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THE MORAL STANDING OF INSECTS AND THE ETHICS OF EXTINCTION

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ABSTRACT

The alteration of environments by human activity has led to recent concern about the condition of nonhuman animals in endangered ecosystems. To ethically treat nonhuman animals differently than we treat people requires a rational demonstration of a relevant moral difference between humans and other animals. Potential differences include metaphysical, contractual, and mental considerations. These factors are examined with regard to their philosophical merits and applicability to insects. The criterion of sentience which includes concepts of pain, consciousness, thought, and awareness appears to provide an intuitively satisfying, empirically approachable, philosophical basis for including a being in our moral considerations. Existing evidence indicates that insects qualify as sentient and their lives ought to be included in moral deliberations. Given sentience as the rational basis for moral consideration, groups of individuals (including species) are not accorded special moral status. An ethic is proposed which states that, we ought to refrain from actions which may be reasonably expected to kill or cause nontrivial pain in insects when avoiding these actions has no, or only trivial, costs to our own welfare. This ethic is applied to some specific cases in the teaching, science, and technology of entomology.

RESUMEN

La alteración del medio ambiente por la actividad humana ha despertado recientemente un interés sobre las condiciones de los animales no-humanos en sistemas ecológicos en peligro. Para tratar éticamente a los animales no-humanos diferentemente a la manera que tratamos a las personas, requiere una demostración racional de relevantes diferencias morales entre humanos y otros animales. Posibles diferencias incluyen consideraciones metafísicas, contractuales y mentales. Se examinan estos factores con respecto a sus méritos filosóficos y su aplicabilidad a insectos. El criterio del estado consciente que incluye los conceptos de dolor, sentido, pensamiento y con-

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ocimiento, parece dar una base intuitivamente satisfactoria, alcanzable empíricaamente y filosófica, para incluir a un ser en nuestras consideraciones morales. La evidencias que existe indica que insectos califican como criaturas y sus vidas deben de ser incluidas en deliberaciones morales. Dado el estado consciente como base racional para consideración moral, grupos de individuos (incluyendo especies) no se le otorga un estado moral especial. Se propone una ética que expone que debemos de abstenernos de acciones que puedan ser razonablemente capaces de matar o causar dolor a insectos, mientras que evitando estas acciones tenga poco o sin costo para nuestro bienestar. Esta ética se aplica a algunos casos especficos en la enseñanza, la ciencia y la tecnología de entomología.

The impact of humans on the environment and the survival of organisms in altered environments is of growing concern. With 250,000 km^2 of tropical forest degraded or disturbed every year, the total destruction of this rich habitat may take only 60 yr (Raven 1983). As our impact on the world's ecosystems increases, continued existence of thousands of species is in jeopardy. The condition of insect life has become an issue with over 1000 endangered, invertebrate species (Department of the Interior, 1984), and with recent attempts to institute programs of insect conservation (Pyle et al. 1981, New 1984).

For entomologists to rationally address the treatment of insect life requires going further than calling for the cataloguing of endangered insect species (Raven 1983). To deal responsibly, justly, and sensibly with issues of extinction and the moral status of insects requires a blending of ethics with biology. Fundamentally, we must establish a philosophically sound, scientifically consistent, ethical basis for our concerns regarding insects.

This paper provides a basis for discussion of ethics by entomologists through raising awareness of the role of insects in bioethical theories. It is an attempt to stimulate thought and in doing so may create an issue. While argument is not in itself productive, scientists stand only to profit when challenged to engage in thoughtful and rational introspection of our philosophical foundations. Such challenges are especially valuable when they motivate us to make changes based on what we discover of ourselves.

Typical of most entomologists, I am not a professional philosopher. While I have some formal training and an abiding interest in philosophy, I have neither the expertise nor the space to present a comprehensive review of moral philosophy or the ethical treatment of animals and the environment. This paper, relies mainly on references to what appear to be the major ideas in bioethics. These concepts were chosen because of their importance, or because availability and accidents of personal history have led me to read some authors and not others, or because I find them particularly compelling.

What follows is first a brief consideration of moral philosophy and how moral rights are dealt with in this paper. Next is an explanation of the process of moral reasoning, which is then applied to the question of the moral consideration and significance of insects and other animals. From this, an ethic is developed which does not demand a radical overhaul of the science and technology of entomology. The proposed ethic is not really new; perhaps the audience to which it is directed is novel, but the inclusion of insects as beings to which moral consideration should be accorded is not unique. Next, some changes in our teaching, research, and control practices which follow from the adoption of the proposed ethic are suggested. Finally, substantial contributions which entomologists have made and can make to a biological foundation on which to build a rational, ethical system for the treatment of nonhuman animals are discussed.

What is Morality?

A moral claim is one which states the way the world (peoples' actions, beliefs, etc.) *ought* to be, which is not necessarily, or even usually, the way the world *is*. For there to be a moral claim there must be a statement of what ought to be done; not simply a statement of fact. Normative ethics is a branch of moral philosophy which specifically addresses the moral basis of acts and analyzes the duties and obligations of moral agents. Moral duties are derived from moral rights (a concept which will be dealt with in the next section). It is important to keep in mind the admonition of the great German philosopher of the Enlightenment, Immanual Kant, that, "ought implies can". We can not be morally required to do that which is beyond our abilities. Moral principles apply only to the behavior of moral agents, which are beings who can bring impartial reasons to bear on deciding how they ought to act. Although only moral agents are bound by moral principles, entities which are not moral agents may possess moral rights, e.g. newborn and comatose humans.

Moral philosophy rejects Cultural and Egoistic Relativism, systems which define what we ought to do as that which is in accordance with societal rules or that which is in one's own best interests, respectively. Such approaches reduce ethics to questions of preference and frequently generate irrationally conflicting obligations. Having rejected a relativistic approach, it becomes possible to make moral mistakes. This is not to say that immoral actions imply immoral agents, the action and the agent should be examined independently. Finally, morality is not reducible to law, religion, economics, prudence, or taste. That is, one is not engaged in ethical inquiry if a moral act is defined as that which is legal, religious, cheap, best for me, or preferred.

What is a Moral Right?

