In American Psychologist (vol.35, 1980, 970–974) as: “Viability and the concept of selection.” 060

Adaptation and Viability*

At the end of the introductory chapter to his *Sociobiology,* Wilson (1975, p. 6) says that the cannibalization of comparative psychology “seems to be indicated both by the extrapolation of current events and by considerations of the logical relationship behavioral biology holds with the remainder of science.” My colleagues on this panel are more competent than I to examine extrapolations from current events. I shall focus on certain *logical relationships* that seem to be relevant to Wilson’s claim.

Most, if not all, of the heated debates about sociobiology have concerned the question of how much of the behavior of living organisms is susceptible to evolutionary explanation. The question of whether or not evolutionary explanations are, in fact, logically of the same type as explanations in, say, mechanics or physics has hardly been touched upon.[1] I shall argue that they are not of the same type, that they are based on a different conceptual framework, and that the relationship between sociobiology and the “remainder of science” is, therefore, a peculiar one.

“Sociobiology,” says Wilson (1975, p. 4), “is defined as the systematic study of the biological basis of all social behavior.” In the study of behavior, as Wilson sees it, explanations must be formulated in terms of evolutionary biology—that is, “the *Modern Synthesis* … in which each phenomenon is weighed for its adaptive significance and then related to the basic principles of population genetics” (p. 4). Within the theory of evolution, adaptation is the outcome of natural selection, and “natural selection is the process whereby certain genes gain representation in the following generations superior to that of other genes located at the same chromosome positions” (p. 3).

The term natural selection has been around for so long that, as a rule, we take its meaning for granted and are quite ready to accept it as one of the established explanatory principles of science. Sometimes we may become aware of the fact that, conceptually, it had a bad start. Colin Pittendrigh (1958, p. 397) spoke of “the unhappy accident that Darwin himself used the terms *struggle for existence* and *survival of the fittest* as convenient clichés for the process of natural selection which he himself nevertheless saw—at least at times—more clearly as differential reproduction.” The difficulties with the expression “survival of the fittest” are fairly obvious. If we don’t want to define fittest on some idiosyncratic scale—as chauvinists and racists are wont to do—we must define it in one of two ways: either in terms of the capacity to survive, in which case the expression becomes vacuous, or in terms of *inclusive fitness,* in which case the word “survival” becomes metaphorical, because genes, whatever miracles they may be purported to achieve, cannot be said to have a life of their own which they might preserve, risk, or lose; they *live* only insofar as they are part of the organization of a living organism. The metaphors of competition, with their inevitable implication of the goal of winning, however, are only one of the conceptual traps.

A rather more serious trap is the misconception of selection as an ordinary *causative* process. David Chiszar (in this symposium) has drawn attention to the difference among investigations searching for explanations in terms of one or another of the four Aristotelian causes. When we speak of natural selection, it is crucial to remain aware of the fact that we are referring to a conceptual situation that does not involve efficient causation in the same way as do the explanatory concepts of other sciences.[2]

An "efficient" cause is an item to which we attribute the power to create a change, and the resulting change is then considered its effect. The agent in natural selection is the environment, or Nature, if you will—conspecifics and everything except the organism itself—and the change it creates is on the negative side alone: It eliminates. Insofar as it selects, Nature neither fosters nor encourages, it merely kills off. What does it kill? It kills those organisms that do not manage to overcome the difficulties, the obstacles, the pitfalls that it presents to them. Hence it is thoroughly misleading to speak of selection *for*—selection is always *against*. In other words, Nature places constraints in the path of survival and reproduction. That, however, still does not fully explain selection. If all organisms were exactly the same, there could be no selection and no differential reproduction. Facing an obstacle, they would either all perish or all survive. But there is variability, and organisms are never all the same. This is due partly to mutations and partly to the imperfection of their procedures for reproduction and replication.[3] The variations that constitute the stock within which selection can operate are wholly accidental. There must be no suggestion of *evolutionary design* or of *environmental pressure toward survival mechanisms,* for the moment we allow any such idea of directed change, the theory of evolution collapses into a teleological myth. On the other hand, if all variation is accidental, and if selection operates on *what is there,* by setting up constraints that eliminate some variants while others pass, it should be clear that the word "adaptation" cannot refer to any activity on the part of the surviving organisms. In order to survive a particular situation or change in the environment, an organism must have the required characteristics *before* the situation or change in the environment occurs that makes these characteristics necessary. In other words, surviving organisms are adapted before the event and it would make no sense whatever to say that they did or could change *because* of the event. There simply is no causal connection between the selecting event or environmental pressure and the properties the surviving organisms have acquired at a prior time through mutation or some other accident.

