LITERATURE REVIEWS

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TESTING TIME

ABSOLUTE AGE DETERMINATION. 1990. Mebus A. Geyh and Helmut Schleicher (English translator: R. Clark Newcomb). NY: Springer-Verlag. 503 p. Cloth, $69.00.

Reviewed by R. H. Brown, Yucaipa, California

This book fills a long-felt need for a comprehensive and authoritative summary of all physical and chemical techniques for quantitative determination of age. In their Introduction (p 1), the authors state: "This book is meant to be both a textbook and a reference book of all methods of physical and chemical age determination." In the preface (p vi), the reader is informed that the book "is addressed to everyone interested in the application of physical and chemical dating methods to the geosciences and archaeology. It should be especially valuable as a concise but comprehensive reference for students and practitioners using these methods."

For each technique the reader is given an explanation of the scientific principles involved, the materials and time range for which the technique is best adapted, key literature references concerning the technique and its application, and illustrative examples of its use. The literature references take up 64 pages of fine print. The text is written so that readers who do not intend to set up or operate a dating laboratory can skip over the Sample Treatment and Measurement Techniques section of each discussion.

The book treats a total of 56 distinct techniques for absolute-time-interval determination based on fundamental processes which characterize elementary matter. Consideration is given to an additional 15 techniques which are based on chemical reaction rates and cycles resulting from global events. A fold-out at the end of the book lists these 71 techniques, together with summary statements concerning the materials to which they are adapted, the time range of their application, and their suitability rank.

Against a background of implicit general confidence in the prevailing long-age models for the history of the universe, the Solar System, and planet Earth, the authors endeavor to take a critical approach to the

evaluation of each technique they discuss. In their Preface (p vi) they state:

> *It is...becoming increasingly difficult to assess the meaning of the data obtained; for example, the question may arise whether the determined age is the age of formation, early or late diagenesis, or some stage of metamorphosis. Moreover, different components of a sample may yield different kinds of ages, depending on the method applied....The information provided by the absolute dates alone is not sufficient to make chronological sense. This information must be supplemented by* [additional consideration before a reasonable interpretation can be developed].

An illustration is provided (p 6) by "U/Th dates for speleothem that are less than l0ka [and] often prove to be too large by many thousands of years without any indication...that such is the case."

From the viewpoint of most readers of *Origins*, the authors' repeated emphasis on need for age data to be *interpreted* by an *experienced* geochronologist (p 7, 22, e.g.) may be taken to indicate that in some cases valid interpretation(s) other than that which is currently in fashion may be possible. In Chapter 4 ("Treatment and Interpretation of the Raw Data") they state:

> *... each radiometric 'age' is never more than an analytically determined parameter (date) which can provide information about the time of a specific geological event only when all known geological, petrographic, and geochemical aspects are included in the interpretation. It must also be kept in mind that not all of the possible effects of the geological processes on the various dating methods can be completely understood or even recognized* (p 12).

In Chapter 6, which treats radiometric dating methods and extends over 263 pages, it is pointed out (p 55) that *if* a sample has been isolated (i.e., has been a closed system) its K-Ar "age" may designate initial crystallization, cooling, sedimentation, or diagenesis (changes in a sediment after initial deposition), and that this "age" may be unrealistically *low* because of greater argon diffusion than expected at low temperatures (even several orders of magnitude faster), or excessively *high* because radiogenic argon that previously accumulated in the material (by either diffusion or in-situ radioactivity) was not driven out before recooling (p 62).

In 35 pages of discussion on techniques that utilize a measurement of radiogenic lead, seven techniques are treated. Designating by "t(isotope

ratio)" the radiometric time (age) determined from a particular isotope ratio measurement, the usual pattern from measurement of a specific specimen is $t(^{207}Pb/^{206}Pb) > t(^{207}Pb/^{235}U) > t(^{206}Pb/^{238}U) > t(^{208}Pb/^{232}Th)$. This discordance implies either secondary Pb loss or gain in U and Th (p 117). In many cases the discordant data can be interpreted satisfactorily in terms of an initial formation time (age) t_0 and a subsequent modification event at t_1.