As alluded to earlier, a right is a claim that we have a moral duty to grant. We may have duties of perfect (must do) or imperfect (ought to do) obligation, although only the former have a corresponding right. Duties of imperfect obligation, such as charity, are behaviors which we ought to do but not a behavior that another individual has a right to demand of us. Discussions of rights often become muddled and confusing. For example, Rachels (1983) contends that whether nonhuman animals have a right to life (hence we have a duty not to kill) is of little practical importance, since even without such a right, the killing of animals can still be condemned on other grounds, such as the right not to be put in pain (hence we have a duty not to induce pain). This of course begs the question of whether animals can have any rights at all. Indeed, the usefulness of the concept of rights has been seriously questioned (Becker 1983). The highly influential 18th century ethicist, Jeremy Bentham, disregarded moral rights as, "nonsense on stilts", since it is not clear where rights come from or how one can "discover" what they are. Frey (1980) contends that if there are such things as moral rights, animals do not possess them and, furthermore, there are no such things as rights. He and Becker (1983) suggest that the difficulties involved in arguing about moral rights, in resolving conflicting rights, and in deriving duties from these rights, sheds no light on important ethical questions. Hence moral rights become superfluous and there is little philosophical basis for an affirmation that there are any moral rights.

Rachels (1983) argues that it may be wrong to treat an animal in a certain way without any question of rights being asked at all. Our duties to animals may be duties of imperfect obligation. Even if there are no rights, it does not follow that we have no obligations to animals. Fox (1977a) and Singer (1977) agree that moral rights are at best one aspect of morality, and that considerations of rights could be eliminated without effecting their stands on the ethical treatment of animals. Attfield (1983) poses perhaps

the most satisfying resolution to how we should discuss our moral obligations. He does not use the terminology of rights but rather, the concepts of moral consideration and moral significance. An entity that warrants moral consideration is one whose interests must be included before we take an action which effects it. Moral consideration is not to be confused with moral significance (Goodpaster 1978). That is, to include an entity in the scope of moral consideration commits nobody to any particular view about the relative importance of one set of claims or interests over another. However, answers as to moral consideration can provide insight as to a theory of value. If we know the basis of a thing's value, we can compare that value with the value of other states or beings, and thereby consider priorities. These priorities determine the moral significance of an entity which warrants our moral consideration. Thus, a being may deserve moral consideration but have only infintesimal moral significance. In such a case, if there is a conflict in which all other interests are equal, an entity with even infintesimal moral significance may determine the right course of action. Thus, ethical actions and solutions require us to take into account all entities which warrant moral consideration and then to weigh our decisions based on their moral significance. As such, including and excluding things in moral consideration is an important first step, but the resolution of conflicts hinges on the comparison of moral significance.

The Process of Moral Reasoning

Moral questions are addressed in a two-step, cyclic process (Rollin 1981). The start of moral reasoning is intuition. When feelings regarding a moral issue are virtually universal, ethical inquiry proceeds rapidly, since there is a common ground. However, our intuitions with regard to the moral status of animals are mixed; precisely what actions and to what degree specific actions (e.g. captivity, killing, paining) are immoral, is not easily agreed upon. Historically, civilization has been inconsistent in its beliefs and actions with regard to nonhuman animals. Insects have been included in this confusion; for example, the Catholic Church denied that nonhuman animals have souls but excommunicated a horde of locusts in the Middle Ages (Rollin 1981).

Fortunately, intuitions are just the starting point of ethical reasoning. Once an intuition is stated, we must proceed to construct theories that explain, justify, and ground the intuition. The theory or moral principle should be evaluated in terms of its consistency (it should not allow the same action to be both right and wrong), scope (the wider the scope the greater the applicability), precision (it should not be vague, uncertain or ill-defined in its requirements), and intuitive consistency (Regan 1983). This last requirement is somewhat circular and rather controversial in moral philosophy; however, it appears reasonable that we should be very careful in adopting moral principles which are entirely opposed to our intuitive sense of right and wrong. Based on the derivation of a moral theory, we often must revise our intuitions or preconceptions. Thus, as Rollin (1981) points out, the relationship between intuition and theory proceeds dialectically, each modifying the other. Science proceeds, as it were, in a strongly analogous manner. While ethics develop through the process of intuitions leading to moral theories that, in turn, modify intuitions, science advances through the process of perceptions leading to scientific theories which, in turn, modify our perceptions.

Applying the Process of Moral Reasoning to Insects

We are now in a position to search for a common intuition from which to derive our moral theories regarding our treatment of insects. As a starting point, Rollin (1981) suggests the principle of Relevant Differences. That is, each of us generally agrees that

our own life and condition, and probably that of fellow humans, are legitimate and important matters of moral concern. Given the intuition that we are, ourselves, valid subjects for moral consideration, it is not rational to simply cite differences between ourselves and animals (or other people) in order to provide a legitimate basis for excluding other beings from the scope of our moral deliberations. To arbitrarily choose an attribute of humans, such as intelligence, on which to base biological superiority is no more defensible than choosing reproductive potential (which would surely place humans in an inferior position to insects) or any other biological parameter as the criterion for moral consideration. If we wish to morally justify treating other animals differently than we ought to treat one another, we are compelled to show relevant moral differences between ourselves and other animals. This argument is similar to Singer's (1975) contention that while there are distinct differences between humans and other animals (and between races, religions, sexes, and nationalities of humans), these differences do not change our obligation to extend the basic principle of equality to nonhuman animals (and to all races, religions, sexes, and nationalities of people). That is, the differences are not morally relevant.

At this juncture, arguments regarding which beings deserve moral consideration come to the step of ethical postulations. There must now be an attempt to rationally explain our intuition regarding the moral significance of ourselves and fellow humans in the context of other animals. We must search for morally relevant attributes which account for why humans warrant ethical consideration and then apply these criteria to other animals to determine whether we are ethically compelled to consider them as well. The potential criteria will be examined both in terms of their moral relevance and their applicability to insects.

Metaphysical Considerations

First, consider proposed metaphysical differences between man and other animals as a basis for our treatment of other animals. Although the claims may sound absurd to many people, it is not uncommon to argue that humans alone possess an immortal soul, that humans have been granted dominion over the rest of nature by God, and that biblical and evolutionary evidence places man at the apex of mortal being. The agricultural community is certainly not free from such contentions and insects typically fare quite poorly. C. G. Scruggs, a former editor for *Progressive Farmers*, spoke out vehemently in support of insect eradication in his statement, "Nature does exist for the convenience of man, for the Bible tells us so. That's why you will win!" (in Perkins 1982).

