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The Biologic Future of Humankind – An Anthropological Assessment

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Homo sapiens is one of approximately 1.4 million living species thus far known to science. All these organisms including bacteria and plants ultimately are the contemporary result of the same basic evolutionary processes and all share the same DNA material. But more than any other life form humans, through cultural innovation and ever-expanding numbers have come to dominate the planet earth.

In view of the evolutionary history of our species, we are aware that a discussion of evolution and adaptation requires considering the importance of culture in the development of our species. Such investigations of human evolution and the interplay between biology and culture have provided useful information about why humans behave the way they do. The cultural achievements and adaptation helps us to understand how a medium sized bipedal primate came to occupy a position of dominance over many other forms of life on the earth. Today we are aware of the challenges faced by the humanity, challenges that have emerged as a result of our own doing In this discussion we have to keep in mind our place in nature and then we need to focus on how since the domestication of plants and animals we have altered the face of our own planet which certainly is shaping the destiny of thousands of species including ourown.

We are living during a critical period in the earth's history. Indeed, the next few decades will decide the future of much of life on earth. Therefore, it is critical that, we as individuals, cities, and nations make wise decisions. In order to do this we should be well informed and we should know that our decision will beirrevocable.

Therefore, it is valid to ask such questions as what is the future of *Homo sapiens*? Will we continue to thrive? What kind of world will our descendents inherit? What is the future of millions of other species? Perhaps we as anthropologists are in a position to address these and many other questions of immediate concern. The study of human biological and cultural evolution coupled with an examination of the results of early human activities can provide some insight from the past that may help illuminate the future. At least we can provide with an anthropological perspective on the serious problems that face us today.

Evolution of the human species is not confined to the past. The mechanisms that bring about changes of gene frequencies from one generation to the next are still in operation. Knowledge of these mechanisms should help to predict future trends in the genetic

composition of human populations. To understand such predictions and to make proper use of them, we should keep in mind the limitations that are inherent in all such attempts.

(A) We can only extrapolate from trends that are already visible at the present time; human history, however, has often been shaped by unpredicted events. Such an assessment is also true for the biologic history of our species, which is now inextricably intertwined with cultural, social, and political history as well as with the future development of human biology and medicine with the potential to actively influence the future evolution ofmankind.

(B) It is a well-documented fact that the visible signs of revolutionary future scientific developments that will be easily recognized in retrospect are often not clear to contemporary scientists. Future evaluation may cite how important trends have beenoverlooked.

(C) All predictions made here assume that modern civilization will continue to exist and that within modern societies concern for health and medicine will maintain its prominent position. In this context, we assume that preventive medicine will continue to gain inimportance.

If we assume that attitudes toward these problems will be increasingly rational, there is little doubt that concepts of human and medical genetics will be utilized at an ever growing scale. One could argue that this assumption is unrealistically optimistic, as it presupposes that human societies will learn to keep their social and technologic structures from destruction. Thus, it is by no means impossible that a large fraction of the human species will sooner or later be doomed to destruction by an atomic holocaust. We are also intensely conscious that many of the concerns expressed here have a much lower priority in the developing countries of the world where problems of overpopulation, under nutrition, and infectious diseases are the key problems needing solution.

The following extrapolations are subject to the conditions of human survival and the fact that social progress desired by both "capitalistic" and "socialistic" societies will continue.

We have no evidence at our disposal to enable us to state categorically that the evolution of man has ceased. Since the process of evolution so far has been a progressive one, it is expected that this progress will continue in the same direction and probably at the same rate. On the contrary can we accept the fact that man has reached the zenith of his development and will, like many reptiles, undergo degeneration and meet the fate of man's environment either by natural processes or by man's deliberate interference therewith. Notwithstanding the current trends as regards structural and psychological adaptations, it is quite clear that not only does man select his environment but also the environment selects him. Thus it seems probable that the multifarious environments which are in operation today will continue their effect in future.

