Original Article on Ideology and Science

SOCIOBIOLOGY: ANOTHER BIOLOGICAL DETERMINISM

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Sociobiology is a form of biological determinism which argues that human social organization is constrained by genes that have been selected in evolution. In particular, it regards male dominance, hierarchical society, entrepreneurial economic activity, territoriality, and aggression as consequences of human genes. It is shown that sociobiological theory is carefully constructed to make it impossible to test, that it makes a number of fundamental errors in attempting to describe "human nature," that there is no evidence for inheritance of human social traits, and that the evolutionary arguments used are merely fanciful, adaptive stories.

The struggle between those who possess social power and those who do not, between "freeman and slave, patrician and plebian, lord and serf, guildmaster and journeyman, in a word, oppressor and oppressed" (1) is a war fought with many and varied weapons. Of highest importance are ideas, weapons in an ideological warfare by which every class struggling to maintain its grip on the world tries to justify its position morally and rationally, while those fighting to overturn the social order produce their own self-justificatory ideology as a counter weapon. If the revolution succeeds, that revolutionary ideology becomes transformed into a weapon of consolidation and conservation whereby yet further revolutionary challenges to the new dominant class can be resisted. Nothing better illustrates the historical progression of such ideological weapons than the revolution that created capitalist society.

The society of Europe before the 17th century (with the exception of certain mercantile Italian republics) was characterized by a static, aristocratic scheme of relations in which both peasants and landowners were bound to each other and to the land and in which change in the social position of individuals was exceedingly rare. Persons were said to owe their position in the world to the grace of God, or to the grace of earthy lords. Even kings ruled "Deo Gratia," and changes in position could occur only by exceptional conferrals or withdrawals of divine or royal grace. But this rigid hierarchy directly obstructed the expansion of both mercantile and manufacturing interests who required access to political and economic power based on their entrepreneurial activities rather than on noble birth.

Moreover, the inalienability of land and the traditional guarantee of access to

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common land inhibited the rapid expansion of primary production and also maintained a scarcity of labor for manufactories. In Britain, the Acts of Enclosure of the 18th century broke this rigid system, allowing landlords to enclose land for wool production and simultaneously displacing tenants who became the landless industrial work force of the cities. At the same time in France, the old "nobility of the sword" was being challenged by the administrative and legal hierarchy who became the "nobility of the robe" and by the rich commoners of banking and finance. The Bourgeois Revolution was brewing, a revolution that was to break assunder the static feudal-aristocratic bonds and to create instead an entrepreneurial society in which labor and money could more freely adapt to the demands of a rising commercial and industrial middle class. But the Bourgeois Revolution required an ideology justifying the assault on the old order and providing the moral and intellectual underpinnings of the new. This was the ideology of freedom, of individuality, of works as opposed to grace, of equality and the inalienable rights to "life, liberty and the pursuit of happiness." Paine, Jefferson, Diderot, and the Encyclopedists were the ideologues of the revolution and one theme comes through: the old order was characterized by artificial hierarchies and artificial barriers to human desire and ambition; those artificial barriers must be destroyed so that each person may take his or her natural place in society according to desire and ability. This is the origin of the idea of the "equal opportunity society" in which we are now supposed to live.

While the Bourgeois Revolution destroyed those artificial barriers, it seems not to have dispensed with inequality of station. There are still rich and poor, powerful and weak, both within and between nations. How is this to be explained? We might suppose that the inequalities are structural, that the society created by the revolution has inequality built into it and even depends upon that inequality for its operation. But that supposition, if taken seriously, would engender yet another revolution. The alternative is to claim that inequalities reside in properties of individuals rather than in the structure of social relations. This is the claim that our society has produced about as much equality as is humanly possible and that the remaining differences in status and wealth and power are the inevitable manifestations of *natural* inequalities in individual abilities. It is this latter claim that has been incorporated from an early stage into the ideology of the Bourgeois Revolution and which remains the dominant ideology of capitalist societies today. Such a view does not threaten the status quo, but, on the contrary, supports it by telling those who are without power that their position is the inevitable outcome of their own innate deficiencies and that therefore *nothing can be done about it.* A remarkably explicit recent statement of this assertion is that of R. Herrnstein (2), a psychologist and one of the leading ideologues of "natural inequality":

> The privileged classes of the past were probably not much superior biologically to the downtrodden, which is why revolution had a fair chance of success. By removing artificial barriers between classes, society has encouraged the creation of biological barriers. When people can take their natural level in society, the upper classes will, by definition, have greater capacity than the lower.

Here, the entire scheme is laid out. The Bourgeois Revolution succeeded because it was only breaking down artificial barriers, but the remaining inequalities cannot be

removed by a further revolution because what is left is the residue of biological differences which are irradicable. We are not told precisely what principle of biology guarantees that biologically "inferior" groups cannot seize power from biologically "superior" ones, but the conceptual and factual errors of such a statement are irrelevant to their function. They are meant to convince us that although we may not live in the best of all *conceivable* worlds, we live in the best of all *possible* worlds.