In an effort to avoid an extended argument with regard to the existence of God and the validity of the Bible, let us accept the above metaphysical assertions as true. With regard to souls, it is not at all clear why possessing one has anything to do with being an object of moral concern. Theologians have even argued that since nonhuman animals do not have souls, wrongs perpetrated upon them will not be redressed in an afterlife. Hence, nonhuman animals ought to be treated better than we treat one another (Cardinal Bellarmine, in Rollin 1981). In a similar sense, even if man has dominion over nature and is at the top of creation, there is still no clear basis for excluding other animals as subjects of moral consideration. In fact, Attfield (1983) presents extensive and convincing arguments as to our obligation to treat animals as morally relevant beings, based on biblical references and the Judeo-Christian tradition.

Finally, arguments of man's dominion or superiority based on evolutionary grounds demonstrate a complete lack of understanding of evolutionary principles. Singer (1975) calls the granting of special moral status based on the undefended criterion of species, "speciesism" (in the same sense that racism arbitrarily grants special consideration solely on the basis of race). Many ethicists (Clark 1977, Rollin 1981, Regan 1983, Attfield

1983) directly refute misinterpretations of evolution and consider evolutionary evidence to be, if anything, a contribution to the argument for the inclusion of nonhuman animals in the realm of moral consideration.

Animals as Means

The next claim with regard to the moral treatment of nonhuman animals grew historically from the above metaphysical rationalizations. In viewing other animals as means to our ends, actions, such as the torture of animals, are immoral not for their bearing on the animal but because of the belief that people who are cruel to nonhuman animals may tend to behave similarly towards humans. That is, while nonhuman animals are not direct objects of moral concern, there are certain things which are not morally justifiable when done to them because of adverse effects on ourselves. Thus, animals come to have instrumental value (being good for something) and not intrinsic value (having a good in and of themselves). This view of animals as means can yield horrendous duties, such as being morally obligated to torture other animals, if it is shown that such treatment is beneficial with respect to ourselves, e.g. by allowing sadistic individuals to vent their brutality. Thus, the claim that nonhuman animals have only instrumental value justifies actions which are too apalling for the claim to be taken seriously. Furthermore, this approach does not answer the initial question of what criteria should be used to include a being in the scope of moral concern.

Contractual Agreements

A third criterion of moral consideration is that of the social contract. This theory, which dates back to the Sophists, contends that only creatures capable of acting morally are themselves deserving of moral consideration (Rollin 1981). It is argued that since nonhuman animals can not enter into agreements (supposedly lacking both reason and language) they warrant no moral concern. However, even allowing that other animals do not enter into contracts and moreover do not act as moral agents, it is still not clear why only moral agents can be moral recipients; i.e. why is agency morally relevant? All sorts of humans including infants, children, the retarded, comatose, senescent, brain-damaged, and psychotic are incapable of entering into or respecting contracts, but they are not excluded from our moral considerations. As Rollin (1981) goes on to point out, even if Rawls (1971) is correct in believing that only rational beings can enter into a contract, it does not follow that such moral agents must adopt moral rules that are relevant only to themselves and exclude other animals from concern or protection.

Finally, Rollin (1981) contends that nonhuman animals enter into nonverbal agreements such as honoring signs of submission, respecting territories, deferring from arbitrary killing, and interacting with man (as in the case of domestic animals which, like humans, are under intense selection to exhibit contractual behavior). These examples may stretch the definition of social contracts, but the philosophical basis of the concept is weak at best.

Sentience

Sentience is the attribute which occupies the vast majority of ethicists' work. Although it is defined in several ways, many philosophers find the qualities of sentience (pain, consciousness, thought, and awareness) to be intuitively and rationally satisfying criteria on which to define the limits of moral consideration. As such, the moral relevance of the qualities used to define sentience will be addressed separately, rather than

attempting to provide a moral defense for the more general concept of sentience itself. Ideally, the qualities of sentience may be addressed in a quantitative sense to arrive at comparative values for the determination of moral significance.

Fundamentally, sentience includes subjective mental experiences. Such experiences are by their very nature essentially private and, therefore, difficult to examine directly. Historically banished from science for various reasons, subjective experiences, especially in non-humans, have been frequently denied an existence altogether (Griffin 1976, 1984). In response to the conceptual difficulties of studying mental processes, many scientists have adopted the approach of Methodological Behaviorism, which admits that subjective experiences may exist but places them outside the realm of scientific inquiry. Others have taken the tact of Logical Behaviorism, which denies the existence of subjective experience and holds that, for example, pain is nothing but the behavior of writhing, groaning, etc. Unfortunately, these approaches are often confused with the result that scientists have come to view mental events not as simply being difficult to deal with but as having no reality (Griffin 1984). Such a conclusion is blatantly absurd when we consider any of the contemporary philosophical views of science (Atkinson 1985). While attributing sentience to insects without critical evaluation is anthropomorphic, not even investigating the possibility is arrogant anthropocentrism.

We cannot know, for certain, what another animal experiences; however, uncertainty is a poor reason to abandon scientific exploration and deny experimental inference. As Griffin (1984) points out, we can not know, except inferentially, the origin of the universe, the origin of life, the process of macroevolution, and events measured in geological time, but we do not exile them from scientific analyses. The majority of scientifically inferential evidence supports the theory of evolution, the Big Bang, and (as will be seen) the existence of subjective experiences, such as pain, in other humans and other animals. Thus, on the basis of the comparative fields of anatomy, morphology, physiology, neurophysiology and behavior, it seems that there can be rational consideration of potentially shared mental experiences, such as pain, in other people and animals.

Pain as a Criterion of Sentience

Considerable empirical evidence exists to show that a variety of invertebrates experience pain. Alumets et al. (1979) reported that earthworms possess B-endorphins and enkephlins which, by functional analogy, suggest the capacity for pain. The eminent insect physiologist, V. B. Wigglesworth (1980), argued that while cuticular damage apparently causes no pain, insects do experience visceral pain as well as pain caused by heat and electrical shock. He based his conclusions on, "observation and simple reasoning", not intending a profound reflection on philosophy or ethics. In a careful and critical review of physiological and behavioral methodologies, Dawkins (1980) examined evidence of pain and concluded that insects have the capacity to suffer pain. Eisemann et al. (1984) concluded that available evidence did not support the occurrence of pain in insects, "such as occurs in humans." Even with this carefully qualified conclusion, Eisemann et al. (1984) suggest that anesthetizing insects is desirable to guard against the possibility of pain and to preserve an attitude of respect for towards living organisms. From an evolutionary view, the awareness of pain is such an enormously adaptive mechanism, that it is unreasonable to assume that is unique to humans. Pain may be expected in organisms whose survival can be augmented by the experience of pain, either as part of an escape mechanism or as a basis for the capacity to learn from past experience (Dawkins 1980). Churchland (1983) advocates extending functionalist interpretations of mental experiences to postulate that the neurophysiological process resulting in a particular mental experience, e.g. pain, constitutes its underlying actual-

ity. For that organism then, the experience of pain is most certainly real. There is a preponderance of rational evidence to conclude that humans, insects, and other animals have the capacity to feel pain.

