meet in F. R. Cowell's chapter on everyday life in both. I cannot help but feel that the squalor of Athens is overemphasized, and I do not believe that there was less of this in Rome or that the poor of Rome lived better because of the tenements. It is rather the squalor of the latter that has so often appalled us. We know much, from Olynthos and Delos in particular, of the houses and appurtenances of middle-class merchants in Greece, but none of this is mentioned. The picture given here seems quite out of focus with respect to material remains. The statement that there were no tables as we know them seems out of keeping with the evidence (p. 182). With respect to occupations, avocations, education, justice and the law, the account is better.

R. A. G. Carson's account of Roman history, from the founding of the city to the moving of the capitol to Constantinople, is another tightly and masterfully drawn account. The author's interest in numismatics is often evident, nowhere with more pleasing results than in the numerous excellent photographs of coins, often in color, used to give the reader a visual image of the chief participants in the events described; the series of coins shown on pages 216 and 217 is superb. Hardly less can be said for Michael Grant's chapter on Roman literature. There is nothing of importance left out and little that one would want to do without. Its high readability matches that of both Boardman's and Carson's chapters. The illustrations are most varied, and Grant has drawn on every possible source to illuminate his account.

But in Sir Mortimer Wheeler's chapter on Roman art and architecture we are let down with a thud. From the very start there is a feeling that the author protests too much against the usual preference for things Greek and that he is on the defensive as an apologist for the Roman product. One would expect him to muster his best arguments in support of the Romans, and it is disappointing to see that he does not. In an 18-page chapter, more than 14 pages are on architecture, which is understandable since it is in this field that the Romans made their greatest contributions to the material world. But eight pages are taken up with a repetitious account of Roman town planning, an area in which the author claims no great originality for the Romans. Much of this space could, and should, have been saved so that there might have been room to tell of the Roman genius in planning large, symmetrically arranged building complexes, best epitomized by the Imperial Fora but already apparent in the early Republic. The evolution of the Roman temple, as distinct from the Greek temple, might then have been explained with regard to it axial position in great rectangular enclosures, usually at the back and attached to the rear portico of the rectangle. The particular decorative use of the Greek orders in superimposed rows, common as early as Sullan times, might have been mentioned, as might also the use of continuous arcading. The type of multiple-terraced composition represented by the Temple of Fortune at Praeneste, one which had great influence in Renaissance and later times, receives no mention here. But most lamentably, the discovery of concrete and its consequences for Roman architecture, especially the complete change in the concept of enclosed space that comes with the resultant development of vaults and domes, is alluded to so briefly that only in the final summing up at the end of the chapter does one get any idea of its tremendous significance for the whole history of architecture. The Pantheon alone is singled out to epitomize this development, and no monument does so better, but there is much before and a great deal after to the story of this momentous development. For all this there would have been room had the author not indulged an interest in town planning, and a presentation of the material that demonstrates the real genius of Roman architects would have made unnecessary the initial weak pleadings of the apologist. Much of this information on the Roman genius is brought out in Frank Brown's recent book *Roman Architecture* (1961), which is not even mentioned in the bibliography. With but three pages left for other aspects of Roman art, Sir Mortimer did well to choose the development of portraiture, of narrative, and of landscape as most important; each of these is presented well in very brief compass. The conclusions are a better statement than the chapter proper, for here the author has at least alluded to the essential points that add up to a major Roman contribution in art and architecture.

Michael Gough concludes the book with a brief but very well stated account of the triumph of Christianity and of its role as a bridge between the ancient and medieval worlds. Both text and illustrations point out the degree to which Christian iconography, much of it already well formed before the Edict of Milan in 313 and the founding of Constantinople in 330, is indebted to the art of Greece and of Rome, on the one hand, and, on the other, how much it transmits from antiquity to the Middle Ages. Hirmer's photograph of the cupola of the Baptistery of the Orthodox at Ravenna is one of the most glorious in the book; it alone says so much of the union of the new order and the old.

In summation, this is a highly satisfactory series of sketches, done by competent hands in quick and sure strokes. Yet each sketch is of only a part of the whole, and one cannot help but feel that they lose something in not being more closely integrated, for they do not add up to the one great picture of which they are all part. The whole is in this case more than the sum of its parts, for in the dissection a feeling for the whole has been lost, and the links are nowhere clearly established. Yet to ask for more is almost to ask for the impossible. No one person could paint the whole picture as well as these artists have sketched the parts. Only by becoming immersed in the past can one gain a full appreciation of the whole picture, and here is an excellent beginning for the layman along the road to the full understanding of the manifold genius of Greece and Rome.

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Exobiology

Worlds Without Ends. A reflection on planets, life, and time. N. J. Berrill. Macmillan, New York, 1964. x + 240 pp. $5.95.

Appreciation by the public of scientific progress has proven to be a remarkably difficult objective to achieve. The incomparable Jules Verne, who wrote science fiction based on solid scientific fact and on justifiable inference, was perhaps the best practitioner in the art of informative and imaginative scientific writing. By contrast, other attempts to popularize science have often been pedantic and humorless.

