(= Francisco); only feminine logic would lead to the conclusion that all young men south of the border bear the name of Pancho. So a dilemma.

Based on experiments and observations on both inanimate and animate systems, science has been amazingly successful in its ability to make correct predictions. But it ordinarily restricts itself to answering the question *how*?, not *why*?. Although scientific explanations are not unique, they do give one the confortable feeling that the phenomena explained are dependable.

The chapter ends with a discourse on the very small and the very large. Among other things one learns that a person is made up of $10^{15}$ cells, each about 1/1280 of an inch in diameter. Each cell contains some friendly goo and a nucleus. This nucleus consists somehow of some strings of chromosomes and genes plus some DNA. The DNA is supposed to control our hereditary characteristics. There are indications now that biologists may soon be able to modify our inherited characteristics.

Chapter Three deals with Science and the Citizen. Dr. Weaver emphasizes how important it is that the citizen understand clearly the nature and spirit of science. After all, the citizen not only pays for the researches (taxes and the like), but the results, both theoretical and practical, are playing an increasingly vital role in his very existence.

In Chapter Four, entitled Science and Religion, we come into Indian Country. Scientists and clerics have long been edgy toward each other on philosophical grounds. The scientist demands proofs and experimental verifications in any subject matter under discussion; he knows that theories may come and go like bubbles, and he doesn't mind too much if one theory has to give way to an entirely different one overnight. The cleric, on the other hand, is apt to have a fixed faith in principles and traditions of ancient agrarian origin; his focus is on conduct, moral meaning, and revelation. He does not demand fresh verification of old statements of a fact. Moreover, the cleric is apt to be slow in examining his religion in the light of modern scientific findings. Dr. Weaver considers himself a religious man; he feels better after going to church. We might describe him as an enlightened Christian. His present book might well be used as a text in a required course in theology.

Also discussed in Chapter Four is the question of statistical morality. When a workman sets forth in his automobile he increases the chance of traffic accidents; is he guilty of statistical sin? If a nubile, young woman bears a child, she contributes to the already alarming population explosion; is she also guilty of statistical sin? Questions like these bother Dr. Weaver and he very much wishes clerics would take them more seriously. So do we.

Modern medical and biological discoveries have raised some highly important moral and religious questions which the clerics have so far ignored, but this doesn't prevent Dr. Weaver from raising them as for example, transplants, prolonging life, and, we may add, artificial insemination.

The next two chapters are entitled "The Theory of Probability" and "Communications," respectively; both subjects are highly important and Dr. Weaver has made significant contributions to both. One cannot escape the conclusion that man is a highly improbable creature, and women are more so.

Chapter Seven is entitled "Peace of Mind." Dr. Weaver is against it. If he didn't have something to concern himself about, he would be downright unhappy.

Finally, comes the strange Chapter Eight on Lewis Carroll, the author of the Alice books. Lewis Carroll was really his pen name; under his real name he was a mathematician at Oxford, and he wrote books on determinants and symbolic logic. In the latter he poses such delightful problems as

> Fossils are never crossed in love.
>
> Oysters are not fossils.
>
> Therefore . . .

Dr. Weaver has made an extensive collection of the various translations of the Alice books, and it is clear that he has a great admiration for Carroll and fondness for Alice; the Alice books seem to provide fine examples of what imagination and fantasy can add to life. I, the senior reviewer, have never read the Alice books; having grown up in a frontier valley in southwest Idaho, I was surrounded by so many real wonders that any imaginary ones would have left me flat. And besides, Alice was just a girl and probably couldn't ride a horse, climb trees, shoot coyotes, or catch trout, and so couldn't possibly be of much interest. But I, the junior reviewer, have read the Alice stories while sitting up in a tree and found them a perfectly delightful introduction to uncommon sense and skepticism. And who wants to shoot the pretty coyotes and thereby upset the world's ecological balance.

It is easier by far to read and praise Dr. Weaver's book, including the fine Foreword by Professor Beadle, than it is to cover the broad but accurate subject matter in a review. The book is inspiring; it inspires one to look again and again at nature and how she works. It inspires us to look onward for a neater, sweeter maiden in a cleaner, greener land.

*Don M. Yost (1893- ) was reared in the fresh air of Idaho and educated at the Universities of California and Utah, at Caltech, and in the U. S. Navy, which may explain why his countless friends regard him as a true salt of the earth. Author of classics such as Yost and Russell,* Systematic Inorganic Chemistry *(Prentice Hall, 1946), an expert with languages (from Boisean to Boolean), and a professor (Caltech) who could recondition the recondite, Don Yost is equally well known for his book reviews, all of which carry a beautiful Boise Basin briskness.*

*Señora Lupe de Sinaloa, in addition to her obvious accomplishments at tree climbing and her love for coyotes, also likes hiking, cybernetics, swimming, library science, and exploring. She graduated from the University of California at Berkeley (in chemistry) and says she cannot help the fact that she is a girl.*

## FILLING A VOID

*Title* Principles of Radiation Protection

*Editors* K. Z. Morgan and J. E. Turner

*Publisher* John Wiley & Sons, Inc., 1967

*Pages* xix + 622

*Price* $13.95

*Reviewer* Frederick P. Cowan

This is the long-awaited Oak Ridge textbook on Health Physics. It

is the product of 19 prestigious authors but it must be regarded as a fitting climax to the teaching activities of the senior editor, K. Z. Morgan, and his staff in this broad interdisciplinary professional field. Interestingly enough, the junior editor was an AEC Fellow who was trained in applied Health Physics at ORNL and returned years later not only to do research in dosimetry but also to supply the extra help needed to complete the editing of this text. An interesting story of how the book developed is told in a preface, and the history of damage and protection from ionizing radiation is covered in Chapter 1. These are well-written accounts that provide excellent background for the chapters to come.

