Human Ecology: *20th Century*

ENVIRONMENTAL factors in public health attracted a distinguished set of scholars to the fifth annual scientific conference at Albert Einstein College of Medicine, Yeshiva University, New York, on May 27, 1963.

With Dr. Robert S. Morison, director of medical and natural sciences, Rockefeller Foundation, as moderator, the audience heard discussions of health implications of ionizing radiations by Dr. Bentley Glass, Johns Hopkins University; water resources, by Dr. Gordon M. Fair, Harvard; nutritional factors, by Dr. Nevin Scrimshaw, Massachusetts Institute of Technology; population pressures, by Dr. Philip M. Hauser, University of Chicago; communication facilities, by Dr. John R. Pierce, Bell Telephone Laboratories; and evolutionary prospects, by Theodosius Dobzhansky, Rockefeller Institute.

Radiation

Dr. Bentley Glass commented that understanding the effects of ionizing radiations is especially important because the typical popular reaction is either to ignore them or to become hysterically alarmed. Giving much of his talk to reviewing the importance of the various sources of high energy radiation, he emphasized that people have always been exposed to radiations which occasionally induce chemical changes in tissues as a result of an interaction which produces pairs of ions. The natural dose to the gonads, he said, is on the order of 3 to 5 r in the age range when injury from radiation is most likely to affect future generations.

In perspective, hazards of exposure to radiation, short of a holocaust, are likely to bring serious harm to only a small percentage of the present generation, he indicated. Such injuries include radiation sickness, cataracts, burns, breakdowns of tissue, cancer, sterility, and a shorter life expectancy. But they do not now represent a major public health threat for this century.

The great concern for public health, he said, is that single small doses to large numbers of the population may be far more dangerous than heavy doses to the unfortunate few.

Even a holocaust, a nuclear war that would prove fatal to as many as half of the people in the nations attacked, would probably do relatively little radiation damage to the present generation in the noncombatant countries, he said. But genetic damage may persist through 30 or 40 generations.

Genetic injuries, he said, consist of chromosomal breakage, nondisjunction, or point mutation. In general, the degree of injury appears to be directly and linearly proportional to the dose.

A dose of 100 r applied to mice in a short period by Russell at Oak Ridge produced more mutations than the same dose stretched out over several weeks. But another experiment at Johns Hopkins with the corneal epithelium of Chinese hamsters has established that the difference in injury is due not to a difference in the initial frequency of chromosomal breakage but to greater interference with the repair process at the faster dose rate.

Nondisjunction, which has been established

as the genetic factor in mongolism, is also increased by radiation, but so far there have been no studies of the effects of different rates or sizes of the dose.

For the present population of the world, Glass said, an increase of 10 r in the average dose to the gonads could be expected in the next 30 generations to cause about 32 million more deaths at birth, result in about 2 million obviously defective children, and affect about 100 million persons whose vitality and intelligence would be significantly impaired. But this estimate, he added, could easily be multiplied by a factor of 5, as it does not take into account the potential effects of carbon 14.

Because the dose in roentgens or rads is based on external exposure, Glass was asked to estimate the relative significance of internal emitters, radioactive byproducts of nuclear reactions, which may be absorbed in the body with contaminated air, water, or food. If the dose to the tissues is the same, he said, the genetic effect would be the same. But the task of evaluating internal radiation, Glass said, is complicated by the variety of nuclides, half-lives, biological half-lives, dose rates, and different susceptibility of tissues. It is also difficult to predict the quantity and distribution of manmade radionuclides, he added. But he ventured that indefinite continuation of tests of nuclear weapons could alone produce enough fallout to present a serious public health threat.

Water

In a brief reference to the relatively recent development of safe water supplies in modern cities, Dr. Gordon M. Fair observed that within this century, 50 years after the studies by William Budd, it was not uncommon for a city of 100,000 to experience 120 deaths from typhoid fever and 1,200 cases annually. And he recalled the recent Zermatt experience of 1963 as an indication of what can happen when people are not sensitive to the dangers of bacterial contamination of public water supplies.

He proceeded to enumerate examples of modern hazards in the basic water resources which are receiving rather less attention than the agents of typhoid fever and cholera.

Some of these hazards remain mysterious; for example, goiter in India occurs inexplicably at a higher rate in downstream villages than upstream, although the iodine content is consistent in both directions.

Others are sporadic, such as spills of radioactive chemicals, accidental discharges of toxic industrial wastes, blooms of neurotoxic algae, or neurotoxic flagellates in mussels.

Still others are chronic, such as nitrates from fertilized soil, posing the threat of methemoglobinemia to infants given water from shallow wells; the washing of pesticides and herbicides from orchards and farms into streams; the invasion of household water systems by unreduced detergents and other solubles; and the increasing penetration of the environment by manmade nuclides which, Fair observed, are imparting an unconventional radiance to the oyster's pearls.

A particularly startling prospect in pollution, Fair noted, is the eutrophication of ponds and lakes, promising eventual destruction even of the Great Lakes, if the process is not reversed. In effect, the phosphates used as fertilizer drain from the fields into impounded waters where they support the growth of diatoms whose skeletons eventually choke and fill the basin. When they die, they yield the phosphorus to water for new growths, supplemented by the annual increment of fertilizer drained from the fields.

Fair predicted that the greatest benefit of studies demineralizing sea water will be the rescue of the Great Lakes from phosphorus-fed algae.

Fair also expressed the hope that solar energy may be employed to govern the "vertical and lateral movement of water selectively, to favor high areas with rainfall and facilitate the flow of distribution by gravity."

