phenotype matching would allow discrimination among nestmates. Indeed, worker honey bees "retain a sense of self, despite the fact that they also learn and use the signatures of their nestmates for kin discrimination purposes" (p. 392). It will be interesting to see if a self-inspection mechanism also characterizes other social species in which females mate multiply, as well as interspecific parasites. Cowbirds and cuckoos, for example, could recognize conspecifics on the basis of resemblance to themselves, but not to nestmates.

This book updates an exciting and fast-moving field. It should appeal to a broad range of biologists and psychologists. The volume's strengths are its conceptual orientation and multiple investigative approaches. Its primary weakness, apart from some unevenness of quality, is its failure to integrate the widely disparate subject matter and to synthesize this information into a unified framework—a synthesis the field needs at this point. Overall the book should stimulate work on key questions surrounding kin recognition, not the least of which is why such phenomena occur at all.

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Field Chemistry

Principles and Applications of Inorganic Geochemistry. A Comprehensive Textbook for Geology Students. GUNTER FAURE. Macmillan, New York, 1991. xiv, 626 pp., illus. $60.

Academic chemistry has succeeded, over the course of this century, in cutting itself off from the observational sciences, and in particular geochemistry. Gone are the days when Bunsen would make the arduous journey to Iceland to study the eruption of Hecla or when apprenticeship in a School of Mines could lead to the pinnacle of the field and the discovery of new elements. It is difficult to imagine a modern-day chemist of the stature of van't Hoff experimenting on the sequence of precipitation of salts in the evaporation of seawater. Although a few outstanding individuals have in recent years been attracted to the problems of smog formation, ozone destruction, and planetary atmospheres in general, Harold Urey was probably the last great chemist to confront the problems of the natural world in this way.

Such a situation is peculiar among the sciences. The rooting of biology and biochemistry in the natural world goes without saying. Both physics and applied mathematics are also vigorously involved in the study of natural processes through their alliances with meteorology, oceanography, solid-earth geophysics, solar and planetary sciences, and cosmology. By contrast chemists appear to have been diverted from the messier processes that occur outside the laboratory by the elegance of laboratory experimentation and the virtuosity with which matter can be manipulated.

The consequences of this diversion are becoming increasingly serious. Formal recruitment of chemistry students into the field of geochemistry is impossible. A student of chemistry has somehow to discover the field, convince herself that it is respectable, and then be stiff-necked enough to withstand the scorn of many of her peers and undergraduate professors. The random and determined personalities that manage this have given geochemistry unique liveliness as a discipline. Now, as society confronts the shambles it has made of the environment, the number of chemists coming into the field must be greatly expanded.

In the present situation geochemistry has as much intellectual association with chemical engineering as it does with pure chemistry. Our vision of the geochemical cycle of the elements is borrowed wholesale from engineering process theory. The maintenance of an oxygenated atmosphere is not a test-tube affair, and environmental geochemistry is, by default, becoming the province of chemical (and civil) engineers and of geologists. Thus recruitment efforts are strongly dependent on these fields rather than chemistry. Which brings us to the present textbook.

The author is a well-known isotope geochemist who has written what is now the standard textbook on that subject. Though his present book must be reviewed on its face, as a textbook, it is useful also to look at it as a document reflecting the state of play in environmental geochemistry as viewed from the trenches. The title is misleading. The book deals largely with low-temperature processes rather than with mineral-melt relations at high T-P, the core concern of classical geochemistry as pioneered by Bowen. It is explicitly directed at seniors in geology, which is what makes it interesting as a document.

The book begins in a low-key way as if the author is wary of his audience. There is a chapter on the origins of geochemistry that is notable for its lack of hilarity—some corporate image-building here. There are then a couple of schematic chapters on the origins of the universe and the solar system, followed by very basic discussions of atomic structure and weights, bonding, and crystal chemistry and a short chapter on radioactive decay and its applications in geochronology. This section ends with a review of chemical fractionation processes in the solar system as a whole and in the earth, the only reference to high-temperature reactions.

The style of presentation then changes abruptly, an indication, perhaps, that the Drop Date will have been passed. The core of the text contains a comprehensive treatment of the low-temperature reaction chemistry of the important geologic minerals with aqueous solutions. This is the basic mechanics of the field. The author covers this well-trodden ground in an attractive manner, with lots of clear figures, comprehensive tables, and worked examples of the complex reactions of the aluminosilicates. The treatment is unique in that it involves isotopic chemistry as an integral component. For reasons that are mysterious, the authors of previous textbooks in this field have afforded no more than a passing glance at the stable and radioactive isotopes, despite the fact that much of what we really understand about geochemical processes is based on their behavior. The present work does have the common failing of relying too heavily on equilibrium rather than kinetic controls on chemical transformations. A lot of quite spectacular things would happen if the world suddenly adhered strictly to the first and second laws of thermodynamics. Biospheric interactions are referred to only in passing.

The final part of the book discusses applications to soil formation, fluvial chemistry, the weathering of ore bodies, and the disposal of radioactive waste. There is also a short discussion of the overall geochemical cycle of the elements.

The problems presented at the end of each chapter call for a substantial extension of the material in the text. Clearly the author expects some hard work from his students.