As regards the structural adaptations of man, increasing size of brain is the most outstanding characteristic. Possibly next to this is his erect posture. Looking at the development of brain in evolutionary perspective, it is clear that no orthogenetic trend is manifested. The progress in the development of modern human brain is not related to the increased bulk of cerebrum, but to improvement in its quality. In fact, it is improvement in certain association areas and establishment of more intricate connections between different centres of cortical activities that characterize modern human brain. The process of improvement in these qualities has, however, not stopped. In future this is likely to result in still higher mental and moral attributes than possessed by man atpresent.

As regards postural changes, acquisition of erect posture is decisively the major structural modification which was gradually achieved. Further modifications may be very

minor. The changes, however, seem to be indicated in the foot. The little toe is abortive possessing either very small or no nail. This is further associated with degenerative changes in certain tendons descending from the leg. Besides, some of the short muscles of the foot are undergoing fibrosis – transformation into ligaments. Whereas the great toe, the medial side of the foot as well as the arch like structure of the foot are being increasingly strengthened to withstand the stresses of bearing the body weight during walking. Man's upright posture has resulted into many weaknesses particularly due to the gravitational pull. That is why man is prone to downward displacement of various organs like stomach, kidney, uterus, etc., and to the disorders like hernia. It is likely that some structural modifications may be evolved to circumvent these risks.

This development of the specific human form makes him peculiar to other primates. However, the distinctive feature which makes us human is the language. All human groups have a language in which symbols stand for things and humans can communicate about those things in their absence. Some symbolic communications between chimpanzees have been demonstrated by E.S.Savage-Rumbaugh and her associates (1978)

In physical anthropology we have been more concerned with the study of biological differences among human beings and of the differences between them and animals. It seeks explanations of the ways in which they arise and are subsequently maintained. The biological changes are related with time; the processes of genetic transmission, development, growth and evolution are all related phenomena. They are general biological processes and are certainly not peculiar to human beings. However, human culture and language are vastly different from those in other animal forms. Human culture affects his biology; and marriage patterns affect mating whose implications are to be taken into account in human genetics. Similarly, agriculture, weaning practices, system of food distribution and ideas about nutrition affect human growth. The development of technology, particularly digital technology modes of transportation and modification of natural environment set special conditions for human evolution. The development of culture and language have accelerated human differentiation. This has necessitated that physical anthropology must relate to the rest of anthropology and to the culture and language inparticular.

We have considered the general biological principles and have tried to explain the special principles and processes that have been most fascinating to physical anthropology. We have viewed the aspects of biology in human perspective. In human societies social relations and cultural traditions are more important than biology in determining survival.

The relationship among the sickle cell gene, Falciparum malaria and agricultural practices that encourage the multiplication of malarial mosquitoes is a well noted example for the interaction between human culture and human biology. We are also aware that the length of human generation and the comparatively recent development of agriculture and industrialization are playing significant roles in human biological evolution. The cultural factors are exerting ever-increasing influence upon human biology. The marriage rules and patterns of migration have always had an impressive influence upon the biological makeup of human breeding populations and have played an important role in the acceleration of human biological evolution. Individual biological differences, however, are significant within a complex cultural context. We are awarethat all the problems of human evolution and human variability have not been solved. We now know the general course of human evolution and have been able to estimate the degree of human variation. It may be emphasized that the global distribution of human species as compared to rather narrow range of each species of great apes and the greater variety of ways of life imposed by human culture have brought about significant differences between the processes of human evolution and that of the apes.

