Third Bibliography and Index for the Philosophy of Geology[1]

By Claude C. Albritton, Jr.[2]

Introduction and Acknowledgments

The following bibliography and index have the same scope and structure as the two preceding issues.[3] The categories of writings here cited are also the same as listed in the front portion of the second bibliography.

To all those who have called my attention to writings which are appropriately included in a work of this kind, I offer my sincere thanks. Dr. Martin Guntau graciously supplied a long list of German writings on the philosophy of geology. Mr. Stephen Jay Gould, author of a most perceptive analysis of uniformitarianism which recently appeared in the *American Journal of Science,* kindly gave me a lengthy bibliography which he had prepared for this subject.

Mrs. Nadine George of The Science Information Center in Dallas displayed her usual ingenuity in tracking down rare or out-of-the-way items from cryptic or imperfect references. Mrs. Jacquelyn Newbury typed the manuscript, and assisted with the preparation of the index.

Bibliography

Agassi, Joseph, 1964, The nature of scientific problems and their roots in metaphysics, pp. 189-211 *in* Bunge, Mario, ed., The critical approach to science and philosophy: New York, Free Press of Glencoe, xv and 480 pp. "It is my contention that whatever the starting point of a person's interest in a science, the more that person's interest develops the closer it approaches the general interest, the interest which dominates the tradition in that science, and that this general interest springs from, and flows back to, metaphysics."

[1] Prepared with the aid of National Science Foundation Grant G-23887.

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[3] The first bibliography appeared under the title, *Philosophy of geology: a selected bibliography and index*, pp. 262-363 *in* Albritton, Claude C., Jr., ed., The Fabric of Geology: Reading, Mass., Addison-Wesley, 1963; 2d printing by Freeman, Cooper and Co., Stanford, California, 1964. The second bibliography was published in vol. 33, no. 2 (1964) of *The Journal of The Graduate Research Center* (SMU Press, Dallas), pp. 73-114.

Alpern, B., 1963, La palynologie stratigraphique, une oeuvre collective pour un outil valable: Chronique Mines d'Outre-Mer, Paris, vol. 15, no. 58, pp. 1-4. "Il est évident par ailleurs que pour le palynologiste stratigraphe l'espèce ne peut être qu'une *chrono-espèce,* le problème étant de savoir si l'on peut placer des coupures dans une lignée évolutive, et à que endroit."

Amstutz, Gerhardt Christian, 1963, Space, time and symmetry in zoning, pp. 33-36 *in* Kutina, J., ed., Symposium on problems of postmagmatic ore deposition with special reference to the geochemistry of ore veins: Prague, Czech. Acad. Sci., vol. 1, 588 pp. "It is highly improbable if not impossible that two geological phenomena are identical in symmetry and size, but do not have any genetic relation. Therefore congruency can be used as a genetic criterion."

Ascher, Robert and Ascher, Marcia, 1965, Recognizing the emergence of man: Science, vol. 147, no. 3655, pp. 243-250. "Studies of comparative animal behavior suggest that early man differed from his contemporaries in being oriented in time, in operating in a stream of time, or in being capable of thinking about past events while anticipating the future."

Becksmann, Ernst, 1939, N. Steno (1638-1686) und sein Stellung in der Geschichte der Geologie: Deut. Geol. Ges., Zs., vol. 91, pp. 329-336. Credits Steno with laying the foundations of actualism as a scientific method.

2. 1939. Erdgeschichtliche Gestalten: Gründsätzliches zur erdgeschichtlichen Fragestellung: Dut. Geol. Ges. Zs., vol. 91, pp. 734-756 "Von unserer Erdgeschichtsauffassung aus wird es möglich, die Frage nach dem Sinn der Erdgeschichte zu stellen und in Beziehung zum Sinn geschichtlichen Werdens überhaupt zu erörtern."

Beringer, Carl Christoph, 1941, Stammesgeschichte als historische Naturwissenschaft: Jena, Gustav Fischer, 40 pp. "Cuviers Katastrophentheorie war napoleonisch empfunden, Lyells Aktualismus und Darwins Deszendenztheorie bürgerlich-liberal und unsere heutigen Theorien werden vielleicht von der nächsten Generation als dem 'autoritären' oder 'totalitären' Zeitalter gemäsz betrachtet."

Berkner, Lloyd V., 1964, The unity of the geophysical sciences: Am. Geophys. Union, Tr., vol. 45, no. 3, pp. 405-408. ". . . with the advent of space travel, the prefix 'geo' has become completely generalized by extension to the Moon and all the planets."

Beurlen, Karl, 1942, Erdgeschichte und Naturgesetz: Deut. Geol. Ges., Zs., vol. 94, pp. 192-200. "In der Tat gibt es kein Naturgesetz, das aus der Erfahrung geboren wäre."

Birch, Francis, 1965, Speculations on the Earth's thermal history: Geol. Soc. Am., B., vol. 76, pp. 133-154. "Complaints about 'black boxes' are sometimes heard among geologists, but . . . I feel that we ought rather to rejoice that modern techniques are now fulfilling so many of the dreams of earlier geologists, who complained more reasonably about the limitations of the classical models."

Bohm, David, 1961, On the relationship between methodology in scientific research and the content of scientific knowledge: British J. Phil. Sci., vol. 12, no. 46, pp. 103-116. "The notion that everything is, in principle, reducible to physics has . . . the character of being an unproved assumption, which is capable of limiting our thinking in such a way that we are blinded to the possibility of whole new classes of fact and law."

2. 1964, On the problem of truth and understanding in science, pp. 212-223 *in* Bunge, Mario, ed., The critical approach to science and philosophy: New York, Free Press of Glencoe, xv and 480 pp. ". . . it does not seem reasonable to suppose that a mode of understanding which inherently and unavoidably breaks truth into pieces and fixes the form as that of the pieces is likely to be adequate for the task of grasping truth as a totality . . ."

