Hidden Secrets of the Genes

Effect of Radiation Does Not Necessarily Mean Appearance of a 'Monster' in a Blood Line

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Gene mutations — dominants, recessives, lethals and sub-lethals —have been taking place in all species of living things since life began.

They will continue to pile up as long as life lasts. The species

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have learned to live with them and have acquired some sort of balance. Perhaps 1 per cent of the changes have been advantageous. These are credited with being responsible primarily for the progress of races.

The disadvantageous ones tend to accumulate until they are eliminated, one by one through the elimination of a genetic line in which they appear. The accumulation of these disadvantageous ones, it is estimated by Dr. Herman J. Muller of the University of Indiana, is responsible for about a 20 per cent shortening of life and lowering of efficiency for the majority of mankind—that is, compared to the situation if no "bad genes" were present.

Now, in the present generation, the geneticists point out, two forces have appeared which alter somewhat the over-all picture—perhaps catastrophically.

The Cause of Mutations.

What causes mutations? Doubtless many things—heat, chemicals, perhaps even the process of aging. More than 25 years ago Dr. Muller himself demonstrated for the first time that they could be brought about in predictable percentages in fruit fly colonies by various intensities of x-radiation. He has been deeply concerned over exposure of man to radiation ever since—even the amounts handled by physicians, dentists and, more especially, shoe fitters who have no scientific training.

Radiation is the only known cause of mutations which is increasing on earth. This increase in unquestionable, although the amount is debatable. It is the contribution of the "atomic age" with radioactive forms of elements constantly being created.

This is the first, but perhaps not significant, development in this generation. Second is the unparalleled development of medicinal chemicals and biotics.

The accumulation of bad hereditary changes in the past has not been a steady progress. Even slightly disadvantageous genes have tended to be eliminated through failure of the unfit to reproduce. Over long periods this would include the very slightly unfit whose ills cannot be diagnosed. This was part of the eternal struggle for existence, the basis of evolution.

Now this struggle for mere existence for a considerable part of the human race has ceased, or been changed to a considerably different level. Physically those who otherwise might have perished early from slight genetic misfunctionings are preserved to a ripe old age and have about as good a chance as anybody else to pass on their detrimental genes. These continue to pile up in the germ plasm of the race as the rate of their elimination is decelerated.

Evolution vs. Medicine.

Evolution apparently is in a race with medicine. If the detrimental genes which constantly are appearing continue to pile up, Dr. Muller says, "there would be no limit short of the complete loss of all the genes, or their degradation into completely unrecognizable forms, differing chaotically from one individual in the population to another.

"Our descendants' natural biological organization would, in fact, have disintegrated and been replaced by complete disorder. Their only connection with mankind would then be the historical one that we ourselves had been their ancestors and sponsors and the fact that their once-human material was still used for the purpose of converting them, artificially, into some semblance of man. In the end it would be far easier and more sensible to manufacture a complete men de novo, out of approximately chosen raw materials, than to try to refashion into human form these pitiful relics which remained."

He does not actually anticipate this, Dr. Muller says. Some terrible catastrophe is more apt to intervene to stop the disintegration process and man will start over again.

It is probable, Dr. Muller points out, that there are about four times as many sub-lethals as lethals among mutations. Few of these ever are recognized and it would be practically impossible to pin-point many of them. A sub-lethal may, for example, regulate some minor biochemical process, perhaps still unknown to physiologists and bio-chemists, whose proper functioning is essential to the complete health of the individual. Malfunctioning will cause him to be not quite so good a man, physically and perhaps mentally, as he would be otherwise.

The Theory of "Monsters."

There seems to be a popular idea, often prevalent among physicians and even among many professional biologists, that adverse mutations will manifest themselves as "monsters"—such forms as two-headed babies, congenital idiots and the like and that they can be picked up in the first generation or so, Dr. Muller points out.

This, he says, is far from the truth, and the idea is particularly unfortunate at present. If no "monsters" appear there is a widespread idea that no genetic damage has been done. Thus studies on the offspring of those who suffered heavy irradiation in the bombings of Nagasaki and Hiroshima show no strikingly abberant children and there have been conclusions that no major damage was done to the germ plasm.

Few, if any, were to be expected, Dr. Muller says. If any appeared they would not be of any real significance. The "monster" is a tragedy for its parents and itself, but not for the race. It seldom lives to reproduce its kind, or perhaps even to be born. Thus, as an individual, it has no effect on human heredity.

A few rather obvious diseases which do not necessarily interfere with reproduction are known—notably the bleeding disease of European royalty, repercussions of which have had a notable effect on recent history. But generally such a malady is self-limiting. It is easily observed, follows well-known genetic laws, and victims seldom wish to perpetuate their kind. Medical men list about 20 diseases in the same category, the majority rare and little known. New ones probably will appear, Dr. Muller says, but they will be of little real importance.

It is the "hidden diseases," he insists, which are significant for the future of the race. For example, a man develops some sort of anemia at 50. It results basically from the failure of some blood-forming process due to the malfunctioning of the control exercised by some gene.

No physician ever would recognize this condition as hereditary. The victim himself would have no realization of the fact. Yet he may have passed the mutation on to a dozen sons and daughters who will transmit it in turn, and in turn suffer from it in later life. Meanwhile they also will be introducing into the germ plasm of the line more mutations and more obscure ailments.

The next articles in this series will appear Sunday—it will deal with evidence that fear of radiation may be exaggerated.

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 germs 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 26 chromosomes.

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

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

Homozygous—An individual who receives identical genes from both parents.

Hetrozygous—An individual with 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.