BOOKS: CHEMISTRY

Modern Molecular Vision

Shenda M. Baker

The ubiquitous role of chemistry in our lives is easy to take for granted. Nearly everything we use has been created, influenced, enhanced, or preserved by chemistry. And despite the general public's apparent distaste for anything "chemical," during the last 30 years the chemical enterprise has played a crucial role in raising the standard of living around the world and in providing energy, pharmaceuticals, materials, a healthy food supply, and the comforts we enjoy. In *The New Chemistry*, a group of distinguished international authors including three Nobel laureates provides informative articles on the developments in chemistry that have supported this progress.

The New Chemistry
Nina Hall, Ed.
Cambridge University Press, New York, 2001. 505 pp. $49.95, £30. ISBN 0-521-45224-4.

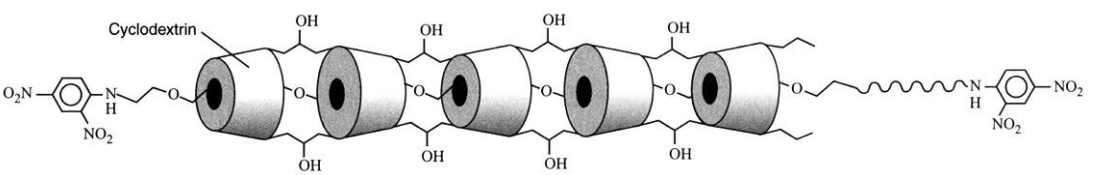
The "new chemistry" is characterized by a combination of the conscious design or examination of matter based on fundamental molecular principles with the ability to "see" the results on that same scale. Before the mid-1900s, scientists lacked many of the tools necessary to link observed macroscopic properties to the molecular and atomic properties that they were beginning to control. As K. C. Nicolaou and his colleagues note in their chapter on molecular complexity, "Indeed, the essence of chemistry lies in its ability to manipulate matter and create new substances." Current chemical practice is even more refined; it is manipulation on the molecular scale. Understandingly, this fact is conspicuous in every chapter of the book. From the earliest laboratory synthesis of an "organic" material (urea) by Wöhler in 1828 to the total synthesis of Taxol (with its 11 stereocenters and strained eight-membered ring) by three independent groups in the late 1990s, this deliberate orchestration of the molecular world reflects chemists' increasing sophistication at specifying site and stereochemical selectivity. Previously, such fine chemical control had been obtainable only through the use of enzymes. The future of such synthetic mastery will likely be a mélange of combinatorial chemistry, mechanistic discoveries, and biosynthesis with a "cocktail of enzymes."

Art and invention, architecture and construction, investigation and serendipity: these themes are woven through the independently authored chapters and reflect the nature of the new chemical enterprise. The artistry of newly developed strategies for synthesizing natural or designed products is akin to the skill and determination of a chess master who plans each move with a particular strategy, but who can be outwitted by the opponent—in this case, nature. Both technical skill and creative elegance are required to precisely plan and execute a "plethora of asymmetric centers" in a single molecule, such as in the 1994 synthesis of palytoxin (a neurotoxin from a soft coral).

Chemical inventors create new elements, following a process carefully outlined in terms of the fundamental forces that define the element's stability. In addition to generating the more stable transuranium elements, they predicted and eventually brought about the fleeting existence of the newest additions to the natural periodic table. Chemical architects and builders examine the organic and inorganic chemistry of life. Using traditional methods and the new tools of microwaves, sonication, and light, they design and construct biomimetics and complex pharmaceuticals with highly specific activities from an atomic palate. They fabricate novel materials ranging from self-organizing nanopores and drug delivery vehicles to molecular photonics, XOR gates for quantum computation, and chemically sensitive field-effect transistors.

New chemical models for synthesis favor the use of molecular rather than atomic building blocks. These geometrically interesting units can be used to take chemical construction beyond the classical "molecule" to assemble devices and structures typically understood on the macroscopic scale. Jean-Marie Lehn and Philip Ball's article considers several examples of such supramolecular constructions, such as threading a linear molecular thread through a molecular needle (a ring) and subsequently adding bulky terminal caps to form a rotating assembly called a "rotaxane," covalently linking cyclodextrins end-to-end to align molecular tubes, and designing a molecular membrane ion pump. Despite warnings against being overly optimistic about "molecular computers," the use of molecules, rather than atoms, as the building blocks of future computers seems quite plausible because molecules can be both resilient and unreactive. As judiciously emphasized in this chapter and cleverly demonstrated in others, complex things do not have to be complicated to build.

The New Chemistry reads much like a high-level textbook. The authors provide substantial detail and assume their audience possesses a hefty vocabulary and knowledge of chemistry. Little background material is offered, and the bulk of the illustrations comprises chemical structures and reactions. Still, a less deliberate reading will give the nonchemist a solid impression of the possibilities, directions, and critical limitations in each of the research areas discussed. Although the book offers only limited coverage of chemistry's involvement in the development of genomics, nanotechnololgy, and biomaterials, it provides some basis for understanding the applications of chemistry in these emerging fields.



Tubes from needle-threading. A linear polymer can spontaneously thread cyclodextrin molecules to form a polyrotaxane. Akira Harada and co-workers constructed a molecular tube by covalently linking the "beads" and then removing the thread.