Boyce, Ronald R. and Clark, W.A.V., 1964, The concept of shape in geography: Geog. Rev., vol. 54, no. 4, pp. 561-572. ". . . geographers have been primarily concerned with an ideographic, rather than a nomothetic, approach to geographical problems."

Brinkmann, Roland, 1958, Grundfragen der Erdgeschichte: Universitas (Zs. für Wissenschaft, Kunst, und Literatur), vol. 13, pp. 295-303. "Finale und kausale Auffassung des Erdgeschens standen in Werner und Hutton einander gegenüber. Erdgeschichte als Schicksal oder Erdgeschichte als Gesetz das waren die beiden Pole, zwischen denen sich die Geologie seit dem vorigen Jahrhundert entfaltet hat."

Brunn, J. H., 1963, La méthode historique et la géologie: Rev. Géog. Phys. et Géol. Dynamique, vol. 5, no. 3, pp. 231-236. "Partie de la Geologie, la méthode historique, *l'utilisation de l'histoire pour la compréhension du présent,* s'est étendue peu à peu à d'autres sciences et d'abord aux sciences biologiques, aux sciences de l'homme."

Bubnoff, Serge von, 1952, Ziel and Grenzen geologischer Erkenntnis: Studium Generale, vol. 5, pt. 7, pp. 393-400. "Die Gestaltung der Schale ist ein geologisches, die des Kerns ein astrophysikalisches Problem."

Buffon, George Louis LeClerc, *Comte de,* 1810, Buffon's Natural History, containing a theory of the Earth, a general history of Man, of the brute creation, and of vegetables, minerals, etc.; from the French, with notes by the translator ("Barr's Buffon"): London, H. D. Symonds, 10 vols. ". . . to preserve consistency, we must take the earth as it is, closely observing every part, and by inductions judge of the future from what exists at present; besides we ought not to be effected (*sic*) by causes which seldom happen, and whose effects are always sudden and violent; they do not occur in the common course of nature; but effects which are daily repeated, motions which succeed each other without interruption, and operations that are constant, ought alone to be the ground of our reasoning." (vol. 1, p. 40).

Bülow, Kurd von, 1964, Aktualismus and Fazies: Geol. Ges. DDR, Ber., vol. 9, pt. 1, pp. 75-83. " 'Aktualismus' heisst in der einfachsten Fassung nicht mehr und nicht weniger als: vom erlebten Bekannten ausgehen, um zu versuchen, ein nicht-erlebtes Unbekanntes zu verstehen."

Bunge, Mario, 1964, Phenomenological theories, pp. 234-254 *in* Bunge, Mario, ed., The critical approach to science and philosophy: New York, Free Press of Glencoe, xv and 480 pp. "The long-run aim of scientific theorizing is not to summarize scientific experience but *to interpret reality* and, in particular, to explain that part of reality coupled to the knower . . ."

Burma, Benjamin H., 1954, Reality, existence, and classification: a discussion of the species problem: Madroño, vol. 12, no. 7, pp. 193-209. ". . . species as classes . . . cannot be said to have real existence in any sense."

Calembert, L., 1962, Le rôle de la géologie de l'ingénieur dans l'aménagement des territoires et les travaux publics: Deut. Geol. Ges., Zs., vol. 114, no. 3, pp. 667-682. ". . . pour l'ingénieur-géologue, si le sacrosaint principe de l'uniformitarisme gard tout sa valeur, il n'est pas moins vrai que, au rebours, 'le passé geologique est la clef du présent.' "

Calvin, Melvin and Calvin, G. J., 1964, Atom to Adam: Am. Phil. Soc., Pr., vol. 108, no. 2, pp. 73-87. "Because man has emphasized his own personal history, . . . the natural laws—which govern the

development of man and the countless life forms which exist with him—are frequently isolated from those laws which govern other matter in the universe."

Cannon, Walter F., 1964, History in depth—the early Victorian period: History of Science (Cambridge, W. Heffer and Sons), vol. 3, pp. 20-38. ". . . the myth that theological ideas retarded geology in this period is not only wrong; it is also an answer to the wrong question. When we see what it is that needs explaining—*i.e.*, why were British geologists so good?—then we may still come upon ideas from theology . . ."

Carozzi, Albert V., 1964, Lamarck's theory of the Earth—*Hydrogéologie*: Isis, vol. 55, pp. 293-307. "For Lamarck the continuity of the processes of nature was never interrupted during the immensity of geological time and the present was actually the key to the past."

Carter, G. S., 1964, Two evolutionary theories, by M. Grene; a further discussion: British J. Phil. Sci., vol. 14, no. 56, pp. 345-349. ". . . we often have hierarchies of theories dealing with wider and wider ranges of fact. A theory of the history of the universe must be concordant with the accepted theory of the history of the solar system, [and] . . . with those of the history of the world and of the evolution of animals . . ."

Chorley, Richard J., 1964, Geography and analogue theory: Assoc. Am. Geographers, An., vol. 54, no. 1, pp. 127-137. ". . . one often has to choose between the clean but noisy model of Davis and the less clean but relatively quiet model of Gilbert."

Chorley, Richard J., Dunn, Anthony J. and Beckinsale, Robert P., 1964, The history of the study of landforms on the development of geomorphology, vol. 1, Geomorphology before Davis: London, Metheuen and Co.; New York, John Wiley and Sons, xvi and 678 pp. A history of the evolution of ideas relating to the development of the physical landscape from late medieval times to about 1890. Contains many illustrations and lengthy quotations from original works.

Chvorova, I. V., 1964, Facies und Formation: Geol. Ges. DDR, Ber., vol. 9, no. 1, pp. 123-140. "Ohne die Faziesanalyse können Formationen nur formal ausgeschieden werden, während die Bildungsverhältnisse der Formation selbst ungeklärt bleiben."