The Moral Relevance of Pain

The next question is whether pain is a defensible basis for the accordance of moral consideration. Using the approach of Jeremy Bentham, upon introspection, there is one intrinsic evil that we can all agree on, the existence of pain. Pain appears to be an universally undesirable state of being. Through inference, we have numerous examples of humans and other animals going to great lengths to avoid that which we would find painful. Haworth (1978) takes this approach in arguing that moral consideration must be granted to animals that are not injuring us, since available evidence clearly indicates that the pain matters to the animal, i.e. they are not indifferent to it. Regan and Singer seem to concur (Fox 1977b) that pain is a sufficient criterion for granting moral consideration. However, arguments with regard to comatose humans, early embryos, and unusual neural anomalies prevent many philosophers from granting that pain is necessary for moral consideration. Singer's position (1975, 1977) is fundamentally Utilitarian; that is, he holds that moral acts are those which achieve the greatest good for the greatest number given equal consideration of equal interests. Regan (1983) believes that utilitarianism places too much emphasis on outcomes of actions (such as pain), and not enough attention to practices which do not immediately impinge on the pleasure and pain of sentient creatures. However, he agrees the principles of equality grant some nonhuman animals an equal interest with ourselves in avoiding pain. Given our intuitions, introspections and observations of other animals, Clark (1977) is on safe ground in arguing that the sparing of unnecessary pain is a minimum principle of ethical behavior. Singer (1975) and others therefore, place the burden of justification on anyone who inflicts undeserved, nontrivial pain on another organism. Thus, there appears to be rational, ethical reasons why pain is a relevant basis for moral consideration.

Consciousness as a Criterion of Sentience

Sentience can also be defined in terms of the consciousness of an organism. In turn, consciousness is often considered in terms of thinking and awareness. At the outset it seems that if one accepts the phenomenon of pain in animals, one is compelled to credit them with self-awareness; however the objections of the Logical Behaviorists must be dealt with. The 17th Century, French philosopher, Rene Descartes, argued that nonhuman animals are simply automata, no more conscious than machines. To argue against this interpretation, one must find an aspect of biological systems which can be reasonably explained only by postulating consciousness. Two approaches have been taken to examine the biology of consciousness—experimental and theoretical. Experimental approaches usually use thinking as evidence of consciousness. Theoretical approaches often deal directly with consciousness or consider awareness as a basis for consciousness. Griffin (1976, 1984) has carefully examined both experimental and theoretical evidence of consciousness in invertebrates; what follows in the next two sections is largely a selected recounting of his arguments.

Experimental Criteria of Consciousness.—

Three classes of behavior have been used in regard to the study of thinking: language, problem solving, and learning. Graven (1967), Walker (1983), Roitblatt et al. (1984), and Griffin (1976, 1984) have presented and reviewed considerable empirical evidence for conscious thought in vertebrates.

Language is frequently used to affirm consciousness. However, using language as an experimental criterion for consciousness is paradoxical (Regan 1982). If one needs language to be conscious, then how can an infant acquire language? That is, if prior to the use of language the infant is not conscious, it would be quite impossible for it ever to learn language. This paradox notwithstanding, Griffin (1984) points out that if nonhuman animals experience conscious thoughts or subjective feelings, we might be able to learn about them by interpreting the signals by which they communicate these thoughts and feelings to other animals.

With regard to insects, considerable evidence exists to show that these animals, particularly social insects, engage in thoughtful communication. Recruitment of weaver ants, *Oecophylla longinoda* (Latreille), to join in a fight (Holldobler and Wilson 1978) exhibits a property not ordinarily found in animal communication, namely, the conveying of specific information about something the communicator has not been exposed to directly but has learned about only by receiving communicative signals. Honey bees, *Apis mellifera* L., do not use the chain of communication of weaver ants, but require their own inspection of a resource before communicating information about it (Lindauer 1971, von Frisch 1967). Bees use an elaborate form of symbolic communication, the so-called "dance language". As Jolly (1985) noted, this dance is the most precise and abstract communication that any nonhuman animal uses about the environment. This dance communication includes information on distance, direction, and desirability, not only about food but about potential nest sites as well. In communicating information about, and eventurally choosing, a nest site, bees fulfill all of the criteria for a deliberate decision in vertebrated (Jolly 1985). These and many more examples of insect communication (Wilson 1971, Matthews and Matthews 1978, Kerkut and Gilbert 1985) indicate that not only do insects exchange information, but discriminate among potential recipients and use appropriate channels under various conditions.

The second experimental criterion for thought is problem solving. Programmed automata may adequately perform tasks in a predictable environment, but solving novel challenges requires the process of thinking. Honeybees provide two particularly relevant examples of problem solving. Alfalfa anthers are adapted for pollination by large insects, and the anthers spring back violently when contacted by honeybees. To solve this problem, honeybees learn to avoid alfalfa until food becomes scarce and then only visit the flowers whose anthers have already been tripped or bite a hole in the back of the flower to reach the nectar (Gould 1979, 1982). It may be proposed that such behavior is preprogrammed for just such cases, although this seems to be a weak argument. A second example involves the ability of individual bees to learn to visit an artificial food source. While this capability is not surprising, bees have a remarkable ability to solve an associated problem which would never occur in nature. If a food source, whose location has been learned, is moved, at first short distances, and later up to 30 m at a time, bees come to realize that the food source is mobile. Individuals that visit it at a given location will later search for it at an extrapolated distance based on its previous movements (Griffin 1984). In nature, no food source moves more than 30 m in a few minutes, and natural analogies to this problem would be difficult to invent. Thus, some insects can solve novel problems, and at the very least, the solutions represent new applications of general concepts or abilities on the part of the insect.

Evidence suggests that insects challenged with novel problems outside their range of natural circumstances fail to act in what we can easily see would be the most efficient manner under the conditions (Gould and Gould 1982). However, our denial of consciousness based on inappropriate behavior is inconsistent. When a child or an adult does something foolish, is baffled by a problem, or fails to learn and in so doing does not show the insight we expect of ourselves, we do not argue that he/she is not conscious. Our historical prejudice of considering insects as genetically programmed robots has led us into a fallacy in our thinking.

