Book Reviews

Radiation, Genes, and Man. Bruce Wallace and Th. Dobzhansky. Holt, New York, 1959. xii + 205 pp. Illus. $3.50.

Over the past five years there have been frequent public debates by scientists about the damaging consequences of the exposure of our store of human genes to atomic radiations. The emotions aroused, to say nothing of the seemingly contradictory statements made, have probably left more people confused than were left either reassured or with heightened apprehension. This confusion is partly because there are many sources of such radiation, and it is not clear to most persons whether the damage is greater from medical and dental exposures, from industrial hazards, or from the fallout occurring after the testing of nuclear weapons. Confusion is even more definitely attributable to the fact that different "authorities," in good conscience, can speak reassuring words or raise their voices in alarm, when looking at the same facts. And it is partly because there are so many gaps in our present scientific knowledge of how much radiation we are exposed to, internally and externally, how many mutations might result, how harmful these mutations might be, on the average, and what the consequences are to an entire population, as well as to particular individuals, from a given degree of exposure. Two well-known geneticists, Bruce Wallace, of Cornell University, and Theodosius Dobzhansky, of Columbia University, have set out to clarify these matters for the general, nonscientific reader. No two persons could in all respects—scientific knowledge of these matters, ability to write clearly and interestingly, and their own participation in the exploration of these questions—be better qualified to perform such a task.

The book, however, quickly exposes the dilemma which faces everyone who undertakes to explain about the genetic hazards of nuclear radiations. The first five chapters, which provide the necessary general background of the subject, are as elegant and clear a statement as could be desired. The titles of these chapters sufficiently indicate their content: "Atomic energy—friend or foe?"; "Heredity, environment, genes and chromosomes"; "Spontaneous mutation"; "Atoms and radiations"; and "Induction of mutation by radiation."

Good diagrams and interesting examples aid greatly in the exposition of the subject. An exception is possibly the world map (pages 72–73) which attempts to show the heaviness of fallout at different latitudes by the *widths* of shaded bands placed at every 15° of latitude from the equator to the poles. This representation might lead some unwary readers to suppose that fallout descends in a peculiar banded pattern, since the real meaning of the widths of the bands is insufficiently explained.

By far the most significant part of the book is comprised by the next three chapters, which are entitled respectively "Genes in Mendelian populations," "Genetic effects of radiation on populations," and "Some unsolved problems." Here most readers will find hard going. Not that the same care has not been given to clear exposition—but the subject itself is not easy at first acquaintance. A certain amount of mathematical treatment cannot be avoided. And especially, some of the concepts, such as "genetic death," have meanings not to be inferred from the ordinary ones. Thus, "genetic death" is not the death of any person—it is the extinction of a gene from the population; and this, while it might occur through the death of its bearer before it is passed on to some child, may also occur because of the bearer's sterility, relative infertility, or even because by chance, and chance alone, the gene in question fails to be handed on to any of the living children of the bearer. (The latter is not uncommon in a species such as ours, where the size of the average family is quite small.) In spite of all such difficulties, the reader must be urged to plow manfully on, for the principles of population genetics explained here are the very heart of the matter.

It is encouraging that Wallace and Dobzhansky have not hesitated to tackle one of the moot issues involved in the assay of radiation-inflicted damage upon genes and chromosomes. This is the question of whether the human species is so highly selected and so well-adapted a species that all mutations which cause a departure from the "norm" can be regarded as unfavorable and are present in human populations only because fresh mutations keep replenishing their supply as fast as they are eliminated by "genetic death," or whether, on the contrary, there are many genes which are maintained in human populations because when heterozygous (that is, when carried in a single dose) they may confer some benefit, even though any individual who is homozygous for the same gene (that is, carries a double dose of the mutant) may be at a disadvantage in the process of natural selection. A good example is the mutant gene for sickle cell hemoglobin, which in the double dose produces a severe anemia from which the bearers commonly die fairly early in life. But normal hemoglobin is more avidly attacked by the plasmodium of tertian malaria than is sickle hemoglobin, so that in areas of Africa where malarial infections are severe, almost the only adult survivors are persons who have one dose of normal hemoglobin and one dose of sickle hemoglobin. The major question is: how common are such relationships between alternative sorts of genes in the human species? The authors are well known among geneticists as being strong proponents of the latter view; while H. J. Muller and others strongly advocate the former theory.