While Studying evolution and biological variation in physical anthropology, there has been concern with the sources of variation and the directions of change among individuals and groups, past and present. These sources of variation are due to genetic differences and environmental modifications of the genetic potential. The directions of change must have originated in the past in differences that arose over a long span of time through evolution. Even today the tendencies towards new variations and change continue. These variations have been analyzed through the study of growth and development responsible for differences in anatomical structures organs and tissues. In addition to these the consideration of innate differences among individuals of different sizes or shapes and particularly the differences among groups from different locations in their response to various conditions are important. In this perspective physical anthropology is the science that deals with the interaction of socio-cultural and other environmental factors with genetic processes in human biology. It is true that the differences in cultural characteristics are considered in detail by using the methods of cultural anthropology which does not take into account the biological differences. However, the very existence of culture and cultural differences depend on the special organism called man who has a suitable brain., tongue and vocal cords for speech, the altered sexual rhythm and delayed maturity suitable to durable family organization and suitable hands to fashion tools and other objects of material culture. He has the adequate mental capacity to conceive, remember and transmit ideas which help to develop culture. It is on the development of culture that the human capacities and their evolution depended. Thus there is unique mutual interaction between human biology and human culture. Humans have survived, adapted and evolved in response to both the physical and the cultural aspects of their environment. Thus our actual subject matter is human evolution, human biological variation and human adaptation to varying physical and cultural environments.

It is now clear that far reaching cultural transformations have manifestly been taking place. Do genetic changes accompany the cultural ones? White (1949) argues that in the man-culture equation over a period of million years, we may assume some absolute increase in magnitude of the biological factor. But during the last hundred or even the last fifty thousand years, we have no evidence of an appreciable increase in mental ability. Many anthropologists maintain that the genetic basis of culture in biological evolution is uniform everywhere. *Homo sapiens* has remarkable plasticity of cultural development and it now appears that this plasticity is a man specific trait resulting from natural selection in biological evolution. Phenotypic plasticity does not preclude genetic variety. However, there are variations in degree of plasticity.

We have considered in detail the question of human variety and examined the factors responsible for human variation and the emergence of races, the criteria for human typology, the attempts made at racial classifications and the current human types. This discussion also refers to the question why the term race is not suitable in the present context and why we should adopt the term population. We have noted that the term race has been polluted owing to its political overtones and the development of the doctrine of racism. In racism we believe that the race or physical type generates culture. The racist ideas were helped to spread by Count Arthur do Gobineau and Houston Stewart Chamberlain during the 29th century. Racism preaches the inherent superiority of certain races and stirs up prejudice and hatred for races said to be inferior. In particular the concept of 'Nordic' or 'Aryan' superiority was put fourth by German propagandists and by others under the guise of anthropology (Hooton 1946:660) However, anthropological data have demonstrated beyond doubt that the facts of racial typology are really not so. In fact all races are equal biologically or in cultural capacity. Anthropological data also prove that there is no connection between the shape and size of the head and the level of culture. Culture, in fact, has nothing to do with racial features. It is determined by social and economic factors. Thus anthropology has made yeoman

contribution in dispelling the racist idea and demonstrating the unity and integrity of mankind which possibly was the basis for the adoption of the Charter of Human Rights at United Nations Organization, and its first recognition and realization by the League of Nations.

Emergence and development of culture make adaptations to changing environment by means of genetic changes. Culture does not make human environment stable and uniform. The diversity of human beings seems to be endless. What parts of the variance are genetic and how much environmental is not adequately known. Thus in human genetics we have much to learn. It seems probable that the transformation of pre-human ancestral species to typical human form involves mutational changes in most or perhaps in all gene loci. Is it the whole genetic system which makes us human? Most of the genes represented in human populations have two or several alleles. It is believed that this genetic variability has some relevance to culture but there may not be one to one correspondence between genetic and cultural traits. Genes create the settings for cultural traits but they do not compel the development of any particular ones. We know that rigid caste structure has genetic consequences, different from and less desirable than those of social systems which accord a rough equality of opportunity to its members. It is surmised that any major social or political change is bound to be reflected in an alternation of the gene pool of the population subjected to such change. This is because the magnitude as well as the direction of natural selection depends on the environment that exert a decisive influence on human species in its socio-cultural context. Thus the changes currently taking place in our modern world need rethinking in the light of genetics and the social situation. The question of population explosion has been engaging our minds as it is likely do deplete the resources of nature in one way or the other. Therefore, people are bound to check the uncontrolled population growth in order to secure a betterliving.