A number of insects have been shown to be capable of learning under rigorous scientific conditions; these include grain beetles, cockroaches, locusts, wasps, ants, and flies (Alloway 1972, Panzo 1985, Eisenstein and Reep 1985). A three-volume compendium edited by Corning et al. (1973-1975) provides a comprehensive review of learning in invertebrates. There is no debate over the ability of insects to learn. Although this capacity supports the existence of mental processes in insects, learning may not constitute sufficient evidence for thought. While it is reasonable that all entities that think also learn, it is not as clear that all entities which learn also think, e.g. computers.

Theoretical Evidence of Consciousness.—While few would deny that insects learn, to deny the importance of genetically predetermined behaviors in insects is absurd. Numerous behaviors have been described and neurologically mapped as fixed action patterns resulting from releasor stimuli (Alcock 1979). The abundant role of instinct in insects brings us to the first theoretical consideration with regard to consciousness—the tacit assumption that instincts are unconscious (e.g., Gould and Gould 1982). What are the grounds for contending that the absence of learning is proof that an animal has no awareness of its instinctive behavior? From our own experiences of instinctive/reflexive actions such as blinking, sneezing, and cries of pain, we reason that unlearned behaviors require no conscious thought. However, the application of consciousness to behavior falls into two categories: conscious premeditation of a behavior and consciousness of bodily actions. That is, we may not consciously plan to sneeze, we are certainly aware of the act of sneezing. Furthermore, in that human reflexes serve as our "type specimens" of instinctive behavior, we may be unwisely anthropocentric in applying these simple cases to unlearned behavior as a whole. Drawing analogy from our own behavior to complex instincts does not establish how tightly consciousness is linked to learning. When an insect or other animal carries out complex behavior, without the opportunity for learning, we often assume that it does so without awareness of its activities. Howse (1975), in his review of the insect brain, does not credit insects with thinking and considers the insect brain to be a selection apparatus. Presumably the brain simply chooses which prerecorded behavior to engage. Not surprisingly then, he is seemingly astounded by the learning capacities and behavioral flexibility of many insects. The idea that an insect is conscious of instinctive behavior is unfamiliar, but it seems to closely approximate and rationally explain much of animal behavior.

In an interesting consideration of complex instincts, Griffin (1984) contends that structures built by spiders and insects such as caddisfly larvae, ants, wasps, and bees are not assembled by rote instinct, but via a template or a pattern within the insect's brain which the insect makes a conscious attempt to match. In this way, the problem of building nests in extremely variable circumstances and repairing unpredictable damage is not solved by a nearly infinite number of preprogrammed contingencies but by application of a general concept. It is most parsimonious to postulate an insect's conscious efforts to match a template rather than to hypothesize a set of neural specifications for motor actions that will produce a characteristic structure under all probable conditions.

A second theoretical consideration of insect consciousness is one of morphology. Fortunately, we have come a long way from Linnaeus' criteria for insects which included the absence of a brain (Howse 1975). The central nervous system (CNS) of insects is minute compared to even the smallest mammal. However, is consciousness a function of size and neural complexity? Even the smallest insect brain contains thousands of neurons, each anastomosing with dozens of others. While the content and complexity of conscious thoughts may well be proportional to the volume of the CNS, or more likely the brain, an absolute, critical size necessary for conscious thinking is not supported by anything we know about the nature and functioning of the CNS (Griffin 1984). The

dogma that only a CNS with a concentrated dorsal nerve cord which is enlarged at one end can support thought processes has been advocated by Grene (1978) and Walker (1983), despite considerable research which indicates that it is the pattern of organization of neurons and synapses that is critical to brain function, not the gross morphology. Hence, it is unconvincing to argue that the paired ganglia of the insect CNS preclude conscious thinking.

Numerous studies have demonstrated the ability of the insect brain to organize and integrate information in ways wholly analogous in complexity and precision to the processes in the vertebrate brain. Nothing so far discovered suggests profound phylogenetic differences in neurophysiology and brain function. While differences in behavioral complexity are apparent between vertebrates and insects, no empirical basis exists to conclude that there are any qualitative differences. Jung (1973) wrote that although he had believed insects were merely reflex automata, "We are . . . faced with the fact that the ganglionic system apparently achieves exactly the same result as our cerebral cortex."

Griffin (1984) contends that given a limited brain size, conscious thinking (particularly the employment of concepts) is neurologically economical. Under circumstances where a behavior results in life or death, and the speed of the solution is not critical, conscious evaluation has real advantages. Paraphrasing Karl Popper (Griffin 1984), a foolish impulse can die in an animal's mind rather than leading it to needless suicide. This line of argument is tenuous, but it can plausibly be extended to insects, particularly those frequently challenged by novel circumstances which impact their survival.

Another theoretical consideration of insect consciousness, is an extension of the work by Humphrey (1978) (who derived his work from that of Jolly (1966)) on the evolution of societies (Griffin 1984). The basic concept states that a critical step in the evolution of animal societies is the establishment of efficient interactions, and these interactions depend on group members' abilities to understand each others' thoughts, intentions, and feelings. Therefore, social insects must correctly judge the frame of mind, as it were, of one another. To carry out the processes of climatic regulation, feeding, brood care, foraging, etc., individuals must be aware of the needs of their nestmates. Given, the small size of the insect CNS, the economy of conscious empathy may be essential. While recognition of individuals does not occur in the social insects, there is clearly a recognition of the category to which a nestmate belongs. Basically, individuals recognize one another as responders or nonresponders in the context of the need or message to be communicated. Humphrey (1978) originally suggested that the basic adaptive value of consciousness to humans was its usefulness, perhaps even necessity, for regulating social interactions for the mutual benefit of all concerned. In the insects, social interactions may be more critical to survival than in any other organism. Insects distinguish only between a few categories of companion, and early humans probably recognized dozens of individuals, but if conscious empathy were helpful in the latter case it would be equally or even more helpful in the former case.

Social insects behave so as to meet the communicated needs of the colony. One can construct a system which awkwardly explains social interaction such as food begging and tropholaxis or behaviors such as grooming, without including self-awareness. However, few would argue that the social insects, and probably all insects, demonstrate an awareness of outside events; they behave according to environmental conditions and, as discussed earlier, they demonstrate the ability to communicate information about these conditions. Allowing that an insect has awareness of external events but does not have self-awareness is somewhat ridiculous—it is rather implausible to contend that through sensory mechanisms an insect is aware of the environment, other insects, and the needs of conspecifics but through some neural blockage, the same insect is selectively unconscious of sensory input about itself.