The field of Health Physics, broadly interpreted, includes almost everything having to do with radiation protection, including applied techniques and research in many fields. A single volume must obviously be selective and the present one is no exception. Biological effects of radiation, internal exposures, and maximum permissible exposure considerations are treated in considerable depth, while engineering aspects, shielding, laboratory design, and other applied matters receive less attention. Despite the multiplicity of authors, the editors have achieved a commendable degree of coherence, the figures are uniformly well done, and typographical or linguistic errors are almost nonexistent.

Chapter 1 is considerably more than a history of radiation damage and protection in that it also delineates the present situation in regard to natural background, fallout, medical exposures, environmental contamination, etc. The figures showing the four series of radionuclides have been reduced to a point of doubtful practical value, but, aside from that, the chapter is packed with interesting and useful information.

After a treatment of the passage of heavy charged particles and $x$ or $\gamma$ rays through matter, there is a chapter on radiation quantities and units. This contains the complete text of the International Commission on Units and Measurements report on this subject plus sections on the relation between gamma flux density and exposure rate, as well as between exposure and absorbed dose. However, the following chapter on the physical basis of radiation dosimetry uses the terms "first collision dose" or "energy imparted" rather than "kerma" which is recommended by the ICRU and defined in Chapter 3. The basic mathematical principles of various dosimetric methods are discussed in considerable detail.

The treatment of dosimetry continues with excellent discussions of excitation, ionization, and W. The figure of $10^{-13}$ amp as the practical limit for current measurements seems a little too high and no mention is made of field effect transistors which are replacing electrometer tubes for many applications. Mixed $\gamma$-$n$ dosimetry is well treated, a variety of methods of dosimetry are taken up rather briefly in a "catch-all" chapter, and the treatment of dosimetry is completed by a chapter on dose from electrons and $\beta$ rays.

The next two chapters take up methods for computing exposures to people, both external and internal. There is a good discussion of build-up factors for gamma radiation and mathematical treatments for gamma sources of various shapes. Decay schemes, computation of maximum permissible values, lung and GI tract models, are all taken up in detail. There are also excellent separate sections on six elements of special importance with regard to internal exposures; tritium, iodine, strontium, radium, uranium, and plutonium.

Chapters 11 and 12 constitute a thorough sophisticated treatment of the effects of radiation on humans from the point of view of both radiation biophysics and radiation biology. Among the subjects covered are mechanisms of biological damage, the effect of radiation quality, mutagenesis, carcinogenesis, effects on specific organs, the acute syndrome and delayed somatic effects. This treatment is continued in the following chapter where acute and delayed effects of large exposures are discussed from the medical point of view, an excellent chapter except for an unqualified statement that "erythema appears on exposure to more than 200 or 300 rad."

Much material on instruments is covered in earlier chapters, but there is a short separate discussion of practical aspects. One might disagree with the statements that the ideal instrument should respond to only one kind of radiation and that GM counters can't be used to determine dose rates, but this is certainly no place to elaborate on such differences of opinion.

The final chapter deals with the prevention of criticality accidents. This is a matter of great importance because of the potential seriousness of such accidents and, although somewhat specialized, is properly included.

In summary then, this is a very valuable addition to the literature of Health Physics. Teachers using it as a text will find it too detailed in some areas and not detailed enough in others, depending on their course orientation. It combines some of the attributes of a text, reference volume, and encyclopedia, and, therefore, will be useful for many purposes. Each chapter has a liberal selection of references and numerous problems which greatly enhance the value of the book. Although intended primarily for graduate-level courses, much of the material can be used for undergraduate or in-service course work. This volume is a welcome addition to the literature of radiation protection which has been very lacking in books covering the field in adequate breadth and depth.

*Frederick P. Cowan has been Head of the Health Physics Division at Brookhaven National Laboratory for the past twenty years. He served as a consultant to the Federal Civil Defense Agency from 1951 to 1955 and was President of the Health Physics Society in 1957-58. He was a member of the American Board of Health Physics from 1962 to 1966, having served as Chairman from 1963 to 1964 and as Chairman of the Board's Examination Panel from 1959 to 1961. He is a member of a number of national and international committees including the National Council on Radiation Protection, the International Commission on Radiation Units and Measurements, and the AEC Advisory Panel on Accelerator Radiation Safety. His PhD (Harvard, 1935) was in physics.*