The equality of opportunity has genetic consequences different from those of hierarchical, stratified and caste societies. Equality decreases the wastage of genetic potential of human species. It favours manifestation of talents which remain hidden in societies that let high culture and refinement flourish while a great majority of people live in misery and ignorance. Equality of opportunity may be ideal but is not uniformly appealing to everyone. Hardin (1959) has argued that when class competition decreases, competition between individuals increases. According to him the biological as well cultural welfare of mankind demands competition of many separate populations, some of these will become extinct while others will survive and repopulate places left vacant by those that have succumbed or have become extinct. It is believed that a large and complex society should be better able to provide for specialized talent and tolerate uniformity than small homogeneous group.

AMONG the biological problems which mankind has to face are the problems of overpopulation and the management and direction of biological evolution. These problems have two distinct aspects :

(I) The alleged failure of weakening the normalizing natural selection.
(II) The improvement of present genetic endowment of humanity by directional selection.

One may realize that the normalizing selection is not acting in the same way as it did in the prehistoric times. Many carriers of genotypes with deleterious effect are now able to survive and reproduce. Selection may have increased in severity with respect to certain genotypes. Natural selection is conditioned by the environment and its direction and intensity can not remain constant when people adapt new ways of life. Selection has been interpreted in terms of Darwinian fitness and Darwinian fitness is the reproductive fitness.

Today medicine, hygiene, social agencies, technology and civilization are able to save many lives which would otherwise have been extinguished. Some of the lives thus saved

carry genes which are likely to engender other lives which will have to be saved in the generations to come. The consequences of these considerations have not been clearly brought out. However, Wright (1960) rejects the basic assumption of the classical theory of population structure that there can be a single, best, optical normal or typical homozygous human genotype and all deviations from which would be detrimental and hence would be selected against. It is assumed that for each mutation there must be on an average one elimination or genetic death and that a population must suffer at equilibrium number of eliminations equal to mutations which arise. However, the elimination of a lethal mutant which causes the death of an embryo may not be noticed. But the suffering accompanying the elimination of a mutant responsible for retinoblastoma or such other disorders which kill an infant apparently normal at birth or those responsible for haemophilia, sickle cell anaemia and Huntington's chorea are likely to cripple or kill children, adolescent or adults. These cause misery to their victims and disrupt the lives of their families. The distant possibility of the discovery of methods by inducting directed mutations is likely to enable us to alter certain genes and thus cure hereditary diseases by removing their causes. Such a possibility will certainly have far reaching evolutionaryimplications.

From the view point of human health and life expectancy most spectacular changes have occurred due to progress in hygiene and medicine. These developments have influenced human fertility and mortality, which in turn are affecting the genetic combinations of future generations. Recent advances in human genetics have led to practical applications at an increasing rate, particularly in genetic counseling and genetic screening. Widespread utilization of genetic counseling and genetic screening is likely to influence the genetic composition of future generations. Molecular biology in recent years has provided efficient techniques for genetic engineering. The implications of all these developments need to be considered by human geneticists in so far as their beneficial effects and implications on human species are concerned.

Genetic counseling refers to the activities in total which establishes the diagnosis of the genetic diseases, assesses the recurrence risks, communicates to the patient and the family the chance of recurrence and provides information regarding the potential medical, economic, psychological and social burdens. Thus, the counselor informs the family about all reproductive options and the implications of various psychological and medical problems posed by the disease. Thus genetic counseling is non-directive and provides the necessary medical and genetic information to allow all couples to make their own decision regarding future reproduction. A counselor should not force his own values on those who seek his advice. He is not supposed to act as Eugenicist. However, some advice seekers may insist for a firm and directive counsel.

