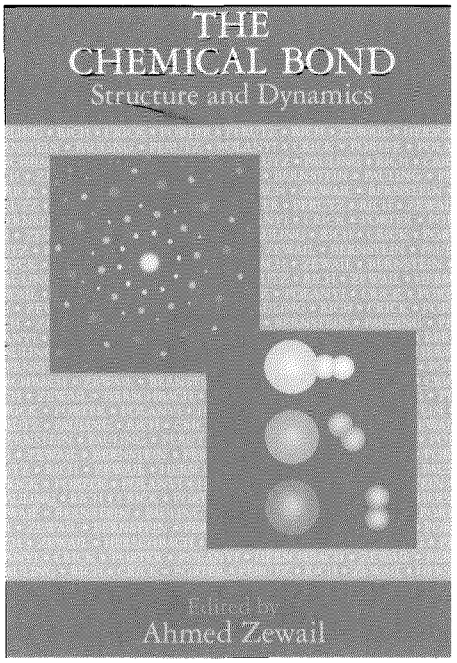
Books



Academic Press, 1992
$42.95
313 pages

This volume is an outgrowth of a remarkable symposium held at Caltech on Linus Pauling's 90th birthday, February 28, 1991. The seven speakers included six Nobel laureates in molecular structure and dynamics. The talks, given before a gathering of close to a thousand in Beckman Auditorium, were aimed in part at a general audience and in part at those more sophisticated in chemistry and molecular biology. The symposium was organized by the present volume's editor, Ahmed Zewail, who is, most fittingly, the first Linus Pauling Professor of Chemical Physics, and who also coauthored the book's only contribution not presented at the symposium. Richard Bernstein, a pioneer in modern reaction dynamics, had been invited to speak; because of his untimely death in July 1990, the editor included an updated version of a review of femtosecond (10^{-15} second) chemistry that he and Bernstein had written two years earlier.

The book contains nine chapters, two by Pauling himself, as well as biographical information on the other authors, and a helpful index. It is copiously illustrated. The opening lecture was by the honoree—a vintage Pauling presentation, in which he spoke for 45 minutes without notes. The printed essay is essentially his talk: in part a rather personal account of the impact of X-ray crystallography on the development of ideas about chemical bonding, and in part a discussion of his recent work, done at intervals over a six-year period, on icosahedral quasicrystals. These puzzling materials, discovered within the last decade, appear to have five-fold symmetry down to the atomic level, in violation of crystal-lattice theory. Pauling's account of his reasoning and calculating (done without a computer, to maximize the need for *thinking*) about possible interpretations of the experimental evidence is a fascinating exposition of his scientific style. He interprets these crystals as twinned cubic crystallites and, after gathering additional evidence in favor of his hypothesis, concludes: "I am now satisfied that the solution to the puzzle of the existence of icosahedral quasicrystals has been found, and that I may from now on devote my time to other pursuits."

Pauling's other brief chapter, "How I Became Interested in the Chemical Bond: A Reminiscence," is of particular interest to those who knew Caltech in the 1920s and '30s. (One of the few misprints in the book is in the middle name of Richard Tolman, in the picture caption on page 105; Pauling, naturally, gives it correctly on page 104).

Two of the other chapters are, in essence, the lectures given by Max Perutz, "The Significance of the Hydrogen Bond in Physiology," and by Francis Crick, "The Impact of Linus Pauling on Molecular Biology: A Reminiscence." Each of these contributions, as well as most of the others, emphasizes Pauling's fertile imagination and remarkable prescience. Crick's remarks are especially gracious and generous, but every chapter contains more than a few genuine and varied tributes to the honoree.

The remaining chapters are longer (25 to 57 pages). Some constitute rather specialized and critical reviews (with detailed bibliographies), others are guided tours illustrating the development of the fields represented. Each is by

When Ahmed Zewail was named the first Linus Pauling Professor of Chemical Physics in 1990, the two visited on the Caltech campus.