The reader of this review must not get an impression that radioisotope ages are characteristically discordant and of questionable interpretation. The frequency with which different isotope systems yield equivalent ages for a specimen is impressive. Examples include: the 3.59 Ga (giga or 10^9 year) age for the Amitsoq Gneiss of Greenland, according to Lu/Hf, Rb/Sr, and U/Pb isotope ratios (p 110), and the 2.72 Ga age for the Archean komatite flows in Ontario according to Re/Os, Sm/Nd, and Pb/Pb isotope ratios (p 113).

The 15 pages of discussion in Chapter 6 on the dating of meteorites and lunar rocks provide convenient access to the uniformitarian concepts concerning the history of elementary matter in the Solar System and the Milky Way Galaxy. A particularly significant observation treated in this section is that "Nearly all meteorites have been found to have a solidification age within the narrow limits of 4.57±0.03 Ga" (p 307; see also p 86 and 144), according to Rb/Sr, Re/Os, Sm/Nd, $^{207}Pb/^{206}Pb$, U/Pb, Th/Pb, and fission-track dating methods.

In their discussions of dating techniques based on recovery from disequilibrium, on the effects of radioactive transformation, on chemical processes, and utilizing paleomagnetism, the authors are thorough in pointing out the large uncertainties involved (p 253-371).

The text is notably free of typographical and grammatical errors. Most of those encountered are spelling errors due to loss of one letter in the typesetting process. The English translation is generally excellent, but there are a few difficult sentences which betray the problems of translation.

On p 125 the text incorrectly uses Ma (million years) for numbers which specify Ga (giga or billion years), or incorrectly uses a decimal point when specifying ages in Ma.

In the discussion on correction of Carbon-14 ages for contamination, Equation 6.62 on p 174 appears to be incorrect (wrong sign on one term?), but the associated Figure 6.55 is evidently correct.

Most readers of *Origins* approach a consideration of physical and chemical age dating with a concern regarding the relationship between the results obtained and the chronological data given in the Bible. In my judgment the raw physical data obtained from our observations of the

physical operation of the universe should be considered as revelations of the deity, and should be considered together with the specifications conveyed in the inspired writings of the Bible. The challenge is to find interpretive models that do not violate either sound basic scientific principles or sound principles of exegesis. Each source of information should illuminate the other. Scientists who are acquainted with the data treated in this book should not be expected to listen to a treatment of biblical material that does otherwise. For example, the $^{87}Sr/^{86}Sr$ data from marine carbonates discussed on p 93 could indicate volcanic activity during the global upheaval referenced in Genesis 7 and 8, with activity building up to the end of the "Jurassic," and declining sharply during the "Cretaceous" and into the early post-upheaval period.

A treatment of physical age data that harmonizes with the historical data in the Bible and is also as persuasive as the long-age interpretations given in this book will probably never be developed. The basis for my confidence in making such a prediction is the extreme improbability that there will be a sufficient number of individuals with adequate information and adequate financing coordinated for development of models that incorporate biblical specifications to the same degree of their potential that models which contradict biblical specifications have been developed to their potential.

There probably are few, if any, individuals who have developed implicit confidence in biblical testimony solely on the basis of supporting evidence from the natural sciences. But confidence in the character of God, and in the universality of truth, requires confidence that models can be developed which coordinate observations from the natural sciences with the witness of inspired testimony in a manner that meets the highest academic standards for interpreting each. In the search for truth there should be scientifically minded individuals who have the humility to recognize that some incorrect interpretations of physical data might be identified by specifications in the Bible, and there should be religiously oriented individuals who have the humility to recognize that some cases of reading more into the Bible than its Author and writers intended to convey might be identified by data acquired through scientific investigation. Models that harmonize both sources of specification do not need to be the most popular, or be widely accepted; but they must be true to the full range of evidence and to sound principles of interpretation. Geyh and Schleicher have given us a valuable resource for progress on the development of such models.