stimulate a revival of concern with Hutton's monumental synthesis of a budding science. For, in my opinion, Hutton has been somewhat eclipsed by a myopic concern with 19th-century workers who, in fact, inherited practically all their geological principles from their Scottish forebear. Bailey's updated source book has advantages over Playfair's *Illustrations* in being a more detached analysis and in being couched in modern geological and compositional style.

The book contains no illustrations or tables and is printed in a modest but readable format. It suffers greatly in lacking an index, and it contains many typographical errors. Most serious, however, is its exorbitant cost. We have come to expect a flood of expensive books from the publisher of this volume, but it is perplexing that this little book should bear a price tag of more than 5 cents a page when American publishers seem satisfied to charge 2 or 3 cents a page for much more complicated scientific books. This seems especially paradoxical when publishing costs are alleged to be significantly smaller abroad.

Bailey presents a brief and reasonably objective biographical sketch of Hutton and then sets forth, at greater length, a more or less chronological account of Hutton's writings, with numerous, well-selected short quotations and abstracts. Probably the greatest value of the book is its clarification of the sequential development and documentation of concepts by Hutton and in showing clearly which other writers most influenced him. Bailey and others have pointed out that Hutton's writings were so cumbersome and verbose that it is extremely difficult to perceive this chronology. Playfair's delightful *Illustrations* did not fully illuminate this point, for it was topically organized. An example of the need for a clear chronological comprehension of Hutton's work is the fact that volume 3 of *Theory of the Earth*, which was not published until 1894 (100 years after Hutton's death), contains detailed accounts of the discovery of the famous angular unconformity at the base of the Old Red Sandstone and of many intrusive granites. Yet it is virtually certain that this volume was written before volume 1, which was published in 1795. Worse still, we find that, like volume 1 of the long version, the early condensed version of his theory published in 1788 contains no inkling that during the preceding three years Hutton had actually observed several clear examples of the angular unconformity and of intrusive granites. Only after these things are sorted out is it possible to assess properly Hutton's own, original contributions.

From Bailey's very readable treatment, Hutton's intuitive genius becomes clearer than ever. His preeminence as the first great synthesizer of the science of geology is unquestioned. He not only hit upon the correct concept of the forceful upheaval of mountainous areas accompanied by faulting, folding, and plutonism as well as by erosional degradation, but he also anticipated the concepts of metamorphism, of past expansion of glaciers, and, according to Bailey, of adaptation and possibly even of evolution of organisms. But Hutton was not perfect. Bailey especially notes his overpreoccupation with the then popular concept of a grand design or purpose in nature. Hutton repeatedly refers to the upheaval of land and its subsequent weathering and erosion as occurring for the sole purpose of providing a "perfect" habitat for plants and animals. From this premise, he developed what Bailey terms a concept of cyclic continuity—a kind of steady-state world. This cyclic concept has had almost incalculable, but not entirely beneficial, influences upon geologic thought right down to the present day.

The many ramifications of Hutton's influence upon the development of geology deserve further investigation, and it surely will be aided by E. B. Bailey's last contribution to geology. This book is a fitting tribute across the centuries from one great Scottish geologist to another.

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Mitotic Phenomenon

International Symposium on the Nucleolus, Its Structure and Function (Montevideo, Uruguay, December 1965). W. S. VINCENT and O. L. MILLER, JR., Eds. National Cancer Institute Monograph 23, Washington, D.C., 1967. 630 pp., illus. $5. Available from the Government Printing Office.

This to the best of my knowledge is the first book to be devoted in its entirety to the nucleolus. It's a thick book that contains the thoughts of some 75 speakers, co-authors, and discussants and considers the nucleolus from most of the possible viewpoints. From this massive amount of information two clear-cut take-home lessons emerge: first, that although nucleoli of different creatures look different by light microscopy, they are all remarkably similar in fine structure, composed as they are of coarse fibers, fine fibers, and granules; and second, that the nucleolus is made by the nucleolar organizer, which we already knew, and that the nucleolar organizer contains the genetic material responsible for the coding of ribosomal RNA.

The first section, on nucleolar structure, contains particularly illuminating sections by L. Chouinard showing, as is generally agreed, that the nucleolus consists of a fibrous network surrounding a more or less structureless center which is full of granules of ribosomal-subunit size. O. L. Miller discusses in detail the multiple nucleoli produced during the development of the *Triturus* oocyte. Each of these several hundred nucleoli, which are unique to the oocyte, contains DNA, apparently circular in configuration (although this is not rigorously proved), in amount sufficient to code for 10 to 100 cistrons of each of the 28*S* and 18*S* ribosomal RNA subunits.

The second section, on nucleolar composition, comes to no clear-cut conclusion. This is due, apparently, to the fact that it is not yet possible to isolate nucleoli with the degree of noncontamination by other nuclear components required for establishment of unique chemical composition. A third section, Nucleolus in the Cell Cycle, contains extensive discussion by D. D. Brown of the appearance of multiple nucleoli during the development of *Xenopus* eggs, and their disappearance at meiosis. It would be more interesting if Brown could tell us why no nucleoli are formed during early embryonic development. This is an important and interesting question concerning the control of the nucleolar organizer, and one that certainly can be approached in *Xenopus* more readily than in most other organisms.

By contrast with the earlier sections, the section Nucleolar Genes provides extensive insight and summarizes much important newly gained knowledge. H.

