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RISK, ETHICS AND AGRICULTURE

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ABSTRACT

Many of the environmental consequences from technological development are related to that subsystem of human practices known as agriculture. This article sketches an approach to the basic categories of ethical values associated with the phenomenon of technological risk, and indicates the issues in dispute with respect to each category. The categories are then related to specific areas of concern within the practice of modern agriculture.

In his article, "Technology and Responsibility: The Ethics of an Endangered Future", Hans Jonas lays down a challenge for ethical theory [1]. