CHAPTER 1

THEORIES AS THE UNIT OF ANALYSIS

1.1 On Assessing an Emerging Science

The Sociobiology Controversy

Sociobiology, rooted in Darwin's (1872) legacy, is the branch of evolutionary biology that studies social behavior in all social species. Applying evolutionary theory to the human species has always provoked heated controversy, and contemporary sociobiology has amply fulfilled this historical role. In the 1970s a fresh wave of publicity, excitement, and shock followed E. O. Wilson's (1975) encyclopedic systematization of work on nonhuman species. Impressed by the success of past work, he conjectured that evolutionary explanations could transform our understanding of human behavior, and early enthusiasts tried prematurely to explain almost everything about the human condition. When initial speculations were reported to the public as a set of assumed-to-be-true explanations that tell us what human nature really is, thereby establishing biological limits to social change, the debate became rancorous. In the late 1970s and 1980s, people struggled to come to grips with the idea of a biology of human society that strives to be a science whose validity is independent of its social context and yet which influences and is influenced by the society of its practitioners.

Advocates glorified the field and critics condemned it. Feeling that sociobiology hurts people, critics fought it in order to protect society from bad science and bad ideology. Feeling that sociobiology had been unfairly put on trial, advocates defended it in order to

protect science from misguided political criticism. Each side claimed to be misinterpreted by the other side and regarded the other's case as exaggerated. Dispute became polemical and accusatory. "The sociobiology debate" became well known among evolutionists, social scientists, and the academic community (Caplan 1978; Leeds and Dusek 1981–82; Kitcher 1985). Polarization led to a stalemate between advocates and critics on the basic issues of sociobiology's validity and significance.

Animal and human reproductive behavior is here chosen to bear the burden of our examination. The reason for focusing on a single phenomenon is that it facilitates detailed comparison of various theories of scientific validity. Reproductive behavior is chosen because it is an important property of societies, i.e., groups of individuals of the same species organized in a cooperative manner. It is also chosen because it is a crucial test case: if anything specific about human sociality can be explained by the theory, it can. Recall the bare outlines of the underlying theory.

Typically, social behaviors are explained as reflecting a history of evolution by selection. All life on earth is connected by an ancient chain of reproduction. As a result, organismic behavior is designed to result in reproductive success. Throughout the animal kingdom, females tend to be more selective and discriminating than males in their mating choice (Darwin 1871). Why? The theory of sexual selection posits that males and females maximize their fitness differently (fitness is the probability of reproductive success, often calculated using a strategic design analysis). Males and females in ancestral populations encountered different reproductive opportunities and constraints. Hence, their different behaviors can be explained as reflecting the outcome of different fitness strategies and historical patterns.

Darwin conceived of natural selection as imposed by environmental demands and of sexual selection as imposed by the demands of species members. However, both operate through the mechanism of differential reproductive success. In the background are statistics about who lives, who reproduces, and who dies. Organisms vary. Some leave more offspring than others. Therefore the traits inherited from the parents more successful at surviving and reproducing increase in frequency in the next generation. The mechanism Darwin had in mind introduces fitness-related biases into these statistics. There is normally much variation in morphology, physiology, and behavior within each species. Such variations often yield different aptitudes for reproductive success (fitnesses). These variations

are often inherited. In ideal conditions, the type of organism with the most fit variations will increase in the population from one generation to the next. In brief, heritable variation in fitness results in evolution by natural selection. Selection acting on variation within a population in each generation results in change in the population from one generation to the next. The evolutionary record of adaptations to local environments and to other organisms is explained as the cumulative result of selection.

Sociobiology's *raison d'etre* is to help complete an evolutionary picture of life. By definition, evolutionary theory would be incomplete if it could not explain phenomena that it should explain. At issue is whether it should be expected to explain various specific facts about animal and human behavior in the same breath, and if so, how to do so rigorously. Can it be complete without explaining the origin of the double standard between the sexes? As an example of how sexual selection theory can be provocative and incite scientific, political and moral debate, take Barash's (1979, 53) "insight":

> Compare these two situations: (1) you are a male animal, paired with a single female, and your "wife" goes around copulating with other males; (2) you are a female animal, paired with a single male, and your "husband" goes around copulating with other females. In which case is your fitness likely to be lower? In the first situation, if you (as male) remain faithful to your "swinging" spouse, she will eventually conceive offspring via other males, and you will have lost out in the evolutionary sweepstakes. However, in the second case, if you (as female) remain faithful to your mate, you can still breed successfully despite his philandering, provided he includes you among his girlfriends. This is the basic biology of the double standard: males are expected to be sexually less discriminating, more aggressive and more available than females. They are also expected to be more intolerant of infidelity of their wives than wives will be of the infidelity by their husbands.