Population

The human being himself as a contaminant of his own environment was evaluated by Dr. Philip M. Hauser, who offered what he regarded as the ultimate in demographic predictions. Looking forward in human history as far as we ordinarily look back, he said that if human numbers continue to increase at the present rate, the population in the year 6200 will

consist of a massive ball of flesh expanding on the surface at the speed of light.

Since neolithic times, about 10,000 years ago, he said, human numbers have increased from 5 to 10 million to about 250 million in the Roman era, to 500 million when the first English colonies were established in America, to more than 3,100 million today.

Unlike other species, Hauser noted, man creates his own culture and changes the rhythm of his reproduction. His technology has made possible the growth of urban centers of a million or more which would not have been possible 150 years ago. It is no accident, he added, that the great historic centers of civilization have been at crossroads where a variety of cultures meet. He offered as an axiom of human history that diversity accelerates cultural development.

Hauser illustrated the changes in population density with the following table:

Persons per square mile	*Persons in 10-mile radius*	*Place*
1	314	North America, 1500.
50	15, 700	United States, 1960.
8, 000	2, 513, 000	Average U.S. central city in metropolitan area, 1960.
75, 000	23, 550, 000	Manhattan Island, 1960.

A psychological factor in urban living, Hauser commented, is that man has been forced into rational behavior. In order to survive, he has had to accept the policy that human relations are utilitarian. Instead of living according to convention and tradition, in the manner of people whose mode of life did not differ from century to century for thousands of years, he has had to learn to make personal decisions and also to establish formal systems for making decisions about compulsory changes. In a high density society, he finds it necessary to construct a bureaucracy which is judged entirely by its capacity to perform the indicated duties.

Urban society has also evolved new philosophies, said Hauser. Among modern man's mixed motives are: to maximize economic gain; the interest in achieving maximum gain or a minimum of loss of any value; the tendency to accept results within a specified range of error; the tendency to quit at a point of satisfaction; the impulse to behave nobly and adventurously; and the concept of a peaceful world of brothers, producing according to ability and sharing according to need. In shorthand, these motives are labeled economic, minimax, sequential decision, satisficing, heroic, and socialist.

Whatever posture man strikes, Hauser said, the present growth of numbers cannot long persist. As a culture builder, man has evolved systems of death control to the point that he can materially reduce mortality and prolong life. But death control without birth control means, he added, as would any rate of increase in the present population, eventual saturation of living space. At present rates, the world population would be about 7 billion by the year 2000. The immediate prospect is congestion, pollution, functional illiteracy, and unemployment.

Except among the poor and the uninformed, he said, some method of family limitation is now practiced by the majority of families in the United States and in the economically advanced areas in general. Hauser asserted that the only hope of less developed areas to meet the rising expectations of their people is to control their numbers so as to be able to increase income per capita.

Communications

The influence of communications on environment, remarked Dr. John R. Pierce, are somewhat contradictory. The mass media, on the one hand, tend to create a society of look-alikes. Some degree of uniformity is essential to communication as well as to personal psychological comfort, he observed, and the technical requirements of large audiences for TV programs and large circulations for newspapers, and even the politician's need for masses of votes compels the search for the common denominator of understanding which is satisfying to the maximum number. Consequently, with respect to public issues affecting man's health, information which leads to rational decisions is often neglected, diluted, or even adulterated.

On the other hand, other technical advances, the telephone, the automobile, the postal service, the low-priced paperback book, and the long-playing phonograph record, he said, encourage a wide range of individual interest, and the development of sizable numbers of people who

are well informed within the spheres of special interest. The range of choice and mobility also has led to a flight from the city which is unlikely to be reversed.

As one called frequently to conferences in other cities, he added, he has found that mobility is something of a mixed blessing, and he looks forward to a time when such conferences may be arranged over long-lines systems, perhaps with television, to permit people to meet and confer in closed sessions without dashing about in airplanes.

Evolution

The philosophical implications of modern concepts of evolution, with respect to the management of man's environment, were reviewed by Theodosius Dobzhansky, who commented that man is the only species that knows it is evolving, both biologically and culturally. This knowledge and self-consciousness, he said, implies that man's fate depends on what he chooses to do.

Natural selection, either through breeding or through the struggle to survive as individuals or as a species, has no purpose in itself, he said. The consequences of selection would depend entirely on man's conscious goals, if they are to represent an improvement of the human condition. These goals are necessarily guided by the cultural heritage because otherwise man would operate at the animal level, with only an instinctive knowledge of the past and no concept of the future. The past achievements of man in evolving to adapt to all environments and to control of environment, he said, gives hope for future accomplishments.

Nevertheless, he concluded, the choice is man's to make, whether to pursue the path of genocide or fraternity.—M.R.

WHO's New Immunology Unit

The World Health Organization has recently set up its first immunology unit. This action implements recommendations of a committee appointed in 1962 by Dr. M. C. Candau, the Director-General, to consider the need for such a unit. The committee reported that WHO could contribute to world immunology by coordinating research, training immunologists, and arranging research services to supply reagents, experimental animals, and authentic lines of tissue culture cells; by standardizing nomenclature and terminology, providing information on serologic methodology, and establishing a network of reference laboratories; by providing and stimulating research on auto-allergic disorders, conducting immunological investigations in protozoal and helminthic infections, aiding in efforts to establish or enlarge banks of human convalescent sera and human immune globulins, and by assisting developing countries in establishing centers for research in immunology.

A member of the committee, Dr. Howard C. Goodman, head of the clinical immunology section of the Laboratory of Immunology, National Institute of Allergy and Infectious Diseases, Public Health Service, will organize and direct the new unit and has gone to Geneva on a year's leave of absence from his NIH post.