PROBLEMS ON THE BORDER

BETWEEN

BIOLOGICAL AND SOCIAL SCIENCES

L. B. Slobodkin

Preface

Some interesting recent studies purport to demonstrate a strong natural selection for the genetic predisposition or "tendency" of humans to maintain particular social attitudes and institutions (Alexander, 1974; Trivers, 1974; Wilson, 1975). This paper will attempt to demonstrate the bases of my disbelief in the validity of these theories, and will discuss the peculiar role of the capacity to form a self-image in the evolution of man's "genetic predisposition to culture" (Dobzhansky, 1973). In addition, I feel it necessary to briefly indicate the social and political consequences of theories of human evolution. My main concern, however, is with the quality of the scientific arguments used.

The Adaptive Paradigm

What is the relationship between evolutionary strategy theory and human evolution? My own involvement in this problem came through an analysis of the sometimes gamelike properties of ecological and evolving systems, as discussed in Slobodkin and Rapoport (1974). There we concluded that there exists a kind of paradigmatic

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Contribution No. 233 from the Program in Ecology and Evolution, SUNY, Stony Brook.

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adapted state attained by evolutionary units[1] which minimizes the degree to which they will be damaged by environmental changes. When subject to any environmental change, the safest course (i.e., that which will minimize the evolutionary unit's probability of leaving no descendants) is to alter phenotype[2] as little as possible. The desirability of minimal alteration can be demonstrated by the fact that the extant phenotype at the moment of perturbation has proven itself appropriate, since the organisms were living up until that moment.

The paradigmatic response pattern typically involves a multiplicity of possible responses to a novel environmental perturbation. If these responses are ordered in terms of the rate at which they are activated, with the most slowly activated responses occurring further in the order, then they will also be ordered in the degree to which these responses represent a major commitment of change in the state of the organisms themselves. When a perturbation occurs, it is immediately met by a quickly activated, relatively minor response. To the degree that the response is appropriate in restoring the status quo, more major responses are not given a chance to be activated (Slobodkin and Rapoport, 1974).

This general sequence can be seen by considering what happens in a classroom when an instructor suddenly throws a piece of chalk at a student. There will be an immediate behavioral response, followed perhaps, after the chalk is well past, by adrenal change, some blood sugar and blood pressure changes, and long-term changes in attitude and posture on the part of the student. To the degree that small-scale individual responses are inadequate, there might be such events as wound healing and so forth. But in fact, head jerking will actually have solved the problem and the full sequence of events leading from adrenal change will not have occurred.

The general paradigm fits the biological data reasonably well--so well that test cases are hard to find. Testability of this kind of theory is a complex question in its own right which is of primarily biological concern, and I will not elaborate here.

But another question is raised. If this is a general paradigm of adaptive behavior and the effect of natural selection on the scheme is restorative, so that organisms may be expected to return to this paradigm after being displaced from it by environmental change, how do we explain the behavior of people?

For example, if I threw a racial or religious epithet at a student, I would anticipate a much stronger response than if I threw chalk. Not only that, I'd expect other students and my colleagues to try to restore the well-being of the student and to take fairly drastic action against me, perhaps in terms of my professional competence to retain tenure. Yet physically, a word falls more softly on a student than does a piece of chalk.

Is the human property of responding strongly to physically minor events unique to humans? That is, is there anything similar in animals? If it is uniquely human, we have a rather difficult problem, of trying to find its evolution in a protohominid line, which is not very amenable to investigation. If it is not unique,

we can treat it in the prehuman as any other biological property and can perhaps do experiments on it.

Humans and Self-image

The first problem is determining exactly what one would look for in an animal system which would be an indicator of departure from the paradigm. I suggest that such departures arise in humans when an environmental event perturbs their perceptions of their own place in the world, their own theory of their own well-being. This, in turn, is contingent on a sense of selfhood. To put it another way, I believe that without the idea of self, humans would behave in such a way as to conform to the paradigm. It is therefore not intelligence, puzzle-solving ability, cultural transmission, or physical similarity to man that is to be looked for to test our theories, but rather animal behavior which restores to an organism its image of self. As it happens, such behavior has been seen in chimpanzees, orangutans, and probably gorillas (Gallup, 1974).