If, nevertheless, we want to consider an organism's survival as the effect of something, we have to look at the organism itself and find the cause in those of its properties that distinguish it from organisms that did not survive. But precisely because we are then coming up with properties that necessarily belong to all of the surviving organisms of that species, we can at best speak of a "material" cause, not of an efficient one. But even that would in no way justify talk of an adaptive activity on the part of the organisms. Such properties as constitute the material cause of their survival are still the result of accidental variation and not of anything the environment has done. In short, organisms are what they are because of the history of genetic variations in their ancestors and because these antecedent variations provided them with the capacity to survive in the particular environments through which they have come in time. To stay within the Darwinian framework, it would be a good deal less misleading to speak of surviving organisms as organisms that have so far remained viable, rather than of their adaptation; that second term, in spite of all caveats, continues to imply a totally non-Darwinian endeavor on the part of organisms (Sahlins, 1976; von Glasersfeld, 1975/1979).

The situation is quite different in ontogeny, where we can, indeed, speak meaningfully of an individual organism's adaptation to environmental circumstances. The changes an organism shows in its behavior can to a large extent be conceived of as learning, and learning can always be considered as selection from a variety of possibilities. There is the variation or generation of a stock of different behaviors, and there is the operational triad of trial, error, and the inductive retention of successful solutions. Unlike what happens on the evolutionary scale, selection in ontogeny does not, as a rule, eliminate organisms but only an organism's unsuccessful attempts or responses. Hence one may also introduce the concept of reinforcement which, in phylogeny, would remain vacuous, since the only thing that could count as *reinforcement* on that level (i.e., survival) is not contingent upon the organism's modification of its behavior but upon its past and therefore immutable history of genetic variation.

On the other hand, the result of ontogenetic adaptation is again *viability*. What an organism learns is retained for the very reason that it leads to satisfactory results. That is what Thorndike's law of effect tells us, and it is also what the principle of inductive inference expresses in its simplest form: If something has been found to work, it is likely to work again.[4]

The fact that both phylogenetic evolution and ontogenetic learning lead to *adaptive* or, as I now prefer to say, *viable* behaviors but do so by different means, will inevitably raise questions as to the origin of organisms' particular behaviors. Some sociobiologists are quite ready to concede that "there is much in human affairs that sociobiology can shed very little light on: it cannot, and probably never will, explain the French Revolution, the music of Bartok, or the meaning of Yom Kippur" (van den Berghe & Barash, 1977, p. 821). Not so Wilson. In his most recent book (Wilson, 1978) he says: "If the brain evolved by natural selection, even the capacities to select particular esthetic judgments and religious beliefs must have arisen by the same mechanistic process" (p. 2).

The idea that everything that a complex piece of machinery such as the brain does or could do must necessarily be subject to the contingencies and constraints under which the machinery itself originated is a widespread fallacy. Although I certainly do not believe that computers are like brains, computers are a useful metaphor in the context of genetic determination. When a computer comes from the manufacturer it has wired-in as hardware a small number of very basic operations. If one looks closely, there are only three operations; to record, to read, and to compare items of a certain form. At that point that is all the computer can do, and one may consider these three operations its genetically determined operational repertoire.[5] Now comes the programmer, who designs *software* in the form of compilers and programs, all of which are, in fact, nothing but intricate variations of combinations of the basic operations—and suddenly the computer can handle numbers, from plain arithmetic to the most abstruse forms of Calculus; it can monitor bank accounts and inventories; it can control the start and splash-down of spaceships; and it can even play all sorts of games. It is difficult to see why and how anyone should want to maintain that these accomplishments, as well as all those that a future programmer might implement, are *hardware-determined* or must be considered the result of the same selective processes that led to the computer's manufacture.

There is a wealth of recent work in psychology that illustrates the very same phenomenon: the novel and wholly heterodox exploitation of basic, genetically determined behavioral elements in activities and skills for which no prior natural selection is conceivable. The remarkable success chimpanzees have scored in the various linguistic communication experiments is a case in point. There is no doubt that, in order to do what they are doing now, Washoe, Sarah, Lana, Lucy, and all the other linguistic chimps had to have some phylogenetically established potentialities. There had to be certain capabilities of memory, pattern recognition, cross-modal association and, above all, certain basic inductive processes. The experiments would, presumably, have had much less success with earthworms or lobsters. On the other hand, there is nothing whatsoever to warrant the assumption that any of the combinations of these phylogenetically evolved elements were genetically predisposed in the various ways in which they are now manifest in the chimpanzees' use of American Sign Language, Yerkish, or the Premack system. In other words, the basic operational elements were there, but their coordination into complex operational systems cannot be ascribed to natural selection, since it is demonstrably the result of learning in a very peculiar and highly sophisticated environment.