The ideology of the modern capitalist society is not one of equality of station, but of a natural sorting process aided by universal education in which "intrinsic merit" will be the criterion and source of success. The social program of the state, then, should not be directed toward an "unnatural" equalization of condition, which in any case would be impossible because of its "artificiality," but rather the state should provide the lubricant to ease and promote the movement of individuals into the positions to which their intrinsic natures have predisposed them.

FORMS OF BIOLOGICAL DETERMINISM

The concept that social arrangements are a manifestation of the inner or intrinsic natures of human beings, and are therefore unchangeable, has come to be called *biological determinism.* The degree of rigidity of the determinism varies in different versions of the system, from the notion that biological factors virtually completely determine each individual, to the more subtle idea that human biological nature establishes only "tendencies," natural states toward which human beings will gravitate in the normal course of events. Biological determinism has two complementary facets, both of which are necessary to complete this scheme. First, it is asserted that the *differences* in manifest abilities and power between individuals, classes, sexes, races, and nations result in large part from differences in intrinsic biological properties of individuals. Some of us can paint pictures and others can only paint houses (Jensen) (3); some of us can be doctors but others can only be barbers (Herrnstein) (2). But these facts alone, if they were true, would not in themselves necessarily result in a society of unequal power. After all, there is no reason that differences in ability, whether intrinsic or not, need imply differences in status, wealth, and power. We might build a society in which picture painters and house painters, barbers and surgeons, would be given equal material and psychic rewards. This is the argument of Dobzhansky in *Genetic Diversity and Human Equality* (4). If taken seriously, this argument would deprive our unequal society of the legitimacy offered to it by the argument of biological diversity. To complete its function as a legitimation argument for the present state of the world, biological determinism requires a second facet: the belief in *human nature.* In addition to the biological differences between individuals and groups, it is supposed (5) that there are biological "tendencies" shared by all human beings and their societies, tendencies that result in hierarchically organized societies in which individuals

> compete for the limited resources allocated to their role sector. The best and most entrepreneurial of the role-actors usually gain a disproportionate share of the rewards, while the least successful are displaced to other, less desirable positions.

This description, it must be noted, is not regarded as a historically contingent

phenomenon in market societies, but as arising out of the biological nature of the human species. A human society like that envisaged by Dobzhansky, in which genetic differences in ability are not converted into status and wealth differences, would be biologically "unnatural" and therefore either impossible or else could be maintained only under the most rigid totalitarian rule.

The assertion that "human nature" guarantees that the biological differences between individuals and groups will be translated into differences in status, wealth, and power is the other face of biological determinism as a total ideology and represents the consolidation phase of the Bourgeois Revolution. To justify their original ascent to power, the new middle classes had to demand a society in which "intrinsic merit" *could be* rewarded. To maintain their position of power, they claim that intrinsic merit, once free to assert itself, *must be* rewarded. It is all natural and inevitable, so why fight it?

Ideas of human nature appear in a great diversity of social theories and in each one explicitly serve to legitimize political ends. Not even the historicist argument of Marx and Engels (6, 7) was free of an occasional appeal to human nature, in their case to unalienated labor as the essence of human self-realization. Like the claims of the natural inferiority of women, recent arguments about the true nature of man have largely been raised in the realm of the popularization of science. In works by Ardrey (8) and Tiger and Fox (9), for example, it is argued that the human species is naturally territorial, aggressive, male dominant, and so forth, through use of carefully selected observations from ethnography, paleontology, and animal behavior. But this claim has not been restricted to popularizers. Konrad Lorenz, Nobel Prize winner in ethology, has attempted to give human relevance to his observations on lower animals in *On Aggression* (10). He argues that humans lack the built-in controls against intraspecific aggression that characterize other dangerous animals because during most of our evolution we were not predatory carnivores, and therefore some social control of natural human aggression and nastiness must be exercised. More important, the domestication of man has resulted in the loss of natural tendencies to reject from the species "degenerate" types. This rejection must then also be exercised by a social agency. In particular, Lorenz (11) wrote *in 1940 in Germany* during the Nazi extermination campaign:

> The selection for toughness, heroism, social utility . . . must be accomplished by some human institution if mankind, in default of selective factors, is not to be ruined by domestication induced degeneracy. The racial ideal as the basis of the state has already accomplished much in this respect.

It is probably a manifestation of the largely unquestioned role of women in our society that the heavy calibre weapons in the hands of the most prestigious biologists and psychologists were, for a long time, not directed against the equality of the sexes. If Terman, Yerkes, Osborne, Agassiz and others felt as threatened by women as they were by blacks, immigrants, and the working class, they did not manifest it in their major pronouncements. Even now, despite the growing women's movement, the number of academics who are willing to publish and legitimize the sexist attitudes they express in private is small, but a few have, and there is some evidence that even the most prestigious are about to enter the fray. The claims of Tiger and Fox (9) for the

biological superiority of men were a well-known feature of "pop" ethology a few years ago, and a similar vein of vulgarization of science is contained in Goldberg's *The Inevitability of Patriarchy*, which makes the claim (12, p. 78) that:

> Human biology precludes the possibility of a human social system whose authority structure is not dominated by males, and in which male aggression is not manifested in dominance and attainment of position, of status and power.