The final theoretical consideration of insect consciousness involves goal-oriented behavior. Lorenz (1981) argued that processes which are determined by an end or goal exist exclusively in living organisms. A goal-directed action must involve: 1) the setting of a goal by anticipating that something will happen in the future, 2) the choice of means which are dictated by the set goal, and 3) the realization of the set goal via the chosen means. Hartman (in Lorenz 1981) argued all goal-oriented behavior requires consciousness, that, ". . . only a consciousness has the maneuverability within conceptual time, can leap beyond sequential time, can predetermine, anticipate, choose means, and retrospectively go back in thought over the skipped spaces . . .". Lorenz contends some behavior (e.g. appetitive behavior) fits the criteria of being purposive but can be explained without requiring consciousness. Precisely why his selected examples specifically avoid the application of consciousness is not clear. There seems to be some semantic inconsistencies in that Lorenz sees ontogeny as being a goal-directed process, and it does not appear that developmental processes involve a genuine choice of means in the sense that Hartman may have intended. Furthermore, appetitive behaviors do not contradict the relationship between goal-oriented behavior and consciousness but offer an alternative hypothesis in some instances.

The Moral Relevance of Consciousness

If, as it appears, insects do think (communicate, solve problems, and learn) and have self-awareness, we are left with the question of moral relevance, or why is it that the consciousness should be used to determine inclusion in moral consideration? Regan (1983) points out that only conscious beings have interests or a life that can be better or worse. Without self-awareness, a being's condition can not be improved or worsened in so far as that being is concerned; hence, the value of that being becomes instrumental (it lacks a good of its own). As Singer (1975, 1977) argues, the death of a being with the capacity to think of itself as a distinct entity with future (even if immediate) goals, frustrates autonomous plans; whereas, the painless death of beings which lack these capacities is, at worst, a loss of pleasure. This loss can be made good by producing another animal which leads a pleasant life. Thus, according to this argument, entities lacking self-awareness are replacable. An important consideration in this argument is an entity's awareness of its future. While it is not clear that all living beings have a claim to a particular quantity of life, we can influence the quality of life of beings possessing self-awareness by killing them and thereby preventing the realization of autonomous goals.

A fundamental principle advocated by Rollin (1981), Rachels (1983) and others for the inclusion of a being into the scope of moral consideration is that the life of the being matter to that being. This criterion requires some level of consciousness. Furthermore, it has been argued that it is the well-being of others and our capacity to help or hinder their condition which describes the scope of moral concern; entities to which nothing matters or to which our actions have no effect do not warrant moral consideration. In as far as we do have the power to know and meet the needs of other conscious beings and in so doing effect that which matters to those beings, we are ethically bound to include such beings in our moral considerations.

Apparently insects meet at least some of the criteria for sentience. At this time, there is considerable inferential evidence that insects feel pain, learn, think, communicate and solve problems as well as considerable theoretical reasons for believing that they possess self-awareness. While sentience is complex, it is empirically approachable and generally provides a rational basis for moral consideration. Based on intuition and rational arguments, it seems philosophically sound that insects belong in the scope of our moral consideration.

INTERESTS

While many philosophers rely on empirical and theoretical evidence for sentience, others defend a less tangible and demonstrable criterion for the moral consideration of nonhuman animals—the possession of interests. Attfield (1983), tentatively denies that insects have pain and is dubious of their sentience, but he argues that they deserve moral consideration and have intrinsic value. He argues that we have a moral obligation to beings which can be benefitted, and the only beings which can be benefitted are those that have interests of their own. What then are "interests"?

An individual has interests if it has the capacity to have a life which can be made better or worse through the conditions in which it exists. Regan (1982, 1983) argues that this capacity requires consciousness which brings us to the earlier discussion. Similarly, Singer (1977) contends that every sentient being is capable of leading a life happier than some other possible life and therefore has a claim to be taken into account. Rollin (1981) contends that interests are reducible to an organism's *telos* or the expression of an animal's nature (as described, for example, through ethological studies). However, he also asserts that an organism must have some awareness of its condition to qualify as having these interests.

Attfield (1983) disagrees with the need for consciousness in possessing interests. He agrees that all life forms have interests or goods of their own, even if their interests are simply to do that which they do by their very nature. An organism without any consciousness, thought, or awareness can be said to have an interest in its own growth, maintenance, and survival. Thus, Attfield criticizes the demand for sentience on the basis that even nonsentient life has purpose, the fulfillment of which has intrinsic value. The use of interests as the criterion for moral consideration lies in the fundamental connection between beneficience (helping), nonmaleficience (not harming) and morality. Accordingly all living thing possess interests (a natural series of processes, fulfilled by each individual, if undisturbed) which we are capable of helping or harming, and hence all living things must be given moral consideration. Attfield's interpretation of interests and their relevance to moral decisions appears to be the most comprehensive contemporary view for placing a being (perhaps even all beings) into the realm of moral consideration.

MORAL CONSIDERATION OF GROUPS

We are left now with one last question before deriving ethical guidelines for our treatment of insects. Do species have unique rights and is extinction immoral? R. L. Metcalf, an entomologist strongly opposed to eradication as a form of pest control, believed that, ". . . species should be regarded as sacred and man indeed has no right or reason to destroy them" (in Perkins 1982). The moral rights view of Regan (1983) and the equality view of Singer (1977) suggest that species have no greater or lesser rights than the composite moral significance of the individuals. As Singer suggests, species are not, as such, conscious entities. The individual of an endangered species has no greater intrinsic value than any other individual. Even Attfield's liberal ethic which includes all life forms excludes species as having any greater value or interests than the sum of the individual members. Only if species are considered to be individuals, as in Ghiselin's (1966, 1974) hypermodern species concept, could biological groups have moral significance beyond that of the members (Flowers 1986).

There may be an instrumental value in diversity or aesthetic value in maintaining variety as suggested by Clark (1977) and Attfield (1983). Raven (1983), Erwin (1983), and others cite numerous potential uses for insects with regard to our own well-being. It may be argued that the instrumental value of species diversity should weigh in our

course of action but should not form the basis of our decision. The value of diversity is itself too complex of an issue to elaborate on here, but as Passmore (1980) argues, its effects are probably a mixture of good and bad. The danger of approaches which address only human interests is that insects and other animals of unendangered species come to be viewed as undeserving of our ethical attention. Moreover, it is precisely such an anthropocentric view, albeit more short-sighted, that created the environmental problems confronting us today.

