through the courts can there be real progress in reversing environmental degradation. Murdoch, as an ecologist, carefully weighs the complex of behavioral and economic factors standing between contemporary man and the steady state. He comes up with several noteworthy conclusions: in America the corporation as an institutional form will more likely impede than complement efforts to solve environmental problems; otherwise, the structure of political and economic systems is not as relevant to solving environmental problems as is the level of environmental awareness in the populace; and, in modeling economic and social strategies, the game ought to be optimization rather than identification of limits within which to maximize.

Overall, Murdoch's conclusions convey cautious optimism, but in no way underrate the implications of current population growth, pollution, and diminution of resources. It is commendable, in a moral sense or to be constructive, not to end on a note of despair. One should ask, however, what other prognosis could come out of the information in this book. Consider the sum result from combining trends in population and birth control (Keyfitz) with trends in resources (Cloud, Brown and Finsterbusch, Hubbert, and Paulik) and the implications of pollution (Hickey, MacIntyre and Holmes, and Rudd), then weighing this all in light of man's history of political responses. From this picture a disinterested ecologist will first recognize a species' population in irruptive growth at the same time that the carrying capacity of its environment is undergoing an accelerated decline (not merely a per capita decline). Such may lead him to predict that a precipitous downward adjustment will occur followed by marked instability for some time. Given the degree of ingenuity with which this species exploits and manipulates its environment, and given its flexible behavior, the ecologist will predict neither when nor how the adjustment will occur. The most frustrating aspect of analyzing man's present dilemma is that while we are now capable of predicting with high probability one or more of a series of unpleasant events, we cannot yet identify which of the events will occur first or where or when.

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Irradiated Water

The Radiation Chemistry of Water. IVAN G. DRAGANIĆ and ZORICA D. DRAGANIĆ. Academic Press, New York, 1971. xii, 244 pp., illus. $14. Physical Chemistry, vol. 26.

In 1961 Allen's excellent book *The Radiation Chemistry of Water and Aqueous Solutions* was published. *The Radiation Chemistry of Water* by the Draganić team is a timely successor. Pulse radiolysis was introduced only two years before Allen's book appeared, but since then radiation chemical research has been dominated by pulse radiolytic investigations into the chemical behavior of short-lived species. The organization and shift in emphasis in the Draganić work appropriately reflect this. The authors have felicitously organized the presentation around well-chosen major topics, one for each of eight chapters. The subject coverage is thorough for a book of only 244 pages which attempts to deal with "radiation-induced changes in water and, to the extent necessary to explain the behavior of irradiated water, changes in aqueous solutions."

The initial, historical, chapter conveys a feeling for the problems encountered and solved in arriving at our present knowledge of aqueous radiation chemistry. (The book as a whole describes many of the principal questions currently under active investigation.) Next the authors consider the interaction of ionizing radiation with water, as derived from radiation physics, and the probable pathways of formation of active species, presumably in nonhomogeneous spatial distributions. Much knowledge gained through pulse radiolysis research is correlated in two chapters on the primary products of water radiolysis: on the reducing species—the hydrated electron, the hydrogen atom, and molecular hydrogen—and on the oxidizing species—the hydroxyl radical and hydrogen peroxide. Listed are some of the hundreds of rate constants measured for these transients by pulse radiolysis. The yields (radicals per 100 electron volts absorbed energy) of primary products, a topic of great interest in the 1950's and a major research interest of the authors, is covered in chapter 5. Perhaps their interest is justified, since with the newly developed picosecond pulse radiolysis techniques one enters the temporal and spatial domains in which these yields arise. Work on the diffusion-kinetic theoretical model, which explains with some success the observed primary radical and molecular yields, is described in chapter 6. Essential experimental radiation chemical methods and measurements are found in the last two chapters.

Finally, why a book on the radiation chemistry of water? The authors note the practical importance of aqueous radiation chemistry for nuclear reactors and in the medical use of x-rays. They also emphasize, but not sufficiently, the contributions radiation chemistry has made to the general field of chemical kinetics, first with competition studies and then with direct measurements of rate constants by pulse radiolysis.

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Wood Chemistry

Lignins. Occurrence, Formation, Structure, and Reactions. K. V. SARKANEN and C. H. LUDWIG, Eds. Wiley-Interscience, New York, 1971. xxx, 916 pp., illus. $35.

The appearance of this long-awaited book marks a milestone in the progress of lignin science. The age of pioneering is over. For the first time the subject has been broached in such a manner as to make it teachable material rather than the traditional obscure alchemy into which the famulus could be initiated only by prolonged contact with the aged and wise magister.

In contrast to its predecessors, which have been either largely uncritical synoptic organizations of all the published literature or subjective reports covering mainly the output of a single school, this treatise on lignin sifts and weighs knowledge accumulated from over a century of thought on nature's most enigmatic polymer and presents a workable, logical text. The senior editor, who is emerging as a leading educator in wood chemistry at the increasingly active College of Forestry at the University of Washington, has succeeded in impressing on his collaborators his own broadminded, didactic approach.

The volume is well organized into nine parts comprising 19 chapters. After a short introduction in which terms and concepts are defined, the occurrence and formation of lignins in plants and their differentiation and distribution are described. The next part