The basic result of these experiments is that a wild-reared orang or chimpanzee which has been given the opportunity to look at itself in a mirror for several days will formulate a normative image of itself. For example, if that image is disturbed by putting color on the animal, it will act to remove that color. The color is not sensible to the touch, odoriferous, nor in any way detrimental to the organism's physical or psychological well-being, except as it disturbs the organism's image of itself. The organism will act to restore that image to its proper state, i.e., normative action is taken.

Thus, man is not unique in his capacity for deviation from the basic responsive paradigm. Such results also suggest that self-image (or the capacity to develop self-image) precedes the capacity to develop verbal speech and so on. Since the capacity to deviate from the paradigm occurs in prehumans and is in no way related to unique properties of man, it must be explicable in terms of general evolutionary theory. There are biological speculations about the evolutionary pathway leading to this, but I will not discuss them further here (see Slobodkin, 1977a, 1977b).

However, another family of questions arises which is more germane to this discussion. First, what is the normal pattern of self-image development in human ontogeny? Second, what are the implications of the assertion that the human capacity for self-image is a biological one (in the sense of being inherited from prehuman ancestry that did not have "speech" and "culture")?

The Development of Self-image

The normal pattern of self-image development in human ontogeny is focal to the fields of psychology and sociology. It has been analyzed extensively by such pioneers as George Herbert Mead (1934), Cooley (1964), and the developmental psychologists of the Piaget

school. As the social scientists and, to some extent, the phenomenological philosophers have it well in hand (if not completely solved), it doesn't require much aid from a biologist. Summarizing this work in brutal brevity:

1) There are limits of neurological structure and function in ontogeny which may set age limits for concept development and behavior.

2) A child responds behaviorally to environmental communications of both verbal and non-verbal forms at an extremely early age.

3) A child indicates first objective, then later subjective self-awareness. After playing with other children, a child playing alone often continues to imitate the others, in particular, imitating their actions with regard to itself by taking on the role of others *vis-à-vis* itself. For example, the child calls itself by the name its social companions have used with reference to itself, as in saying "Billy is bad" when its name is Billy. This is behavioral evidence of objective self-awareness--or seeing itself as a "me." Later, it develops a subjective self-awareness from within the "me," facing the world as an "I."

4) The child incorporates attitudes of others toward itself in its definition of self, and once having done so, sees the world in terms of itself.

The philosophers' *Ding an Sich* is hidden from us by our own identity and internal ordering of the world--or is it? That is, the "I" is that which could conceivably achieve relationship with any *Ding an Sich* but it is precisely the "I" which impedes such relationships. Once here, we've entered into the world of the major philosophers of the last two hundred years and again, they may not have the situation under control, but their competence is at least as high as that of any biologist.

Returning to the biological implications of the "I" and "me," and the development of and departure from the paradigm, we turn in particular to the implications of evolutionary theory to man. From the arguments presented above, it is implied that the evolutionary history of man is divisible into three stages:

1) A stage of normal evolution which follows from the paradigm of optimal evolutionary strategy.

2) The development of the capacity for normative introspective self-image by a process of natural selection acting on some prehuman animals in the ordinary way that natural selection is assumed to act.

3) A stage in which the capacity for self-image production has in fact developed and the organisms have departed from the optimal strategy paradigm (Slobodkin, 1977a).

The Genetic Character of Natural Selection

When speaking of natural selection, we usually discuss "genetic characters." A great deal of care is required in defining a particular character or property as "genetic." To say that a property of an organism is "genetic" typically means that genetic differences

exist between individuals with reference to that property. For example, the genetic control of eye color in the fruit fly became apparent only with Morgan's discovery of the white eye gene. Only after the observation of an alternative to the red eye color did it become meaningful to discuss the evolutionary significance of fruit fly eye color from a genetic standpoint. Therefore, if we are to say that a particular property is of selective significance we are also asserting that there exist individuals with different manifestations of this property and that such differences can be correlated with differences in genetic material between these individuals.

