technological machinery required for the investigation of the properties of these highly versatile subcellular structures.

In essence, this book will impress the reader with the importance of a thorough understanding of catabolic processes mediated by lysosomes in the interpretation of numerous cellular physiological and pathological events.

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Neoplasia

The Cancer Problem. A Critical Analysis and Modern Synthesis. ARMIN C. BRAUN. Columbia University Press, New York, 1969. x, 214 pp., illus. $8.50.

Research in cancer for many decades has been guided and even dominated to a considerable degree by the notion that cancer is an expression of altered genetic composition of the precursor cell more or less resembling a somatic mutation. This concept has inevitably led many workers to the consideration that the neoplastic transformation is a series of irreversible changes all leading to an irrevocably altered cell. The factual basis for this generalization is indeed meager, being mainly the ubiquitous experience that the neoplastic expression is transmitted from cell to cell. Obviously, this judgment ignores another possibility—many biological expressions, such as those associated with differentiation of somatic cells, that are transmitted from the parent cell to the progeny as in the case of neoplastic cells may be the consequence of a modulation of a common genome rather than of an alteration in genomic information.

The present exposition of the cancer problem by an expert in plant pathology, especially plant neoplasia, is a clear and welcome challenge to the dogma. This small monograph gives a lucid description of some of the highlights of our present knowledge and concepts concerning the metabolic and molecular basis of cellular behavior in growth and differentiation and how such knowledge may well explain the essence of the neoplastic process. Although the author emphasizes plant systems, he by no means ignores animal systems, including the human. In fact, he makes every effort to show the basic similarities between plant and animal cells with respect to their response to carcinogenic hazards in their respective environments. As described by the author, the ways in which plant systems can be influenced by the various environments, including their ability to revert from obvious neoplastic behavior to normal, are impressive. Yet he stresses that, their greater manipulability notwithstanding, plant cells do show many of the features shown by animal cells during carcinogenesis.

Unfortunately, there are several weaknesses in the exposition. The treatment of carcinogenesis in animals is arbitrary and not very sophisticated. For example, the author repeatedly refers to the "two-stage" hypothesis, when there is no evidence for *two* stages, only for more than one. The omission of any serious consideration of different cell populations during carcinogenesis in several tissue systems is an obvious and regrettable flaw, and the author bases his discussion of chemical carcinogenesis on groups of chemicals for which we have the least information about possible mechanisms (for example, polycyclic aromatic hydrocarbons).

Despite these shortcomings, the book is highly recommended for any serious student of the cancer problem, especially the young but also the veteran investigator. The emphasis on the reversibility of cellular changes in neoplasia and on the need for a much more dynamic approach to understanding cancer is a welcome antidote to the rigid thinking that pervades too much of cancer research today. The continual attempt to relate biological behavior to chemical activities makes the book an especially useful one for the incoming cancer research worker with a strong chemical or biochemical background who would like to begin to appreciate conceptually the biology of neoplasia.

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Geochronological Method

Potassium-Argon Dating. Principles, Techniques and Applications to Geochronology. G. BRENT DALRYMPLE and MARVIN A. LANPHERE. Freeman, San Francisco, 1969. xiv, 258 pp., illus. $7.50.

Many recent books in geochronology are like the camel, which, according to some wag, is a horse put together by a committee; not so this book by Dalrymple and Lanphere. The book grew out of a pamphlet written in response to requests from a number of U.S. Geological Survey geologists who wanted a better understanding of potassium-argon dating. The authors attempted to preserve the simplicity of the original pamphlet while making the book more nearly complete and more useful. As they point out in their preface, the book is not intended to be a scholarly or comprehensive review of potassium-argon dating, but rather an introduction to the principles, techniques, and applications of the method. Nevertheless it succeeds in doing for potassium-argon dating what Willard Libby's book *Radiocarbon Dating* did for that radioactive clock; it provides a balanced and sufficiently comprehensive introduction to the subject for the nonspecialist user of the data. It also contains a substantial amount of practical information that will help earth scientists and anthropologists use potassium-argon dating results to better advantage.

Except for a few errors, the first three chapters present an excellent, simplified review of the physical principles underlying the potassium-argon dating method. However, as anyone can verify by going to the literature of nuclear physics, it simply is not true that "no detailed theories of nuclear structure and radioactivity can yet be developed" (p. 25). Also, the assertion that "in the earth's atmosphere the inert gases are about a thousand times less abundant than they are in the solar system" (p. 21) is a great underestimation; the least depleted of the inert gases, xenon, is over a millionfold less abundant in the earth's atmosphere relative to the solar system, and helium is depleted by a factor exceeding 10^{12}.

Chapter 4 presents a good, conventional description of the ideal potassium-argon clock. I prefer a more general approach, that is, to start with a non-ideal open-system model including an external argon pressure and derive the ideal model as a special case. Extraneous argon is thus explicitly included as a separate term and need not be introduced later, *ad hoc*, as an afterthought. The open-system model would also lead conveniently and without discontinuity to discussion of argon loss (treated in chapter 9 of this book). The net effect of introducing the open-system model is not unnecessary complication but rather simplification and increased continuity.