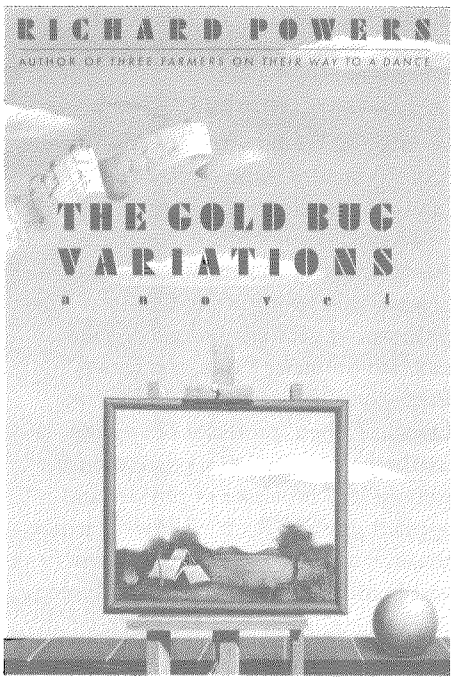
someone who has helped to create and define the field. The speakers were chosen, however, not just for the substance they could offer but for their style, and most of the chapters are eminently readable and contain new ideas and suggestions. They are by Alex Rich, the only former coworker of Pauling among the speakers, "Molecular Recognition between Protein and Nucleic Acid"; George Porter, "Chemistry in Microtime"; John Polanyi, "The Transition State"; Dudley Herschbach, "Chemical Reaction Dynamics and Electronic Structure"; and Ahmed Zewail and Richard Bernstein, "Real-Time Laser Femtochemistry: Viewing the Transition from Reagents to Products." There is little redundancy in the different contributions. Some contain valuable insights into the way fashions in science change, and the way in which creative scientists operate, particularly in showing that "accepted limitations" can sometimes be overcome by re*think*ing the fundamentals involved.

The book is of special interest and significance to the Caltech community—not just, but particularly, those who were in Pasadena during the Pauling years—because of the seminal role Pauling played in developing the CIT aura. He made it a mecca for chemists (and eventually molecular biologists) throughout much of his more than 40 years on the campus, and he revolutionized the teaching of introductory chemistry through his Chem 1 course. It is especially gratifying to those who knew the Institute in those days and who were drawn to it by his magnetism and inspiration, that the "distant period" referred to in Zewail's preface, which began after Pauling received the Nobel Peace Prize (1962) and resigned from the faculty (1964), has now been replaced by one of genuine good feeling. The ice was broken during his 85th birthday celebration, also at Caltech, when Pauling discussed his reasons for leaving, but made it clear that his heart had always been in Pasadena. It is highly apposite that the chief architect of this rapprochement has been Professor Zewail.

Pauling's name is synonymous with the nature of chemical bonds and 20th-century structural chemistry. He taught chemists and what are now called molecular biologists to think about chemical structure three-dimensionally, rather than just in terms of the two-dimensional topological diagrams that were universally used through the first half of this century. But it is not so often appreciated that he made seminal proposals in chemical dynamics as well. These, cited by several of the speakers, include his 1946 recognition that enzymes must stabilize transition states of the reactions they catalyze; his 1947 bond-order/bond-energy relationship, which provided a key to early interpretations by Johnston of the changes occurring as reactant molecules pass through transition states; and (at the other extreme of the time scale), his 1965 suggestion, with Zuckerandl, that evolutionary change could be timed by a "molecular clock," the accumulation of mutations in proteins. Dudley Herschbach puts it well in one of his concluding sentences: ". . . compiling this chapter has made me realize more fully the awesome impact and scope of his ideas." Anyone who reads this book is bound to feel the same way.

Kenneth Trueblood
Professor of Chemistry, Emeritus
UCLA

Trueblood received his PhD under Pauling in 1947, remaining at Caltech as a postdoc till 1949. From 1950 he was on the chemistry faculty (x-ray crystallography) at UCLA until becoming emeritus in 1989. He was department chairman from 1965 to 1970 and dean of the College of Letters and Science from 1971 to 1974.



Morrow, 1991
$25.00
639 pages

From a quick synopsis, Richard Powers's novel *The Gold Bug Variations* would appear relatively simple. Nominally there are three main themes: deciphering the genetic code, as told in the story of Stuart Ressler, a young researcher beginning his career at the University of Illinois in 1957; Bach's *Goldberg* Variations, which become Ressler's parallel obsession; and a pair of more-or-less conventional love stories. But just as Nature has arranged that all biological function arises from the permutations of only four bases in DNA, Powers manages to develop and combine his themes to produce incredible richness: a hymn to the endlessly evolving, infinitely variable, living universe.

