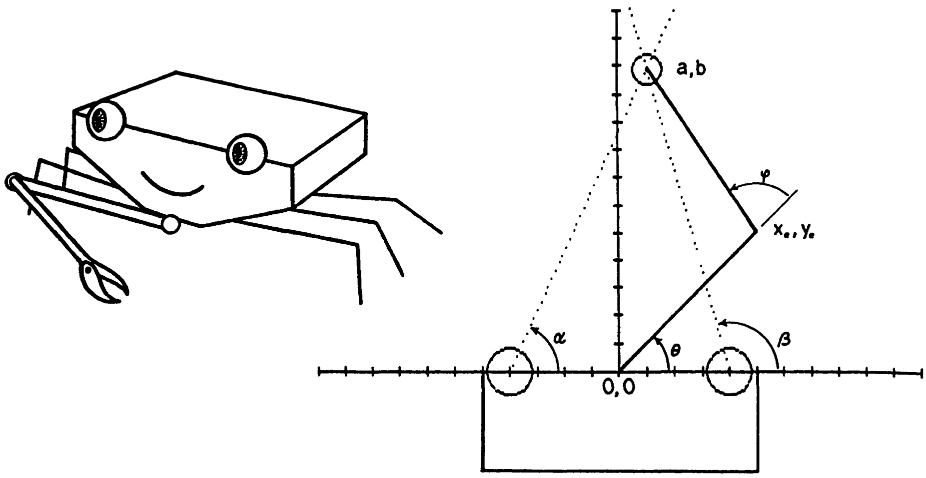

Roger the Crab, representing a simplified problem of sensorimotor coordination for an arm. Roger is a computer simulation who has (mapped at right) "a pair of rotatable 'eyes' for detecting the presence of external stimuli and a single-jointed, extendable arm for making contact with what his eyes see in his impoverished 2-D space. Roger's sole task in his limited life is to detect stimuli and contact them with the tip of his hand. . . . Just as Roger has a 2-D 'visual' space in which the position of the target is represented, so he has a 2-D motor space in which his arm position can be represented. But, and this is crucial to understanding the problem of sensory-motor coordination in its most general aspect, *these two state spaces are very different.*" [From *The Computational Brain*; P. M. Churchland, *Mind* **95**, 279–309 (1986)]

erties that will surely play a role in further developments. The final chapter, "Concluding and beyond," disappoints since it all too briefly presents topics that can only be understood against a background of attempts made by the artificial intelligence community to build visual systems and control robots, a background outside the authors' focus.

This attractive and well-illustrated volume concludes with an appendix on anatomical and physiological techniques, a glossary, copious references, and a subject index, but lacks an author index (thus complicating the reviewer's task!). The book falls somewhere between a trade book and a textbook, with a style well suited for the *Scientific American* reader, as well as the active scientist, who may know something of either computer science or neuroscience but welcomes a crisp narrative that includes the necessary background from each discipline. As the authors disarmingly note in their preface, the book is focused on "research based in California, especially in San Diego." Actually, although the authors have used their local "networking" in the choice of models, they have made a thorough review of the global literature on the empirical results that ground these models, and the reader will be well rewarded who seeks to understand, from well-chosen examples, how to merge the analysis of neuroscientific data with the development of computational principles.

Michael A. Arbib
Center for Neural Engineering, University of Southern California, Los Angeles, CA 90089–2520

HTSC for Newcomers

High Temperature Superconductivity. D. P. TUNSTALL and W. BARFORD, Eds. Hilger, Philadelphia, 1992 (distributor, American Institute of Physics, New York). xiv, 404 pp., illus. $130. From an institute, St. Andrews, U.K., June 1991.