CREDIT: FROM *THE NEW CHEMISTRY*

In the final chapter, on chemistry in society, Colin Russell reminds chemists that our understanding on the molecular level brings with it responsibility. As we have developed the tools to examine molecular materials, we have also increased the sensitivity of measurements and our knowledge of chemical effects on our surroundings. To regain and retain public support, Russell encourages us to admit past mistakes but additionally "to expose fallacies in anti-chemical propaganda." Finally, he advises us to seek a balanced perspective regarding the effects of the chemical enterprise on the environment. Although Russell's discussion centers on chemists, his

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suggestions are pertinent to a much broader audience. A rational risk-assessment policy would go far in leading society into the molecular age through applications and further developments of the research trends discussed in *The New Chemistry*. Likewise, although the authors present research from a chemical perspective, individual topics and particular implications should interest scientists from a wide range of fields.

BOOKS: FORENSIC SCIENCE

Crime-solving Bugs

Jason H. Byrd

The opening paragraph of the first chapter of *Maggots, Murder and Men* offers a succinct summary of the basic carrion ecology that drives the science of forensic entomology: As time passes and decomposition progresses, different insect species are attracted to the highly nutritious resource of a dead human body. Each leaves a "mark for future interpretation by those who look into such things." The succession of insects occurring on a body provides a measure of time since death. The paragraph's simple and straightforward explanation of a relatively obscure science typifies this book.

Maggots, Murder and Men
Memories and Reflections of a Forensic Entomologist
by Zakaria Erzinçlioğlu
Harley, Colchester, UK. Paper, 256 pp. £13.95. ISBN 0-946589-65-8.

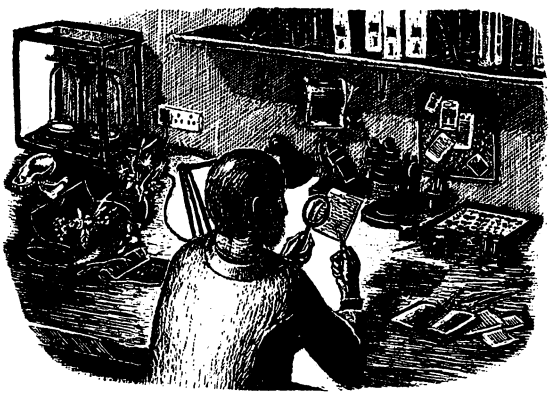
Zakaria Erzinçlioğlu, the former director of the Forensic Science Research Centre at Durham University, is one of Britain's preeminent forensic entomologists and a world expert on blow fly biology. "Dr. Zak" has previously written for both professional and lay audiences and has appeared in several television programs on forensic topics. This book demonstrates his ability to intrigue the seasoned expert as well as captivate the casual reader. That ability makes the work stand apart from other recent titles that have attempted adventurous explorations of careers in forensic entomology. It should be a welcome addition to the library of anyone interested in this rapidly growing field.

The author artfully weaves his discussions of the basic principles and applications into colorful stories and case histories. He incorporates thorough outlines of such germane topics as insect growth and development, insect succession, DNA methods, and the significance of varying colonization patterns. Readers lacking an advanced understanding of this material will receive an excellent education along with the fascinating tales.

Erzinçlioğlu uses a carefully selected sample of historical and modern cases to illustrate principles and to highlight the field's usefulness in criminal investigations. For each, he concisely summarizes the relevant concepts and the case's importance. Most of the recent examples are drawn from the author's own experiences. It seems clear that he has chosen these cases for the perspectives they offer on forensic science, not simply because of his involvement. Thus, he avoids a common shortcoming of similar works.

Although many of the individual cases and the history and development of the field have been covered elsewhere, it is refreshing to find so much information summarized within one book. And when he addresses commonly reported topics, such as the earliest known use of entomology in criminal justice, Erzinçlioğlu does not belabor the issues. Most of his accounts of historical cases introduce little known facts or personal inferences that keep the topic fresh and even spark the interest of readers familiar with it.

Maggots, Murder and Men is more than a repository of case histories from forensic entomology. It also offers an intriguing account of the author's experiences working within other realms of forensic science. In addition to providing details of other, nonentomological, investigations of crime, the author incorporates forays into purely entomological, nonforensic, science. And in the final chapter, Erzinçlioğlu turns to address the status of forensic science in the environment of adversarial criminal trials. (He argues for state-funded, independent forensic science.) These digressions, about which he seems almost apologetic, serve to maintain interest and round out the coverage. But the reader is never far removed from discussions of the insects that lie at the heart of the author's interests and serve as the common thread in his engaging and informative book.



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CREDIT: (TOP) MICHAEL ROBERTS/FROM *MAGGOTS, MURDER AND MEN*; (BOTTOM) K. R. WRIGHT/WRIGHT WATER ENGINEERS

BROWSINGS

Machu Picchu. A Civil Engineering Marvel. *Kenneth R. Wright and Alfredo Valencia Zegarra.* American Society of Civil Engineers Press, Reston, VA, 2001. Paper, 144 pp. $49. ISBN 0-7844-0444-5.

The remains of the "Lost City" of Machu Picchu (occupied 1450 to 1575) straddle a rugged ridge on the eastern slopes of the Peruvian Andes, a breathtaking setting that presented considerable challenges to the Inca who built this royal retreat. The authors discuss the planning and construction methods the Inca used to solve such problems as site constraints, water supply, drainage, and food production. Their account includes an extensive selection of instructive photographs and sketches, a detailed map, and an engineering-oriented guide to a walking tour of these renowned ruins.