We are not told how the discoveries of biology "preclude the possibility" of female equality or domination, but it is clear from the work as a whole that the author believes that "tendencies" inherent in males and females lead ineluctably to a "naturally" asymmetric social system. In addition to males' innately greater aggression, Goldberg maintains (12, p. 204):

> The stereotype that sees the male as more logical than the female is unquestionably correct in observation, and probably correct in its assumption that the qualities observed conform to *innate sexual limitations* analogous to those relevant to physical strength.

The two strains of aggressivity and logic are explicitly drawn together by Eleanor Maccoby (13), who suggests:

> There is good reason to believe that boys are innately more aggressive than girls . . . and if this quality is one which underlies the later growth of analytic thinking, then boys have an advantage which girls will find difficult to overcome.

Like Goldberg, Maccoby brings in fallacious notions of innate tendencies and then converts these tendencies into limitations on groups. The entire typology of "*the* male as more logical than *the* female" is an outmoded 19th-century concept of typical individuals standing for entire groups. What proportion of males manifest a greater logical ability than what proportion of females? What are the "innate" differences in population means? Is the "tendency" manifest simply as a small difference in the average of all males as opposed to the average of all females? If so, why does a difference in average "preclude the possibility" or even make it "difficult to overcome" the dominance of women by men. The intellectual bankruptcy of the vague speculation of male intrinsic superiority immediately appears when any attempt at analysis is made.

The reader should not imagine that the inevitability of male domination is a feature only of the writings of popularizers. The most recent declaration (14) of the biologically inevitable domination of women by men has been made by E. O. Wilson, Professor of Zoology at Harvard and generally regarded as the leading authority on the evolution of animal social behavior:

> In hunter-gatherer societies, men hunt and women stay at home. This strong bias persists in most agricultural and industrial societies and, on that ground alone, appears to have a genetic origin. . . . My own guess is that the genetic bias is intense enough to cause a substantial division of labor even in the most free and most egalitarian of future societies. . . . Even with identical education and equal access to all professions, men are likely to continue to play a disproportionate role in political life, business and science.

The theory that the relation of domination of men over women that characterizes our society has a biological cause and is thus inevitable provides a bridge between

theories that differences between groups are genetic and theories that human societies are the result of an innate "human nature."

SOCIOBIOLOGY: THE NEWEST DETERMINISM

The newest wave of human nature determinism has culminated in the publication by E. O. Wilson of *Sociobiology: The New Synthesis* (5), which announces the creation of a new field—sociobiology—and which asserts that such human cultural manifestations as religion, ethics, tribalism, warfare, genocide, cooperation, competition, entrepreneurship, conformity, indoctrinability, and spite (the list is incomplete) are tendencies that are genetically coded in the human genome and established there by natural selection. No evidence at all is presented for a genetic basis of these characteristics, and the arguments for their establishment by natural selection cannot be tested since it postulates hypothetical situations in human prehistory that are uncheckable. For example, homosexuality is asserted to be genetically conditioned (no evidence), it is then asserted that homosexuals leave fewer offspring than heterosexuals (no evidence and a confusion between homosexual *acts* and total homosexuality), but then it is postulated that the "genes" for homosexuality may have been preserved in human prehistory because homosexuals served as helpers to their close relatives (uncheckable story with no ethnographic evidence from present hunters and gatherers to suggest such a phenomenon). The intended use of sociobiology in human social affairs is made crystal clear by its inventor, however. The book begins with the statement (5, p. 4) that

> It may not be too much to say that sociology and the other social sciences, as well as the humanities, are the last branches of biology waiting to be included in the Modern Synthesis. One of the functions of sociobiology, then, is to reformulate the foundations of the social sciences in a way that draws these subjects into the Modern Synthesis.

And it ends with a vision of neurobiologists and sociobiologists as the technocrats of the near future who will provide the necessary knowledge for ethical and political decisions in the planned society (5, p. 574):

> If the decision is taken to mold cultures to fit the requirements of the ecological steady state, some behaviors can be altered experientially without emotional damage or loss in creativity. Others cannot. Uncertainty in the matter means that Skinner's dream of a culture predesigned for happiness will surely have to wait for the new neurobiology. A genetically accurate and hence [*sic*] completely fair code of ethics must also wait.

Sociobiology is a frankly and explicitly political science whose program is to provide, eventually, the scientific tools of "correct" social organization. Yet the world to be made will be pretty much the aggressive, domination-ridden society we live in now. Why is this? Because (5, p. 575):

> . . . we do not know how many of the most valued qualities are linked genetically to more obsolete destructive ones. Cooperativeness toward groupmates might be coupled with aggressivity toward strangers, creativeness with a desire to own and dominate, athletic zeal with a tendency to violent response, and so on. . . . If the

> planned society–the creation of which seems inevitable in the coming century–were to deliberately steer its members past those stresses and conflicts that once gave the destructive phenotypes their Darwinian edge, the other phenotypes might dwindle with them. In this, the ultimate genetic sense, social control would rob man of his humanity.

