USES OF PHYSICAL ANTHROPOLOGY

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Past and present physical anthropology have been concerned with at least six topics, vis., evolution, osteology and odontology, somatology and somatiscopy, genetics/familial, growth and maturation, and bodily systems and soft tissues (Krogman 1976:1-14). The concerns of physical anthropologists are directed towards an understanding of biological human origins as these may have predictive value towards the future of man. The big topic of evolution is a primary concern here. Part of this topic is focused on primatology which contributes not only to an understanding of biological origins, but also to present behavior of man.

The topics are not mutually exclusive. In fact, it is extremely difficult to talk of evolution without talking about any of the others. The topical delineation is merely one of emphasis, based on the peculiar interest of a scientist. Some have been dealt with more often than others and some are dealt with because of opportunities offered by archeology and by funding institutions.

This paper will review some of the salient reports published during the decade in order to highlight some uses of physical anthropology.

First, we will examine the overall preoccupation of physical anthropologists which is man's origin, and second, we will deal with the new concerns of nutritional anthropology and medical anthropology.

Man's Origins

In 1975 (CA 15(4):367-456) a number of papers appeared which brought out new evidences on human evolution. For example, on the evidence of paleoecology, the Taung hominid seemed to have "appeared" immediately prior to the Middle Pleistocine and hence contemporary with or even younger than Swartkrans and Kromdrai instead of coeval with Sterkfontein and Makapansgat (utzer 1974:367-382). Geological and faunal evidences are presented. By implication, the Taung hominid may postdate the arrival of true *Homo* in Southern Africa and thus question the original hypothesis concerning an ecological basis for differentiation of gracile and robust australopithecines. Taung or Australopithecus Africanus becomes immediately prior to the pithecantrophines. This opens up the questions: Is there really a single phylogeny at least from A. Africanus to Neanderthal H. sapiens? Does this mean that A. Africanus becomes Homo Africanus and that Australopithecines did not become extinct as suggested by others?

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On the other hand, Blumenberg and Todd (1974:389), on the basis of selective value state that: "The gradual extinction of Australopithecus may have been an inevitable outcome of the breakdown in the association with *Homo,* for predation pressure would inexorably have shifted to Australopithecus". The authors are inclined to believe that the specimens from East Rudolf found by Richard Leakey are the immediate ancestors of H. erectus. *Homo* erecti as we may recall are a sympatric species found not only in Africa but also in Europe (Mauer, Vertezolles) and Java (Djetis and Trinil) as early as two million years before present. Korthlandt, however, states:

> Given the paleocological conditions that existed from East Africa, one can imagine a perfect lineage that led from ***dryopithecus africanus*** via an early form of Australopithecus (sensu stricto) and an array of subsequent transitional form (such as "***homo nabilis*** and "telanthropus") towards full human status. The concept of man and humanoid being in general should not be conceived as a unitary ***tantheitheiches*** concept. On the contrary, trends towards humanization converged from various angels and were present on all primate-inhabited Old World continents. Even Madagascar had its own lemurian humanois. Full "pre-human" or "nascent human" status has apparently been reached twice independently . . . The possibility of a biphyletic humanoization or so-called australopithecines, more or less as proposed by Napier (1964) therefore deserves serious consideration.
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> An intriguing question is how the two humanoids (Paran and Australo) could have co-existed side by side, and evolved in convergent directions, for a stretch of some 3 to 4 million years at the least. One possibility is that they developed a symbiosis based upon a mutual antipredator defense system in which the one was a better spotter and the other a better fighter. Evidence of similar relationships between chimpanzee and man in Africa support this speculation. (CA 1974: 15(4):429-430).

Of course not everyone accepts Kortlandt's arguments on the ground that "geographic speciation is naive" (Blumenberg & Todd 1974:431); "there are significant contradictions that may require modifications of his thesis" (Butzer 1974:367-382); "symbiotic coexistence seem simplistic" (Curry-Lindahd 1974:432); and "unsubstantiated assumptions" (Delson 1974:433); among others. In any case, the debates and rebuttals make one thing clear – we are still far from accepting either a monophyletic, biphyletic, etc. family tree notwithstanding the geographical and ecological evidences. These studies and findings tell us that the biological and ecological history of man or evolution continues to intrigue anthropologists as new discoveries are

found. In addition to paleanthropology, the molecular basis of human evolution is a preoccupation of many anthropologists.