There is an alternative sense in which the words "genetically determined" are used and much controversy resides in confusing the two meanings. "Genetically determined" can be used to refer to those properties of an organism which are invariant under the range of tolerable environmental alteration. In this sense, the assertion "the possession of a head in humans is genetic" means that over the range of all environmental circumstances which admit the survival of individual humans, heads are developed and retained. This usage is effectively identical with the term "highly canalized," as developed by Waddington (1957).

The concept of canalization refers to the degree that definable properties of organisms are invariant under environmental alteration. For example, the adult shape in most species of living sponges is loosely canalized in the sense that genetically identical sponges reared under different conditions of feeding and water temperature will have different shapes and sizes. However, the cell structure of these same sponges is highly canalized as the choanocytes of each species all look alike despite large environmental differences. Cell types of each sponge species will resemble each other very closely. Further, those environmental properties that will drastically alter the cell structure will also kill the sponges.

To say that a particular attribute is universally held by members of particular species over a broad range of environments, is to say that the attribute is "highly canalized." To say that a particular attribute varies between individuals of a species and that this variation is due to differences in the properties of DNA of these individuals is to say that attribute is genetically variable or simply "genetic." Genetic attributes in this sense are subject to alteration in frequency from generation to generation by natural selection.

A particular attribute may be both highly canalized and genetic. Again, eye color in fruit flies is subject to very little variation between individuals within genotypes, but a population of flies may have several genetically different types of flies each with its own highly canalized eye color.

In order for natural selection to be effective in altering genes of a population, those genes must relate to attributes of organisms which are simultaneously genetic and significantly canalized. By "significant" I mean that, despite differences in

environmental history, some portion of the observed variance between individuals in a population can be statistically assigned to known parental differences. In the literature of population genetics, traits with this property are referred to as having significant "heritability."

Careful control of environmental properties might reveal heritability in situations where it would otherwise be masked, in the sense of being statistically inseparable from environmental difference between individuals. For example, cuttings from the same fruit tree will show high uniformity if raised under controlled conditions. If the growth conditions are highly diverse, however, it may be the case that the differences between the growth characteristics of a set of cuttings from one tree might be indistinguishable from those of cuttings from a second, genetically different, tree.

In summary, the properties of a population are not always being altered by natural selection. Selective alteration will occur only if there is genetic diversity between individuals with reference to properties with reasonably high canalization, and the environment is sufficiently uniform from the standpoint of different individuals so that significant heritability is manifested. Furthermore, these manifested differences must have significant consequences. A population of organisms, each of which has the capacity to respond adequately to an enormously wide range of environmental circumstances without alteration in its probabilities of death and reproduction, is immune to natural selection altering its gene frequencies. This continues unless, and until, either the alteration in the environment exceeds previous limits or new genetic variants are introduced by migration or mutation which have a significantly different set of death and reproductive probabilities.

This in no way denies the importance of natural selection. It does admit of the possibility of developing a population of organisms that are "well adapted" with regard to at least some of their properties. That is, some properties of some kinds of organisms are sufficiently well suited to normal environmental circumstances that we do not expect natural selection to be of immediate effect on them in the absence of environmental alteration or of new (and highly unlikely) genetic improvement as a consequence of mutation or immigration.

Low Canalization and Human Behavior

An ideally adaptive genotype is one which provides the organism with a set of directives for correctly solving the problems posed by the organism's environment. What is meant by "correct" in this sense is discussed in Slobodkin and Rapoport (1974). What is of immediate relevance to our present problem is that one general class of correct solutions is to maintain low canalization, thereby leaving the organism with a high flexibility of responses to environmental problems. If canalization is so low

that the response patterns of genetically different organisms effectively overlap, then natural selection for these genetic differences will not occur. This solution is subject to restraints related to other properties of the organisms. It is not practical to maintain infinitely weak canalization for all of an organism's properties simultaneously.

