

Radiation Peril to Humans Is Question With Two Sides

By Thomas R. Henry
Science Editor of The Star

In the face of warnings from some of the world's foremost geneticists that the human race may suffer serious deterioration over a course of generations because of the inevitable buildup in the background radiation of the earth due to atomic bomb explosions and other atomic experiments, the only extensive animal experiments to date indicate the danger may be quite exaggerated.

These experiments have been with fruit flies—colonies of thousands exposed for as long as 135

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generations to various intensities of ionizing radiation. The implications are that nature may tend to adjust the genetic constitution of a population over a considerable period to almost any nonlethal radiation dose. Many mutations take place in the germ plasm. Many of them are, *per se*, deleterious. With free intercourse between individuals, and with lines of lethal mutations self limited, these gene changes tend to be hooked up in all sorts of ways and bad and good are mixed together in the shuffle. A bad gene in one set of circumstances might be a good one in another.

Analogy in Poker Hand.

A suggested comparison is with a poker game—only in this case played with from 1,000 to 50,000 cards instead of 52. Every individual can be likened to a hand. Certainly in 99 cases out of a hundred the deuce of clubs would be a "bad gene." In the hundredth hand it might fit into a straight flush.

Still, it is stressed by Dr. Bruce Wallace who is working at the Carnegie Institution of Washington's Division of Genetics at Cold Spring Harbor, Long Island, and Dr. M. Demerec, director of the division, the results to date must not be considered as an answer to some of the alarming predictions. They are loath that their reports should be considered as discounting the need for a far more extensive and intensive study of the problem than ever has been possible. Both scientists recognize clearly that fruit flies are not men and that there are considerable differences between the two animal species. They believe, in common with most geneticists, that the rules of heredity hold generally through the whole range of life. Details, however, are debatable. The *Drosophila* remains the most convenient experimental animal. The Cold Spring Harbor workers are letting the cards fall as they will and abiding by the results—stressing that they were obtained with fruit flies.

Effects May Be Good.

There is some indication, Dr. Demerec says, that even some human genes with deleterious effects have at the same time certain effects that are advantageous. Such may be the case with sickle cell anemia, a rarely fatal anemic condition due to a peculiar type of blood cell which results from a germ plasm

mutation, perhaps in the not too distant past. The disease is most frequently encountered along the shores of the Mediterranean. It is serious and quite disabling.

It now appears, Dr. Demerec says, that persons who inherit sickle cells also inherit a high degree of immunity to malaria which has been a scourge of the Mediterranean world. Thus bad and good tend to balance each other and the race persists. Why sickle cells and malaria resistance should be caused by the same mutation nobody knows—but nature tends to take care of its own. There may be many such associations in human heredity. One explanation is that the malaria organism cannot live in the radically changed blood cells.

Details of Experiments.

Dr. Wallace irradiates his fruit fly colonies in a chamber with rather intense radiations from radium—from 300 to 2,000 roentgens. This is far more than human beings could stand. The lowest dose would kill almost anybody, but a fruit fly can take it and smile. The percentage of mutation in the germ plasm, it previously has been determined, increases proportionately to the intensity of the radiation to which it is exposed.

It is assumed that by far the greater part of all mutations will be injurious to the species. Many will be lethal. Eggs will not hatch because the embryos will die. Hence the experimental fruit fly populations could be expected to decline in numbers.

Dr. Wallace's procedure and statistical treatment are somewhat complicated, but the overall results is that the expected doesn't happen. Natural selection, which means elimination of the unfit, is more effective enough so that fly populations adjust and go on living and breeding with their increased number of mutating genes.

Geneticists Surprised.

Both Dr. Wallace himself and Dr. Demerec are somewhat surprised at the result which seems to fly in the face of theory. Much of the genetic experimentation with fruit flies in the past has been carried out with individuals. Bad mutations have been isolated and their courses followed. This may have led to some false conclusions, Dr. Wallace holds. His own work is not concerned with individuals, but with mass effects in populations of thousands. This is the important consideration when studying the effects of increases in the world's background radiation on the human race. The work at Cold Spring Harbor is only a single line of experimentation and should not, the geneticists stress, be considered entirely conclusive. It is only highly suggestive.

It emphasizes the need, they say, of controlled experiments with mammals living as nearly as possible under natural conditions, not in cultures like the insects. There can be no truly valid extrapolation between the somewhat noxious little insects and man.

Tomorrow: How much radiation is dangerous?

Glossary of Genetic Terms

The following glossary will be found helpful in connection with Science Editor Thomas R. Henry's six-story series exploring the effects of atomic radiation on the human race:

Gene—An invisibly minute particle of protoplasm which is the recognized unit of heredity. It has the unique property of "guiding and bonding together of raw materials around it into an exact duplicate of itself."

Each of the trillions of cells which make up the human body contains the full human complement of thousands of genes. Those in the germ cells are passed on to the next generation.

Chromosome—A fine thread thousands of times longer than thick, differentiated along its length into hundreds or thousands of functionally distinct and individual self-reproducing regions—the genes. Every cell in the human body has 48 chromosomes.

Gamete—The mature germ cell of one individual, plant or animal.

Zygote—The union of two germ cells to constitute a new individual.

parental chromosomes which do not completely match.

Mutation—A change in the gene structure of protoplasm which results in changed hereditary characters.

Half-life—The interval during which half of any radioactive, originally present will disintegrate. Uranium has a half-life of several billion years. Radioactive iodine used in thyroid treatments has a half life of eight days. After six half lives, it is calculated, only infinitesimal traces of the original substance will remain.

Roentgen—The accepted unit of radiation defined as "the quantity of gamma or X-rays that will produce a certain electrical conductivity in a cubic centimeter of air under constant pressure and temperature."

Gamma Rays—Exceptionally potent X-rays, the principle radiation causing genetic damage

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