In genetic counseling appropriate diagnosis of genetic diseases is essential. Many genetic diseases pose problems in recognition and differentiation. Similar appearing diseases may have different modes of inheritance. Chromosomal examinations may be required in the diagnosis of complex birth defects in the children. Thus, in order to provide genetic advice, expert diagnostic assessment is necessary. Counseling further requires the calculations of genetic risks which is clearly defined in diseases with Mendelian mode of inheritance. In diseases which depend on autosomal dominant inheritance there is often variable penetrance, expression, and late onset of many disorders. The patients or their family members are generally interested in knowing the actual risk of the clinical symptoms than the formal genetic risks. With our increasing knowledge and understanding of human gene map it is possible to identify the gene carriers by a consideration of the segregation of closely linked marker genes in families where such variants exist. The disorders determined by multiple factors eg. Birth defects, major psychosis and some common diseases of the middle life lack precision in the calculation of recurrence risks as is possible in Mendelian diseases, because neither the number of genes nor their relative contributions are usually known. In counseling the use of empirical risk figures is necessary. These figures are based

on the frequency of the recurrence of diseases in affected families. Such recurrence risk is usually lower to the tune of 3-5 per cent as in the case of Neural Tube defects, Cleft lip and palate, etc. Generally, the risks for the first degree relatives which include sibs, parents and the children and for the more common diseases of middle life (hypertension, schizophrenia and other effective disorders) range between 10-15 per cent. A rare monogenic variety of a disease that appears multifactorial must be carefully distinguished, e.g. male patients with coronary heart disease, well below 60 years of age, may have familiar hypercholesterolemia (an autosomal dominant trait) in at least 5 per centcases.

Whenever a disorder is due to a transmitted chromosome abnormality, it may not segregate by Mendelian ratios. In such cases the counselor's advice will have to be based on empirically derived risk figures. In Mendelian conditions recurrence risks are fixed regardless of the fact whether several or no affected children preceded. In multifactorial diseases such as congenital heart disease or cleft palate, if two or more first degree relatives are affected then it would mean that more disease producing genes are operative in that family. Naturally the risk for future off springs becomes higher than the usual.

In a counseling session the meaning of genetic risk must be conveyed in a way understandable to the patient. In such a situation, 3-4 per cent of all children of normal parents are likely to develop serious birth defects, genetic diseases or mental retardation. This should be communicated as a measure against which additional risk can be worked out. Thus the total impact or burden of the disease must be clearly explained. Various reproductive options and alternatives must be discussed. Sometimes it may be necessary to have several counseling sessions and it is recommended that counselor should preferably provide a written summary in an easy language.

Sometimes heterozygote detection becomes particularly important eg in sisters of boys affected with X-linked recessive diseases such as colour blindness where in hetero zygotes will be affected with these diseases. On the other hand, autosomal recessive diseases become evident when both parents are hetero zygotes. However, specialized laboratory tests for carrier detection may be helpful (Graham 1977). In some situations additional statistical techniques may be helpful in proper genetic prognosis.

Counseling in some diseases should include testing of relatives at risk, e.g. in hereditary spherocytosis, Gardner's syndrome, familial hyperparathyroidism, etc. Sibs of patients with hereditary polyposis have a 50 per cent chance of being affected and thus carry the risk of malignant transformation in one of the many polyps in this condition. Thus it is recommended that vigorous attempts should be made to examine relatives when a genetic condition causes serious preventable or treatable disease.

Intrauterine diagnosis may also be helpful eg. Amniocentesis performed in the beginning of the second trimester (14-16 weeks of pregnancy) allows diagnosis of chromosomal aberrations and some Mendelian and multifactorial diseases in fetuses (Harris 1975). Ultra sonographic localization of the placenta may be further helpful to allow optimal amniocentesis. Generally, amniocentesis is used to rule out the following conditions:

(1) Chromosomalaberrations

(2) Male fetuses with 50 per cent risk of being affected with serious X-linked diseases

(3) Inborn errors ofmetabolism

(4) Neutral tube defects and Anencephaly and diagnosis of haemoglobinopathies. Intrauterine examination provides a definite diagnosis and replaces statistical likelihood withcertainty.

