.; Toulmin 2; Woodford
gologic divisions: Woodford
gologic, geographic and paleontologic concepts: Barth
lunar time scale: Shoemaker
postulated by Hindus: Haldane
relation to physical processes: Hanson
standard geologic time scale: Woodford

Toulmin, George Hoggart
influence on Hutton: McIntyre 1
uniformitarian thought: Toulmin 1

Truth
scientific: Malik

Unconformities
classification: Tomkeieff
history of the idea of unconformity: Tomkeieff
stratigraphic significance: Hedberg

Uniformity, principle of
ambiguity: Albritton 1
analyzed: Kitts; Simpson 1; Toulmin 1
applied to:
geology and paleontology: Kaiser
origin of flints: Rutten 3
paleoclimatology: Durham
paleoecology: Ager; Scott
paleontology: Kaiser
paleopathology: Kaiser
sedimentology: Brouwer
species, genera and larger groups: Ager

basic geologic principle: Hölder
critique of Hooykaas' views: Rudwick
defined: Huxley, T. H.
difficulties of applying: Rutten 1
evolutionary implications: Hull
exemplified: Rutten 2
first approximation: Conant
fruitful doctrine: Moore, L. R.
fundamental geological tenet: Fairbridge
George H. Toulmin's views: Toulmin 1
history of idea: Scott
Hutton's views: Bailey; McIntyre 1; McKenzie; Toulmin 1
hypothesis: Hubbert
importance in early history of geology: Hagner
importance in geology: McKenzie
inconsistency of Lyell's concept: Barth
limitations: Ager; Huxley, T. H.
Lyell's views: Bailey; Lyell; Scott; Toulmin 2
Lyell's views criticized: Barth; Newell 2
Mantell's views: Mantell
maxim: Quine
method of Louis Agassiz: Merrill
19th century and modern views compared: Guntau
operational principle: Cloud
opposed by providential arguments: Jobert
philosophical importance: Alonso del Real
postulate: Conant; Oakeshott
qualified: Engel; Pompeckj; Prestwich
relationship to principle of association: Leopold
same as actualism: Bailey
same as principle of simplicity: Goodman; Quine
sources of Lyell's uniformitarianism: Wilson, L. G.
species of simplicity: Goodman; Quine
supplemented by principle of spiralling evolution: Pospelov
Toulmin's views: McIntyre 1
universal methodological principle: Schlesinger
use in constructing theories for origin of life: Bernal
vs. actualism: Tikhomirov
vs. catastrophism: Bailey; Kaiser
vs. catastrophism and evolutionism: Huxley, T. H.
vs. gradualism: Cloud
USSR Stratigraphic Commission
critique of views: Hedberg

Value judgments
in science: Hutchinson
Verification
criteria: Lowther
of archeological statements: Lowther; Spaulding
Verification, principle of, analyzed: Schlesinger
Vitalism
in paleontology: Daber
Vulcanism: Toulmin 1
Watt, James
influence on Hutton: McIntyre 1

Werner, Abraham Gottlob
interest in applied geology: Legget
Neptunist theory: Kaiser

Zones, paleontologic
depth zones: Woodford
facies zones: Woodford
Jurassic, significance of: Woodford