Since a mutation occurs in one of a pair of genes, and most deleterious genes are recessive, only occasionally will two come together to reveal the mutant trait. Mutations can occur in either somatic (body) cells, which can lead to cancer, or in gonadal cells (sperm or egg), causing hereditary defects in the offspring. This essay is concerned only with hereditary mutations of direct eugenic interest. It is important to note that there is a positive correlation between mutagenicity and carcinogenicity. This is not surprising, as the mechanisms are identical (Ames 1975). It is, therefore, legitimate to use the more readily available statistics for cancer studies to estimate proportional mutation rates. This is especially useful for predicting trends and for identifying possible mutagens to which we are exposed in the environment.

It is probable that environmental mutagens increase the frequency of genetic defects such as phenylketonuria, which involves mental retardation and has an incidence of 1 in 25,000 in the U.S.A.; of albinism, 1 in 10,000 in Norway; cystinuria, 1 in 40,000 in England; galactosemia, 1 in 100,000 in the U.S.A.; and alkaptonuria, which involves crippling arthritis, with an incidence of 1 in 1,000,000 in England (Strickberg 1976). These figures apply to the homozygous sufferers--the number of carriers is much greater.

It has been estimated that 4% of all human conceptions are chromosomally abnormal, and of these about 10% survive implantation to be born. Fears about genotoxic effects of pharmaceuticals (e.g., thalidomide) and increasing awareness of genetic developmental disorders and teratology have led to the fairly routine use of cytogenetic and biochemical procedures to detect malformations early. The technique of amniocentesis is now widely used to detect possible cases of Tay-Sachs disease and cystic fibrosis, among other diseases, but these tests are relatively crude, since they examine only one specific enzyme. For instance, the test for the lack of Glucose-6-phosphate dehydrogenase can only predict cases of

hemolytic anemia. Most genetic errors induced by environmental mutagens cannot be seen and are handed down from one generation to the next. It is likely that genetic damage incurred today may only manifest itself in the distant future.

Mutagens can be divided into two categories: chemicals that affect DNA, and physical agents, such as radiation. Some chemical causes of human mutation (including somatic mutation) are those with which people choose to come into contact; smoking is the best example of such a carcinogen. Perhaps more relevant, habitual takers of the drug LSD risk serious chromosomal damage that is hereditary (Hollaender 1971 et seq). A number of unavoidable air pollutants, including polycyclic hydrocarbons, hydrocarbon metal complexes of nickel and cobalt, and certain pesticides have been shown to be mutagenic (Ames 1975). Those who live in or near industrial centres are more likely to be affected, and once again, assuming a correlation with cancer, it is worth mentioning here that rural inhabitants are 10-20% less likely to develop lung cancer (both non-smoking). Though little research has been done on human hereditary disorders on a similar basis, it is not unreasonable to expect urban dwellers to be at greater risk from mutagenesis (Berk 1979).

Well-known chemicals that are now considered mutagenic in laboratory animals include: formaldehyde (also associated with lung cancer); vinyl chloride (used in plastics); benzene (formerly found as lighter fluid); tryptophan pyrrolyses (found in broiled meats); and by-products of certain bread moulds and moulds in fruit. In addition, some compounds found in cooking oil that has been repeatedly heated and cooled may be mutagenic. Compounds found in a number of commercial goods, including hair dyes, detergents, and food additives, are also suspect.

Mutagenic physical agents include medical gamma and X-rays and background radiation. Fortunately, present-day codes of practice in hospital radiology departments restrict hazardous exposure, except where vital. It is now