review high-energy hadron scattering, hyperon decays, and charmed-baryon production respectively. Their lectures nicely illustrate how QCD has become the natural language of strong interactions for experimentalists and theorists alike.

Some of the most beautiful recent experimental work has been carried out at electron-positron colliding-beam facilities. Good overviews of that research are given by H. L. Lynch and J. E. Augustin. Their papers are particularly clear in explaining the extraction of useful phenomenology from raw data. On the theoretical side, R. Gastmans describes calculations of radiative corrections to high-energy e^+e^- annihilation. Although the subject matter is rather technical, it is presented in a clear and understandable manner.

The bound-state problem is discussed by D. R. Yennie and A. Martin. Yennie describes recent advances in calculations of hyperfine splittings for relativistic two-body systems that provide high-precision tests of quantum electrodynamics. Martin presents some general results obtained for nonrelativistic potential models that are very successful in explaining the observed charmonium and bottomonium spectra.

A description of neutrino scattering experiments is given by H. Wahl. Experimental specifications are clearly explained, with primary emphasis on the extraction of hadron structure functions. Radiative corrections to neutrino scattering are discussed by M. Veltman. He points out how precise measurements of such corrections may unveil properties of as yet undiscovered heavy elementary particles, an interesting suggestion.

The deep-inelastic electron-deuterium scattering asymmetry measurement performed at the Stanford Linear Accelerator Center is briefly described by M. Borghini. That beautiful experiment confirmed the validity of the Weinberg-Salam model of electroweak interactions and has become a classic piece of work.

J. Weyers reviews the problem of quark masses and attempts to relate mass scales and quark mixing angles by imposing discrete symmetry requirements. This is an interesting area of theoretical investigation that is ripe for new creative ideas.

A detailed theoretical overview of weak, electromagnetic, and strong interactions is presented by M. K. Gaillard and L. Maiani. They cover a variety of interesting topics, the most exciting of which is proton decay. This exotic possibility arises as a very solid prediction of grand unified theories. Experimental searches for proton decay are now under way around the world. If the proton lifetime is in the range 10^{30} to 10^{32} years, as predicted by theory, we should have experimental verification within the next year.

The proceedings conclude with speculations on the future of elementary particle physics by S. L. Glashow. After nicely summarizing the status of theory, he suggests experiments for the future. A novel suggestion to look for neutron-antineutron oscillations has motivated several new experiments, which are now getting under way. As usual, Glashow's ideas are interesting, entertaining, and thought-provoking.

In total I found *Quarks and Leptons* to be a useful, well-written collection of reviews. Its papers provide clear exposés of some of the most interesting topics currently being investigated by high-energy physicists.

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Interferon

Interferon and Interferon Inducers. Clinical Applications. DALE A. STRINGFELLOW, Ed. Dekker, New York, 1980. xii, 330 pp., illus. $39.50. Modern Pharmacology-Toxicology, vol. 17.

The first flowering of interferon studies occurred in the late '50's and early '60's. During this time the basic biological properties of interferons were elucidated, they were hailed as general antiviral agents with therapeutic potential, and they were shown to be involved in natural recovery of animals from some primary virus infections. Gradually the enthusiasm generated during this period subsided, possibly because not enough interferon could be obtained to carry out significant clinical trials in humans. Studies of interferons seemed to become a backwater of virology.

The second flowering interferon studies are now undergoing was generated by several remarkable findings. Cantell's group in Helsinki developed methods for obtaining sufficient amounts of human alpha interferon from leukocytes to carry out a small number of significant clinical studies. These demonstrated that interferons might be useful in the therapy of respiratory virus, herpes virus, and chronic hepatitis B virus infections in humans. With methods developed in studies pioneered by Paucker, large quantities of human interferons can now be purified, and these purified interferons possess a remarkable specific biological activity—a concentration of $10^{-15}M$ has the ability to inhibit virus growth.

Interferons are induced proteins that have distinct messenger RNA species that are produced in response to many viral or chemical inducers. The mechanisms of interferon action have been partially elucidated; they involve the induction of intracellular enzymes apparently also active in several biological systems other than interferon. In addition to their antiviral properties, interferons have marked inhibitory effects on cell growth and act as regulatory factors in many phases of the immune response. Three immunologic types of human interferon have been described: alpha, beta, and gamma. The genes for human alpha and beta interferons have been cloned in bacteria, and the amino acid sequences of the alpha and beta interferons are now known. The alpha interferons are a group of proteins produced by distinct but closely related genes. Gamma interferon, which seems to be produced only by T lymphocytes in response to mitogens, or to secondary exposure to an antigen, is an intriguing substance that may well be very important.

It is therefore an appropriate time to consider a book such as *Interferon and Interferon Inducers*, which attempts to review "many promising approaches that may lead to the fulfillment of interferons' potential as effective chemotherapeutic agents." The volume contains an introduction to interferons together with ten chapters that stress possible clinical application of interferons. Unfortunately, because of the small number of studies that have been carried out in humans to date, it is difficult to say much that is definitive about the clinical application of interferons. Moreover, the book is not particularly useful as a general reference on interferons. An overview chapter by Stringfellow is too brief to cover the gaps in the volume on such topics as the mechanisms of action of interferons.

A chapter on the production, purification, and properties of human interferons by Berg, Osther, and Heron contains an excellent discussion of interferon production by leukocytes; however, much of the chapter has unfortunately been left behind by already published work on cloning of human interferon genes and by changes in nomenclature. Thus, rapid progress in the field has taken a toll on the usefulness of the volume.