Crombie, A. C., 1963, Introduction, pp. 1-11 *in* Crombie, A.C., ed., Scientific change: New York, Basic Books, xii and 896 pp. "The

goal of historical scholarship is said to be to reconstruct the past, but the only past available for reconstruction is that which we can see from the present."

Cummins, W. A., 1962, The greywacke problem: Liverpool and Manchester Geol. J., vol. 3, pt. 1, pp. 51-72 ". . . if the principle of uniformitarianism is applied, the peculiar texture of greywackes cannot be an original detrital feature, but must be the result of post depositional alteration of 'normal sand.' "

Datta, Naresh Chandra, 1963, One hundred years of Darwinism: Science and Culture, vol. 29, no. 6, pp. 280-287. ". . . evolutionary philosophy raised many momentous questions but gave very few answers."

Davidson, C. F., Uniformitarianism and ore genesis: J. Univ. Sheffield Geol. Soc., Supp. for 12th Inter-University Geol. Cong., Dec., 1963, pp. 8-13. ". . . if due consideration is given to the fourth dimension of geological time, the assumption of non-uniformitarian conditions to explain the formation of ore deposits is a confession of mental lethargy."

Davidson, W., 1962, Philosophical aspects of cosmology: British J. Phil. Sci., vol. 13, no. 50, pp. 120-129. ". . . in the last analysis, the properties of the universe as a whole are likely to be relevant to many terrestrial and astral sciences. Indeed, it seems not too much to say that the logical goal of every pure science should be to find its place in a unified cosmology."

Davies, Gordon L., 1964, Robert Hooke and his conception of Earth-History: Geologists' Assoc., London, Pr., vol. 75, pt. 4, pp. 493-498. ". . . it is clear that by 1668 Hooke had formulated the shadowy outline of a theory of the earth that is almost identical with the theory that James Hutton presented to the Royal Society of Edinburgh in 1785."

Davies, J. T., 1964, The simple laws of science and history, pp. 255-265 *in* Bunge, Mario, ed., The critical approach to science and philosophy: New York, Free Press of Glencoe, xv and 480 pp. "Only by adopting Popper's principle of testing all theories, including those of history, with data chosen to try to *disprove* them are we applying scientific method to the subject. Even when our theory connects a wide range of historical data it is never inevitable. It has no logical status . . ."

Dineley, D. L., 1964, The chronological value of fossils, pp. 9-19 *in* Geochronology in Canada (Osborne, F. Fitz, ed.): Roy. Soc. Canada, Spec. Pub. 8; Toronto, Univ. Toronto Press, 156 pp.

"There are differing concepts of how, in detail, biostratigraphic principles should be applied but all are based on the simple fact that the palaeontological succession, tied to guaranteed stratigraphic sections, remains the geologist's surest means of recognizing relative age."

Dreyfuss, M., 1962, Réflexions sur quelques "unités" employées en stratigraphie et en paléontologie: Chronique Mines d'Outre-Mer, Paris, vol. 14, no. 56, pp. 1-5. Stages and species are the basic units in stratigraphy and paleontology, respectively. For purposes of time-correlation the standard stages should be selected on the basis of their continuity and abundance of characteristic marine fossils. Paleontologic species should be refined by the application of biometric methods, so as to show extremes in variations as well as median forms.

Dunham, K. C., 1964, Neptunist concepts in ore genesis: Econ. Geol., vol. 59, no. 1, pp. 1-21. ". . . Neptunist concepts have now been applied to some of the world's most important and interesting ore deposits."

Dury, G. H., 1963, Geographical description: an essay in criticism: Australian Geographer, vol. 9, no. 2, pp. 67-78. " . . . some geographical writing, purporting to belong to a factual but not especially technical cluster, is in actuality located high on the scale of evocation. Writing of this kind, offering itself as logical reasoning, uses figures of speech in place of argument."

Eccles, John C., 1964, The neurophysiological basis of experience, pp. 266-279 *in* Bunge, Mario, ed., The critical approach to science and philosophy: New York, Free Press of Glencoe, xv and 480 pp. ". . . the development and precise formulation of an hypothesis so that it encourages attempts at falsification greatly economizes the experimental effort, and gives it significant direction."

Ecker, R. Th., 1964, Les recherches paléoécologiques et leur importance: Chronique Mines et Recherche Minière, Paris, vol. 16, no. 63, pp. 1-9. "Les thèmes paléoécologiques . . . imposent aux paléontologistes l'établissement d'une *systématique écologique* des organismes disparus, en complément à la seule systématique génétique existant actuellement."

Eyles, V. A., 1964, Abraham Gottlob Werner (1749-1817) and his position in the history of the mineralogical and geological sciences: History of Science (Cambridge, W. Heffer and Sons), vol. 3, pp. 102-115. ". . . Werner's claim that the sedimentary

rocks succeed one another in an orderly succession that is universally the same was a distinct advance in geological thought and, as a generalisation, has stood the test of time."

Eyre, S. R., 1964, Determinism and the ecological approach to geography: Geography, vol. 49, pt. 4 (no. 225), pp. 369-376. "Although it is highly desirable that every one of its practitioners should have a proper understanding of some category of phenomena, either natural or human, geography either stands or falls as an integrating discipline."

Feuillée, Pierre, 1962, Historique de la notion d'étage dans le Tertiaire du Bassin Parisien: Cahiers Naturalistes, n.s., vol. 18, no. 3, pp. 57-62. Traces the development of stratigraphic classifications for the Tertiary sequence in the Paris Basin, as lithologic, paleontologic, sedimentologic, and paleogeographic criteria were applied in succession.