Who should read this book? Certainly the geology seniors at whom it is directed. Civil engineers will also find it useful. Chemists and chemical engineers contemplating a career in the environmental sciences and hungry for information on this unadvertised subject will rush through the first two sections, even if they are put off by the mineralogical jargon, the inconsistency of units (chemistry comes in moles), and the unfamiliar-looking reactions. They will be surprised that many of the pioneers of their own disciplines are similarly claimed by geochemistry. They will be equally surprised that there is little discussion of atmospheric photochemistry, the one area with which they are familiar, and no real attempt to present the earth as a chemical system—this opportunity was lost among the arrows and boxes of the chapter on geochemical cycles. They will probably feel uncomfortable with the choppy, episodic nature of the presentation, though some may recognize in this the sign of an open field.

A training in geology is unique in giving students the ability to read landscapes in terms of physical and chemical processes and the appreciation that what we see today is the result of complex interactions that occurred at highly variable rates over long periods of time. Until recently the chemical emphasis in geology was on high-temperature igneous and metamorphic reactions of the aluminosilicates. This text is a notable attempt to redress the balance in favor of the water-rock reactions at low temperatures that determine the environmental characteristics of the planet and that have been accelerated, often drastically, by human activity. Their study has hitherto been left to a small band of geologists fascinated by their incongruity relative to igneous processes and of a handful of chemists wanting to do science in the vast arena of the open air in a milieu free of the manic and stifling competition of academic chemistry. Their former colleagues do not know what they are missing. There is a great need for a textbook "Geochemistry for Chemists." In its absence this is a good place to start.

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Neural Science III

Principles of Neural Science. ERIC R. KANDEL, JAMES H. SCHWARTZ, and THOMAS M. JESSELL, Eds. Third edition. Elsevier, New York, 1991. xlvi, 1135 pp., illus. $65.

The first edition of this now-standard textbook emerged from Columbia University's medical neuroscience curriculum in 1981 and met widespread success. It provided a definitive, encyclopedic view of neuroscience from a mammalian (and largely human) perspective, derived from lectures in a course led by people who themselves had made major contributions to the field. Although there were 20 contributors, their writing was edited into a smooth, uncomplicated pedagogical style, accompanied by abundant illustrations, declarative section headings, brief bibliographies with each chapter, and handsome typography. A second edition followed in 1985, substantially expanded from the first, and now a third has appeared.

After browsing through the new edition and making notes for a draft of this review, I reread my review of the first edition (*Science* 217, 240 [1982]). I discovered that in the intervening ten years neither the authors nor I have changed our views very much. The third edition continues the strengths of the first by providing up-to-date, broad, thorough coverage of neuroscience as currently understood. It also continues the "fill 'em up" tradition of medical education, supplying abundant information but underplaying the development of ideas and experimental history that (in my view) could make it a more stimulating book.

What *has* changed dramatically in ten years is the book's size. The first edition had 52 chapters and 3 appendixes for a total of 731 pages. The second edition expanded to 62 chapters in 979 pages. Including a 25-percent enlargement in page size, the second edition was more than 60 percent bigger than the first. The new, third edition has grown another 18 percent, acquiring a third editor (Jessell), six more contributors, three new chapters, and a revised set of appendixes, topping out at a massive 1135 pages. (One should note, however, that the cost per page is very competitive with that of the book's less gargantuan rivals.) Neuroscience as a discipline is certainly growing vigorously, but it seems impossible for textbooks to expand at such rates indefinitely. Can students engulf this much information? Do they remember it?

The topics added to the newest edition largely reflect the areas (such as molecular neurobiology) in which neuroscience has grown recently, but some of the new material in the second edition also resulted from an expanded view of what the book should cover. The second edition added new chapters on cytology and the synthesis and transport of proteins, a revision of the section on synapses with two additional chapters on postsynaptic channels and molecular aspects of receptors, an entire new section on functional anatomy (four chapters), a new chapter on taste and smell, and a substantial reworking of the sections on development and behavior. The third edition's new chapters are on ion channels (an overview includ-

Vignettes: The Life of Science

"Rationalist philosophy is an altogether democratic discipline," noted A. Comte. For a scientist, this observation had a profound practical implication: it broadened the market for books and increased the number of jobs.

—Jaroslav Malina and Zdeněk Vašíček in *Archaeology Yesterday and Today* (Cambridge University Press)

America's first Jewish professor not appointed to teach a Semitic subject was a British mathematician, James Joseph Sylvester (1814-1897). He arrived at the University of Virginia in Charlottesville late in November 1841. But his stay was short. Tension arose from a combination of Anglophobia, anti-Jewish prejudice, and general student unrest. It was increased by Sylvester's antislavery opinions, and perhaps by the fact that he rather enthusiastically taught a difficult and unpopular subject.

—Susanne Klingenstein in *Jews in the American Academy, 1900-1940* (Yale University Press)

We North Americans who have persisted in working in Latin America [as professional biologists] form a small coterie of frequently stubborn, single-minded individuals who have often overcome personal and professional adversity to pursue a passion. . . . We comprise a group of individuals accustomed to doing things the hard way, for the simple path was rejected when foreign research was begun. Such biologists are generally inured to criticism and professional barbs from colleagues at home and abroad, and are accustomed to ignorance from domestic and foreign bureaucrats. They are also accustomed to the hardships involved with field biology, including disrupted home lives, unsympathetic administrators, and frequent health problems. . . . Field biologists do not suffer fools easily.

—Michael A. Mares in *Latin American Mammalogy* (M. A. Mares and D. J. Schmidly, Eds.; University of Oklahoma Press)