Combes (which I found too diffuse in presentation and too terse in its technical parts) are very well written. Special mention should be made of an encyclopedic review by E. Lieb of the work (most of it by Lieb and his collaborators) on Thomas-Fermi and related equations and of a paper by J. M. Combes, P. Duclos, and R. Seiler on the Born-Oppenheimer approximation, which is the most complete presentation to date of a set of ideas that the authors announced over five years ago and that have previously been presented only in bits and pieces. It should be mentioned that the title is somewhat misleading concerning this part of the book. Roughly half the material deals with atomic and molecular problems, but the other half discusses general nonrelativistic quantum mechanics.

The second 163 pages discuss Coulomb systems. All four papers on this subject are excellent, but with the partial exception of J. L. Lebowitz's paper on free energy and correlation functions of Coulomb systems their connection with the first seven papers is tenuous at best. The editors (who were the organizers of the school) write in the preface that the recent work of D. Brydges and P. Federbush shows for the first time from first principles that Debye screening is a consequence of Schrödinger's equation. This work (which Brydges and Federbush discuss in the book) and all other rigorous proofs of screening have been for classical Coulomb systems, however. Papers by M. Aizenman and by J. Frohlich and T. Spencer are even further removed from atomic problems; they deal with Coulomb systems in one and two space dimensions respectively, where Coulomb potential diverges at infinity. So only about a third of the book deals with atomic and molecular physics, but virtually all of the book is rigorous.

The editors might have included the papers on Coulomb systems in order to make the point that there is too little known about the special features of quantum mechanics with Coulomb potentials. For example, we don't even know how to prove that for atoms with more than three electrons it takes more energy to remove the second electron from the atom than the first. Since there isn't enough rigorous quantum Coulomb theory, why not present rigorous quantum theory side by side with rigorous classical Coulomb theory?

The book would have had greater coherence and would probably have been more useful had the three papers on classical Coulomb systems been replaced by papers on some of the items missing or only briefly discussed in the overview of Schrödinger operators: properties of wave functions, the Mourre theory, eigenfunction expansions, the complex scaling theory of resonances, and path integrals. It would have been exciting if the book had included something from the more mathematically inclined chemical physicists.

In spite of these reservations, the high quality of the papers makes this a most welcome addition to the literature. The caliber is so high that many mathematical physicists will want to have a copy on their shelves.

BARRY SIMON
Division of Physics, Mathematics and Astronomy, California Institute of Technology, Pasadena 91125

Far Eastern Archeology

Prehistory of Japan. C. MELVIN AIKENS and TAKAYASU HIGUCHI. Academic Press, New York, 1981. xviii, 358 pp., illus. $37.50. Studies in Archaeology.

A rapid economic development in a small archipelago that has been occupied for thousands of years churns up archeological remains. In order to salvage part of what would otherwise be completely lost, 11,000 archeological excavations are planned for the fiscal year ending in March 1982. There is an avalanche of excavation reports, which the law requires, reports of scientific analyses, which are increasing with the number of interdisciplinary investigations, and a large number of interpretative works on specialized topics. An up-to-date synthesis of the whole of Japanese prehistory has become an impossible task that no prudent person would undertake.

In *Prehistory of Japan*, Aikens and Higuchi have wisely chosen to present a collection of summary translations of site reports, with introductory and concluding chapters where they set forth the central theme of cultural continuity for both the Ainu and the Japanese. In its matter-of-fact descriptive approach the book is somewhat unusual for the Studies in Archaeology series, which contains a number of highly theoretical works. Detailed summaries of 17 out of some 1000 Paleolithic sites, 18 of about 10,000 sites of the Jomon period (around 10,000 to 300 B.C.), and nine Yayoi (300 B.C. to A.D. 300) and seven Kofun (A.D. 300 to 700) sites, out of several thousands each, are carefully interwoven with connecting passages where the theme is developed.

The work and skill involved in producing such coherent and readable summaries will be appreciated by those who have tackled Japanese site reports, which are often voluminous and not always well coordinated. The use of original reports as the main source, however, has obvious drawbacks. The authors arrive at the surprisingly early dates of 400,000 years ago for Sozudai and over 65,000 years ago for Cultural Stratum 3 (which, by the way, consists of chert, not quartzite, specimens) of Hoshino by basing their account on site reports published in the 1960's. In later publications, C. Serizawa, the investigator of the two sites, states that Sozudai may be about 100,000 years old and Stratum 3 of Hoshino is younger than 21,000 years.