When the risk for further reproduction is too high for a certain couple, several options, besides contraception, should be discussed. Sterilization of either husband or wife may be recommended with definite information and due emphasis that this is an irreversible procedure. However, the possibility of remarriage after possible death or divorce of the

spouse is always there. In addition to this, artificial insemination by donor other than the husband may be useful if the particular disease or disorder is contributed by the husband.

Genetic screening is another area which has significant implications. With a better understanding of various genetic diseases, public health applications of human genetics have been developed. It is suggested that all members of a population at risk should be screened for a given defect, so that treatment or preventive measures are possible. Similarly, screening of genetic carriers may allow intrauterine diagnosis for genetic counseling even before a sick person has been born. In genetic counseling the patients and their families ask for the advice because person with certain genetic disease or disorder exists in the family, whereas genetic screening is normally done prior to the birth of a person with genetic disease. It may be emphasized that the program for genetic screening has been useful in the prevention of mental retardation. This can be done with the help of phenylketonuria screening. It is one of the most common inborn errors of metabolism in a population. Genetic screening for mothers at risk for chromosomal malformations may be quite useful. In recent years screening for autosomal recessive traits to identify the carrier couples has been useful and such programs have been most successful in relatively well informed populations. It has been suggested that in future extensive screening for all newborns for many polymorphisms may be possible. Such screening would have significant social impact. However, an ethical question is involved if genetic screening is undertaken for the identification of sex and consequent termination of female or male pregnancies. That is why in certain countries genetic screening for sex identification has beenbanned.

Genetic engineering is the latest development having significant implications for the biologic future of man. The manipulation of genetic constitution of human species has been going on ever since man has been able to control his environment and more recently by the treatment of hereditary diseases. The discovery of the Watson-Crick model of DNA has initiated a new period of genetic research. The prospects of genetic manipulation were discussed in great detail in a symposium entitled 'Man and His Future' (Wolsten holme 1963). Since then many efforts have been made to apply the knowledge of human genetics in the field of genetic engineering manipulation. Today we can divide the proposed methods of genetic manipulation into two groups:

1. A conservative approach utilizing well established biological principles and requiring only some technicalimprovements.
2. A more revolutionary approach requiring major breakthrough in molecular biology.

Muller was the main promoter of conservative approach. He suggested that prospective parents may not rely on their own germ cells but may choose freely from the germ cells of many individuals. Thus they can select future phenotypes of their children. This proposal has now become possible because of the feasibility of the storage of human sperms. However, in humans artificial insemination is mostly being done with fresh semen obtained from health donors particularly in cases where women can not conceive because of their husband's sterility. Sperm banks have been established as some men want to deposit their sperm before undergoing vasectomy. Though artificial ovulation is difficult, still oocytes have been repeatedly gathered from human ovaries duringlaproscopy.

Further use of the results of molecular biology in genetic engineering springs up from the following facts:

1. The mutagenic activity of certain chemicals can be utilized to induce specific mutations at well defined geneloci.
2. DNA can be incorporated by extra-sexual means into the

microorganisms. Similar attempts may be made inhumans.

3. Defective genes may be replaced by functionally homologous viralgenes.
4. DNA splitting enzymes may be used to cut DNA and insert specificgenes.
5. Artificially synthesized genesmay be incorporated into the human genome.

In recent years, in vitro synthesis of genes is one of the most spectacular success of molecular biology. Khurana's group synthesized the gene for alanine transfer RNA *in vitro*. The exact nucleotide sequence was already known and the gene was synthesized by techniques of organic chemistry starting with single fragments. Some years later Khurana's group managed to induce this gene to function in transfer RNA (tRNA) synthesis. Thus not only the gene, but all surrounding regulating regions necessary for activity were produced. Subsequently, there have been attempts to synthesize a gene *dnovo*. Some success has been achieved in the synthesis of hemoglobin gene. In view of these developments it seems possible that in future gene synthesis with a desired nucleotide sequence and information content will bepossible.

The above details give us a brief account of the applications of human genetics which have implications for the biologic future of our species. As students of human evolution we have always been concerned not only with the past events which have shaped the destiny of man but also his current predicament and the way ongoing human differentiation is shaping our future.