It is six years since the now-famous paper of G. Bednorz and K. A. Müller appeared announcing to a then largely indifferent world the possibility of superconductivity in the Ba-La-Cu-O system at temperatures above 30 K. That was the event that ushered in the era of "high-temperature" superconductivity (HTSC). (HTSC is still a low-temperature phenomenon: the acknowledged world record is still about 125 K.) The saga of the announcement of both the unimpeachable confirmation and the extension of the results of Bednorz and Müller at the 1986 fall meeting of the Materials Research Society, followed by a rapidly growing frenzy of activity and publicity, marked by the famous (some say notorious) "Woodstock of Physics" 1987 March meeting of the American Physical Society, and culminating in the award of the Nobel prize in physics for 1987 to Bednorz and Müller has achieved mythical status. The totality of the scientific attention paid to the materials, mechanisms, and possible technological applications of HTSC has been overwhelming: Colin Gough of Birmingham University in England has estimated that about 20,000 publications on this topic appeared within less than five years following its discovery. (I leave it to the reader to guess what fraction of this flood of paper either has been read or is genuinely useful.)

The initial response of the popular press, incited by both the exuberance and some extravagant claims for revolutionary technological payoffs by scientists overjoyed by this new bauble (and potential funding gold mine), was one of wild enthusiasm. This was soon followed by equally unrealistic pessimism when the considerable difficulties in realizing the promise of the technological applications of these new materials became apparent, as well as the realization that even if some of these promised applications—in electric power transmission, microwave electronics, energy storage, and exquisitely sensitive magnetic field detection, for example—materialized, the economic and technological returns were neither going to come as soon nor be as large as the early enthusiasts had hoped. Now there is a more balanced and cautiously optimistic attitude about the time scale and magnitude of the arrival of HTSC technology. However, the extraordinary scientific significance of the discovery of the cuprate superconductors with high critical temperatures is even more apparent today than ever. A consensus on the mechanisms of superconductivity, and even a theory of the normal (resistive) metallic state, in these materials is still elusive, posing a worthy challenge to the best condensed-matter theorists of the day (at least three Nobel prize-winners in physics, Philip Anderson, Nevill Mott, and J. Robert Schrieffer, have been actively engaged in the lively debates), and the difficulties and opportunities posed by the understanding and control over multi-element compounds with complex structures, at the same time metallic, covalent, and ionic in character, will stimulate and frustrate materials scientists and solid-state chemists for decades. Thus it is likely that, far from merely being a "bandwagon phenomenon," the science and technology of HTSC will continue to attract new recruits to the ranks of researchers on this topic, the vagaries of funding and other market forces permitting.

The volume under review is aimed at such newcomers, intended as a broad survey of the current status of HTSC research, and consists of 11 chapters, ranging from an introduction to superconductivity, device applications, and current experimental problems to introductory descriptions of some of the most modern theories of electronic structure and superconductivity. The chapters grew out of lectures given at the 39th Scottish Universities Summer School of Physics and are pitched at a tutorial level suitable for graduate students and postdoctoral fellows in physics, chemistry, materials science, and electrical engineering. The authors are an international cast of distinguished researchers, including the formidable Mott, now in his 88th year, all very active in various facets of HTSC research ranging from both applied and theoretical physics to solid-state and quantum chemistry. Although the range of coverage is broad, I would have liked to see a more thorough description of the novel aspects of magnetic flux structures and properties in the cuprates, a very active and important area of current research, as well as a chapter on the materials science of cuprates, especially the nature of crystal lattice defects, their pinning of magnetic flux and their contributions to granularity. (These topics are at the very heart of the difficulties in realizing the technological potential of HTSC.) The quality of the chapters is uniformly rather good, and they will provide a nice introduction to various features of HTSC for the novice, especially graduate students embarking on their own studies of the fascinating materials and phenomena of high-temperature superconductivity.

David O. Welch
*Materials Science Division,
Department of Applied Science,
Brookhaven National Laboratory,
Upton, NY 11973 1992*

Vignettes: Fields of Science

Chemistry is an empirical science, and the textures of things get into the memory: the viscosity, mobility and viscidity of different liquids, and the gritty, unctuous or glassy feel of solids; the indescribable but unforgettable smells of things (for our language of stinks is impoverished and textbooks fall back on "a characteristic odour" in their lists of properties); colours and their changes; and the tastes of things, tried voluntarily or accidently through a mismanaged pipette; bubblings, test-tubes becoming too hot to hold, sharp colour changes, sudden turbidities and precipitations are the stuff of chemistry: a science where the secondary qualities of things (ideas linked to sense data) are of great importance if one is to get a sense of what is going on in reactions.