In any event, these "Early Paleolithic" assemblages, according to the authors, do not demonstrate human workmanship. What the authors accept as the earliest indications of human presence are the stone tools that date to between 25,000 and 30,000 years ago. Some of these assemblages, such as those described here, actually contain nothing that could not be understood as the continuation of the Early Paleolithic tradition, whose existence I happen to accept. Within the specified time range are other assemblages, not mentioned in the book, that include edge-ground axes and scrapers, as well as parallel-sided blades. If the blades signify the "Advanced Palaeolithic," then, the authors' "Aurignacian-like" industries began about the same time in Japan as their "Mousterian-like" industries. The only benefit of using European terminology for Japanese Paleolithic, it seems to me, is to imply a long-range diffusion. According to Aikens and Higuchi, the Japanese Paleolithic is to be seen as part of "the evolutionary process . . . that involved both autochthonous development, and diffusion, going on more or less simultaneously throughout Eurasia" (p. 326).

The rest of Japanese prehistory is also to be understood in terms of the combination of indigenous development and diffusion, without invoking major population replacements. The transition from the Paleolithic to the Jomon was effected when ceramics were introduced from a yet unknown locality on "the continent via Korea" (pp. 114, 328) about 12,500 years ago. The continuity in stone tools from the Late Paleolithic to the early phase of the Initial Jomon is stressed, and the emergence of "the mature Jomon tradition" about 9500 years ago is described as the results of readaptation of Japan's Ice Age occupants to the new environmental conditions (p. 328). Simi-

larly, the introduction from abroad of cereal grains, agricultural tools, and other traits that make up the Yayoi Culture before it emerged in its characteristic form is emphasized, as are indications of social stratification during Yayoi that anticipated the political developments during Kofun and historic times.

For the protohistoric period, less emphasis on the impressive tombs (*kofun*) of the Nara-Kyoto area and more on the varied burial practices elsewhere, as well as on palaces, fortresses, and workshops, which are being excavated in increasing numbers, would have brought out a more balanced picture of this crucial stage. Aikens and Higuchi subscribe to the view that the keyhole-shaped, *zempo-koen* (which they spell *zenpo-koen*) tumuli symbolize the power of the Yamato state. The gradual spread of these tombs out of the Yamato Plain, however, is in part the artifact of the relative chronology based on the nuclear model, which the chronology is supposed to demonstrate. The concentrations of large tombs in the economically important areas, such as northern Kyushu, along the Inland Sea, and the Kanto Plain, may not necessarily indicate that these were "major centers of the Yamato domination" (p. 287). They could be interpreted as the indications of the power that the local groups could have exercised against the Yamato domination. The "clashes with northern barbarians during the Heian and Kamakura periods" (the 8th to the 14th centuries) occurred in northern Honshu, not in Hokkaido as the authors seem to imply (p. 319), and the "barbarians" were simply those who rebelled against the central state. The first recorded clash with "a people who are unmistakably the Ainu" happened in A.D. 1456–57, after which the prehistoric era ended for Hokkaido.

The authors argue that both the Japanese and the Ainu have been living in Japan for a very long time. This is in sharp contrast to the interpretation of dental data presented by C. G. Turner, who restated the old view that the Japanese arrived at the beginning of the Yayoi period and the Ainu are the remnants of the Jomon population that were pushed northwards. Aikens and Higuchi also dismiss in one paragraph (p. 336) the idea, originally proposed by N. Egami and recently revived in English by G. Ledyard, that equestrian invaders from the continent established the Japanese state during the Kofun period. None of these works are specifically cited in the book. In fact, the sparse bibliography, which consists mainly of primary sources in Japanese and includes a very small proportion of interpretative works that have been published in English or other Western languages, would prove disappointing to those scholars and students without Japanese language skills who nevertheless wish to pursue various issues in Japanese prehistory.

Rather numerous errors, as well as inconsistencies in transliteration and translation, have slipped through. Especially regrettable are the errors that occur in the captions for figures, which detract from the value of the well-illustrated book. For example, the redrawn map of the stone circle (p. 176) is better than anything I have seen, except that the caption incorrectly identifies its location in Aomori Prefecture (it is in Akita). "Kiridashi knives" are those shown in the bottom, not the top, row of the photograph on p. 46, and the large and very clear photograph of stemmed scrapers (p. 140) is accompanied by a statement that "similar specimens occur from pre-Jomon times throughout the Jomon period," when no stemmed scraper has been recovered with a reliable pre-Jo-

"Hilltop residential sites, some with moats and palisades, became increasingly common in Middle and Late Yayoi times. Shown is the Middle Yayoi Otsuka site, Kanagawa Prefecture, central Honshu." [Courtesy J. Okamoto; from *Prehistory of Japan*]

mon context. "*Dotaku*," which is correctly explained in the text as denoting a bell-shaped ceremonial object in bronze, is for some reason translated as a "copper bell" under the series of figures on pp. 219–221 and 246, and bronze points are called "copper" points on p. 233 and "nickel alloy" points on p. 272.