Phenotypes are the result of inheritance of protein metabolism which in turn is directed by the base sequence in the DNA. This sequence is a code for a sequence of amino acids. Therefore, *the evolution of proteins and the evolution of heritable phenotypes is the same evolution* (Byles 1976:71). The apparent paradox between the rates of protein evolution and the rates of phenotypic evolution is troublesome to molecular biologists. Goodman, et al. suggest that the rate of molecular evolution in the primate line has decelerated due to changes in the structure of the placenta. B.J. Williams maintains that the rates of molecular evolution are not constant hence the paradox (in Byles 1976:77).

Questions are raised on the factors affecting the rates of evolution of substances i.e., proteins and deoxyribonucleic acids that determine for the most part the evolutionary process. In order to make this clearer, primate evolution is evoked. A simple but commonly used hypothesis states that the more ancient the common ancestor for a species is, the greater the genetic distance for their pair of species. Men and chimpanzees are closer to each other than chimpanzees and gorillas although the three still share a common ancestor even after the gibbons and orange-utans separated from the lineage of the former. In fact, the three belong to the sub-family Hominidae instead of the previous classification of Homo alone belonging to the Family Hominidae. Further African ape-human divergence is now placed at a very recent six million years ago! The genes of *Homo* based on the finds of Kenya and Ethiopia is 2.6 million years old so that Australopithecus is now a Homo and should properly be renamed Homo Africanus (Goodman 1974). Further, all the information taken in toto which seem to indicate a split between the chimpanzee and man earlier than 25 million years ago are not based on very solid evidence (Byles 1976:83). Ramapithecus is now rejected as part of the hominid line of our ancestry.

Molecular evolution is marked by deceleration in the Hominoidea owing perhaps to fewer mutations being neutral to natural selection while more mutations were detrimental and hence eliminated. A second point mentioned was that the steadily increasing gestational age and generation lengths for the selected genes might have decreased the rate at which mutations occur in absolute time. Finally, the human placenta which favors exchange of proteins between maternal and fetal circulation possibly contributed to the further occurrence or expression of the mutant genes. In short, the species has been adapting and becoming specialized.

B.J. Williams argues for coadaptation in the metabolism of protein. There is primary adaptation of genes for most proteins to each other and not to the environment resulting in an efficient metabolic system. In other words,

the metabolic system had adaptive significance and thus the activity of a protein must be measured in terms of the other parts of the bodily system.

However, in the case of tyrosine which is involved in a wide variety of metabolic pathways, it will have almost no latitude for change simply because of the myriad of metabolic neighbors which it has to interest. Thus, interaction of molecules can be a constraint to the direction and amount of acceptable change. It seems that if mutation is unfavorable, change occurs, i.e., there is the possibility of rejection/elimination. In other words, deaths that may be undiagnosable may have been owing to unfavorable mutation hence selected against. In this case, change will be slow. However, if small and minor changes begin to occur and accumulate, they lead to divergence. Interaction between molecules will also be divergent hence coadaptation is altered. While the *constraint* on change remain equally rigid in both descendant groups, the areas of latitude slowly begin to separate and become different. Molecular difference between parent and offspring is exponential but not between offsprings. The major difficulty becomes one of estimating the degree of coadaptation.

In sum, the most striking finding in molecular evolution is that the chimpanzees and gorillas are genetically and genealogically closer to their human cousins than to orang-utans, gibbons or any other primates. However, because rates of change are not uniform in all lineages, the accuracy of proteins as evolutionary clocks is under close scrutiny, and rates of nucleotide substitutions should be averaged over sufficient periods of time to provide estimates of divergence dates.

From the above discussion, it is apparent that as knowledge of evolution of proteins and that of homo sapiens is acquired, new understanding of ongoing evolution will also be gained. Insights into ongoing evolution can be of predictive value to the future of man.

Also on molecular biology, there is the potential contribution to the evolution of the nervous system and hence behavior. Goodman (1976), whose paper on protein molecular clock has provoked a great deal of discussion, suggested that the rationale for some of the complex immunoglobulin models may now have some applications in studying the nervous system at the molecular level. Much remains to be studied in this area before substantive statements can be uttered.