Furon, Raymond, 1963, Réflexions sur les méthodes de la Paléoclimatologie: Chronique Mines d'Outre-Mer, Paris, vol. 15, no. 60, pp. 1-7. ". . . la paléontologie stratigraphique et la paléobiologie restent les seules bases valables pour entreprendre l'étude de la Paléoclimatologie."

Gass, I. G., 1963, Vulcanicity and uniformitarianism: J. Univ. Sheffield Geol. Soc., Supp. for 12th Inter-University Geol. Cong., Dec., 1963, pp. 32-41. "In appraising the application of the theory of uniformitarianism to the problems of pillow lavas and ignimbrites, it seems that in the case of pillow lavas the key has been given to the origin of the minor occurrences of pillowed lava where these are in association with unpillowed lavas of the same composition."

George, T. Neville, 1964, Syllabus and method in the teaching of geology: Adv. Sci., vol. 20, no. 88, pp. 546-563. "In a satisfactorily organised general science geology occupies a particularly appropriate central position precisely because of the multiplicity of its contacts with most of the other sciences, and of the ease with which it incorporates the other sciences into its substance."

Gould, Stephen Jay, 1965, Is uniformitarianism necessary?: Am. J. Sci., vol. 263, pp. 223-228. "Substantive uniformitarianism, an incorrect theory, should be abandoned. Methodological uniformitarianism, now a superfluous term, is best confined to the past history of geology."

Gruber, Jacob W., 1964, Darwinism and its critics: History of Science (Cambridge, W. Heffer and Sons), vol. 3, pp. 115-123. "It is true that [in the 1860's] man still reigned supreme as God's special and most recent creation—but even this last refuge was endangered, not so much by Darwin nor even by evolution, as by the geological demonstration of man's antiquity, and by a developing naturalism of which Darwinism was but one important expression."

Guntau, Martin, 1963, Zum Problem der Klassifizierung der geologischen Wissenschaften: Ber. geol. Ges. DDR, Sonderh. 1, 1963, pp. 3-29. "Die dialektisch-materialistischen Kriterien für die Klassifikation der Wissenschaften sind das Prinzip der Objektivität und das Prinzip des wechselseitigen Zusammenhangs, die beide in einer untrennbaren Einheit betrachtet werden müssen."

2. 1963., Bemerkungen zum Aktualismus in der Geologie; Beitrag zu einigen Fragen des Determinismus in der wissenschaftlichen Arbeitsmethodik der Geologie: Geol. Ges. DDR, Ber., vol. 8, no. 4, pp. 377-389. "Die sinnvolle Verbindung von dediktiver und induktiver Methode—wobei zwischen beiden ein relativ weiter Bogen gespannt ist—kann eine brauchbare Grundlage für die Diskussion um die Weiterentwicklung des Aktualitätsprinzips sein."
3. 1964, Die Erde im wissenschaftlichen Weltbild, pp. 175-201 *in* Guntau, Martin and Wendt, Helge, eds., Naturforschung und Weltbild, eine Einführung in Probleme der Marxistischen Naturphilosophie: Berlin, Deutscher Verlag der Wissenschaften. "Ob in der Geochmie, Petrographie, Geophysik, Paläontologie oder gar historischen Geologie, immer ist die Aussage über das Verhalten der zu untersuchenden Objekte oder Zusammenhänge in der *Erdgeschichte* die krönende Antwort auf die geologische Fragestellung."
4. 1964, Die Bedeutung von Physik, Chemie und Biologie für die Erforschung der Erde, pp. 264-292 *in* Hörz, Herbert and Löther, Rolf, eds., Natur und Erkenntnis, philosophisch-methodologische Fragen der modernen Naturwissenschaft: Berlin, Deutscher Verlag der Wissenchaften. "Die organische Einheit der Erforschung der physikalischen, chemischen und biologischen grundlegenden Prozesse der Erde einerseits und ihrer spezifischen geologischen Zusmmenhänge andererseits gibt uns Aufklärung über die Gesetzmässigkeiten der Entwicklung und des gegenwärtigen Zustandes unseres Planeten."

Gunter, Gordon, 1947, Catastrophism in the sea and its paleontological significance, with special reference to the Gulf of Mexico: Am. J. Sci., vol. 245, pp. 669-676. ". . . catastrophic mass mortalities of marine animals in the Gulf of Mexico are very important . . . with respect to fossilization of the fauna of this region."

Hall, A. Rupert, 1963, Commentary on "The function of dogma in scientific research" by Thomas S. Kuhn; pp. 370-375 *in* Crombie, A. C., ed., Scientific change: New York, Basic Books, xii and 896 pp. ". . . there has never yet been a single unified intellectual framework for the whole of science."

Hayek, Fredrich A. von, 1964, The theory of complex phenomena, pp. 332-349 *in* Bunge, Mario, ed., The critical approach to science and philosophy: New York, Free Press of Glencoe, xv and 480 pp. "Until we have definite questions to ask we cannot employ our intellect; and questions presuppose that we have formed some provisional hypothesis or theory about the events."

Herneck, Friedrich, 1964, Der Beitrag der geologisch-paläontologischen Wissenchaften zum Welbild des 19. Jahrhunderts: Geol. Ges. DDR, Ber., vol. 9, pt. 1, pp. 57-73. "Das geologische Denken des 19. Jahrhunderts hat das kosmologische Denken des 20. Jahrhunderts psychologisch vorbereitet."

Hildebrand, Joel H., 1964, The use of models in physical science: Am. Philosophical Soc., Proc., vol. 108, no. 5, pp. 411-417. "Valuable and nearly indispensible as analogies are for the communication of ideas, one must resist temptation to mistake an analogy as evidence."

Holmes, Chauncey D., 1964, Equilibrium in humid-climate physiographic processes: Am. Jour. Sci., vol. 262, no. 4, pp. 436-445. ". . . no process of geologic change can possibly be time-independent."