Moral consideration of the life of each living being compels us to acknowledge the instrumental value of abiotic entities and to respect ecosystems and the stability generated by mutual dependence. To accept the mystical metaphysics by which individuals in a community are subjected to the good of the whole causes potential conflicts between the maximization of the excellence of the ecosystem (a goal about which we know very little) and the intrinsic value of its members. The moral consideration of individuals accomplishes a preservation of biotic communities without needing a metaphysical, holistic mystery or a anthropocentric approach. Endangered species and environments are matters for serious concern, but the moral basis of our concern should stem not from the shallow concerns regarding the anthropocentric value of diversity, stability, and economics, but rather the intrinsic value of individual organisms.

Insect conservation is an example of perceiving other forms of life as "resources" which deserve concern based only on their potential benefits to the human condition (Pyle et al. 1981, Raven 1983). New (1984) reiterated Pyle et al.'s (1981) anthropocentric justification for insect conservation and asserted that humanity's interests were the basis for our ethical concern. There seems to be an overall aversion to recognizing insects as organisms deserving of moral consideration, in and of themselves. To those who contend that nonhuman animals deserve moral consideration, much of the current conservation movement is ethically shallow and, in effect, produces generally commendable results for the wrong reasons.

A Proposed Ethic

Considerable empirical evidence supports the assertion that insects feel pain and are conscious or aware of their sensations. In so far as their pain matters to them, they have an interest in not being pained and their lives are worsened by pain. Furthermore, insects as conscious beings have future (even if immediate) plans with regard to their own lives, and the death of insects frustrates these plans. In that sentience appears to be an ethically sound, scientifically viable basis for granting moral status, and in consideration of previous arguments which establish a reasonable expectation of self-awareness, planning, and pain in insects, I propose the following, minimum ethic:

We ought to refrain from actions which may be reasonably expected to kill or cause nontrivial pain in insects when avoiding these actions has no, or only trivial, costs to our own welfare.

A reasonable expectation of death or pain in insects should be based on our intuition, experience, and inference from what we know of other animals. Trivial pain is that which is extremely short in duration or frequency or mild in degree (e.g. decapitation and short term food/water deprivation). While many animal rights advocates may find this rule understated, I believe that it is a philosophically sound, scientifically defensible position from which we can build further moral dialogue. With regard to Regan's (1983) criteria for valid normative ethics, the ethic suggested above does not seem counterintuitive, overly vague, or imprecise, although it is rather limited in scope.

In reference to my earlier definitions, morality must deal to some degree with what is; ethical principles are not rational if they are not actualizable. Given our sociopsychological milieu, we can not reasonably expect to abolish the use of insects or other

animals in the development of new technologies and the investigation of biological processes (nor perhaps should we), but we can expect to perform our work as scientists in such a way as to minimize, and where possible avoid, killing and the infliction of pain on the organisms which we study. Meaningful ethical progress will be made if entomologists accept insects as individuals of intrinsic value, warranting moral consideration, and having some moral significance which must be taken into account in our science and technology.

The proposed ethic shifts the burden of justification onto those who engage in practices on insects which can be reasonably expected to induce nontrivial pain. For example, Wigglesworth (1980) argues from observations, that piercing the cuticle is not painful to an insect but shock and heat are painful. Such observations are useful, but a more rigorous analysis would be most beneficial. Scientific approaches to investigations of animal suffering are elaborated in Dawkins' (1980) work; her thoughtful review provides a rational starting place for considerations of pain in nonhuman animals. Shifting the burden of proof onto those who claim that a specific treatment does not cause suffering, immediately expands our scope of moral consideration. This shift prevents possibly horrendous mistakes in moral judgement at the risk of overextending our moral concern. If, as further work is done and historical barriers give way to rational investigations of morally relevant biological processes, insects are found to be totally lacking in sentient capacities, we will have committed no wrongs to have acted in an overly-humane fashion. Surely it is preferable to err on the side of moral consideration than on the side of moral exclusion.

From an historical perspective, we can easily argue that scientists who investigated insects and other nonhuman animals without regard for the welfare of the animals were simply unaware of the potential suffering of their experimental subjects, hence many procedures were immoral but the agents were not. As stated earlier, it is important to separate the agent from the action. In consideration of the renewed investigations into the mental states of insects and other animals we are less able to plead ignorance as to the outcome of our actions.

While it is difficult to quantify awareness, planning, and pain in other animals and thereby know how to balance their interests with ours, the proposed ethic can be applied to some clear examples. Even if insects are of infintesimal moral significance, where there is no conflict with our own interests, other than simple convenience or preferences, the moral significance of insects should determine the course of events. In other words, the lives of insects and their interests in not suffering pain override our interests in convenience and expediency. The proposed ethic can be applied to the areas of research/teaching and technology.

Application of the Proposed Ethic to Research and Teaching

In regard to teaching and research, the use of anesthetics prior to dissection or other potentially painful treatments on insects is ethically mandatory. In many cases, an anesthetic perturbs the system under investigation no more than the induction of pain. The only exception to the anesthetic rule occurs when anesthetic is entirely contrary to the goal of the procedure, and when the procedure is the only method to answer the research question. Insect physiology and/or behavior courses should include a discussion of insect pain if we expect students to engage in ehtically responsible experiments and research. The work edited by Westerlund (1982), is a useful resource in this regard, although some sections demand a more extreme ethic than proposed in this paper.

As a general rule there is a considerable chance for suffering when insects are overproduced in laboratory colonies; in large colonies the needs of insects are most easily overlooked. In my experience, excess insects and insects of unneeded develop-

mental stages are often allowed to starve; such a practice is morally indefensible. With only trivial time and effort, excess insects can be released (if this is feasible) or killed quickly if there is insufficient food or other resources. Most insects (and many other animals) can be reared in captivity without inducing suffering, as evidenced by physiological and behavioral information (e.g. Lorenz 1952). While some animals do suffer from captivity, laboratory reared insects, when given ample room for normal activities (which may be more demanding for highly mobile species) and provided with adequate environmental conditions, may be better off than their feral counterparts.