Finally, when we come to the genesis of culture, we have to take into account a phenomenon that is radically different from anything that occurs in biological evolution: the rapid propagation, within a population of organisms, of novel behaviors that, at the time of their spread, have nothing whatever to do with the organisms' survival or their genetic fitness in terms of the perpetuation of their genes. We have, today, enough observational material to say that there are indeed behaviors that spread in a population without the help of genetic processes or natural selection. They spread for reasons that many of us may be reluctant to specify. Let me cite one example that is particularly well-documented and well-known: the Japanese macaque Imo on Koshima Islet that started washing her sweet potatoes (Kawai, 1965). Within 10 years the entire population, with the exception of a few old males who were too conservative, practiced potato washing. There was no time for a mutation or some other genetic accident to increase or decrease anyone's viability. Nor, indeed, is there any evidence that potato washing has increased anyone's genetic fitness. But as the new activity quickly created exceptional familiarity with water, it led to yet another novel behavior: swimming. Since all this has taken place in a country where earthquakes and tectonic disasters are not at all impossible, it might be tempting to conjecture that if Koshima Islet should one day sink into the sea, the swimming skill might yet become the crucial feature that allows these macaques to reach a safe shore while the macaques in other sinking regions perish. Subsequent generations of sociobiologists could then use the swimming macaques as a textbook example for “evolutionary explanation.”

But such a scenario in which swimming might become an important asset toward the survival of macaques or macaque genes has not yet happened. Yet the washing of food and swimming have become part of the behavioral repertoire of a macaque population *without* the benefit of an evolutionary explanation. Who is to say how many quite generally exhibited behaviors in the repertoire of more or less sophisticated organisms have arisen in the same spontaneous, selection-independent way? The proposal of radical sociobiologists to reduce the origin of *all* behaviors to the “mechanistic” process of natural selection seems doomed from the start. The reason, I believe, is again the misconception of selection as a mechanistic, i.e., efficient cause.

From an evolutionary point of view, it would be far more consistent to say that, like mutations, novel behaviors may arise for no biological reason at all and may be perpetuated from generation to generation, provided they do not *diminish* the organisms’ biological viability below a critical point. This, of course, immediately raises the question as to why such behaviors arise.

In the case of the Japanese monkeys, Kawai (1965, p. 27) himself provides the hypothesis that seems the most plausible one: There was a change in the monkeys’ attitude and in their value system. Until recently, behavioral psychologists and primatologists were very anxious to avoid (at least in their publications) concepts such as attitude and value. Yet, as Bill Mason puts it (in this symposium), “Objects are rarely neutral to animals.” In other words, there is good reason to assume that organisms of a certain complexity perceive qualitative differences and come to form preferences such as, for instance, a preference for sweet potatoes without, rather than with, sand. Although the basic elements for the constitution of such attitudes and value systems may well be susceptible to evolutionary explanation, their particular surface manifestation can be free of selectional constraints and may even run counter to any principle of fitness, genetic or otherwise. There is, then, in that area alone, a whole world of observations and experiments to be carried out and interpreted, a world in which comparative psychologists can study incipient culture and animal cognition without the least fear of being superseded by sociobiology.

Notes

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1 It has at times been suggested that evolutionary explanations are tautological from the point of view of classical logic. R.H. Peters (1976) provides a summary of that view.

2 Gregory Bateson (1967) was, as far as I know, the first to draw attention to that peculiarity.

3 Francois Jacob (1977) has given an impressive example of the imperfection of the processes of replication involved in meiosis: “In various human populations, 50 percent of all conceptions are estimated to result in spontaneous abortion … Many of these abortions appear to be due to an odd number of chromosomes” (p. 1165).

4 The concept of *viability is* a promising tool also in the philosophy of science. The idea that scientific theories and knowledge in general should be considered viable or unviable rather than true or *false* (von Glasersfeld, Note 3) seems to be compatible with recent developments in epistemology (e.g., Feyerabend, 1975; Kuhn, 1970).

5 The introduction of "chips" that may contain all sorts of wired-in operations has changed this (E.v.G., 1998)

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