A chapter on stability and pharmacokinetics by Greenberg, Harmon, and Couch is a useful compilation of diverse

data not otherwise accessible in such a compact form. Several other chapters discuss the biological actions of interferons on cell growth (Ito and Buffett), on viral infections (Billiau and DeSomer), and on the immune system (Johnson). A chapter on the effects of interferons on cell growth reviews some data on interferon-induced inhibition of the growth of tumors in mice; such findings led to current efforts to treat human cancers with interferons. At best, it would seem at present that interferons will serve as adjuncts to chemotherapy of tumors, although it is still possible that some human tumors will be found to respond to interferon alone. One advantage of interferon treatment of tumors is that interferon has very limited toxicity. However, we still do not know whether the possible anticancer properties of interferons are based on their growth-inhibitory, immunoregulatory, or antiviral effects—or some combination of them.

In the chapter by Billiau and DeSomer herpes B virus is given the designation HB (p. 114); then, HB is used throughout the chapter to refer to what is clearly work on hepatitis B virus. Also on p. 114, the authors suggest that perhaps interferons should not be used to treat chronic hepatitis B infections, since an efficient vaccine for preventing hepatitis B infection is being developed. The millions of patients now afflicted with the disease will not be helped by the vaccine, however, and interferon treatment might prevent them from suffering the worst consequences of the disease as well as from spreading it. On p. 116, the authors state that exogenous administration of interferon "should not achieve more than what is achieved by interferon spontaneously produced during virus infections, a delay in virus replication and virus spread and an alleviation of symptoms." With a natural substance, however, it is sometimes possible to achieve desirable pharmacological effects not seen with the normal physiological production of the substance; take for instance the therapeutic application of adrenal steroids.

The strength of this volume is a series of six chapters on interferon inducers. There is a general chapter on interferon inducers by Stringfellow, and there are chapters on polynucleotides (Levy), tilerone and related compounds (Mayer and Krueger), propanediamines (Betts and Douglas), and polyanions and other polymers (Breinig and Morahan). These chapters are a compilation of useful information on interferon inducers and as such are valuable.

Although therapy with interferon inducers sounds like a good idea, this book points out a number of problems associated with their use. Many inducers are not terribly effective in humans; they tend to be very toxic; it is sometimes not clear that their therapeutic activity is due to their ability to induce interferon; their use is often followed by a period of hyporeactivity during which interferon production cannot be induced by the particular chemical involved; and potentiation of virus disease, a paradoxical response, sometimes is associated with their use. With all of these problems, it is no wonder that many have opted to work on the application of exogenous interferon as a form of therapy. With the cloning of the genes for alpha and beta interferons, there should soon be enough interferon available to carry out the critical studies that will establish whether it indeed has a role in the therapy of human diseases.

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Factors Predisposing to Cancer

Genetic and Environmental Factors in Experimental and Human Cancer. Proceedings of a symposium, Tokyo, 1979. HARRY V. GELBOIN, BRIAN MACMAHON, TAIJIRO MATSUSHIMA, TAKASHI SUGIMURA, SHOZO TAKAYAMA, and HIRAKU TAKEBE, Eds. Japan Scientific Societies Press, Tokyo, 1980. (U.S. distributor, ISBS, Forest Grove, Ore.). xvi, 370 pp., illus. $49.

This volume contains the papers presented at the 10th international symposium of the Princess Takamatsu Cancer Research Fund. The subject is approached predominantly through epidemiologic studies, with additional papers on carcinogen metabolism, DNA repair, and the genetics, pharmacogenetics, and immunogenetics of human and experimental examples. The extremely important but little appreciated topic of the genetics of carcinogen metabolism in the human is discussed by E. S. Vesell. The role of the immune system in ultraviolet carcinogenesis of the skin, a topic of recent interest and importance, is covered by M. L. Kripke. Equally interesting and timely is a report by a group from the People's Republic of China headed by M.-H. Li on experimental investigations of the carcinogenicity of presumed fungal products found in contaminated food obtained from Linxian County, where the incidence of esophageal cancer is extremely high. These studies should serve as a model for the investigation of the role of dietary contaminants in human disease.

The discussions of specific examples and systems of DNA repair are good but somewhat dated because of the rapid advances that have been made in this field since the time of the symposium. Papers on several genetic conditions in the human predisposing to cancer as well as a paper on cancer mortality and morbidity among 23,000 unselected twin pairs are highlighted by an interesting new look at hereditary retinoblastoma by Matsunaga. He suggests that the development of this disease may be the result of altered differentiation rather than of somatic mutation as was originally postulated by Knudson.

The epidemiologic studies reported in the book range from investigations of specific cancers, such as mammary carcinoma in several geographic locations, to investigations of the incidence of a variety of neoplasms in selected human populations, such as the Mormons and Hutterites and the Japanese in Hawaii. The report from Honolulu by Kolonel and his associates and from Fukuoka, Japan, by Hirohata, who has worked closely with the group in Honolulu, present interesting cancer incidence rates in Japanese migrants to Hawaii. In view of the major differences between the United States and Japan in the incidence of stomach, breast, and colon cancer, these investigations, which have been aided by the excellent Hawaii Tumor Registry and the cooperation of the Hawaii Department of Health, are among the most promising for the elucidation of specific environmental factors in the causation of these cancers.

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The Case for Conservation

Extinction. The Causes and Consequences of the Disappearance of Species. PAUL and ANNE EHRLICH. Random House, New York, 1981. xiv, 305 pp. $15.95.

In this volume Paul and Anne Ehrlich consider the soaring extinction rate and the implications for society of what could become the first major reduction in total world species number in human history. In their usual readable fashion, they have prepared a careful and well-