On first impression, the message of this somewhat jaunty version seems to be that men are by nature promiscuous while women are naturally prone to be faithful. So we debate whether the explanation is scientific fact or sexist drivel. Such matters can be decided only if the explanation's meaning is clear. Organisms enhance their fitness equally by copulating successively with the same or different members of the other sex, if offspring number and quality are the same. Promiscuity and faithfulness are selectively equivalent in that sense. So the explanation is compatible with both men and

women being promiscuous, both being faithful! Despite the male-oriented presentation, promiscuity is just as advantageous as faithfulness for women in the above scenario. And when the promiscuous woman reproduces, her husband may not.

What is explained is not a certain number of sexual partners in either sex, but a relative difference, whatever degree of "faithfulness" or "promiscuity" a species exhibits. The evolutionary import of the fact that women, not men, bear children is this: men and women have evolved differently because a woman can transmit her genes to the next generation only through her own body, whereas a man can transmit his genes through the bodies of multiple women. "The more mates, the more potential offspring" holds for men, not women. The sex investing more potential reproductive output in an offspring should be more careful in choosing mates. The bearing of offspring by women makes their investment heavier. Women put a far greater amount of reproductive potential at risk with every copulation or fertilization than men. These conditions set up an asymmetry in mate-choice strategies. Other things being equal, selection favors greater mate quantity in men. They may not be equal, e.g., if the current mate is suboptimal, females may benefit from multiple mates. The story is complex and depends on the current forms of selection theory.

It is easy to see why loosely phrased statements of sociobiological explanations fire emotional responses stronger than the normally tepid strictures of scholarly disagreement. The following claims and charges are distillations of actual assertions from a variety of sources cited in the bibliography. They capture the point and counterpoint driving the debate.

Advocates claim that sociobiology: "offers an intellectual revolution" which "unites the biological and social sciences," "lays the foundation for social theory," "offers a scientific basis for social policy," "explains culture and history," "shows that social institutions grow out of individual interactions," "provides the key to human nature," "identifies the ultimate reasons for why we do what we do," "undermines the received dichotomies between nature/nurture, genetic/learned, and biological/cultural," "can be rejected only at the price of rejecting evolution," and "is the first genuine application of scientific method to human behavior"!

Bold promises invite scepticism. Critics typically retort sociobiology is simply "bad science with politically dangerous implications." They claim that sociobiology: "has contributed nothing of value," "attacks the social sciences," "offers a scientific excuse for dangerous social policy," "pretends that what is cultural and histor-

ical is really biological and natural," "disregards the autonomy of social institutions from biological predispositions," "uses a human nature ideology to justify status quo inequalities between races, sexes, and classes as natural, genetic and inevitable," "projects human attributes onto animals and reads them back onto humans as pseudo-explanations," "assimilates nurture to nature, learning to genes, culture to biology and so forth through a one-sided perspective," "replaces the role of God in producing perfect adaptation in nature with natural selection," "extends evolutionary theory where it has no business being," and "collapses into a caricature of science"!

Each side finds the assessment given by the other side unjustified and irrational. We need to make sense of the fact that an array of intelligent, informed thinkers can arrive at starkly opposed conclusions. Is the sociobiology of sex a science?

Among advocates, the commitments of sociobiology are straightforward. They are: to bring the standards of rational validity associated with the sciences to bear upon the extension of well-established biological knowledge to animal (that is, nonhuman) sociobiology and human sociobiology. By calling some work "scientific," we normally think of it as valid, established science. Evolutionary biology has long been an established science, and animal sociobiology is now an established science, whereas human sociobiology is not. Some work in human sociobiology is now far more rigorous than the early sensationalized edicts about human nature. By focusing on the presentation of human sociobiology to the public, the critics neglect the rigorous work in the scholarly journals (such as *Ethology and Sociobiology*, *Behavioral and Brain Sciences*, *Human Evolution*, *Journal of Social and Biological Structures*, and *Behavioral Ecology and Sociobiology*).

The critics think that this is only part of the story. They charge that the very content of the explanations which allegedly result from "the scientific method" is molded by intellectually unworthy ideologies. These include: biological determinism (all human events are biologically, genetically determined through evolution); naive reductionism (social science is reduced to biology just because humans are evolved organisms); vulgar adaptationism (all behaviors are assumed to be optimally adaptive); neo-Social Darwinism (e.g., the double standard between the sexes is inevitable and hence justified because it is an evolved genetic adaptation); and panbiologism (biology is the single privileged key to human nature). Indeed, the allegedly "scientific aims and results" are merely rationalizations of these "isms."

The pendulum had swung from too easy acceptance in the mid-1970s to overly harsh rejection in the mid-1980s. Whereas some had accepted sociobiology on Wilson's authority, others came to reject it due to criticisms of Wilson's work. Sociobiology does not stand or fall with Wilson's scientific approaches or his claims about its import. In practice it takes a variety of forms, many quite different from Wilson's work and unanticipated by past criticisms. Still, it is important to be clear about what Wilson was getting at in his attempt to complete the Darwinian revolution through a new sociobiological synthesis.