Of course it is all put in a hypothetical mode, but the message is clear: the only safe thing to do is to leave things as they are, at least at present. Don't rock the boat until the sociobiologists tell you how.

Sociobiology is an attempt to explain all of animal and human behavior as the product of evolution by natural selection. This includes not only the stereotyped individual and group behavior of lower organisms, but *all* aspects of human social and individual activity that are within the normal human gambit.

Darwin's theory of evolution by natural selection, then, rests on three general principles which are unchallenged in their generality: (a) there is variation in morphology, physiology, and behavior among organisms belonging to the same species–the principle of variation; (b) there is a correlation between parents and offspring in phenotype, so that relatives resemble each other more than do unrelated individuals–the principle of heredity; and (c) some phenotypes leave more offspring than others–the principle of natural selection. These three principles are sufficient to guarantee an evolutionary process. Provided there is variation among objects, that there is some temporal stability in this variation by some mechanism of heritability, and that different sorts of objects leave different numbers of descendants in time, there must be evolutionary change in the composition of the population. So, rocks evolve by natural selection since they vary in hardness, split off rocks of equal hardness, and have different rates of erosion and therefore of survival. Automobiles too evolve by natural selection, as do soft drink containers. The system of explanation is so powerful that it can be applied to almost any situation, and herein lies its weakness. A system of explanation that can potentially be used to explain any observation invites caricature and will be used in a crude and vulgar analogical way by ingenious people. This is what happened to the system of Freudian psychology, which was so all encompassing that it has been used to explain all of history, science, and the arts. So too has the Darwinian theory been vulgarized for the purpose of easy explanation of phenomena. The latest episode in this caricature of Darwinian explanation is the collection of theories, speculations, and observations about animal and human behavior that is called by its adherents "sociobiology."

The general form of sociobiological argument is the following. The behavioral phenotype of a species is described. As for any other aspect of the phenotype, this description cannot be exhaustive, but is framed in terms of those elements that seem significant to the observer. It is then to be demonstrated that this phenotype has been established in the species by natural selection. To do so requires, first, an adaptive story to explain the circumstances that would cause individuals of that phenotype to leave more offspring than individuals of other phenotypes, and, second, an argument that phenotypic differences with respect to the trait are or were heritable. Evolution by natural selection requires genetic differences, or else the differential rate of reproduction of phenotypes can have no effect on population composition in

future generations. Each of the three elements of sociobiological theory—description, heritability, and adaptive story—has its own deep methodological problems that have not been faced, or apparently even been considered, by the practitioners of the program.

THE SOCIOBIOLOGICAL ARGUMENT

A Description of Human Nature

The first element in the sociobiological argument is to describe the set of phenotypes under investigation. This is done by making very general and very superficial characterizations of "human nature" by universalizing conventional wisdom. Thus, in Wilson's *Sociobiology* (5) we are told that "men would rather believe than know" and the people are "extraordinarily easy to indoctrinate, indeed they seek it." Xenophobia, domination, entrepreneurship, territoriality, and male dominance are all said to be universals of human behavior and then provided with a biological explanation. The facts of history and of ethnography do not support the universality of these traits, but history is almost completely ignored by sociobiologists and exceptions to these generalizations in the ethnographic record are accounted for by redefinition. For example, it is stated that the exceptions to the "rule" of genocidal warfare are only "temporary aberrations," or that the reason all human societies do not appear to be territorial is that "zoologists have been too narrow in their definition of territoriality." In some cases their claims are directly contradicted by the ethnographic record. For example, present-day "primitive" hunter and gatherer societies do not engage in genocidal warfare, an invention of the modern state, but, on the contrary, engage in a kind of semi-ritual combat in which very few combatants are killed or wounded.

What is immediately striking to the reader of Wilson's *Sociobiology*, or of books by Dawkins (15), Lorenz (10), and others, is the total lack of consideration of the problems of correct description of behavior. While anthropologists have agonized for years over problems of ethnocentrism and, more recently, of sex bias, in the description of human culture, while behaviorist psychologists have concerned themselves with anthropocentrism in studies of rats, and while evolutionary morphologists have questioned the relationship between growth processes and commonly identified units of morphology, sociobiologists seem to have no consciousness of the fundamental problems of the description of behavior. They treat categories like slavery, entrepreneurship, dominance, aggression, tribalism, and territoriality as if they were natural objects of unquestioned status, rather than as historically and ideologically conditioned constructs. Yet any argument about the evolution of entrepreneurship depends critically upon whether it has any existence outside the minds of modern sociologists and historians. There are four forms of error of description committed by sociobiologists, and all require serious study if the field is to become serious science.

Reification. It cannot be assumed that any behavior or institution to which a name can be given necessarily has an existence as a real thing subject to the laws of nature.

Is entrepreneurship a real category for which there are genes and upon which natural selection operates as an entity, or is it an arbitrary construct, historically determined and useful as a way of describing human socioeconomic activity? The same question applies to religion, kinship, altruism, and so on. Any historical view of social thought, as well as any sophisticated comparative ethnography, shows immediately that the categories of description of social institutions are historically contingent. What did "religion" mean to the Greeks (they had no word for it and it did not exist for them as a separate social category), or "revenge" to the Tasaday? Is "violence" real, or is it a social construct without any one-to-one correspondence to an actual physical act (what is "verbal violence" or a "violent exception")? Nothing has a more obfuscating effect on the understanding of society (itself a reification!) than the total confusion between categories of thought and real objects.