The theme of the infinite is sounded continually and in many guises, most notably in the challenge: how should we live our necessarily finite lives in a world of infinite possibility? Ressler gives up his research career, on the very brink of probable success, in the face of the realization that the code problem, as important and challenging as it is, is trivial compared to the complexity and variety of life—even though the latter is contained in the former. In fact, virtually the entire research team (suggestively titled "Cyfer") drops out: one kills himself (taking all the laboratory rats with him); one abandons his wife and daughter based on nothing more than a low genetic probability that the child is his; one undergoes what can only be described as a religious conversion, stuck overnight in the library during a storm. Where else should a religious experience take place, in this Age of Information?

The general concept of code is a major focal point of the work—not only in the obvious manifestations of the genetic code and of computer programming (after abandoning his research career, Ressler reappears years later in a data processing shop), but also concerning language as code. The novel is full of allusions, metaphors, puns, that need to be translated before the underlying message can fully be read. One need read no further than the title—punning on the Bach work as well as the Poe story, where decoding a secret message leads to discovery of a great treasure—to appreciate that the book is in this sense its own subject.

Furthermore, the structure of the work is closely tied to the subject material, both overtly and subtly. The *Goldberg* Variations consist of 32 sections: an aria, thirty variations, and the aria repeated. The book is arranged in an introductory "aria," a poem that has the same number of lines as Bach's aria has measures, followed by 30 chapters, and a closing "recapitulation." Every third variation in Bach's work is a canon, where a theme begins in one voice, continues while the theme reenters as a second voice after some time delay, and a third voice in the bass ties them together. Powers's two love stories—one between Ressler and a married woman on his research team; the other between Franklin Todd, a coworker in the data processing facility, and Jan O'Deigh, a librarian whom Todd recruits to help him find out about Ressler's past—are highly imitative and told simultaneously (or as close to it as the medium allows), but with one displaced in time relative to the other—in this case, by 25 years. O'Deigh also functions as the third voice in this

canon, looking back at both Ressler's scientific work and her own part in the story from a couple of years further on.

Powers's intricate interweaving of materials is continually original and striking. One example begins with the recurring metaphor of the Perpetual Calendar: simple rules allow us to determine in which future year the calendar will look the same as this year; but what happens in that year is eternally different; life is far too complex and varied to repeat itself. The end of the *Goldberg* Variations is marked "*Aria da Capo e Fine*"; Powers ends his book with that heading followed by: "What could be simpler? In rough translation: Once more with feeling." It *doesn't* mean that, but rather: "Play the aria again from the beginning, *and end.*" Going back and repeating equals termination. Ressler tells O'Deigh he is returning to Illinois to participate in a research project; for a moment she is excited to think he is resuming his scientific career, then understands: it is a cancer study, and he is going not as scientist but as subject. Ressler hears the *Goldberg* Variations on the radio and first thinks it is the same recording he has been listening to for years, but then realizes it is a new version by the same performer. What great luck, after all these years, to be able to hear a new conception of the piece—but at its end, Ressler learns that the recording is being played in tribute to the artist, who has just suffered a fatal stroke.

The artist in question is, of course, Glenn Gould, who constitutes an important figure in the book even though he is never named. Reminiscent of the phrase beloved by patent attorneys: "The entire content of [an earlier patent] is incorporated herein by reference," here we have an entire character, whose story is in many ways parallel to Ressler's, built into the story simply by allusion. An efficient and essential device, if a book dealing with the infinite is to be kept short of infinite length.

Clearly this book will reward most those readers willing to devote the effort needed to extract its richness from these complexities; but untangling the structural network and deciphering the code are by no means its main points. The *Gold Bug Variations* has an important message for everyone—a remarkable achievement.

Jay Labinger
Administrator, Beckman Institute

Labinger received his BS from Harvey Mudd in 1968 and his PhD from Harvard in 1974. He's been a member of the professional staff at Caltech since 1986 and has a local reputation as a solver of puzzles.