Medical Anthropology

Medical anthropology has expanded its horizons from the cultural concerns to the genetic and physiological fields. Previously confined to studies of Fabrega, von Mering and others, the additional concerns embrace genetics, growth and maturation, diseases, and even human engineering. The main focus of genetics has been the study of blood groups. The classic work of Allison on the sickle cell and hemoglobin remains a strong influence to many

physical anthropologists interested in blood groups and diseases. Mourant's (1961) Huxley lecture which touched on Allison's work was reprinted in a 1978 issue of RAIN, and it seems to deliver a message that much work need to be done along this line. As may be recalled, the persistence of the hemoglobins or sickle cell hemoglobin, which reaches high frequencies in certain African and other populations has an effect on fitness. A very large number of inheritable variants of the hemoglobin are know, but apart from the normal (adult) type known as Haemoglobin A, there is another type known as Haemoglobin S or sickle cell haemoglobin. These are inherited by means of alternative allelomorphic genes. Each individual carries on each of his cells two haemoglobin genes. Most individuals everywhere have the genetic constitution AA, but some, especially in Africa, are AS and others SS. Each AS person passes on an A gene or an S gene, but not both, to each member of the next generation. Thus, two AS persons can have a mixture of two types. When in the normal circulation of the blood Haemoglobin S gives up its oxygen to the tissues, it becomes insoluble in the red cell fluid and forms semi-solid crystals which distort the cell and cause it to assume a sickle-like form and to break up. Thus, nearly all individuals of Type SS die of sickle cell anemia in infancy, but AS persons, with mixed haemoglobin, have an almost normal life expectation. AS persons were much more highly resistant to endemic malignant tertain malaria (due to Plasmodium falcifarum) than were normal AA persons. In a malarial environment, AA persons tend to die of malaria, and SS persons tend to die of sickle cell anemia, but AS persons survive preferentially to pass on both genes (one at a time) to the next generation. Thus, in the presence of malaria the "abnormal" type is actually favored, and the distribution of the S gene closely follows that of the falcifarum parasite.

While we are on the subject of malaria, Wood (1975:93-104) in a study of bloodgroups and disease found some possibility that malaria must have been a recent introduction in the New World. She found that individuals bearing A or B genes will have a definite selective advantage relative to blood group O persons in environments were malaria is endemic. However, there is an overwhelming prevalence of blood group O in the population studied, which meant that in the absence of malaria, the naturally occurring selection against groups A and B due to mother-child ABO incompatibility would result in time in the virtual elimination of the A and B genes in the population. She concluded that there was no force selecting for the presence of blood groups A and B such as malaria until quite recently. As a result ABO incompatibility pressures remained unopposed, and A and B genes declined to their present levels. Dore et al, on the other hand, reported continuing experiments in the laboratory (i.e., biting and landing of mosquitoes) and found no significant evidence of a blood group preference as regards Anopheles biting or landing bahavour (1975). Wood countered that her continuing experiments

indicated other possible factors such as bodily secretions and sweat and other substances that may influence biting and landing behavior of mosquitoes. It is obvious from the foregoing that no conclusions can yet be formulated on the selective advantage in blood group AB and malaria. In any case, this is the kind of study that is relevant to medicine and population genetics.

There is the well-known association between hemolytic disease of the newborn and incompatibility between fetus and mother with Rhesus blood groups. From the standpoint of natural selection, there is a paradox. The babies at risk are all Rhesus positive but they all have one (dominantly expressed) Rh positive gene (from the father) and one Rh negative from the mother. This was formerly a highly fatal disease but with the advent of exchange transfusion (in which the newborn infant's blood is exchanged with new blood of the same type) infants are surviving to lead quite normal lives. Previously equal numbers of positive and negative genes are destroyed and we would have expected to see an elimination of the gene. Yet it has persisted in Europe even then. The RH problem is not found in the Philippines since Filipinos are dominantly Rh positive. However, other types of incompatibility exist.

In hemolytic disease of the newborn, a woman of blood type O is more likely to risk loss of a fetus than a woman who is Rh negative, because the former has an anti A and anti B antibodies in her blood from birth. These antibodies can attack the fetal red cells if the fetus carries type A or B or AB from the father. This implies that we might expect reduction of offsprings of type A from group O mothers. However, to balance the reduction of group A, group O children seem to be most susceptible to viral diseases more than type A children. Not all incompatible pregnancies result, however, in abortion or fetal death because the antisera which give the usual anti A and anti B are composed of more than one antibody. In this connection, it would be interesting to find out the differential fertility among women of different blood types in the Philippines.