Howard, Arthur David, 1959, Numerical systems of terrace nomenclature: J. Geol., vol. 67, no. 2, pp. 239-243. Discusses basic defects in numerical systems of terrace nomenclature, and proposes binomial system similar to that used in naming stratigraphic formations.

Hummel, K., 1940, Geochemie and Erdgeschichte: Deut. Geol. Ges. Zs., vol. 92, pp. 459-468. "Ob die geschichtliche Betrachtungsweise auch für die nichtbiologischen Naturwissenchaften sich fruchtbar erweisen wird, dies wird wesentlich davon abhängen,

ob es gelingt, Geochemie und Erdgeschichte zueinander in die richtige Beziehung zu bringen."

2. 1942, Bemerkungen zu dem Aufsatz K. Beurlen's über "Erdgeschichte und Naturgesetz": Deut. Geol. Ges. Zs., vol. 94, pp. 201-202. "Die Anwendung der von K.E.A. v. Hoff eingeführten aktualistischen *Methode* hat (im Gegensatz zu Lyell's *Grundsatz* des Aktualismus) durchaus nicht zur Voraussetzung die Annahme, dass stets in der Vergangenheit die heute wirkenden Kräfte und nur diese wirksam waren; der Nachweis, ob es so war oder nicht so war, is vielmehr erst das Ziel der Anwendung dieser einzig brauchbaren erdgeschichtlichen Methode."
3. 1942, Gibt es eine geschichtliche Entwicklung der Naturgesetze?: Deut. Geol. Ges., Zs., vol. 94, pp. 183-192. "Die erdgeschichtliche Forschung ist daher dazu berufen, die weltanschaulich wichtige Frage der zeitlichen Wandelbarkeit der heutigen Naturgesetze kritisch zu untersuchen."

Hurlburt, Cornelius S., Jr., 1964, The elementary course in a changing mineralogy: Am. Mineralogist, vol. 49, nos. 3, 4, pp. 227-241. "The mineralogist starts with a crystal as an accomplished fact and from this imperfect reality works toward generalizations regarding structures and properties. The physicist and chemist do the reverse."

Imbrie, John, 1963, An appraisal of uniformitarianism in palaeontology and stratigraphy: J. Univ. Sheffield Geol. Soc., Supp. for 12th Inter-University Geol. Cong., Dec., 1963, pp. 6-7. The principle of uniformity "expresses in geological terms the fundamental axiom of all science: Nature is orderly."

Janjic, Milosav, 1962, Ingenieurgeologische Karten: Deut. Geol. Ges., Zs., vol. 114, no. 2, pp. 327-336. Gives a classification of geological maps, including ten specialized varieties.

Jaspers, Karl, 1964, Three essays—Leonardo, Descartes, Max Weber (Translated from the German by Ralph Manheim): New York, Harcourt, Brace and World, vii and 274 pp. "Leonardo's discoveries, especially in anatomy, botany, and geology, are not guided by a constructive theory in the modern sense, but spring from an optical view of things, guided by an all-embracing cosmic consciousness."

Jeletzky, Jurij Alexander, 1965, Is it possible to quantify biochronological correlation?: J. Paleont., vol. 39, no. 1, pp. 135-140. "Any attempt at the quantification of biochronological correlation is . . . precluded by the fundamentally *qualitative*

and *nonstatistical* nature of its most valuable data (index fossils)."

Jepsen, Glenn Lowell, 1964, Princeton University Museum of Natural History: Princeton, N.J. (Published by the Museum), 19 pp. and appendicies. "Nature is here to stay. An exquisite mineral or fossil is, like a good painting, an aesthetic experience."

Kedrov, B. M., 1964, Methodological problems of natural science: Soviet Studies in Philosophy, IASP Translations from Original Soviet Sources, vol. 3, no. 2, pp. 3-14. ". . . the structure of a natural object takes the form of a distinctive *criterion* for the assumed genesis of the given object and its history, just as the present is, in the general sense, the key to the past and consequently to the structures from which the given object arose and which preceded it."

Kelvin, William Thomson, *Baron*, 1894, The doctrine of uniformity in geology briefly refuted, pp. 6-7 *in* Popular lectures and addresses of Sir William Thomson, vol. 2, Geology and general physics: London, MacMillan. Concise statement of Kelvin's rejection of substantive uniformitarianism (*See* Gould, this bibliography).

Krynine, Paul Dimitri, 1956, Uniformitarianism is a dangerous doctrine: J. Paleont., vol. 30, pp. 1003-1004. "Conventional uniformitarianism or 'gradualism,' i.e. the doctrine of unchanging change is verily contradicted by all post-Cambrian sedimentary data and the geotectonic histories of which these sediments are the record."

Kuhn, Thomas Samuel, 1963, The function of dogma in scientific research, pp. 347-369 *in* Crombie, A. C., ed., Scientific change: New York, Basic Books, xii and 896 pp. ". . . even a cursory examination of scientific pedagogy suggests that it is far more likely to induce professional rigidity than education in other fields, excepting, perhaps, systematic theology."

Legrand, P., 1964, Considérations sur l'évolution de quelques concepts de stratigraphie; Application a l'exploration d'un nouveau bassin sédimentaire: Chronique Mines d'Outre-Mer, Paris, vol. 16, no. 62, pp. 1-8. A summary of the principles of stratigraphic nomenclature and correlation.

Loeblich, Alfred Richard, Jr., and Tappan, Helen, 1964, Foraminiferal facts, fallacies, and frontiers: Geol. Soc. Am., B., vol. 75, pp. 367-392. "It seems that the past is the key to the present

in foraminifers for much more is known about the fossil species and their geological occurrence than is known of the living forms."