Arbitrary Agglomeration. Related to the error of reification is the supposition that the world of phenomena is naturally divided along a given set of suture lines and that this same division applies for all purposes. The problem is serious enough for physical attributes. Is the "hand" an appropriate description for an object that has both genetic and adaptive coherence in evolution? The question is whether it is sensible to talk of the "evolution of the hand" as opposed to, say, the evolution of the fingers, or of the separate parts of the fingers, or of the entire limb. As an example of how the erroneous subdivision of anatomy can give rise to pseudoproblems, let us consider the chin. The chin is the one apparent anatomical exception to the rule that the evolution of the human anatomy has been *neotenic.* That is, the anatomical features of the adult human are much more like those of the fetal ape than the adult ape, so that we may describe human evolution as a trend toward earlier and earlier maturity in embryonic development. But the chin is an exception since it has enlarged during human evolution, while the fetal ape has even less of a chin than its adult form. It turns out, however, that the chin is not in fact an exception because, in an important sense, the chin does not exist. There are two growth fields in the jaw: the *alveolar* containing the teeth and the *mandibular* which is the jaw bone on which the alveolar sits. Both of these show neoteny, in that both are getting smaller in evolution, relative to the rest of the skull, as is the case with the fetal ape. However, the alveolar growth field is regressing faster than the mandibular, so that a protuberance we call the "chin" results. Of course, one might invent a variety of fanciful natural selective stories to explain why the "chin" is getting larger in human evolution, but the truth is rather more prosaic.

What is true of anatomy is even more important for behavior and social organization. Is xenophobia a trait in evolution, as sociobiologists would have us believe? What is the methodological program that will allow us to make a decision? Clearly there are two requirements for an evolutionary trait. There must be genes whose action is nearly entirely concerned with the formation of the trait, so that genetic variation for the trait can occur without important effects on the remainder of the phenotype. Otherwise we cannot isolate the trait for separate evolutionary explanation. Second, the trait must be a unit under natural selection. That is, variation in the described trait must be associated with significant differences in fitness, when the rest

of the organism is averaged out. In statistical terms there must be a *marginal* effect of genes on the trait and a *marginal* effect on natural selection. Otherwise the so-called "trait" is an arbitrary unit of description of the organism with no relation to the direct forces of evolution.

False Metaphor. Many of the descriptions of animal behavior are taken metaphorically from human behavior and laid on animals as natural. Human behavior is then seen as a special case of the more general phenomenon "discovered" in animals. The most famous case, antedating sociobiology but incorporated totally into its theory, is that of caste in insects. Caste is a human phenomenon, originally a race or lineage but later a hereditary social group associated with particular trades and social positions. The application of ideas of caste to insects gives legitimacy to the idea that human castes are simply another case of a more generalized phenomenon. But in what sense are insects divided into "castes"? Class structure is an economic and social phenomenon related to and coming out of human historical events and regulating the social and material power of individuals. Castes in India were the outcome of an invasion and conquest of Dravidians by Aryans. High-caste Hindus had a monopoly in social, political, and economic power while untouchables lived at the margin of existence. What has all this to do with ants? Nor does an ant "queen," a totally captive egg-producing machine, force fed by the "workers," bear any resemblance to Elizabeth I or Catherine the Great, or even to the politically powerless Elizabeth II who is nevertheless a multimillionaire. Like caste, slavery is another human institution which bears no important resemblance to its claimed equivalent in insects. Ants do not know commodities, nor capital investment, nor rates of interest, nor slave revolts, nor the anguish of mothers and fathers torn from their children and spouses on auction blocks. But what is true for obvious cases like caste and slavery applies also to "aggression," "warfare," "cooperation," "kinship," "loyalty," "coyness," and a host of other behaviors and institutions that sociobiologists find in animals.

Conflation. Quite different behaviors and institutions are sometimes included under the same rubric as part of the reductionist program of sociobiology. Thus, "aggression" is a term used to explain both antagonistic encounters between individuals in which one attempts to achieve social or physical domination over the other and political aggression as embodied in war. The purpose of this conflation of two quite different phenomena is to derive war from individual aggression and thus explain war reductively as the outcome of the evolved aggressiveness of individuals. Yet war and individual aggression have little to do with each other. War is a calculated political phenomenon undertaken for economic and political gain by a collectivity, and "hostilities" begin without the least "hostility" between individuals. People kill each other in wars for all sorts of reasons, not the least of which is that they are forced to do so against their own wishes by the political power of the state. Similarly, tribalism, a political phenomenon, is confused with individual relationships within communities of linguistically and geographically proximate people. Yet it is now the concensus of anthropologists that tribalism in its modern political meaning has been the enforced product of contact of primitive people with state-organized societies and has been

created and exploited for political ends. Conflation is an essential element in sociobiological theory because, without it, the reductionist program fails.