It is greatly to the credit of Wallace and Dobzhansky that they discuss this question with calmness and balance, and do not overadvocate their own position. In any case, as they strongly emphasize, when it comes to a matter of those mutations induced by high-energy radiations rather than mutations that arise spontaneously, there is every reason to regard the mutations as overwhelmingly harmful. Atomic radiations are not gentle agents. They smash chromosomes and mutate genes in a far more destructive way than do the normal causes of mutation, other than the background radiation that none of us can altogether escape.

A question of great importance which

the authors discuss is whether a continuing heavy exposure to radiations may actually cause the extinction of human populations, over and above the consequences in the form of increased numbers of defective individuals. Their answer to this question is on the reassuring side. This is because the 400- to 500-roentgen dose which is sufficient to cause death in half the exposed persons tends to preclude exposure to the very much larger doses it would take to extinguish the population because of whatever dominant lethal mutations might be induced. This conclusion is based, however, on the assumption that human genes and chromosomes are not a great deal more sensitive to radiation than those of fruitflies; but this assumption may be questioned on the basis of the observed sensitivity to low doses of x-rays of human cells growing in tissue culture. It is furthermore too bad that, in appraising the total situation, the authors have neglected to emphasize the relative significance of medical and occupational exposures to radiation. The treatment becomes focused a bit too much on the effects of fallout and possible nuclear war, and not on the multiplicity of exposures that the nuclear age may bring with it.

Let the last word be one of high praise for the efforts the authors have made to clarify a debate often marked by more heat than light. They bring out in their final conclusions the inescapability of making value judgments —far more political in nature than scientific—respecting the relative damage done by fallout and the desirability of a cessation of weapon testing. They point out the deficiencies in our present knowledge as well as the fact that radiation damage to living things is not all genetic damage. They take hope in the fact that mankind has acquired in its evolutionary progression not only a particular genetic heritage but also a means of passing on knowledge and of growing in wisdom through experience. They hope, therefore, that our species will surmount this threat to its continuance even as it has survived the lesser threats of the past. Unquestionably, this is the finest book yet published in the sharp debate over the genetic damage done by nuclear radiations. May it have many readers, and may each one cope manfully with its difficulties until he concludes its final page! He will be amply repaid.

BENTLEY GLASS
Department of Biology,
Johns Hopkins University

This Sculptured Earth: The Landscape of America. John A. Shimer. Columbia University Press, New York, 1959. xii + 255 pp. Illus. $7.50.

Americans yearly become more and more travel minded, and John Shimer has written *This Sculptured Earth* for the increasing legions of men and women now criss-crossing the United States.

So this is a travel book. But it will not tell the traveler where to find a motel with a swimming pool, a gourmet's dinner, or an out-of-the-way antique shop. It won't tell the wayfaring American the shortest distance from here to there. But it will tell him how to look at the American landscape.

As we become a nation of travelers, we forget that our landscape has beauty and majesty, that it has a past and a future, that it can evoke awe and wonder, that it can provide inspiration and solace. John Shimer is trying to remind those of us who have forgotten—and tell those of us who have never known —that the physical land mass of the United States is something more than a barrier dividing the Atlantic and Pacific Oceans. To Shimer it is a landscape to be seen, to be understood, to be appreciated, to be treasured.

The author has managed to describe and to explain a vast amount of the physical geography of this country. Are you going to Boston? Then why is there a harbor there, and whence came the islands that dot the bay? Will you know the explanation of the towering Tetons as you drive by them on your way to Jackson Hole, Wyoming? Or (on a more intimate scale) will you understand that ridge of hummocky land that you speed over on the Indiana Turnpike near South Bend?

Shimer does more than describe. He gives us some idea of the vastness of time and the complexity of history behind the American landscape. He even gives us, in places, a glimpse of what another traveler might see in some far future eon.

The book contains a minimum of technical jargon. Needed terms are defined, and most of these appear again in a useful little glossary illustrated with neat line drawings by the author's wife, Florence Henry Shimer. Florence Shimer has also contributed some effective,

Meanders of the White River, Indiana.