The discussion evolved in the 1980s to the point of fruitfully reassessing evolutionary explanation in general. Some advocates have retracted their most ambitious, extreme claims on behalf of sociobiology (e.g., Wilson, Trivers, Barash). Some critics find hope for better work in the future (e.g., Maynard Smith, Kitcher) or are satisfied that their concerns have been generally appreciated (e.g., Gould, Lewontin). A new body of serious, improved explanatory work in human sociobiology is being produced and will be reviewed throughout the book (e.g., Betzig, Borgerhoff Mulder, Turke, Buss and Barnes, Lancaster, Hrdy, Daly, Hawkes and Hill). In the effort to meet well-taken criticisms, Wilson embarked on a new program, one in which the significance of mind and culture for population genetics and population ecology are directly addressed. As of 1990, there were a wide variety of research programs for producing a unified evolutionary account of cultural change and genetic change. Many invoke a complex psychology in order to meet well-taken criticisms showing that traditional evolutionary explanations could not fulfill their task. For example, Barkow (1989c) shows how mind, self-consciousness, culture, and human choice intervene in the explanation of social patterns from genetic evolution. The research programs of Alexander, Boyd and Richerson, Tooby and Cosmides, and others will be identified and discussed where pertinent throughout the book.

The cooling down of the debate is due more to fatigue, to tolerance, and to a desire to get on with one's work than to a resolution of the issues or even to a better grasp of how to argue them. Sociobiology's ambitious aim to bring human sociality under the explanatory tenets of evolutionary theory was bound to bring ideological and political concerns to the fore. This accounts for the heat, but the stalemate also stems from lack of agreement about the routine topics of philosophy of science: e.g., the role of theories, tests for accepting hypotheses, the structure of explanation, and the aim and scope of the science (see Brody 1970; Kourany 1987).

This book has no interest in spreading news of a "sociobiological breakthrough" or in puncturing "sociobiology's scientific pretensions". Nor shall it try in vain to turn critics into advocates or advocates into critics. To participate in that debate would be to continue to obscure an even more fascinating role for sociobiology. The sociobiology controversy provides a splendid opportunity to reflect on the adequacy of the methods by which we reach our evaluative conclusions about emerging sciences, whatever those conclusions may be. If at times the attention paid here to the foibles of advocates and critics seems excessive, the motive is to make full use of a striking test case for philosophies of scientific method and to transform the debate by changing the very terms and assumptions which have guided it.

Let us put to advocates and critics alike the question, "What is required for sociobiological explanations to count as acceptable scientific explanations?" A question central to the debate over the scientific status of sociobiology, it calls for an evaluation-centered approach to the philosophical study of science. This book is evaluation-centered and will present a model of the criteria, the analytical tools, intellectual structures, and goals which bear upon an answer to our question. A moderately complex model is needed if questions aren't to be forever begged, and our model will differentiate the roles of theories, research programs and conceptual frameworks, and will use these to refine the evaluations.

Evaluating Explanations: The Three-Unit Model

The preceding perspective alerts us to the need to utilize a relatively rich conception of evaluation in order to assess projects such as human sociobiology. It inspires us to replace the impoverished image of science most people employ in reasoning about science with one that does justice to the richness of its characteristic structures and procedures of decision making. What makes our image impoverished is that it is blind not only to the subtle interplay between science and ideology, but also to the deep structure of explanatory inquiry, the aims of science and the way they bear on emerging sciences, and the full array of criteria which enter into the determination of what counts as an acceptable scientific explanation.

As a step in the right direction, we here propose what may be called the "three-unit model" for analyzing and evaluating science. Everyone admits that there is more to science than observation. How much more? The traditional answer is "theory"; call that the "one-unit model." The recent answer is "theory, and in addition, research programs"; call that the "two-unit model." The proposal here is "theory, research programs, and conceptual frameworks." We are ready to state the bare bones of this three-unit model, realizing that it will be elaborated by application to sociobiology throughout the book.

The three-unit model has two main components: a view of the scientific enterprise and a view of how explanations should be evaluated.

The model postulates that the scientific enterprise involves three kinds of activities: (a) the use of logic and facts to verify or falsify a hypothesis; more precisely, setting up plausible explanatory and predictive hypotheses based on one or more theories and then checking them against observed facts to see whether the hypotheses are confirmed or disconfirmed; this aspect of science has been thoroughly investigated by traditional logical empiricist philosophies of scientific knowledge (Carnap, Hempel, Quine, etc.); (b) the continual revision and changing of hypotheses; more precisely, continually proposing, revising, or discarding plausible explanatory and predictive hypotheses and theories as motivated by evidential and nonevidential considerations under the guidance of one or more research programs; this aspect of science has been thoroughly investigated by recent philosophies of scientific change (Lakatos, Kuhn, Laudan, etc.); (c) the determination of the research value of hypotheses within the current research situation; more precisely, the determination of the aim-oriented conceptual roles of explanatory and predictive hypotheses in terms of their underlying conception of the explanatory problem addressed, the phenomena to be explained, and the factors doing the explaining; this aspect, involving a conceptual framework irreducible to the basic concepts of a theory, is here identified as something worthy of investigation by philosophies of research structure.

