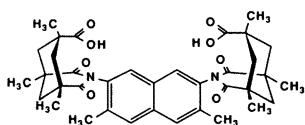
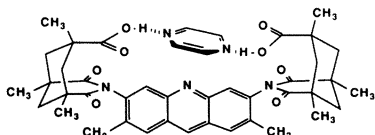


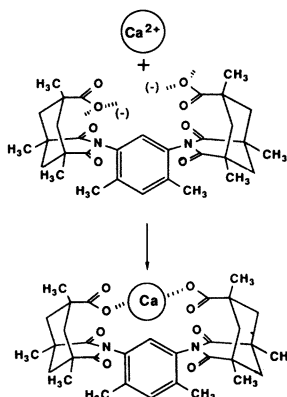
Molecular Clefts



A typical molecular cleft consists of two carboxyl groups separated by a spacer unit such as naphthalene.



The compound pyrazine is caught in the jaws of a particular molecular cleft.



Even spherical ions, such as calcium ions, respond to the vise-like shape of certain molecular clefts.

Rebek

lecular recognition is a special set of synthesized molecules, each roughly shaped like the letter C. This rigid but adjustable scaffolding provides a convenient basis for pinpointing how one molecule responds to another.

A typical C-shaped "molecular cleft" consists of two specially modified carboxyl groups separated by a rigid molecular spacer. The carboxyl groups act somewhat like sentries at a gateway, screening visiting molecules and allowing only a select few into the cleft. The spacers, made up of naphthalene-like molecular segments, keep the carboxyl groups separated from each other.

"The molecules are quickly assembled in the laboratory, they can be adjusted for size and shape, and their chemical linings can be altered," says Rebek. "This high degree of control is a dramatic improvement in exploring the rules of recognition."

By changing the nature of the carboxyl groups at the molecule's tips and by altering the spacing between the groups, Rebek can tailor his compounds to recognize a wide variety of specific substrates, including acids, metal ions and certain neutral compounds. "These concave clefts can be lined with all sorts of functional groups," says Rebek. "You can make whatever microenvironment you want." The trick is to find complementary groups that will attract the appropriate substrate to make a perfect match.

Like the work of Cram and Breslow, Rebek's research also leads to an improved understanding of how large molecules found in biological sys-

tems function. Rebek's approach is unique because his molecular mimics are so small. Both the binding process and the chemical reaction take place close together inside the structure. "Rebek's systems have the elegance of simplicity," says Cram.

"It seems reasonable that clefts could now be designed and efficiently assembled to recognize almost any small molecule or ion," Rebek writes in the March 20 *SCIENCE*. "Larger substrates such as carbohydrates, peptides and nucleotides are likely future targets for recognition." One group of molecular clefts is so good at trapping calcium ions that Rebek has applied for a patent, and the process is being tested for medical and industrial use.

"The opportunities for fruitful research in the host-guest complexation field are boundless," writes Cram in the December 1986 issue of *ANGEWANDTE CHEMIE* (International Edition in English). Host molecules that specifically bind any ion of the periodic table remain to be synthesized and tested. Practical methods for extracting gold or uranium from seawater still elude researchers. A variety of organic guests such as carbohydrates and fats have yet to be complexed.

"One of the beauties of this field," says Cram, "is that it's big enough to embrace a tremendous number of different approaches." He adds, "Research in this field is particularly rewarding because scientific and aesthetic content merge and become visible in the structures of the many complexes." □

Books

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Birding Around the World: A Guide to Observing Birds Everywhere You Travel — Aileen R. Lotz. The objective of this book, according to the preface, is to encourage the pursuit of birdwatching in fascinating places around the world or anywhere you travel. Includes information to help the local birdwatcher "graduate into the world birding class." Suggests localities around the world for birdwatching, and lists birding tour operators worldwide and selected "birder-friendly accommodations" in North America. Dodd, 1987, 266 p., illus., \$18.95, paper, \$10.95.

Brown Bear Summer: Life Among Alaska's Giants — Thomas Bledsoe. At McNeil Falls in Alaska, brown bears fish, fight, mate and play with little or no regard for their human observers, according to the author. This wildlife biologist spent three summers on a Utah State University research project studying the brown bear. The book is a fascinating account of this bear's behavior. Dutton, 1987, 249 p., line drawings by Elizabeth Mills and photographs, \$18.95.

Doing Things: A Guide to Programming Activities for Persons with Alzheimer's Disease and Related Disorders — Jitka M. Zgola. Although the book is written for adult day-care programs, its insights translate easily into care for persons living at home. Provides an understanding of the working of the impaired mind and of effective approaches to use with patients with dementing illnesses. Johns Hopkins, 1987, 149 p., illus., \$20, paper, \$8.95.

The Gardener's Illustrated Encyclopedia of Trees & Shrubs: A Guide to More Than 2,000 Varieties — Brian Davis. Offers information on trees and shrubs together with color photographs illustrating many of these plants and highlighting their outstanding seasonal features. Entries include details on plants' origins, their use for particular sites and descriptions of foliage, flowers, fruit and bark. Practical details about soil conditions for growing, hardiness, height over a period of years, sun/shade and pruning requirements and propagation are also included. Both the botanical and common names are given and indexed for each tree and shrub. Rodale Pr, 1987, 256 p., color illus., \$24.95.

Heroes in Space: From Gagarin to Challenger — Peter Bond. Tells in detail the fascinating story of the first 25 years of manned spaceflight in the United States and the Soviet Union. Focuses on the human aspects of space travel rather than the technology. Basil Blackwell, 1987, 467 p., illus., \$24.95.

Scientific Genius and Creativity: Readings from SCIENTIFIC AMERICAN — Introduction by Owen Gingerich. Biographies of 10 great scientists representing science from the Renaissance into the Atomic Age. Each biography shows how a major breakthrough in science was achieved. Together these biographies raise a provocative question, says the introduction, about the role of scientific genius in the shaping of science. Includes articles by Jacob Bronowski and Gunter Stent that probe the nature of scientific creativity and discovery. W H Freeman, 1987, 110 p., illus., paper, \$11.95.