Innateness of Characters

In order for a trait to evolve by natural selection, it is necessary that there be genetic variation in the population for such a trait. Thus, although I might argue that the possession of wings in addition to arms and legs might be advantageous to some vertebrates, none has ever evolved a third pair of appendages, presumably because the genetic variation has never been available. Not only is the qualitative possibility of adaptive evolution constrained by available genetic variation, but the relative rates of evolution of different characters are proportional to the amount of genetic variance for each. These considerations make both retrospective and prospective statements about adaptive evolution extremely uncertain unless there is evidence about genetic variation. For example, it is common in adaptive theory to try to explain life-history patterns (life-history strategies, as they have come to be called by adaptationists) by asserting that the particular pattern of reproductive rates and longevity exhibited by a species has evolved because it is optimal. Codfish lay millions of eggs, each of which has virtually no chance to survive, while the eelpout, *Zoarces,* has very few offspring and bears them alive, rather than laying eggs. Why such a contrast between two marine fish? The adaptationist program attempts to give an answer solely in terms of the relative advantage of increasing egg numbers, as opposed to increasing investment in survival of each egg (see reference 16 for a numerical argument of this kind). But such an argument is illegitimate, for it can only be correct if the available genetic variance for fecundity and maternal care are equal. It may simply have been that codfish ancestors had much more genetic variance for fecundity whereas the ancestral line of *Zoarces* had much more genetic variance for developing a broad pouch. Knowledge of the relative amounts of genetic variance for different traits is essential if evolutionary arguments are to be correct rather than simply plausible.

For prospective studies it is possible, at least in principle, to assay additive genetic variance for different characters in present populations of animals. What is required is that individuals of different degrees of relationship be raised under controlled environmental conditions so that genetic and environmental components of variance can be distinguished. It is not necessary to make controlled matings, provided natural relatives of different degrees, especially parent-offspring, full-sib, and half-sib combinations, are available. It is essential, however, that genetic similarity not be correlated with environmental similarity or else genetic and environmental components of variance will be totally confounded. Unfortunately there is no way in human populations to break the correlation between genetic similarity and environmental similarity, except by randomized adoptions. Such adoptions do not exist as large groups and as a result we have no way of estimating genetic variances in human populations except for single-gene traits in which environmental variation is trivial, e.g. blood groups. The consequence of this methodological difficulty is that we know little or nothing about the genetic variance for any human metric trait—even including height, weight, metabolic rate, and skin color—except that there is clearly some heritable component.

For human psychological traits absolutely nothing is known, because adequate random adoption studies do not exist. It is simply not possible to state whether there is any genetic influence at all on an individual's degree of xenophobia, dominance, entrepreneurship, conformity, indoctrinability, fear of incest, homo- or heterosexuality, or any of the other myriad psychosocial traits with which human sociobiology deals. Although a list of such traits is given by Wilson as having moderate heritability, he appears to have depended on secondary sources for his information. Studies of the heritability of psychosocial traits are virtually all parent-offspring or identical twin correlation studies, neither of which gives estimates of genetic variance unconfounded with environmental variances. Indeed, the highest parent-offspring correlations known are for political party and religious affiliation (17). Nor is there any likelihood that methodologically adequate studies will be made in the foreseeable future.

The problem with retrospective studies is that to argue about the evolution of present-day human populations, it would be necessary to get information about genetic variance in the past. Evidence for genetic variance in the present, even if it were available, would be of little help because evolution by natural selection destroys the genetic variance on which it feeds. It is a fundamental theorem of population genetics that as natural selection proceeds, additive genetic variance is used up and eventually disappears. Thus, if present human populations show no genetic variance for, say, entrepreneurship, it can be claimed by sociobiologists that there used to be such variance but it was used up by selection for the trait. On the other hand, if there were some variance at present, sociobiologists could point to it as evidence for the heritability of entrepreneurial activity. There is no conceivable observation about genetic variance at present that could disprove the contention of past evolution of the trait.

What is so distressing about sociobiological theory is not that adequate estimates of genetic variance are lacking, since that is a problem that plagues all of evolutionary reconstruction, but that the problem is either totally ignored or recognized and glossed over. Genes for conformity, xenophobia, and aggressiveness are simply postulated because they are needed by the theory, not because any evidence for them exists. Especially if characteristics are social rather than individual, the postulation of specific genes is inappropriate.

Sociobiologists sometimes say that they do not really envisage specific genes for warfare or tribalism, but only human genotypes that make these social manifestations possible, given appropriate environmental circumstances. But this argument throws out the baby with the bath water. All manifestations of human culture are the result of the activity of living beings and therefore it follows that everything that has ever been done by our species, individually or collectively, must be biologically possible. But that says nothing except that what has actually happened must have been possible. If sociobiology is to accomplish its program, it must do better than that. It must state what human society cannot do and what it must do and why, or at the very least provide probability statements or descriptions of human norms of reaction for psychosocial traits.