In the sociobiology controversy, what is at issue is not evolutionary theory in general, but the way it is extended to explain animal and human sociality. This kind of research situation occurs often in science; an established underlying theory is extended to new domains. So instead of talking about validating theories, it is more appropriate to talk about validating explanations and analyz-

ing the criteria of their validity in terms of their basis in theories, programs, and frameworks. The model postulates that explanations in cases of this kind should be evaluated in the following manner: (d) the unit of achievement and the object of validation is the particular explanation or explanatory hypothesis; (e) the commitments arising from accepting an explanation are induced by the explanation's role in the quest for completeness, which contours one's commitment to an affiliated theory, an affiliated research program, and an affiliated conceptual framework; and (f) the scientific status of these explanations is properly assessed by evaluating particular explanations in terms of these three units, as described in (a), (b), and (c).

Completeness is a basic property of theories, a relation between a theory and its domain. The degree of completeness is the extent to which the theory covers its domain. By definition, an established theory would be explanatorily complete if it explained everything in its domain in need of explanation. If evolutionary theory were complete, it would explain each behavioral fact that is evolutionarily significant and so in need of evolutionary explanation. Before the advent of sociobiology, evolutionary theory was incomplete in practice but complete in principle: the evolution of social behavior in animals and humans could not yet be explained by the theory of the forces that govern evolutionary change.

On the present view, the current image of science that recognizes only observation, theory, and research programs, and not conceptual frameworks as distinct from them, is impoverished. To see why, we have to argue that scientific practice is richer than the customary image of science admits. It will be argued, in part 1, that the issues over sociobiological observations, theories, and research programs turn on matters involving conceptual frameworks, by showing that completeness is the fulcrum upon which evaluations in terms of observation, theory, and programs turn. Then it will be argued, in part 2, that these matters are connected to matters that directly concern conceptual frameworks built around the concept of completeness. Chapter 6 puts the cumulative results of all previous chapters together so as to show how the evaluation of sociobiology is appropriately conceptualized according to an integrated employment of all these units of analysis.

The model postulates that a justifiable evaluation of explanations in an emerging science must take into account not only the surface structure of an explanation (the way it answers a why question), but also the deep structure of explanatory inquiry (the context of assertions and ideas in which it is embedded). Our review of the

sociobiology debate has already given credibility to the model's assertion that the deep structure includes three kinds of elements: theory (evolutionary theory in general, mate selection theory), research program (gene-culture theories and related aims and methods), and conceptual framework (conceptualization of what aspects of social behavior are or are not evolutionarily significant).

We are now ready to exhibit the way the three-unit model will be developed. We will connect the structures of explanatory inquiry with issues in evaluating sociobiological explanations in the designated chapters. An explanation's theoretical structure embodies the way it attempts to help show that social facts are neither independent of nor incompatible with the theory (chap. 1). An explanation's programmatic structure embodies the way its guiding assumptions embody choices about how to make biological fitness, natural selection, genes, and so forth relevant to and consistent with sociality in nonhuman and human organisms (chap. 2). An explanation's conceptual structure embodies the way the quest for completeness orients decisions about the way it connects evolutionary theory with social facts: choice of the explanatory problem it addresses (chap. 3), choice of the facts it explains (chap. 4), choice of the factors it employs to explain (chap. 5), and choice of the specific explanatory task of acting as the target for evaluating its performance (chap. 6).

We will develop a working concept of the differences between theories, research programs, and conceptual frameworks sufficient to handle issues in sociobiology, revealing the ways in which reference to them arbitrates issues it raises. That is, instead of providing a logical analysis of these units of thought in the traditional sense of analytic philosophy, we will provide a concrete identification of their differences as revealed in and by scientific practice. To get on with the project of identifying conceptual frameworks, it will be assumed that we know the sort of thing we are talking about when we talk about theories, lest we become bogged down in the usual debates over theory structure. Gene-culture theories act as presuppositions guiding explanatory work on particular explanations, as theoretical cores of research programs. The interacting components of research programs are intertwined theory, methods, and aims that guide selection, evaluation, and revision of explanations. A conceptual framework of commitments regulates the direction of a sequence of research programs and theories as it provides a system of intellectual controls over the conceptualization of explanations.