Earlier we have discussed the question whether human evolution has ceased. The fact remains that humans represent a stage in the course of evolutionary process which represents its culmination into *Homo sapiens*, the highest evolved species. We have also noted earlier that population genetics helps us to understand evolution. The concepts developed in population genetics and the examples from human genetics help us to understand human evolution and the resulting genetic differences between humans and other mammals, particularly our closest relatives, the Great apes. These concepts enrich our understanding of genetic variability with in and between present day human populations and also provide us a clue for a proper assessment of the future evolutionary course. The mechanisms that bring about changes in the gene frequencies from one generation to the are shell in operation and therefore we can say that human evolution is not yet over. (Vogel 1973). A clear understanding and proper knowledge of these mechanisms are helpful in predicting future trends in the genetic composition of human populations. However, in making such predictions we have a number of limitations. At best we can extrapolate from trends that are visible at the present. The biologic history of our species is inextricably coupled with cultural, social and political history and also the developments in human biology and medicine, which are also likely to influence the future evolution ofmankind.

GLOBAL WARMING

Global warming is another important factor which is currently affecting our species. It refers to the documented warming of the earth's surface based upon global temperature records since 1880's. It is believed to be the combined result of anthropogenic emissions of green house gases and changes in solar irradiance. Though the term global warming often synonymously used with the term climate change yet climate change actually refers to any change in the state of climate identifiable by changes in the average variability of its properties like temperature, precipitation etc. that persists for an extended period. A global assessment of data, since 1970, has shown that it is likely that anthropogenic warming has had a discernable influence on many physical and biological systems. In the Intergovernmental Panel on Climate Change (IPCC) fourth assessment report scientist conclude that warming of the climate system is unequivocal, as is clearly evident from the increase in global average air and ocean temperature, wide spread melting of ice and snow,

and rising global average sea-level. There are multiple factors that contribute to the 'warmth' of the Earth Green house gases are the ingredients of the atmosphere that act to the greenhouse effect. Some greenhouse gases are present naturally in the atmosphere where *few* are the consequences of human activity. The natural inclusion of the greenhouse gases includes *water vapour*, *carbon dioxide*, *nitrous oxide*, *methane* and *ozone*. The human activities increase the level of the most naturally occurring gases. In recent times the concentration of the various greenhouse effect gases has substantially increased because greenhouse gases are able to trap heat in the Earth's atmosphere. The main reasons for the emission of gases causing the greenhouse effect are burning of fossil fuel like coal in the power plants for generating electricity. Fossil fuel burning leads to high emissions of carbon dioxide (CO_2) gas. Methane, another greenhouse gas, is more than 20 times effectual as carbon dioxide (CO_2) at entrapping heat in the atmosphere. Methane is obtained from rice paddy, bacteria in bugs and fossil fuel, manufacture as well as bovine flatulence. When rice fields are loaded an anaerobic is build up and the organic matter in the soil decays releasing Methane to the atmosphere. Nitrous Oxide, another greenhouse gas has its main source nylon and nitric acid production, cars with catalytic converters, use of fertilizers in agriculture and burning of organic matter. Beside these, man made chemicals like hydroflurocarbons andperflurocarbonswhichareinitiatedasasubstitutetootherchemicalsthatdeplete the atmosphere's protective ozone layer. The speedy increase in greenhouse gases over the past century is a matter of worry.

Climate changes triggered by global warming can bring in their wake extreme conditions like abnormal storms, drought and floods and may pose an immediate threat to life. Recent out-breaks of Malaria, Dengue Fever, Hanta Virus and similar diseases due to climate change are the consequence of the global warming. The long term serious consequencetohumanhealthislikelytothreatenourexistenceonthisplanet.