Prehistory of Japan unquestionably is a vast improvement over the last book-length overview in English of Japanese prehistory, which had its own share of errors and is now hopelessly out of date. In the face of papers such as those by Turner and Ledyard that have appeared recently in English, the book does put the relative importance of continental influence "into a more realistic perspective," and it certainly serves its stated objective of publicizing, "in English as a language of international communication, some of the more salient aspects of Japan's long and fascinating prehistory" (p. x).

FUMIKO IKAWA-SMITH
Department of Anthropology,
McGill University,
Montreal H3A 2T7, Canada

Carbon Dioxide Fixation

Organic and Bio-organic Chemistry of Carbon Dioxide. SHOHEI INOUE and NOBORU YAMAZAKI, Eds. Kodansha, Tokyo, and Halsted (Wiley), New York, 1982. xii, 280 pp., illus. $49.95.

Dwindling fossil fuel reserves and concern over the potential hazards of increasing atmospheric concentrations of carbon dioxide now provide powerful incentives for chemists to imitate the carbon dioxide fixation of simple organisms. It is no mere coincidence that the seven authors contributing to this book are natives of a country essentially devoid of fossil fuel resources.

The purpose of the book is to summarize the current status of efforts to develop laboratory and industrial processes for the chemical utilization of carbon dioxide fixation.

Following a brief introduction, the first major chapter, by Haruki, surveys recent advances in organic syntheses with carbon dioxide, focusing particularly on base-promoted carboxylations of active hydrogen compounds, phenols (Kolbe-Schmitt reaction), and amines (giving ureas). This extensive coverage is punctuated by numerous tables of yields and sample general procedures, especially from the author's own work with diazobicycloundecane-promoted carboxylation of active hydrogen compounds. Unfortunately, the promised answer to the question "What directions should future research pursue?" is never provided.

A chapter by Ito and Yamamoto reviews the stoichiometric and catalytic reactions of carbon dioxide with organometallic compounds, particularly of the transition metal variety. In first assessing the thermodynamic feasibility of carbon dioxide reactions (mostly with hydrogen and organics) the authors make the serious error of using enthalpies rather than free energies. Indeed, many of the exothermic reactions listed have positive (unfavorable) free energies. The authors do provide a very complete coverage (unfortunately only through 1978) of the coordination chemistry of carbon dioxide and its insection into M–H, M–C, M–O, and M–N bonds. The final section, on the design of catalytic processes using carbon dioxide, nicely suggests future areas of investigation within a reasonable mechanistic framework.

Yamazaki, Higashi, and Inoue then discuss the rapidly developing field of polymer syntheses incorporating carbon dioxide. The preparation of polyureas and polycarbonates under mild condition using carbon dioxide is covered, followed by copolymerization reactions of carbon dioxide with epoxides, aziridines, and other important monomers. Japanese workers have been pioneers in this subject of considerable industrial importance.

The final two chapters deal with biological carboxylations and model studies of such reactions. Asada provides a current overview of the utilization of carbon dioxide in biological processes, namely hydration-dehydration (mediated by carbonic anhydrase) and carboxylations both photosynthetic and nonphotosynthetic. The biological significance and details of the carbon dioxide acceptors, carboxylated products, participating enzymes, and mechanisms are discussed. The chapter is well written and provides interesting and understandable reading especially for nonbiochemists.

The final chapter, by Inoue, appropriately seeks to integrate the chemistry in the earlier chapters by comparing biochemical carbon-dioxide–fixing reactions and those of simpler organic and organometallic models. The length of the chapter (it is only 21 pages long) underscores our rather limited success thus far in modeling and understanding the natural processes, and the chapter serves to make clear the many subjects that need attention.

Collecting together organic, organometallic, and biochemical aspects of carbon dioxide utilization was an excellent idea and may stimulate novel and interdisciplinary approaches to this important problem. The book is recommended reading for both academic and industrial chemists already active in the field and for those considering entering it.

KENNETH M. NICHOLAS
Department of Chemistry,
Boston College,
Chestnut Hill, Massachusetts 02167

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(Continued on page 182)