Mourant (1961) saw some statistical associations between certain diseases and blood groups, but more important is the functional relationship between diseases and the blood group specific substances. For example, the knowledge that the gastrointestinal tract in secretor individuals contain large amounts of the A, B, or H substances, implies susceptibility to particular diseases. Chemical similarity between ABC antigens and certain pathogenic microorganisms are suggestive of dues and hypotheses such as group B individuals are less susceptible to streptococcal infections and may not be at risk for rheumatic heart disease, but at risk for paralytic polio. One comparatively newly discovered set of heredity blood factors has been found to be in connection with histocompatibility antigens. These antigens are found in most organs but tests for them are performed on lymphocytes of the white cells. These antigens are important to determine for purposes of transplants and

auto-immune diseases in which the body forms destructive antibodies against its own tissues. One of the best examples is multiple sclerosis in which there is destruction of supporting tissues of the nervous system.

The above data provide avenues for research. More tests may enable us to identify heterozygote advantage and the evolutionary trend of the ABC system. Clinical and statistical studies to determine the magnitude of the effects of natural selection and long term population surveys to obtain estimates of fitness are a fertile field for study.

The Nuffield Blood Group Centre provides the world with data on distribution of blood groups and blood groups and diseases. It boasts of some 10,000 papers and some 20,000 bibliographical references. Japan has such a centre on a small scale. Knowledge of blood groups and diseases helps give safe blood transfusions, and can provide clues to origins of a people. On the local level, studies of this kind are awaiting researchers.

Freire-Maia et al. (1977) submitted a gist of research conclusions in a Brazilian island which has 18 albinos in a breeding population of 194. Albinism is a recessive autosomal gene and this study is being mentioned because of its possible relevance to our country which has some 45 islands that are inhabited and some small ones with a very few inhabitants. The potential for studying such phenomena as the founder principle, drift and their correlates supported by genealogical, clinical, histologic and cytological aspects in addition to other parameters such as prenatal mortality, infant mortality, fecundity and fertility are of tremendous importance for obvious reasons.

On another level, it is found in a European study that while the average weight of newborns has remained constant, the length (i.e. stature) has increased one centimeter every two generations. The data point out that genetics rather than maternal nutrition account for the increase. This remains to be investigated cross-nationally (Chiarelli 1977: 524-525). The question is – does this also hold true for Filipino women? Still on another level, Hiernaex studied some living populations of Sub-Saharan Africa and confirmed the findings elsewhere that socioeconomic status and menarche are related; i.e., the higher the socioeconomic status the earlier the menarche. Nutrition and hygiene which are relative to socioeconomic factors are the significant variables. While on the subject of nutrition, the Masai compared to the Europeans have a diet rich in cholesterol and beta-lipo proteins, but blood studies reveal low readings. It does seem that the Masai compensate for the absorption of rich dietary cholesterol by a higher capacity to block the synthesis of endogenous cholesterol. The process is not clear although there are indications that some genes may be working to help the individual. If the effect or the process is known, then the knowlege could have wide practical applicability since high cholesterol is a scourge in the later years of life and one of the highest contributors to causes of death.

Neumann (1977:288-308) studied salt taboos in Southeastern United States using the biocultural approach. He suggests that while all humans require sodium, their requirements are not stable, but change in conjunction with the physical state. There can be no quarrel along the line. The need for sodium is regulated by the medical profession, but in areas where no medical institutions are present to regulate it, salt taboos provide the needed control. In the study by Neumann, taboos on salt were found during menstruation, pregnancy, disease and mourning – the last is a period of emotional agitation when the adrenal cortex is stimulated to increase the secretion of corticosteroids, among which is aldosterone. This will result in retention of salt and water in the body. There is subsequent rise in blood pressure and a tendency toward edema, while the body in the meantime is trying hard to restore hemeostasis. The taboo on salt prevents this mechanism; hence, it becomes functional although the people themselves do not know it.

One recent work on nutrition is that among the Aguariva Jivaro. The Aguariva Jivaro Indians have an approximately 3,000 K caloric intake daily, but they have been found to suffer from mild anemia. The Indians do have a high level of protein and caloric intake, but perhaps these are simply adequate rather than excessive in the light of probable malabsorption caused by the presence in the body of helminths and protozoan parasites (Berlin and Markellin Ross 1978:191:14). Locally, among some groups (e.g., Ivatans) while caloric intake is higher than that reported for Filipinos, there still exists malnutrition owing obviously to the same malabsorption condition among the Jivaro Indians. At the time of one study (Recio 1973), approximately 80 percent of school children in Batanes were found to be positive for one or even three types of intestinal parasites. To make matters worse, protein intake is still below the MDR notwithstanding the predominance of fish in the diet. Thus, while there may be an adequacy of caloric intake, the insufficient amount of protein and the presence of parasitic infestation contribute to the malnourished state of the children and even the adults.