—*David Knight*, in *Ideas in Chemistry: A History of the Science* (Rutgers University Press)

In some fields, ideas can be actuated quite quickly . . . . In other fields, it takes years to articulate an idea . . . . The contrast between "zombie biology" and physics illustrates this point: The molecular biologist Sydney Brenner once thought of founding a journal called the *Journal of Zombie Biology*, not for the biology of zombies, but for zombie biologists. His reason: "Because that's all you have to do. You just have to wind yourself up in the morning, and go to the lab and just do things . . . many of the answers come from just doing things. Biology isn't a subject in which you can have great thoughts in the bath." The nuclear physicist Leo Szilard (who left physics to work in biology) once told Brenner that he could never have a comfortable bath after he left physics. "When he was a physicist he could lie in the bath and think for hours, but in biology he was always having to get up to look up another fact."

—*Paula E. Stephan* and *Sharon G. Levin*, in *Striking the Mother Lode in Science: The Importance of Age, Place, and Time* (Oxford University Press)

Cytotoxins and Cytolysins

Sourcebook of Bacterial Protein Toxins. J. E. ALOUF and J. H. FREER, Eds. Academic Press, San Diego, CA, 1991. xii, 518 pp., illus. $175.

Although approximately 240 protein bacterial toxins have been identified, our understanding of their action on the eukaryotic cell is limited to a relative few. Diphtheria toxin and cholera toxin have been well characterized, and the field is rapidly advancing for others such as the membrane-damaging cytolysins and the clostridial neurotoxins. In the common path of such progress a protein that is capable of disrupting cell physiology and perhaps causing cell death is isolated from a bacterial pathogen and implicated as a virulence factor. The molecular mechanism of action is identified, permitting categorization of the protein as a cytotoxin if it is an enzyme with an intracellular mode of action or as a cytolysin if it is membrane-damaging. An interesting extension to this area of research is the recent use of bacterial toxins as molecular tools to study cell physiology. Isolation of the toxin structural gene can then be followed by mutational analysis, which is used to investigate structure-function relationships and better assess the role of the toxin in disease. Once the active site of the toxin has been identified and modified these findings can be used in the development of superior vaccines.

As research progresses and the mechanisms of action, primary amino acid sequences, and x-ray crystallographic structures are elucidated for an increasing number of protein bacterial toxins, there emerge distinct similarities and family classifications. Examples are the ADP-ribosylating toxins, which constitute the largest category of cytotoxins, and the family of Shiga toxins, which are produced by *Shigella dysenteriae* and *Escherichia coli*. One of the most exciting aspects of toxin research is that the families identified are not restricted to bacteria but include toxins produced by plants, insects, other invertebrates, and reptiles. The identification of prokaryotic and eukaryotic toxins with similar structures and mechanisms of action indicates an evolutionary correlation and suggests that at one time these proteins had a role in the normal processes of cell physiology. This hypothesis is supported by studies demonstrating that bacterial toxins and endogenous ADP-ribosyl transferases have common substrates in eukaryotic cells.

The *Sourcebook of Bacterial Protein Toxins* is a collection of 22 reviews covering these aspects of toxin research. The contributions dissect a variety of protein toxins and the cell processes they affect on a molecular level. The chapters with the broadest coverage describe a particular toxin or family of toxins, providing detailed descriptions of the commonly used purification techniques, molecular mechanisms of action, genetic regulation, and structure-function analysis. Additional chapters provide more specialized supporting information regarding enzymatic reactions, bacterial processing and secretion of extracellular toxins, receptor binding, entry, and trafficking within the target cell. This arrangement causes some repetition, but the contributions are well indexed, making the book a good source on specific topics of interest. In addition, there are contributions devoted to the techniques used to study bacterial toxins and their effects, including the patch-clamp, which is used to investigate the effect that cytolysins have on membrane voltage potential, and transposon