And if past experience is any basis for judging, most of these efforts are destined to a quick and merciful oblivion.

It is therefore refreshing to read this unusual book by N. J. Berrill, who is Strathcona Professor of Zoology at McGill University and the author of a number of books and articles. In this volume Berrill's ostensible purpose is to extrapolate to other worlds what is known about life on earth and to speculate about the possible existence and nature of extraterrestrial life. In a kind of rambling discursive style, which has some of the attributes of free association, the author examines some of the components of the solar system, the nature and diversity of life from the viewpoint of a classical biologist, and finally the problems and prospects of space communication and travel.

The real intent of the writer, however, soon reveals itself, if the reader has not already guessed it by scanning the table of contents. The titles of some of the chapters are "Moonstruck"; "Out of their minds"; "Landed gentry"; and "Is sex necessary?" The overall impression left with the reader is that of a tongue-in-cheek discussion of "exobiology." By far the best part of the book is that which deals with the subject that the author knows best—the overwhelming variety of the earth's ecology and the questions raised about the nature of life itself. There is, however, some implied teleology in certain involved sentences—for example, "So what we see when we look at a horse is what a horse has to be if it is to be as big as it is and run as well as a dog" (p. 98). The author makes no significant reference to the key discoveries of modern genetics.

The book is also marred by a number of inaccuracies; for example, in describing the Martian dark areas Berrill says: "Often the colors become brownish, reddish, black, or even a moss green" (p. 55). But there exists substantial evidence suggesting that these colors are the result of an optical illusion arising from the contrast against the bright areas of the planet. Certain sweeping statements—for example, "Taken altogether, the evidence makes the existence of life on Mars almost a certainty" (p. 57) and the statement denying that relativistic time dilation applies to biological systems (p. 217)—are, to say the least, unwarranted. Anthropomorphisms of the type found on page 71—"Jupiter . . . turns on its axis in less than ten hours, blowing and rumbling as it spins around"—whether intentional or not, seem flippant rather than witty.

Perhaps the author's main contribution has been to provide an enjoyable and quite readable alternative to the plethora of space books that suffer from exaggerated optimism and labored enthusiasm.

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Organic Chemistry Series

Carbene Chemistry. Wolfgang Kirmse. With a chapter by H. M. Frey and one by P. P. Gaspar and G. S. Hammond. Academic Press, New York, 1964. vii + 302 pp. $9.50.

During the last decade or so, at least four areas of organic chemistry have emerged from a position of relative obscurity to one of permanent importance in the field. One of these areas is the subject of this monograph, the first in a new series edited by Alfred T. Blomquist of Cornell University.

The chemistry of carbenes covers a rapidly growing class of highly reactive divalent derivatives of carbon, the central significance of which lies in its relevance to the fundamentally organic chemical problem of transforming one covalent bond into another. During the past 50 years it has been found that the great bulk of organic chemical reactions involve three classes of highly reactive trivalent intermediates—the positively charged carbonium ions, the neutral free radicals, and the negatively charged carbanions. Divalent carbon, which has now been established as a fourth class of reactive intermediates, has given rise to a host of novel chemical transformations.

The story of these intermediates is told simply and clearly by Kirmse in an orderly sequence, beginning with the parent unsubstituted methylene and proceeding chapter by chapter through carbenes substituted by alkyl groups, double and triple bonds, aromatic rings, the ester grouping, ketones, halogens, and miscellaneous types. Within each chapter emphasis is placed on methods of preparation of the divalent intermediates and on the chemical reactions to which they give rise. The presentation of these more classical aspects represents an impressively successful effort to cover a rapidly growing literature in complete form.

The fascinating mechanistic aspects of the field are woven into the formal development skillfully and with a fine sense of relevance. It is particularly in these sections that Kirmse's long experience as an imaginative contributor to the chemistry of carbenes, his command of the current theory of organic chemistry, and his inately critical and analytical mind have combined to lift this monograph far above the level of the customary review.

Two features in the chemistry of carbenes are of particular interest to physical organic chemists. One involves the behavior of the so-called "hot" molecules that are formed with abnormally high energies as the initial product of gas-phase reactions of methylene; the other concerns the calculation and establishment of the electronic spin states of carbenes. These subjects are expertly handled by Frey (University of Southampton) and Hammond (California Institute of Technology) and Gaspar (Washington University, St. Louis).

Because it was mainly written by one good man, this book achieves a coherence that is a most welcome change from the more customary collection of chapters written by several authors of disparate points of view and abilities. It is well indexed and free of serious errors; I recommend it highly for those whose background permits them to indulge their interest in the exciting events at the frontier of organic chemistry.

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Plasma Physics

Dynamics of Charged Particles. Bo Lehnert. North-Holland, Amsterdam; Interscience (Wiley), New York, 1964. 310 pp. Illus. $11.50.

The subject of plasma physics is studied by scientists in a variety of disciplines, partly because of its intrinsic complexity and partly because of its appeal in diverse applied areas. A division exists between the particle approach and the gas dynamic approach; the present text follows the former choice. In this plan, it becomes a major addition to the field. A basic