Chapters 1 and 2 go to show that standard views of science emphasizing theories or research programs require connection to the

quest for completeness in order to apply appropriately to sociobiology. Traditional logical empiricist views that analyze science in terms of theories alone are illustrated by applying the views of Hempel on explanation (chap. 1), Popper on disconfirmation (chap. 2), and Quine on plausibility (chap. 2). The Rudner-Jeffrey-Hempel debate about standards of confirmation will be applied (chap. 1). Recent historicist views are illustrated by briefly applying the views of Lakatos on research programs, Kuhn on paradigms, and Laudan on research traditions (all in chap. 2). These are, primarily, philosophical applications, not philosophical summaries or analyses. By showing that the usual evaluative methods are misleading unless completeness is given center stage, the need for analysis in terms of a conceptual framework built around completeness is motivated.

Ensuing chapters identify criteria for evaluating the explanatory role of explanatory activities in the quest for completeness. To understand their explanatory role, we must understand how an explanation's distinctive features—its goals, development, scope, modality, resources, kind, power, and limits—are characterized by its relation to a conceptual framework. These distinctive features are not normally recognized in philosophy or biology as systematically integrated. Explanatory work is well-articulated only if it clearly presents its claims in relation to these distinctive features. Chapters 3 through 6 individually elucidate relations between the distinctive features of explanation and each component of an explanatory framework. By unduly neglecting an explanation's conceptual structure, evaluations miss their target and distort what a given piece of explanatory work means, presupposes, implies, is expected to accomplish, and contributes to ongoing research.

Problem specification, addressed in chapter 3, answers the question "How should we formulate problems addressed in extending evolutionary theory to explain features of sociality left out of our picture of evolution?" Domain specification, addressed in chapter 4, answers the question "How should we formulate statements of the evolutionary facets of the behaviors to be explained?" Disciplinary structure specification, addressed in chapter 5, answers the question "How should we marshal the resources of the evolutionary subfields to formulate statements of the explanatory factors?" Performance-evaluation specification, addressed in chapter 6, answers the question "How should we formulate evaluations appropriate for assessing progress toward completeness by speaking to the type of explanation and type of evidence pertinent to the explanatory study being examined?"

The structures and procedures of thought used in asking and answering these questions form a conceptual framework: *As specific studies solve problems in achieving the completeness of evolutionary theory (problems) by applying explanatory factors from various subfields in evolutionary biology (disciplinary structure) to various topics concerning animal and human sociality (domain), the resulting explanations are evaluated for research value (performance evaluations) in order to make revisions that promote completeness.* Chapters 3 through 6 develop this idea in detail.

Now we are ready to explore the idea that we and all other social species are connected by the undeniable fact that we are evolved organisms, and as such, we use our social abilities to behave in ways which enable us to survive and reproduce. In order to develop explanations of sociality from the evolutionary theory of differential reproduction, many more kinds of research decisions are made than are usually recognized. The focal point for understanding how all these decisions fit together lies in its chief aim. Sociobiology, whether animal sociobiology or human sociobiology, should be evaluated as an extension of the revised, updated Modern Synthesis into the realm of sociality in order to complete evolutionary knowledge.

1.2 Explanatory Completeness

Confirmationist Methodology

Suppose we grant that a causal source of behavioral differences among males and females in many species is that natural selection favors greater mate quantity in males. Critics attack sociobiology by saying that the explanations generated by this idea do not satisfy scientific standards for being well-developed, correct explanations. Advocates defend sociobiology by insisting that the explanations so far proposed are based on explanatory insights. What would justify evaluating a sociobiological explanation as an acceptable scientific explanation? We will begin by examining the implications for our answer of the traditional view that the scientific enterprise consists basically of the use of logic and facts to verify or falsify a hypothesis; more precisely, setting up plausible explanatory and predictive hypotheses based on a theory and then checking them

against observed facts to see whether they are confirmed or disconfirmed.

Many evaluators of sociobiology, upon hearing the question "Sociobiology is fascinating, but is it science?" think to themselves, "Is it supported by the evidence?" If you evaluate the scientific status of sociobiology in terms of evidential support and only in terms of evidential support, then we shall say that you employ a "confirmationist methodology." Is a confirmationist methodology adequate for assessing sociobiology as a science? If our answer is to appeal to mainstream philosophy of science, then we cannot afford to overlook the once-dominant school of logical empiricism, whose insights can often be taken on their own merits quite independently of the excesses of positivist philosophies.

Confirmationist methodology is an attitude, a preoccupation with confirmational success, that can be made precise and represented through an associated postulate. Let us define confirmationist methodology as a method based on 'confirmationism', a class of views of validation that treat the validity-making property of being well-confirmed as a necessary and sufficient condition for acceptability. Confirmationism postulates that explanations in sociobiology, as in any science, are acceptable scientific explanations if and only if they are (sufficiently) confirmed by the observational evidence.

Confirmation is itself a celebrated mine-field in need of remapping and renewal, but that is not our task. We want only to consider what difference, if any, the notion of explanatory completeness would make to confirmationist methodology.