Manser, A. R., 1965, The concept of evolution: Philosophy (J. Roy. Inst. Phil.), vol. 40, no. 151, pp. 18-34. ". . . Darwinism . . . is not open to experimental refutation in the way that is normally expected of a scientific theory."

McGee, W. J., 1894, The extension of uniformitarianism to deformation: Geol. Soc. Am., B., vol. 6, pp. 71-102. "It is vain to explain the seen in terms of the unseen; and the time is gone by for the primitive appeal to the rare and remote in explanation of the common and the near at hand, to the imaginary in explanation of the real."

Miller, O. M. and Voskuil, Robert J., 1964, Thematic-map generalization: Geog. Rev., vol. 54, no. 1, pp. 13-19. "The codification of information on maps by the use of symbols . . . is the preferred method of transmitting information, because in cartography, as in mathematics, symbols can express relationships and convey information precisely and with the utmost economy of space."

Miller, T. G., 1965, Time in stratigraphy: Palaeontology, vol. 8, pp. 113-131. "It is a paradox that while the chronological aspect of stratigraphy is interpretative or derivitive, and hence strictly secondary to the visible physico-geometrical aspect which is the actual matrix of the evidence, it must nevertheless be considered aetiologically primary, since the processes involved are causally anterior to their material product."

Moreau, Jacques, 1964, Problèms et pseudo-problèms du déterminisme: physique, biologique, psychologique: Paris, Masson, 398 pp. "Au fond, la notion du temps rend superflue la notion de cause, car la relation causale est justiciable des rapports entre effets successifs."

Nash, Leonard K., 1963, The nature of the natural sciences: Boston, Toronto; Little Brown, xix and 406 pp. "We assume that things behave here and now in much the way that 'similar things' behaved there and then, and will again behave in other eras and places."

Neale, E. R. W., 1964, Twelfth inter-university geological congress: British Commonwealth Geological Liason Office, Liason Rept. 71, 19 pp. Summarizes talks on uniformitarianism by John Im-

brie, P. C. Sylvester-Bradley, L. R. Wilson, Ph. H. Kuenen, G. D. Nicholls, C. F. Davidson, I. G. Gass, S. K. Runcorn, and T. N. George.

Needham, Joseph, 1959, Science and civilization in China: Cambridge, Cambridge Univ. Press, vol. 3, Mathematics and the sciences of the heavens and the earth, xlvii and 874 pp. "It is . . . safe to say that at some time between the +2nd and +6th centuries, the expression *sang thien* had a familiar connotation equivalent to what we should now call 'geological time.' "

2. 1963, Poverties and triumphs of the Chinese scientific tradition, pp. 117-153 *in* Crombie, A. C., ed., Scientific change: New York, Basic Books, xii and 896 pp. "The basic principles of Huttonian geology were stated by Shen Kua in the late eleventh century A.D., but this was only a counterpart of a Plutonian theme recurring since the fourth century A.D., that of the *sang thien* or mountains which had once been at the bottom of the sea." (*See* pp. 143-144)

Nicholls, G. D., 1963, Sedimentation—past and present: J. Univ. Sheffield Geol. Soc., Supp. for 12th Inter-University Geol. Cong., Dec., 1963, pp. 25-31. "The principle of uniformitarianism which has served the geological sciences so well during the past is still appliable for the later part of geological time, covering the rocks, the interpretation of which was the basis for its introduction."

Nicol, David, 1964, The present not always a key to the past: Nautilus, vol. 78, pp. 17-18. Advises care in drawing paleoecologic inferences by comparisons of modern species with distantly related Paleozoic ones.

North, F. K., 1964, The geological time-scale, pp. 5-8 *in* Geochronology in Canada (Osborne, F. Fitz, ed.): Roy. Soc. Canada, Spec. Pub. 8; Toronto, Univ. Toronto Press, 156 pp. ". . . in cases in which the palaeontologist and the radiometrist are really in conflict, the ring will have to be held by that otherwise old-fashioned looker-on, the geologist in the field."

O'Faolain, Sean, 1964, A writer in search of himself: Atlantic Monthly, vol. 214, no. 4, pp. 104-120. "Where scientist and artist radically differ is in the nature of their material, not of their pursuits. We can classify crystals. We cannot classify the endless variety of the human psyche. But the pursuit of each seems to me to come from a similar intellectual desire to find order in the seeming chaos of Life."

Osborne, F. Fitz, 1964, Introduction, pp. 3-4 *in* Geochronology in Canada (Osborne, F. Fitz, ed.): Roy. Soc. Canada, Spec. Pub. 8; Toronto, Univ. Toronto Press, 156 pp. "In general, the ends [of geology] are satisfied if the nature, the causes, and the time of an event are determined."

Panel on Solid-Earth Problems of the Geophysics Research Board and Division of Earth Sciences, National Academy of Sciences—National Research Council, 1964, Solid-earth geophysics, survey and outlook: Washington, D.C., Natl. Acad. Sci.-Natl. Res. Council Pub. 1231, ix and 198 pp. "As its own laboratory and its own experiment, the earth is appalingly difficult to investigate."

Park, Charles F., 1964, Is geologic field work obsolete?: Econ. Geol., vol. 59, no. 4, pp. 527-537. "In recent years geologists have become so engrossed in astrogeology, the Mohorovicic discontinuity, and the laboratory aspects of our science, that they appear to have lost sight of the more orthodox, but still cardinal area of study—field work."

Passega, R., 1962, Problem of comparing ancient with recent sedimentary deposits: Am. Assoc. Petroleum Geol., B., vol. 46, no. 1, pp. 114-124. ". . . the better known recent sediments may have few equivalents in the geologic record and . . . the most common ancient sediments may be represented in modern seas only by peculiar deposits . . ."

Platt, John R., 1964, Strong inference: Science, vol. 146, no. 3642, pp. 347-353. "Many—perhaps most—of the great issues in science are qualitative, not quantitative, even in physics and chemistry."