It is my contention, developed further below, that certain aspects of human behavior are genetically fixed in a state of low canalization to the degree that there is no evidence that genetic differences between individuals significantly alter these aspects of behavior. Further, I will contend (cf., Ruyle, *et al.*, 1977) that there is a curious but quite definite distinction between "advantageous" and "having selective advantage." An advantageous behavior or morphology confers some benefit on an organism where the concept of benefit is defined by arbitrary agreement. This may even include an improvement in the organism's likelihood of being an ancestor. By contrast, "having a selective advantage" refers to a very tightly defined evolutionary situation in which some particular class of organisms within a population in some particular environmental context has genetic properties which confer on their possessors the capacity to increase the relative frequency of their type of genes in the population concomitant with a relative diminution of other types. Therefore, as Durham (1976) points out, demonstration that a particular behavioral property would have selective advantage, if individuals of differing genotype differed in that behavior, does not in any way demonstrate selective advantage in any usual evolutionary sense. This is of absolutely central importance.

Sociobiology and Human Decision Behavior

Despite agreement by various "sociobiologists" (as defined by Wilson, 1975), that a significant portion of human decision behavior is genetically determined (Wilson, 1975; Alexander, 1974, 1975), my primary point is that it is precisely such behavior which is most loosely related to genotypic differences, and that the lack of genetic control of decision behavior is a central part of what has been called the "genetic basis of culture" (Dobzhansky, 1973).

Note that selection can only alter genetic properties of populations by effecting the selective survival and reproductive rates of genetically different individuals. Once it is conceded that individual humans are not presently genetically different from each other with regard to a particular trait, then natural selection can no longer be of significance in modifying that trait (although the present genetic homogeneity may have been produced by natural selection in the past).

I will concentrate on the views of Alexander (1974, 1975) as representative of the general position of the "school" of human sociobiology. His discussion is more specific than the magisterial claims of Wilson (1975) or Trivers (1974). Both Wilson and Alexander agree that a significant portion of human decision

behavior is genetically determined. Both also find the occurrence of human altruism a major problem, and both solve it by speculative use of the theoretical analysis of Hamilton (1964) as interpreted and expanded by Trivers (1971).

Alexander's (1975) central intention, with which I agree completely, was to refute the idea that group (or population) selection is necessary for evolution (Wynne-Edwards, 1962; Williams, 1971; West-Eberhard, 1975). In particular, some social and "altruistic" behavior patterns have been attributed to selection acting on whole populations so that only those populations displaying the behavior survive. This was thought to permit evolution of properties which could not be selected for on the basis of individual selection, since they are not of benefit to the individual but only to the group to which he belongs.

Alexander attempted to show that group selection was not necessary for human evolution, since application of the concept of "inclusive fitness" (Hamilton, 1964) permits apparently altruistic acts to be interpreted as maximizing the inclusive fitness of the altruists. Alexander's general conclusion was that individual selection with the idea of inclusive fitness makes group selection extremely unlikely to have been of importance in human or any other kind of evolution (but see Wilson, 1975).

But it is the postulated history of human behavioral evolution used by Alexander to demonstrate this point which is likely to receive more general attention from non-biologists, and with which I take issue.

Alexander's theory, as I understand it, states:

a) A large share of human behavior is devoted to "earning a living" in the broad sense. It is therefore conducive to maximizing fitness, whether or not the precise activities are genetically programmed. (Acting as a doctor, lawyer, or thief may be equally effective ways to make a living, but knowledge of torts and picklocks is not highly canalized.)

b) Some human behavior is highly canalized. Sexual activity, nursing, eating, drinking, and playing with or watching small children are considered pleasurable in essentially all cultures. It would be difficult to argue that they were not genetically programmed in some sense. These activities are intimately and obviously related to survival and fecundity which are major components of fitness.

c) For any set of environmental circumstances, it is possible to postulate a class of general behaviors and attitudes that will maximize inclusive fitness. For example, certain kinds of aggressiveness, marriage rules and kinship systems, and even behaviors that are considered purely altruistic will result in maximal numbers of immediate, collateral, and related progeny given particular distributions and environmental restraints. If there is a genetic basis for the tendency of individuals to prefer these kinds of behavior and institutions, then this genetic basis will be selected for, so long as environmental circumstances do not change.