This chapter argues for the three-unit model by showing that the concept of completeness acts as the glue, so to speak, which holds together evaluations in terms of standards for satisfying criteria for acceptability related to theories, research programs, and conceptual frameworks.

The following themes connect the arguments of the rest of this chapter to various aspects of confirmationism. The concept of completeness is clarified so as to make sense of Wilson's view of sociobiology as a New Synthesis, revealing that the scientific legitimacy and scientific significance of sociobiology lie in the quest for a synthesis that achieves explanatory completeness. The character of scientific explanation is clarified in relation to completeness, using Hempel's model of sound explanatory reasoning. Brought to bear on Barash's explanation of male-female differences, the model implies that we use the right assumptions to reach explanatory conclusions

and that what counts as confirming evidence depends on the inferential structure of the explanation under study. A summary of Betzig's evidence for these conclusions shows that there is some respectable confirmation, raising the question of whether the evidence is sufficient for accepting them. In the face of Kitcher's appeal to high standards of sufficient confirmation due to the political risks incurred in accepting sociobiological explanations of human nature, it is argued that the dispute over human nature is irrelevant to the scientific validity of sociobiology and premature if separated from the quest for completeness. Clarification of acceptance shows that standards for acceptance are relative to the current state of research aimed at completeness and specific to the use of explanations in inquiry, belief, or action and that their use in inquiry turns on their generative potential for promoting completeness.

Explanatory completeness in biology has never received sufficient attention. In the rest of this section, 1.2, we will do so in three ways: in a historical sense, in an intuitive sense, and in a metalogical sense.

The Historical Context of Completeness

Evolutionary theory has to be made applicable to and true of all the main kinds of phenotypic traits (e.g., sociality) in all the main kinds of species (e.g., the social species, including humans) in order to be complete. Hence, completeness demands the principled legitimacy of both animal and human sociobiology as sciences. Completeness, however, only provides the rationale for doing sociobiology, not a justification of its results.

Sociobiology should be analyzed as a means of completing the best version of evolutionary theory we have, given by the legacy of the Modern Synthesis as currently revised. To see the scientific significance of sociobiology as a culmination of the scientific history of evolutionary biology, consider the fact that the persistence and character of adaptation is to be explained in part by the theory of evolution by natural selection. This theory has undergone three phases of maturation, whose broad outlines will be described in a way pertinent to sociobiology.

In the original Darwinian revolution triggered by Darwin and Wallace, natural selection was conceived as a natural process that tends to cause the survival of individuals and groups best adjusted

to the natural and social conditions under which they live. So the idea of sociobiology in this sense is not new at all, but, rather, a part of Darwinism from the beginning, as evident from Darwin's writings on the descent of man and on the evolution of the emotions and even morality. Darwin anticipated the sociobiological viewpoint that, "we were selected for the capacity for culture (Spuhler 1959), and the societies generated by our cultures were the environment to which natural selection adapted us." (Barkow 1989c, 143).

However, widespread Darwinism did not begin with Darwin. In the latter half of the nineteenth century, many theorists were converted to evolutionism without Darwinism. Still under the influence of Lamarkian ideas, they regarded evolutionary change as a guided, purposeful process. Darwin had some Lamarkian ideas about the inheritance of environmentally produced variations, e.g., his theory of pangenesis. But he posited that evolutionary change moved in no preordained direction through a series of developmental stages. It was due to a relatively mechanical process of sorting among variations produced in ways undirected to organismic needs according to the differential effects of variant traits on survival and reproduction. Undirected variation was followed by natural selection among variants within a population. Evolution was to be explained by variational explanation, not developmental explanation (for details, see 5.3).

Darwin applied natural selection to the struggle for existence of organisms within a population. Social Darwinists reapplied it to the struggle for existence and power between races, classes, and nations. Current uses of selectionist theory to explain male-female differences envisage struggle for power between the sexes, "a battle of the sexes" (Dawkins 1975). Each sex is selected to control the sexuality of the other sex and to overcome control by the other sex, resulting in relentless intersexual conflict (Barkow 1985, 337). In species as diverse as insects and humans, males and females face different reproductive constraints, females with limited eggs and males with virtually unlimited sperm. These differences lead to competition between males for access to females and between females and males to control mating success. Such competition is a causal source of social behaviors.

In the modern Darwinian revolution triggered by the Modern Synthesis of Darwinism and Mendelism, genes were found to provide the sort of undirected variation required by Darwinism. Genes also provided a continual source of new variation, so that selection was not merely a temporary process, sorting quickly among a few existing variants and leaving nothing further to operate on. Natural

selection was conceived as a natural process that not only had the tendency to produce local adaptation, but also to both perpetuate genetic qualities transmitted through reproduction and eliminate untransmitted genetic qualities in ways affected by other forces of evolutionary change, such as mutation, migration, and immigration. Sociobiology attempts to connect forces of cultural and biological evolution in a unified scheme, on grounds, for example, that the species-specific behavioral abilities, skills, motives, and goals presupposed in culture itself have already been subjected to the effects of biological evolution. So the project of unifying biological and cultural evolution in terms of an evolved psychology is not new, but, rather, an extension of the project to connect the forces of biological evolution in a unified theoretical scheme (for details, see 2.4).