Rappaport, Rhoda, 1964, Problems and sources in the history of geology, 1749-1810: History of Science (Cambridge, W. Heffer and Sons), vol. 3, pp. 60-78. "The history of geology suffers many of the ailments of other areas in the history of science: relative paucity of scholarly monographs and articles; an array of outdated secondary works; inadequate study of major and minor figures; and some scarcity of primary sources."

Richter, Frank, 1964, Diskussionsbermerkungen zu dem Beitrag von M. Guntau: "Zum Problem der Klassifizierung der geologischen Wissenschaften": Geol. Ges. DDR, Ber., vol. 9, pt. 2, pp. 269-273. "Als selbständige Wissenschaft mit eigenem Gegenstand besitzt die Geologie spezifisch geologische Gesetze und Regeln.

Die Existenz spezifischer Gesetze impliziert jedoch die Existenz einer besonderen Bewegungsform nicht."

Rogers, John J. W., 1964, Some applications of statistical models in geologic research: Texas J. Sci., vol. 16, pp. 342-349. "Certain geological processes may . . . approach more closely to an idealized mathematical treatment than equivalent operations in laboratory apparatus."

Rothstein, Jerome, 1964, Thermodynamics and some undecidable physical questions: Philosophy of Science, vol. 31, no. 1, pp. 40-48. ". . . evidence used to probe the early history of some object of interest generally involves observations on much more than the object of interest itself."

Rudwick, M. J. S., 1962, Hutton and Werner compared—George Greenough's geological tour of Scotland in 1805: British J. Hist. Sci., vol. 1, no. 2, pp. 117-135. Excerpts from Greenough's field journal reveal the sources of his scepticism toward both the Huttonian and Wernerian theories of the earth.

2. 1963, The foundation of the Geological Society of London, its scheme for co-operative research and its struggle for independence: British J. Hist. Sci., vol. 1, pt. 4, no. 4, pp. 325-355. ". . . perhaps the most remarkable achievement of the early Geological Society was its recognition that at least in some areas of science co-operative research could produce results that individual effort could never achieve."

3. 1964, The inference of function from structure in fossils: British J. Phil. Sci., vol. 15, no. 57, pp. 27-40. "The Synthetic theory [of organic evolution] . . . and the theories standing in opposition to it do indeed show many of the marks of closed all-explanatory systems."

Rucorn, S. K., 1963, The Earth's magnetic field and continental drift: J. Univ. Sheffield Geol. Soc., Supp. for 12th Inter-Univ. Geol. Cong. Dec., 1963, pp. 42-45. ". . . researches on continental drift illustrate Lyell's principle 'The Present is the Key to the Past.' "

Said, Rushdi, 1950, Geology in Tenth Century Arabic literature: Am. J. Sci., vol. 248, pp. 63-66. A classic Arabic work, dating from the Tenth Century, anticipated the main lines of Hutton's geostrophic cycle by about 800 years.

Schäfer, Wilhelm, 1962, Aktuo-Paläontologie nach Studien in der Nordsee: Frankfurt am Main, Waldemar Kramer, viii and 666

pp. ". . . wie sollen Geologen und Paläontologen die fossilen Meere und ihre Lebewesen rekonstruieren können, wenn sie nicht die Tierwelt wenigstens eines der rezenten Meere in ihrer fast verwirrenden Vielfalt an Zahl, Gestalt, und Verhalten erlekt haben?"

Schindewolf, Otto H., 1962, Neokatastrophismus?: Deut. Geol. Ges., Zs., vol. 114, no. 2, pp. 430-435. Faunal discontinuities of the magnitude that appear at the boundaries between the Paleozoic and Mesozoic, or between the Mesozoic and Cenozoic, are firmly established on empirical evidence. They imply universal biological changes of short duration, such as might have been caused by sharp changes in cosmic radiation. "Neocatastrophist," a label sometimes attached to one who recognizes worldwide faunal discontinuities as the facts that they are, is a misleading term, for it wrongly implies that neocatastrophism is a return to the metaphysical catastrophism of the last century.

Schlegel, Ernst, 1964, Diskussionsbeitrag zu einem Artikel von M. Guntau: Ber. Geol. Ges. DDR, Sonderh. 2, pp. 103-112. Proposes a new scheme for the classification of the geological sciences.

Schumm, S. A. and Lichty, R. W., 1965, Time, space and causality in geomorphology: Am. J. Sci., vol. 263, no. 2, pp. 110-119. "The distinction of cause and effect among geomorphic variables varies with the size of a landscape and with time."

Shaw, Alan B., 1964, Time in stratigraphy: New York, McGraw-Hill, xiv and 365 pp. "Paleontology should stand preeminent in stratigraphic geology as the only practical means of establishing time correlations, but it does not."

Shneiderov, A. J., 1961, The plutono- and tectonophysical processes in an expanding earth: Bol. Geofisica Teorica ed Applicata, vol. 3, no. 11, pp. 215-240. "The hypothesis of a cataclysmic formation of continents, oceans, seas, and other features of the Earth's surface from the primordial parent continent and parent ocean is proposed . . ."

Sigal, J. 1964, Une thérapeutique homéopathique en chronostratigraphie: les parastratotypes (ou prétendus tels): Chronique Mines et Recherche Miniere, Paris., vol. 16, no. 64, pp. 1-8. Discusses problems related to the designation of standard stratigraphic sections for use as time-rock units.

Skilling, Hugh, 1964, An operational view: Am. Scientist, vol. 52, no. 4, pp. 388A-396A. "I can see no boundary beyond which

ideas are beliefs, while short of the boundary they are facts. I can see only beliefs at all levels; beliefs with probabilities."