A final consideration for both teaching and research is the practice of insect collecting. A great deal of research involves some collecting and insect collections are required in numerous entomology courses. Insect collecting may be justified when it makes a substantial contribution to our understanding of insects or improves our ability to protect our resources. In context of this justification, the validity of both the process and the quantities of insects required as part of the teaching process should be critically examined. At the very least, both researchers and students should abide by the guidelines adopted by the Joint Committee for the Conservation of British Insects (in New 1984). Although the guidelines do not specifically express moral concern for insects, they do include commendably rigorous standards for the capture, killing, examination, and release of insects. Not uncommonly, pinned insects in taxonomic collections will recover and struggle to escape; this event should be viewed with moral concern. In my limited experience, an intuitive level of concern by some individuals with regard to the pinned insect is often expressed. The insect should be killed quickly and the student (or colleague) made aware of the basis for our actions. Although Wigglesworth (1980) contends that cuticular damage is not painful to an insect, the pressure, internal damage, and physiological changes associated with being impaled can be reasonably expected to cause some suffering.

Teachers and researchers must recognize the capacity of insects to suffer and then choose procedures and experimental designs which minimize, and where possible avoid, the infliction of nontrivial pain. When a particular option accomplishes this goal at no or minimal costs to our welfare and that of other sentient beings, we are morally compelled to choose that option above all others.

Application of the Proposed Ethic to Technology

In terms of insect control practices, most people, including myself, would contend that even millions of insects are of less moral significance than a single human life. Clark (1977), Singer (1977), Rollin (1981), Regan (1983), Scanlon (1983) and most other ethicists defend the protection of our food from insect damage. We have very good reason to believe that overriding the interests of certain pest species prevents vastly greater harm to ourselves. Singer (1977) contends that it is not arbitrary to hold that humans with self-awareness, abstract thought, plans for the distant future, and complex communication are of greater value than organisms without such capacities in kind or degree. Becker (1983) also defends the priority of human interests, although his arguments, which are based on virtue, seem flawed in some respects (Cargile 1983). It is not counter to the goals of entomology to acknowledge the validity of the statement made by the philosopher, MacIver (1948), "If I tread on a woodlouse, I do wrong . . . but it is not only a very small wrong, and to exaggerate its wrongness is sentimentality. If I kill a Colorado beetle, I do wrong by the beetle, but if I fail to kill it, I do wrong by all the growers and consumers of potatoes." However, the lives of millions of insects are not so easily discounted when compared to the moral significance of a tobacco field or of a housing development. Recall that ethics are not reducible to economics; what is most profitable is not necessarily what is right (although the effects of economic condi-

tions on the well-being of people is morally relevant). Indeed, the control of insects on crops which are themselves damaging to human welfare, e.g. tobacco, is difficult to defend from a moral standpoint. Similarly, the control of insects to prevent cosmetic damage which does not influence the nutritional value of a food becomes an issue; in this latter case, we place greater moral significance on our preference for visually appealing produce than on the lives of millions of insects (and the condition of the environment). Again it seems difficult to morally justify such practices.

When provided with various methods of pest control, the moral consideration of insect life becomes of relevant issue. The philosophical foundations of insect pest management (IPM) are detailed in an historical perspective by Perkins (1982). Entomologists are aware of moral obligations; however, few have spoken out. Perkins (1982) cites a recognition of the relationship between ourselves and the natural world as a principle consideration in the philosophical development of pest management strategies. The philosophical basis for IPM (as opposed to eradication or chemical control) is the recognition of humans as biological entities who are firmly embedded and thoroughly dependent on a complex ecosystem in which we compete for resources. The important distinction between this view and those expressed by many ethicists is the instrumental value (being good for something) of nonhuman life which apparently forms the basis for IPM, as opposed to the intrinsic value (having a good in and of itself) of nonhuman life which is the basis for the ethical treatment of animals. There is a philosophical relationship of IPM to the conservation movement, both are founded on a concern for our own well-being. However, this generalization should not be applied to all of the proponents of IPM; in fact, there are those such as Pimentel (1971), Pimentel et al. (1978), Metcalf (1980), and undoubtedly others who express concern over our treatment of other animals without the anthropocentric trappings of IPM. Pimentel's consideration of "external costs" includes concern for wildlife and natural vegetation without an immediate reference to the impact of these entities on the human condition. Rabb (in Perkins 1982) has spoken directly of our moral obligations in recognizing that living things warrant moral consideration, "The use of [technological] power is a tremendous responsibility and must be done without arrogance and with a subtle sensitivity, if not a reverence, for the value of all life".

Conclusion

An active dialogue between moral philosophers and biologists is critical to rational solutions to complex bioethical issues. The relationship is of mutual benefit and promises to advance the boundaries of both fields. Contrary to Wilson's (1975) argument that ethics should be "biologized", we have a great deal to learn from philosophers. While evolutionary biologists may be able to suggest, in a sociobiological sense, why we do what we do, how ethical inquiry is adaptive, and when morality evolved, none of these informative contributions answers the fundamental ethical question of what we *ought* to do. The solution to the complex problem of defining what beings warrant moral consideration is in need of both further work by ethicists and biologists. Entomologists have an opportunity to contribute significantly to our empirical understanding of sentient processes. Such an understanding allows ethical theories to be rationally applied and analyzed. Numerous philosophers include insects in their ethical arguments (Clark 1977, Singer 1977, Rollin 1981, Attfield 1983, Johnson 1983, Jamieson 1983). As Griffin (1984) recognized, insects provide a manageable system with which to ask scientific questions regarding thought, consciousness, awareness, learning, and pain. He suggests future methodologies and cites numerous entomological studies which have already made meaningful contributions to this field.

One is tempted to conclude that our society places little or no value on the life of an individual insect, but we retain the colloquial definition of a sadist as "one who pulls wings off of flies" and a humanitarian as "one who wouldn't hurt a fly." There is an observable, largely intuitive basis for ethical consideration of insects in our society and some understanding that there can be immoral treatment of them. As scientists, we must realize that debates which shape the views and actions of our society with regard to the ethical treatment of humans and other animals are, in large part, founded on knowledge generated by us. As such, we have a responsibility to provide empirical information and rational interpretations of data gathered from careful experimentation. The scientific process and our freedom to think and interpret our findings must not be dictated by historical bias, religious speculation, cultural tradition, casually-accepted intuition or unexamined philosophy.

The science of entomology is burdened with the economic reality that our field exists largely because of the potential application of our knowledge to control, and frequently kill, insects. Recent advances in IPM have removed some of this stigma but we are still frequently compelled to justify our work in terms of its (often imaginative) applications to pest control. Given both the history of our technological mission and the classical interpretation of insects as instinctive automata, the ideas in this paper may be viewed with considerable skepticism. However, through the process of determining which ethically relevant criteria are met by insects and through a recognition of our relevancy to philosophy, we can expect our students and ourselves to achieve a higher regard for life, a more careful treatment of our world, and a deeper appreciation of the organisms we study.

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