When isolating mechanisms were added to this list of evolutionary forces, it became possible to understand the origin of species and macroevolution as an outgrowth of microevolution insofar as it involves within-population change. However, the role of natural selection in the origin of new species and higher taxa has been subject to continuing debate, e.g., any radical changes required intermediate variants that were adaptively neutral or maladaptive. So concerns over sociobiological methods that take social behaviors to be made optimally adaptive as a result of natural selection is not new, but, rather, an outgrowth of similar worries about macroevolution. In any case, the experimental crossing of many forms, either within or between species, gave rise to the sorts of hybrids and intermediary forms postulated by evolutionism. Where the Modern Synthesis sought to complete Darwinism by connecting natural selection to macroevolutionary phenomena, sociobiology's New Synthesis seeks to complete Darwinism by connecting natural selection to social phenomena (for details, see 3.1).

Unless evolutionary theory is incomplete, variation in social behavior within and among species should also be explained in ways that conform to evolutionism. As with the Modern Synthesis, the debate has centered on the role of natural selection in the evolution of sociality. To make evolutionary theory in the legacy of the Modern Synthesis empirically adequate, adequate to explain the available social facts, the role of natural selection is being reconceptualized. We will highlight two themes here.

First, there is a reconceptualization of the genetic basis of selection. An influential theme is that natural selection has been maximizing the perpetuation of genes, including the effects on copies of genes in one's own body and in other bodies. This has given rise to

the idea of the selfish gene: we are motivated to behave in whatever ways maximize the survival of copies of our genes, regardless of whom we help or hurt to do so (non-kin, kin, or self), providing we can launch more copies of our genes into succeeding generations by doing so than by some available alternative.

There are numerous variations on this theme. Altruism to progeny is favored by Darwinian individual selection when it perpetuates (copies of) one's genes better than alternative behaviors. Altruism to kin is favored by kin selection when benefits to kin perpetuates one's genes better than alternative behaviors. Altruism to non-kin is favored by reciprocal altruism when benefits to non-kin are reciprocated so as to perpetuate one's genes better than alternative behaviors. Manipulation of progeny to provide altruism to siblings is favored by parental manipulation when benefits to siblings perpetuates the parent's genes better than alternative behaviors. Altruism to the group is favored by group selection when benefits to one's group better perpetuates one's genes than alternative behaviors. The phrase "better than alternative behaviors" has been made specific for a tremendous diversity of evolutionary scenarios by application of various models that specify mathematical values for all the relevant variables and constants. Actual evolutionary scenarios are likely to involve several of these selection processes at the same time, as well as interacting selection forces and other forces of evolutionary change (for details, see 3.2, 3.3).

In addition, there is a reconceptualization of the social effects of selection. An influential theme is that natural selection affects nongenetic variations in sociality. These selection processes concern effects of behavior on genes, not the effects of genes on behavior. Between genes and behavior there is the brain (or the mind), and so we don't expect one-to-one gene-behavior effects. Behavior is learned, but learning has been subject to genetic evolution; the brain has evolved specific information-processing capabilities to handle environmental, experiential, or cultural data pertinent to specific adaptive problems. Natural selection is conceived as a natural process that not only has the tendency to produce adaptation in the sense of the Darwinian revolution and the tendency to produce genetic change in the sense of the Modern Synthesis, but also the tendency to screen nongenetic variations in social behaviors, social roles, and social organizations for their harmony with evolved social motives (for details, see 2.4, 4.2).

If we put these two themes together, we arrive at the projected New Synthesis of both natural and social causes and effects. The

phenomena to be explained are observed patterns of connections between variations in social behavior and variations in reproductive success. The factors doing the explaining are psychological skills used to screen social variations for their concord with evolved social motives directed to achieve genetic selfishness. Since selection has established in us the goal of attracting mates likely to maximize our genetic fitness, we seek mates with qualities that are fitness-enhancing and the psychology of mate attraction functions as the array of proximate mechanisms we use to perpetuate our genes. In the sense of such efforts, efforts not yet validated, sociobiology aims to create a New Synthesis that is both a theoretical and an empirical completion of the Darwinian revolution (for details, see 3.1).