Many Filipino doctors have commented on the carcinogenic practice of chewing betel nut (buyo). Since chewing buyo is a widespread practice, the epidemiological data on this is awaited, but in the meantime one is led to suspect some biological reasons for the persistence of the practice among Filipinos. For example, a study on coca chewing and high altitude stress among Andean Indians seems to be associated. But more importantly, pain from chronic polycythemia (this is not clearly understood) that is a common occurrence in places of high altitude seems to provoke the Andeans to seek relief from pain in coca chewing (Fuchs 1978:277-291). The potential exists for this cultural practice and the possible biological reasons.

Another intriguing area for research is the role of *bagoong* (fermented fish) on physical performance. Since bagoong is salty, and since working under the intense heat of the sun may decrease the sodium and electrolyte

level of the body, the intake of bagoong may be physiologically useful, but no tests seem to have been undertaken along this line.

One of the problems besetting our country is that of increase in population. There has been stated a hypothesis that periods of high fertility correspond to periods of high infant mortality. However, it is not ascertained which is cause and which is effect. Now that we have reason to believe that infant mortality is on the decline, would fertility be expected to decline? It has also been found that there is a direct association between increased adipose tissue of the women and decreased fertility because hormones are stored in these tissues instead of being metabolized rapidly as is the case among lean women. Since health is improving among Filipino women and an increase in adipose tissue is culturally defined as being healthy by some women, fertility might be expected to decline. However, it has been demonstrated that in order to have regular ovulation and to avoid difficulties in the implantation of the embryo, a minimum of 16 kgs. of stored fat is necessary for the American and European girl. We also need studies if this is true among Filipinos.

To the rule that within a polytypic warm-blooded species, the body size of a sub-species usually decreases with decreasing mean temperature of the habitat, there is an apparent need to clarify body size because actual weights vary according to socioeconomic and nutritional standards. As a corollary to Bergmann's generalization, Allen states that in homeotherms there is a marked tendency towards decrease in size of the extremities and appendages in colder climates. The assumption here is that in animals heat production is a function of mass, and heat dissipation is a simple function of surface area. Wilbur (1962:108) argued that man has not responded to his environment in a "willy-nilly" fashion, but has done everything possible to control and shape the environment to conform to his ideas of comfort and convenience. In the cold, homeotherms adjust for survival by increasing metabolic rate and by increasing insulation by selecting a favorable micro-climate and by maintaining cold extremities to reduce heat loss from the core. For example, the Australian aborigine shows physiological adaptations characteristic of Arctic animals; that is, extremely active control of cutaneous circulation which results in maintenance of cold skin and extremities in decreased environmental temperatures with consequent saving of heat. These adaptations are functions and do not involve changes in exterior body form.

The general conclusion is that people of different ethnic origins, morphology, activities, nutritional states, degrees of exposure to the local climate show only small differences in their reactions to a standard heat stress. By contrast, men of the same ethnic group who live in climates as different as those of Johannesburg in winter, or the Sahara desert, or the hot humid tropics of Australia, show significantly relatively large differences in their states of acclimatization. It appears that the climate in which men live and the level of their activities play a greater part in their states of acclimatization to heat

and cold than do differences in morphology. There are also significant differences in certain details of physiological responses to the stresses of heat, cold and exercise although the differences are small. In spite of these differences, however, the predominant impression is the remarkable similarity in their physiological reactions (Wyrdham in Baker & Weiner:1966).

Garn has stated that body size is also a product of selection. Famine, for instance, is a powerful selective force, differentially elimating the massive and large and in the face of continual caloric restriction, the genetically small individuals have a better chance to reach maturity and to reproduce themselves. Population differences in size, build, body proportions (and skin pigmentations) may be viewed as adaptations to particular environmental stress, although a particular climatic stress may not always be met by the same physiological adaptation.

The above studies are now part of the so-called human engineering aspect of physical anthropology. Such studies lead to innovations designed to contribute to the comfort of man. For example, a recent study in anthropometry resulted in standardization of seat sizes and army uniforms in America. Similarly, the flooding of ready-to-wear clothes in the market is one result of studies on anthropometry. Anthropometry as part of human engineering has become more and more useful to industry.

In sum, physical anthropology and its concerns have provided insights into the biological origins of man and are likewise contributing insights into its future. Practical applications are apparent in growth and maturation, nutrition, diseases, and human engineering. All data of these nature are needed for Filipinos.

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