The *norm of reaction* is the basic concept of development genetics (18). The phenotype is the unique result of development of a given genotype in a particular

environmental sequence. There is, in general, no one-to-one correspondence between genotype and phenotype, but a function that relates phenotype to the particular combination of genotype and environment. The norm of reaction of a genotype is the enumeration of phenotypes that will arise from various environments. Obviously, the complete norm of reaction of a genotype cannot be specified since that would involve specification of every possible environmental sequence during development. In practice, norms of reaction are determined for specific ranges of particular environmental variables like temperature. There are no generalizations about the shape of norms of reaction and they must be determined experimentally for each genotype and environmental variable. Norms of reaction have not yet been determined even for human anatomical traits, because of the lack of control of human developmental environments. For social traits, the question of what is prohibited by the human genotype becomes a problem of extrapolating social behavior from historical social organizations to unknown future social institutions. Thus, there is no sound scientific basis for statements such as: "Thus, even with identical education and equal access to all professions, men are likely to continue to play a disproportionate role in political life, business and science." (14) Even if domination of women by men were a compositional trait, simply the collection of individual behaviors, it is impossible to say what the manifestation of genotypes relevant to this character—if any—will be in the most egalitarian society.

In summary, both retrospective arguments which attempt to rationalize the current state of a species as adaptive, and prospective arguments which attempt to predict the future evolution or social manifestation of current genotypes, require absolutely that there be information on the kinds of genetic variance available to species and on the norms of reaction of genotypes. The absence of such information, as in humans, makes the adaptive program an exercise in plausible storytelling rather than a science of testable hypotheses.

Adaptive Stories

The easiest part of the adaptive program is the creation of a plausible story explaining why the observed traits of a species are optimal. There are two methods, depending upon the degree of specification of the trait. The first, an experimental one, can be used for extant species where traits and environment are measurable. I will call this method *progressive ad hoc optimization.* A particular aspect of the organisms's life history is isolated as a problem to be solved. By an engineering analysis, the optimal solution is deduced, subject to certain constraints about the nature of the species, and then the species is measured to see whether it has provided the optimal solution. If it has, then a plausible argument is made that the trait examined has in fact arisen as an optimal solution to the posed problem. If, on the other hand, the solution appears not to be optimal, one can try again with a different problem, or what is more usual, a second additional problem is proposed for which the trait must also be optimizing so that the organism is really optimizing both simultaneously. In general, a maximum of a function of N dimensions is not a maximum in each dimension separately. This procedure can be extended until a satisfactory fit is obtained. Often the added

problems are not stated quantitatively but added heuristically to rationalize the lack of optimality under the original criterion. Such a progressive *ad hoc* procedure, especially when only one variable is experimentally determined, is guaranteed success, so nothing is tested.

The second method is a nonexperimental, nonquantitative one I call *imaginative reconstruction.* In this method one simply thinks about a species, past or present, and literally inserts a reason why a certain trait should have been favored by natural selection. All of human sociobiological explanation is of this kind. Some such explanations are no doubt correct, but others are not, and, in the absence of experimental falsifiability, there is no way to tell which is which.

The possibility of plausible imaginative reconstruction has been immensely enhanced by Hamilton's (19) principle of extended fitness. Hamilton realized that natural selection could increase the frequency of a trait even if the possession of the trait was at a selective disadvantage, provided the trait increased the fitness of close relatives because close relatives also may carry the gene. So altruists may give up their own reproduction to enhance the reproduction of, say, sibs, and the result would be an increase in the frequency of the altruistic genotypes, if any. A paradigm example of the application of this principle in sociobiology is Wilson's imaginative reconstruction of the evolution of homosexuality (5). It is first postulated that homosexuality is genetic, although there is no evidence on this point and, of course, the manifestation of homosexuality is strongly dependent on history, culture, and class. Second, it is asserted that homosexuals themselves leave fewer offspring than heterosexuals. While this must be true for persons who are exclusively homosexual, there is no information whatever on the reproductive rate of persons engaging in mixed homosexual and heterosexual behavior. Given the two unsubstantiated assumptions of heritability and lower fitness, there is clearly something to be explained since natural selection should have eliminated homosexuality. The answer given is that homosexuals may have devoted their energies to helping their sibs raise children, since they had no children of their own to feed, and thus by the principle of extended fitness increased the frequency of the genes for homosexuality.

The principle of kin selection does not cover every contingency, however. What are we to make of altruistic acts performed toward unrelated individuals? To handle this problem, Trivers (20) has introduced the concept of reciprocal altruism, according to which individuals will benefit from altruistic acts toward others if the recipient remembers the altruistic act and reciprocates at a future time. Genotypes that lead to such reciprocation will be selected for.

By combining arguments of individual advantage, kin selection, and reciprocal altruism, an imaginative reconstruction can be made for any observed behavior. In this way the underlying assumption, that all traits are adaptive, is always confirmed and can never be falsified.