d) It is possible to show that cultural institutions of the sort that would be selected for actually do occur in what would seem appropriate environmental circumstances (Harris, 1971). This assertion is the converse of the usual anthropological procedure of first describing an event and then finding a way to rationalize its function (Rappaport, 1968; Vayda, 1976).

e) It is possible to argue that unselfish or altruistic behavior occasionally occurs under circumstances which will maximize the inclusive fitness of the apparent altruist, i.e., on occasion, apparent altruism is evolutionary self-interest.

The general inference then drawn by Alexander is that a considerable share of human behavior may be explicable in terms of its selective value.

It would be impossible to deny that natural selection has had a role in the development of both human behavior and of human behavioral capacities. This raises a series of residual questions, the answers to which are of major scientific and social importance:

1) To what extent are the behavioral properties of modern man at present under the control of natural selection? ("Modern" is used in a temporal sense, as distinct from the terms "industrial," "nonprimitive," "unnatural," etc.)

2) Which behaviors are under the current control of natural selection and which are not? This requires showing that people now differ from each other in a measurable way with respect to these properties and that these differences are genetically heritable in the actual environment. That is, the development of these properties in each individual must be sufficiently highly canalized to permit measurement of differences between individuals and statistical association of these differences with differences in parentage.

3) Has the significance of natural selection with respect to behavioral properties altered during human evolution? This has two possible meanings, both of which are intended. One is whether some traits have always been of selective advantage, as opposed to sometimes being advantageous and other times disadvantageous. The other meaning is related to the fact that natural selection may act on a particular trait until such time as the organisms have been modified to an essentially selectively neutral situation with respect to that trait. This may be achieved by an appropriate flexibility of development of the trait contingent on environmental circumstances.

Alexander's attempts to solve social problems using biological theory raise an obvious danger, as can be seen in the following situation. Alexander says:

> It is difficult to know how much strife, suffering, and cruelty may be perpetuated by thwarting efforts at reasonably dispassionate examinations of probable sources of our tendencies and motivations in the context of group cohesion and intergroup competition. [Alexander, 1975]

In context, this might imply that if we "objectively" examined human behavior we would realize that ideas of classical altruism (i.e., altruism to absolute strangers which will not be reciprocated and cooperation of the sort which could not have any selective value) are contrary to human "tendencies." Such behaviors are therefore unfeasible, unhealthy, or both. While not the only possible interpretation, it is one which a careful and intelligent reader might easily reach. Since Alexander does not specifically repudiate it, he is in some way responsible for such an interpretation with its serious social consequences.

Weaknesses in Alexander's Theory

If someone were to say that the behavioral differences between sparrows in New York City and sparrows in the countryside were genetic, we would demand that certain experiments be done to demonstrate this genetic basis. We would not be satisfied by a plausibility argument which says that so many things are genetic that this must be genetic also. Are we to be satisfied with less definitive data and theory with regard to human behavioral differences or regularities?

The argument is made that people can't be experimented with the way one experiments with sparrows, therefore a kind of likelihood assertion is needed. But really, what kind of likelihood is it?

There are well-known and clear-cut examples of genetic differences between persons which alter their behavior in significant ways, so that persons suffering from various metabolic deficiencies (say Tay-Sachs disease or porphyria) may behave in a curious fashion (Ehrman and Parsons, 1976). These well-analyzed cases of human behavioral genetic differences do not involve the kind of traits that are considered by Alexander, Wilson or Trivers.