In this research situation, the idea of completeness eventuates in the idea of a synthesis. Evolutionary biology would be complete with respect to the general scientific goal of explaining nature in terms of natural processes if it describes all significant evolutionary processes and forces so as to explain all kinds of evolutionary phenomena in need of explanation. Now, the core of evolutionary theory posits that the various types of animals and plants have their origin in other preexisting types and that the distinguishable differences are due to modifications in successive generations. It is necessary for evolutionary theory to be able to explain not only the evolution of the bodies of organisms, but also the evolution of organismic behavior. Given the work of the last fifty years following the Modern Synthesis, evolutionary theory can do this, although there are always unsolved problems to work on. So, it is almost complete.

We say "almost complete" because it must also explain the evolution of social behavior and any other evolved aspect of sociality. To do so, it takes two available bodies of information and puts them together: evolutionary theory and social data. Evolutionary theory must cohere with social data if the range of explanatory results in evolutionary biology is to be complete. The degree of success that may be achieved in carrying out this task is constituted by the degree of coherence achieved. Sociobiological reasoning is aimed at creating a synthesis of theory and data, a rational unification whereby theory and data fit together in a suitable, orderly, cohesive, logical manner.

In this way, the concept of completeness leads directly to the concept of the "new synthesis," a culmination of the Darwinian revolution, that E.O. Wilson proposed as the fundamental conception of sociobiology. This concept, as derived here, is a relatively un-

problematic idea of sociobiology's scientific aim, although even an unproblematic scientific aim is sociopolitically problematic. We can accept it without being logically committed to any of Wilson's excessive claims that have been so polemically debated, although we shall expend much effort at figuring out what commitments it suggests. It is a conception of sociobiology's basic scientific aim that should be acceptable to advocates and critics of sociobiology alike, a conception pivotal for moving the examination of sociobiology well beyond the confines of the usual debate.

The Intuitive Sense of Completeness

Intuitively, such a synthesis would consist in creating coherence between the accepted theory and the accepted data. The proper conception of the test situation essential to sociobiology's aim is radically different from the standard one found in confirmationist methodology. Normally, we think of testing theories by means of data. We know what the theory is and how it is supposed to apply to the data. We test the expectations for observation induced by the theory by making observations. The issue in question is whether old and new observations conform to or violate those expectations. However, in cases like sociobiology, we know what the theory is and we know what the data is. What we don't know is how the theory is supposed to apply to the data. We are not testing the theory, since it is already well established. What we are testing, first and foremost, are assertions about the way in which the theory is supposed to apply to the data. The expectations for observation induced by the theory are not taken as a fixed background for testing the theory. Rather, those expectations are the objects of the test. We are not theory-testing, but application-testing. The issue is whether the statements that intervene between the given theory and the given data are appropriate for creating a coherent relationship between them.

Intuitively, such coherence consists in explanatory relevance (application of theory to data in a way that creates a logical connection between them) and explanatory consistency (the statements of theory and data used in the application do not contradict one another, and so form a consistent set). If sociobiology succeeds in helping to achieve explanatory completeness, it would rule out all

sources of irrelevance or inconsistency between the explanatory factors of evolutionary theory and the social data in need of explanation. Explanatory relevance would vindicate our faith in the lack of total independence of sociality from the fact, course, and processes of evolution (a distinction made in Ruse 1979). Explanatory consistency would vindicate our faith in the lack of incompatibility between social facts and evolutionary theory.

The utility of this concept will be given philosophical defense by showing that it makes sense of, focuses, and clarifies the issues surrounding sociobiology. For example, reconsider Wilson's (1975, 2) opening statement that altruism is the central problem of sociobiology, one basically solved by the new selection processes of kin and group selection. The very selection of altruism as a primary problem is motivated by its logical subordination to the goal of completeness, as is evident in the following tacit but influential research-generating reasoning. Given the many ways organisms give aid to others at their own expense, some sort of altruism is a precondition for observed animal and human sociality. Hence, a completed evolutionary theory would explain altruism. But Darwinian individual selection, understood through the theory of the Modern Synthesis of Darwinism and Mendelism, cannot explain altruism. Darwinian individual selection "helps those who help themselves." In this context, the observed altruism just doesn't make evolutionary sense; we cannot understand how it could have possibly evolved. Either the observed altruism is irrelevant to selection or it is inconsistent with selection. That is, prior to sociobiology, applications of Darwinian selection theory to altruism result in relations of irrelevance or inconsistency between statements of the explanatory factors and statements of the phenomena to be explained.

Likewise, what counts as a proper solution to the problem of altruism is constrained by the quest for completeness. If Darwinian selection theory exhausted all the selection processes of evolutionary theory, evolutionary theory would remain incomplete. So let us develop new theories of the way selection processes work and associated methods, data, concepts, and hypotheses that extend the Modern Synthesis to cover altruism so as to attain explanatory relevance and explanatory consistency. No other sort of solution would be adequate. Kin selection theory shows how behavior that benefits other organisms sharing one's genes but hurts one's own chances for reproductive success can be selected for and evolve by selection. Group selection theory shows how behavior that benefits the group