There is one final aspect of sociobiological theory that insulates it from testability. Population genetics makes *quantitative* predictions about the rates of change of genetic composition with time and also provides actual data on the quantitative genetic differences in gene frequencies in present-day human groups. Both kinds of numbers are too small to fit sociobiological theory. Only 100 generations have passed

since the Roman Republic, and this time span is far too short for there to have been any major change in gene frequencies. Yet human social institutions have undergone an extraordinary change in those few generations. In a mere 30 generations, Islam rose from nothing to become the greatest culture of the Western World and then declined again into powerlessness. How can one compare the social institutions of the modern British with the political, social, and economic institutions of Roman Britain? Moreover, at least 85 percent of known human genetic variation exists, at present, within any local national population and at least 95 percent within any modern major race. How are we to explain, on a genetic basis, the immense cultural differences between present-day populations? The sociobiologists have the answer. It is the "multiplier effect" (5, pp. 11-13, 596-572), which asserts that an arbitrarily small but unspecified degree of genetic difference will be multiplied up into an arbitrarily large but unspecified degree of cultural difference because culture is such a complex trait. No evidence is given for the existence of such an effect, nor are we told how it would be measured, quantified or specified. This completely free and arbitrary multiplier is the next to the last step in building an air-tight edifice completely impervious to test. The final step is to explain why the multiplier effect has not had a similar role to play in lower animals. It is because of the "threshold effect" (9, p. 573), which guarantees that the multiplier effect will only take hold when the behavior becomes sufficiently complex.

Alternatives to Adaptation

An examination of the dynamical theory of natural selection, of the effects of stochastic variation in gene frequencies, and of the facts of development shows that there are a number of evolutionary forces that are clearly nonadaptive and which may be correct explanations for any number of actual evolutionary events.

First, natural selection does not necessarily lead to adaptation. A mutation which doubles the fecundity of individuals will sweep through a population rapidly. If there has been no change in efficiency of resource utilization, the individuals will leave no more offspring than before but simply lay twice as many eggs, the excess dying because of resource limitation. In what sense are the individuals or the population as a whole better adapted than before? Indeed, if a predator on immature stages is led to switch to the species now that immatures are more plentiful, the population size may actually decrease as a consequence, yet natural selection at all times will favor individuals with higher fecundity.

Second, there are multiple selective peaks when more than a single gene is involved in influencing a character. The existence of multiple peaks means that for a fixed regime of natural selection there are alternative paths of evolution and the particular one taken by a population depends upon chance events. Thus, it is not meaningful to ask for an adaptive explanation of the difference between two species that occupy alternative peaks. For example, there is no adaptive explanation required for the existence of the two-horned rhinoceros in India and the one-horned rhinoceros in Africa. We do not have to explain why two horns are better in the East and one in the West. Rather, they are alternative outcomes of the same general selective process.

Third, the finiteness of real populations results in random changes in gene frequency so that, with a certain probability, genetic combinations with lower reproductive fitness will be fixed in a population. If fitness differences between genotypes are small, there is a very high probability of the loss of favorable genes. This is especially true during times of restriction of population size, which is precisely when environment is likely to be changing and selective pressures for new genotypes most likely to appear. Even in an infinite population, because of Mendelian segregation, a new favorable mutation has a probability of only $2s$ of being incorporated into a population, where s is the selective advantage. Thus, natural selection often fails to establish more fit genotypes.

Fourth, many changes in characters are the result of pleiotropic gene action, rather than the direct result of selection on the character itself. The yellow color of the Malphigian tubules of an insect cannot itself be the subject of natural selection since that color can never be seen by any organism. Rather, it is the pleiotropic consequence of red eye pigment metabolism, which may be adaptive. A special but important case of pleiotropy is the allometric growth of different body parts. In cervine deer, antler size increases more than proportionately to body size (21) so that larger deer have more than proportionately large antlers. It is then unnecessary to give a specifically adaptive reason for the extremely large antlers of large deer. All that is required is that the allometric relation not be specifically maladaptive at the extremes.

Fifth, there is an important random or noise component in development and physiology. The phenotype is not given by the environment and genotype alone, but is also subject to random noise processes at the cellular and molecular levels. In some cases, as for example bristle formation in *Drosophila,* variance from developmental noise may be as great as genetic and environmental variance (22). All individual variation, especially in human social behavior, is not to be explained deterministically and cannot be taken as demanding specifically adaptive stories.

It is undoubtedly true that kin selection has operated in some instances to establish some traits of organisms. It is undoubtedly true that human behavior, like human anatomy, is not impervious to natural selection and that some aspects of human social existence owe their historical manifestations to limitations and initial conditions placed upon them by our evolutionary history. The problem is to create a methodology that will allow a constructive investigation of these questions. Sociobiology is not such a methodology because its chief ambition is total explanatory power over all human social phenomena. It makes itself only into a vulgar caricature of Darwinian explanation in the process of realizing its ambition. Finally, sociobiological theory rests on an erroneous confusion between materialism and reductionism. It is sure that we are material beings and that our social institutions are the products of our material beings, just as thought is the product of a material process. But the content and meaning of human social organization cannot be understood by a total knowledge of biology any more than by a total knowledge of quantum theory. War is not the sum total of individual aggressive feelings, and a society cannot be described if we know the DNA sequence of every individual in it. The naive reductionist program of sociobiology has long been understood to be a fundamental philosophical error. Meaning cannot be found in the movement of molecules.

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