Again, looking at altruism, Dr. J. Sohn has pointed out an interesting statement by Maimonides:

> It is well known that man requires friends all his lifetime....When man is in good health and prosperous he enjoys the company of his friends. In times of trouble he is in need of them. In old age when his body is weak he is assisted by them. This love is more frequent and intense between parents and children and among other relations. Perfect love, brotherhood, and mutual assistance is only found among those near to each other by relationship. The members of a family united by common descent from the same grandfather, or even some more distant ancestor, have towards each other a certain feeling of love, help each other and sympathize with each other....
> [Maimonides, *Guide to the Perplexed*, Chapter 49]

It is the apparent contention of Alexander, Wilson and Trivers that these feelings, modulated by distance of relationship, represent a deep genetic property of man and that somehow it is genetically natural for man to feel this way. However, they make no explicit genetic analysis. Maimonides did not consider these feelings to be instinctual. In fact, his passage continues: "To affect this [sense of love and mutual assistance] is one of the chief purposes of the law." That is, since one cannot rely on men to naturally feel this way, one imposes laws which encourage this feeling. The remainder of his passage is concerned with the rules of divorce, fidelity, and the relationship between married persons and between families.

The idea that cultural institutions, such as law, are the *cause* of these warm feelings invites the counter-argument that cultural institutions are reflections of the genetically based feelings themselves. It should be apparent by now that one can build vast polemical structures on this subject without any particular end.

Even relatively simple sounding assertions about the genetic basis of human traits other than the grossly morphological or biochemical are at the moment extremely controversial (cf., Kamin, 1974). Yet Wilson (1976) asserts that the time has come "for ethics to be removed temporarily from the hands of the philosophers and biologicized [*sic*]" and that "the question that science is now in a position to answer is the very origin and meaning of human values from which all ethical pronouncements and much of political practice flow."

One may ask why suppositions about frankly nonexistent genetic analyses are being presented as if they represented scientific communication. Note the possibility that it is related to the oracular role that has been imposed on scientists in the popular imagination and by the temptation to fulfill the oracular role in response to an ever-present eager audience.

The presentation of loose plausibility arguments as if they were fact, or as if they had the weight of normal scientific theory is not particularly dangerous in pure biology, as say, in a discussion of the evolution of bryozoans or bryophytes. But curiously enough, it is precisely in such areas that the most rigid scientific standards are applied before a work is permitted to be published and promulgated. In the area of human behavioral evolution there is a tendency to be looser, rather than more stringent, in the intellectual criteria applied, as if the depth of our ignorance about human behavior required us to say something at any cost rather than to remain silent. This is an extremely dangerous state of affairs from both the political and social standpoint (see *New York Review of Books*, Nov. 13, 1975).

Summary

1) In general, evolutionary units make minimal responses to environmental perturbations.

2) Humans, chimpanzees, and orangutans share the biological capacity to develop a normative introspective self-image which permits them to deviate from the general paradigm of minimal response. So far, no other organisms have been unequivocally shown to have this capacity.

3) The capacity for normative introspective self-image development, combined with learning capacity, interact with environmental differences between individual humans so as to produce extraordinarily weak canalization in the development of human decision making behavior.

4) By normal biological standards it would, therefore, be expected that it would be extremely difficult to demonstrate genetically significant heritability for particular decision making behavior in humans, chimpanzees, or orangutans. In fact, no such heritability has been demonstrated in these organisms.

5) If it could be demonstrated for some particular species, that particular kinds of social behavior have high canalization, high heritability, are genetic, and have selective advantage, then the evolutionary development and maintenance of that behavior might be explicable by the theories of Alexander, Hamilton, Trivers, and Wilson.

6) Since none of the properties listed above are demonstrated for humans, chimpanzees, or orangutans, and since there are special biological properties of these three species (cf., 1 - 4 above) that make the demonstrations listed in (5) extremely unlikely, assertion that the theories of Alexander, Hamilton, Trivers, and Wilson are applicable to humans is at best premature.

NOTES

1. An evolutionary unit is here defined as the aggregate of organisms characterized by a particular set of genetic frequencies such that if natural selection changes an evolutionary unit, it will alter those frequencies and will alter either the anatomical, physiological, behavioral, biochemical, cytogenetic, or other properties of the individuals that make up the evolutionary unit when taken in the aggregate. I will also use the terms organism or population in a loose way meaning evolutionary unit.

2. Phenotype here is defined as the full array of describable properties of the organism, excluding only the DNA base sequence itself.

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