Slobodkin, Lawrence B., 1964, The strategy of evolution: Am. Scientist, vol. 52, no. 3, pp. 342-357. ". . . the absence of morally and philosophically satisfying conclusions about the ultimate meaning of evolutionary history are not weaknesses of biological theory, nor are they due to a shortage of biological facts."

Sticker, B., 1964, Herschel's cosmology: History of Science (Cambridge, W. Heffer and Sons), vol. 3, pp. 91-101. "For this [deeper insight into the *historical* character of the cosmic, geological and biological phenomena] we owe most (and until now this has usually been overlooked) to a very few geologists, palaeontologists and astronomers who worked at the end of the eighteenth and the beginning of the nineteenth centuries."

Stokes, William Lee, 1960, Essentials of earth history: Engelwood Cliffs, N. J., Prentice-Hall, x and 502 pp. "Geologists have a particular interest in the specific time interval during which the earth has existed as a planet, and their most important contribution to modern thought is a concept of just how vast the prehistoric phase of the earth's history really is."

Strakhov, N. M., 1962, Principles of historical geology (Translated from the Russian edition of 1948 by J. Kolodny and E. Rosenthal): Jerusalem, Israel Program for Scientific Translations, Pt. 1, 257 pp., Pt. 2, 432 pp. (Available from the Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C.). ". . . historical geology . . . is the field wherein the geologist attains final insight, and where the basis is laid for building up further specific knowledge and working techniques."

Sylvester-Bradley, P. C., 1963, Fossil sex: J. Univ. Sheffield Geol. Soc., Supp. for 12th Inter-University Geol. Cong., Dec., 1963, pp. 14-17. Shows how studies of the life cycles of modern cephalopods and ostracods may be used to interpret dimorphy in the fossilized tests of these animals.

Ullmo, Jean, 1964, The agreement between mathematics and physical phenomena, pp. 350-359 *in* Bunge, Mario, ed., The critical approach to science and philosophy: New York, Free Press of Glencoe, xv and 480 pp. "The value of science can only be proved by the very development of science; and the old problem of *adequation*, or agreement between mind and nature, is today more mysterious than ever . . ."

Vella, Paul, 1964, Paleoecology and uniformitarianism: New Zealand J. Geol. and Geophys., vol. 7, no. 1, pp. 242-243. While an empirical approach to paleoecology is required in order to sort out facts from inferences, the hypothesis of uniformitarianism must be applied if inferences are to be made regarding the depths of ancient marine biofacies.

Wagenbreth, Otfried, 1964, Fazies und Formation, eine geologie-geschichtliche Betrachtung: Geol. Ges. DDR, Ber., vol. 9, pp. 149-158. "In den geologischen Anschauungen von A. G. Werner und in denen von W. Smith war kein Platz für die Entwicklung des Faziesbegriffes, da beide ihre Bestimmungsmerkmale des Gesteinsalters—der eine die Petrographie der Gesteine, der andere die Versteinerungen—für weltweit einheitlich verbreitete Kriterien hielten."

Wahlstrom, Ernest E., 1964, The validity of geologic projection—a case history: Econ. Geol., vol. 59, no. 3, pp. 465-474. "Downward extrapolation of geological features is necessarily highly subjective and interpretive."

Watznauer, Adolf, 1964, Der Begriff der petrographischen Facies: Geol. Ges. DDR, Ber., vol. 9, no. 1, pp. 109-122.

Wegmann, Eugene, 1963, L'exposé original de la notion de faciès par. A. Gressly (1814-1865): Sciences de la Terre, vol. 9 (1962-1963), no. 1, pp. 83-119. Contains a reproduction of the chapter in Gressly's *Jura Soleurois* in which the concept of sedimentary facies was developed, together with a critical analysis of Gressly's contributions and a sketch of his life.

Wheeler, Harry Eugene, 1964, Baselevel, lithosphere surface, and time-stratigraphy: Geol. Soc. Am., B., vol. 75, pp. 599-610. ". . . time as a stratigraphic dimension has meaning only to the extent that any given moment in the Earth's history may be conceived as precisely coinciding with a corresponding world-wide lithosphere surface and all simultaneous events either occurring thereon or directly related thereto."

(Whewell, William), 1832, Principles of Geology by Charles Lyell, Esq. F.R.S., Professor of Geology in King's College, London, vol. 2, London, 1832: Quart. Rev., vol. 47, pp. 103-132. In this review Whewell coined the term uniformitarianism.

Whitrow, Gerald James, 1959, The structure and evolution of the universe: New York, Harper and Bros., 212 pp. ". . . the number of dimensions of physical space is necessarily three, no more and no less, because it is the unique natural concomitant of

evolution of the higher forms of terrestrial life, in particular of Man, the *formulator of the problem.*"

Wilson, J. Tuzo, 1964, Science is everybody's business: Am. Scientist, vol. 52, no. 3, pp. 266A-276A. "Hotly as many scientists will deny it, science is as much subject to fashion as other human activities."

Wilson, L. R., 1963, Morphology of modern spores and pollen as an index to the ecology of the past: J. Univ. Sheffield Geol. Soc., Supp. for 12th Inter-Univ. Geol. Cong., Dec., 1963, pp. 46-57. ". . . there is good reason to conclude that palynological studies of living species of plants hold the key to an understanding of the palynology of the past . . ."

Wilson, P. R., 1964, On the argument by analogy: Philosophy of Science, vol. 31, no. 1, pp. 34-39. ". . . the argument by analogy, in conjunction with a crucial test, has a legitimate place in scientific logic."

Yefremov, Yu K., 1964, The place of physical geography among the natural sciences: Soviet Geography—Review and Translation (Am. Geog. Soc.), vol. 5, no. 2, pp. 3-10. ". . . the object of study of geologic science is not only the past, since the past is being studied mainly to gain knowledge of . . . the earth in its present form."

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