With the exception of the treatment

of the dynamic method of argon analysis, the chapters on argon measurement and potassium measurement present a lucid and informative description of experimental techniques. Contrary to the authors' statement, leak systems for the dynamic method need not be more complicated than a constricted capillary, a hole formed by drawing a wire through hot glass, or an ordinary, commercially available leak valve. For example, with a commercial leak valve, we obtain a Graham's law relationship among the three stable argon isotopes. Of course, we must plot the isotopic data as a function of time, as in the static method, and not average the isotope ratios as stated by the authors (p. 82). The Graham's law relationship provides an additional boundary condition which must be satisfied for a good analysis. The increased sensitivity obtainable with the static technique makes it essential to use this method for very young samples requiring larger air corrections. For older samples, however, the dynamic method provides ample sensitivity and is free from the bothersome memory effects that are frequently encountered in the static method. Dalrymple and Lanphere do not mention that mass spectrometers employing low-voltage ion acceleration, such as the MS-10, trochoidal tubes, and omegatrons, are said to be relatively free of memory effects by workers who have used them.

The chapter on accuracy and precision, in accord with the authors' intent, is simplified but quite adequate. In the chapter on extraneous argon, the authors state that "in order to test for excess Ar^{40}, it is necessary to establish the age of the rock or mineral by some independent means" (p. 122). In fact, when different minerals from the same rock are analyzed, the expected age of the rock need only be known in a very general way. Graphical techniques for analyzing data, which are not discussed by the authors, frequently make clear the existence of extraneous argon and, in addition, yield a good approximation to the correct age of the rock. Except for minor points not worth mentioning, I find this the only flaw in an otherwise excellent chapter.

Many readers will find chapter 10, entitled "What can be dated?", alone worth the price of the book. It clearly answers the most frequent questions concerning the amount, purity, and suitability of various materials for dating purposes.

In the final chapter, the authors give case histories of some of the most important potassium-argon dating problems: the dating of early man (*Zinjanthropus*), age of mineralization, chronology of geomagnetic reversals, and dating Precambrian rocks, as well as the use of potassium-argon dating to establish an "absolute" time scale and to evaluate provenance of detrital components of sedimentary rocks. One fault is the absence of any discussion of the dating of metamorphic rocks. The determination of "cooling" ages and "overprint" ages can be a valuable tool for evaluation of geotectonic and petrologic problems.

For some time now there has been a difference of opinion between Arizona and California geochronologists concerning the dating of the Precambrian of Arizona. Although outnumbered, we Arizonans have the advantage of living in the midst of Arizona's Precambrian terrain. Californians are welcome here, but we do wish they would read all of our papers (and more carefully) and spend a little more time in the field studying Arizona's Precambrian rocks. The fact is, contrary to the impression left by Lanphere (p. 221), we had dated 1600- to 1800-million-year-old igneous rocks in Arizona and Sonora long before the publication of the paper by Wasserburg and Lanphere in 1965 (Damon *et al.*, Annual Report No. 3 to Research Division USAEC, Contract AT[11-1]-689, July 1961, and subsequent papers and publications prior to 1965). However, it was a fellow Californian, L. T. Silver, not referenced by the authors, who first became aware that the antiquity of the Arizonan Precambrian was greater than had previously been suspected (Silver and Deutsch, *Ann. N.Y. Acad. Sci.* **91**, art. 2, 279 [1961]). Silver is in agreement with Wasserburg and Lanphere concerning the great antiquity of the Mazatzal Revolution. However, our late Arizona colleague Eldred Wilson, who defined the Mazatzal Revolution, agreed with our conclusion that this Revolution was terminated by the intrusion of approximately 1400-million-year-old batholiths and thus was of lesser antiquity than was supposed by the Californians. It will probably take somebody from back East to settle our differences. At any rate, potassium-argon dating can be not only controversial but also fun.

It is far easier to criticize an excellent book like this than to write it. The authors have fulfilled the hope they expressed in their preface that "both students and working earth scientists will find this book valuable not only as an introduction to potassium-argon dating but as a practical guide to its use."

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Computer Science

Theory of Automata. ARTO SALOMAA. Pergamon, New York, 1969. xii, 264 pp., illus. $12. International Series of Monographs in Pure and Applied Mathematics, vol. 100.

Theories of Abstract Automata. MICHAEL A. ARBIB. Prentice-Hall, Englewood Cliffs, N.J., 1969. xviii, 414 pp., illus. $14.95. Prentice-Hall Series in Automatic Computation.

In the past few decades, mathematical automata theory has been developed. It is now firmly established as a basic course in almost all computer science departments. At the research level, there are now deep results which exhibit surprising connections with logic, algebra, probability theory, linguistics, and computer programming.

In this context, the two books under review offer an interesting contrast. The book by Salomaa is intended as an advanced undergraduate text. It is a book that attempts to cover only certain basic areas but does so quite thoroughly. Salomaa's book is organized around finite deterministic automata and regular expressions. The language of regular expressions characterizes the manner in which finite automata behave. These topics are generalized and studied in various ways; examples include two-way automata, nondeterministic finite automata, and probabilistic automata. Salomaa has contributed a great deal to the study of the algebra of regular events, and he summarizes much of his research in the book. There is a concluding chapter on formal languages and their characterizations by automata. To summarize, Salomaa builds a textbook around a few basic notions, and it is a rigorous and clear introduction to the subject.

Arbib's book is in many ways the opposite of Salomaa's. Arbib wishes to exhibit the many diverse aspects of automata theory. The book begins with an overview and a chapter on algebraic background. The section