HUMAN GENOME PROJECT : IMPLICATIONS

It is significant to note that since the discovery of DNA structure and function in the 1950's, the field of genetics has completely revolutionized biological sciences and reshaped our understanding of inheritance, genetic disease and evolutionary processes. For example the Polymerase Chain Reaction (PCR) technique developed in 1986 now enables us to produce multiple copies of DNA so as to analyze segments of DNA as small a segment of DNA as one nucleotide. PCR has limitless potential for many disciplines including forensic sciences, medicine and evolutionary biology. During the last three decades the use of the technique of the recombatant DNA technologies has enabled scientists to transfer genes from the cells of one species into that of another. The most common method has been to insert human genes that direct the production of various proteins into bacterial cells. Thus, causing the altered bacteria to produce the human gene products which not only has commercial implication but are also aimed at treating genetic diseases like diabetes in humans. The most important advance in genetics has been the progress made by the Human Genome Project (HGP). Sequencing of the entire human genome the goal of this international effort begun in 1990. The main motivation for financing human genome project has been to identify the underlying causes of disease and the risks to humans from new energy resources and technologies. The HGP has implications for physical anthropology study of human diversity and evolution as well. Further advances in understanding the human genome will result from comparisons to other organisms particularly our closest living relative-the chimpanzees.

In May 2002 the scientific world learned that the next primate genome to be studied is that of chimpanzee. Researchers. Believe and anticipate learning even more about the bases of human disease. It is also expected that this study will help us to understand the evolutionary implications of the differences between chimpanzee and the humans.

All the future scientific developments can not be foreseen. While making such predictions one has to assume that modern civilization will continue to exist with full concern for health, medicine and human welfare, it may be reemphasized that the processes of genetic drift, mutation and selection will continue to operate and modify in view of the utilization of the concepts of human genetics in human welfare. The human societies will learn to keep their social and technologic structure from destruction. Thus, the balance of both favourable and unfavourable trends will determine our biologic future. It may involve abandoning of genetic adaptation with otherwise-unfavorable effects. Artificial Selection by Genetic counseling genetic screening and genetic manipulation will play its role and affect the future human species at least partially and may lead to genetic improvements.

In view of the above considerations, it seems that overall genetic composition of human species will continue to remain similar to the present. Ethnic diversity may be minimized with slightly higher risks of genetic defects which may be under more rigid or effective control. With better diagnostic facilities, autosomal chromosomal aberrations may be rare. On the other hand polygenic diseases may be more frequent. A short synopsis of the favourable and unfavourale trends affecting the genetic composition of future human population as conceived by Vogel and Motulsky (1979 :549) is reproduced herewith.

Table :Favorable and unfavorable trends (without genetic engineering) affecting genetic composition of future human populations

Trends	Probablesignificance
Mutation rate increase due toionizingradiation	Not verysignificant
Mutation rateincreasedue Unknown to chemicalmutagens	
Higher reproductionofpatients withinheriteddiseases	Probably notvery significant
Increase ofrecessivediseases (newequilibrium)	Insignificant infew countries
Deterioration of normal functionsdueto besignificantin 'Selectionrelaxation'	May the longrun
Favourable Elimination ofgeneticadaptations gnificant withotherwise Unfavourable effects (infections or malnutrition)	Possiblysi
Decrease of mutationratesfor gnificant chromosomeaberrations And point mutations due to decreasing	Si

parental age.

Voluntarilydecreasedreproduction families withGenetic diseases	Unknown,will bec omeeven more importan t in the future
Geneticcounselingincluding antenataldiagnosis.	Important, evenafter a shorttime

Thus with tremendous development in the field of human genetics and molecular biology which are bound to affect the evolutionary process, physical anthropology needs to consider all these aspects in order to understand and evaluate the trends of human variability which is the main objective of our discipline. It is concerned with understanding the dimensions of life, the times, places and conditions under which our ancestors lived, the processes which produced and are producing changes with particular reference to ecological and cultural influences. The vision of evolutionary understanding that comes from the synthetic theory which is the union of genetics and paleontology requires the synthesis of efforts of all the branches of anthropology. Perhaps this new perspective will enable us to fulfill the objectives of physical anthropologywhich,however,remainthesamebutwithmoreintegratedapproach.

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