Wallace shows that the transfer-RNA cistrons are located outside the nucleolar organizer, and the accompanying paper by Birnstiel, Wallace, Sirlin, and Fischberg, together with that of Ritosa, Atwood, Lindsley, and Spiegelman, shows elegantly that the nucleolar organizer contains all of the cistrons for ribosomal RNA synthesis. Each paper points, too, to a paradox. In *Xenopus* the ribosomal RNA cistrons are clustered in molecules of molecular weight 50 million or more, and each *Xenopus* genome contains about 1000 to 2000 for each of the 28*S* and 18*S* ribosomal RNA's. The number of ribosomal cistrons is smaller in *Drosophila*, considered by Ritosa *et al.*, but still is 130 or so. What is the nature of this redundancy? It will certainly be of great interest to study it further by, for example, kinetics of renaturation of the nucleolar-organizer DNA. Ritosa *et al.* go on to show also that there are phenotypic expressions of ribosomal cistron deficiency. Thus the *bobbed* mutants of *Drosophila* are partial deletions of the nucleolar organizer. Similarly, the *minute* mutants of *Drosophila*, scattered throughout the genome, are deletions for transfer-RNA cistrons. There are approximately 55 *minute* mutants known, corresponding closely to the 60 or so species of transfer RNA, for each of which on the average there are 15 cistrons in *Drosophila.*

A final section on the nucleolus and ribosome biogenesis comes to only one general conclusion: to wit, that 45*S* RNA, the precursor of 28*S* and 18*S* RNA, is made in the nucleolus. Whether 45*S* is cleaved to 28 and 18 in the nucleolus, whether or not the ribosomal protein is made in the nucleolus, and the form in which RNA is exported from the nucleolus to the nucleus and thence to the cytoplasm, are all unsolved problems awaiting a further conference on the nucleolus.

C. H. Waddington, in his summation, captures the spirit of the meeting and of the volume: "Possibly many of us thought . . . that we had the nucleolus pretty well under control, and that a general consensus would emerge. Few of us can still suffer from such optimistic delusions." There is much to learn about the nucleolus, although that it has a role in ribosome biosynthesis is established. The totality of its role remains to be discovered.

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Tools of Science on Display

Scientific Instruments in Art and History. HENRI MICHEL. Translated from the French edition (Brussels, 1965) by R. E. W. Maddison and Francis R. Maddison. Viking Press, New York, 1967. 208 pp., illus., 101 color plates. $18.50.

The historian of science is now in the company of the art critic, the collector of furniture, and the architect, to name no others, in being able to leave a really beautiful book on his coffee table, a book which will at the same time make an eloquent plea for the subject that is his vocation or his hobby. An attentive guest, left alone with Henri Michel's book for an hour or so, not only will find a feast for the eye but may learn a great deal about the history of the tools of science.

This is a book for the intelligent layman. In the text there are no formal references for the specialist, although the translators have added a list of suggestions for further reading and one of important collections. The arrangement of the book could scarcely be bettered. Each of the five groups of color plates is preceded by an elegant short history of the branch of instrumentation concerned and is followed by brief articles on each of the objects displayed. A subject index and an index of names conclude the volume. The reviewer would not presume to take issue with such a great authority as Michel on matters of fact, except in part 5 of the book (Physical Measurements), where there are two or three small errors: Fontana's ingenious recording barometer was not "the first attempt at recording variations in barometric pressure" (p. 195); Robert Hooke had done it about a century earlier, but for some obscure reason Hooke is nearly always forgotten. Pascal did not make the Puy-de-Dôme experiment (p. 171); and surely it is unfair to Michael Faraday to state (p. 173) that "the whole of modern electrotechnics has developed" from the Voltaic pile.

The translation has been so well done that one forgets that he is not reading an original. The production of the book is superb, with very few misprints, the most noticeable being the apparent omission of a subheading on page 199, with the result that magnetic and electrical apparatus is presented under "heat." High honors must go to the photographers, nearly all named, whose taste and skill have made the plates such a delight to the eye. There is a lesson in this book for the curators, or perhaps the builders, of museums. The reviewer has probably seen, or walked past, most of the objects in these pictures. Isolated and illuminated as they have been for this book, they all look much more attractive than he remembers them as being.

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Study of a Technique

Mass Spectrometry. Theory and Applications. R. JAYARAM. Plenum Press, New York, 1966. 239 pp., illus. $12.50.

This book is the result of the author's attempt to inform himself as to recent theoretical and experimental developments in the field of mass spectrometry. It is thus a work written with enthusiasm but does to some extent bear the marks of its origins. The author has nonetheless given a satisfactory account of the different types of mass spectrometers and a very useful account indeed of radio-frequency mass spectrometers. The chapters on cyclotron-resonance mass spectrometers and on the mass filter as a mass spectrometer are likewise quite well done, though possibly somewhat too brief. High-resolution mass spectrometers are somewhat ignored.

Though there is undoubtedly a somewhat derivative character about the book, it should provide a useful introduction to this rapidly expanding field. Perhaps one of its weaknesses is that the sections dealing with applications are almost entirely restricted to upper-atmosphere research. This seems almost unpardonable, particularly as the title would lead one to believe that the author intended to discuss the whole of the field. There is no doubt that the value of the book would have been greatly enhanced had the author included chapters showing applications of different types of mass spectrometers in many different areas of research in physics and chemistry.

Naturally, from what has been said, it would be too much to expect the author to have provided extensive references. Those selected are satisfactory, but many classical key references have been omitted.

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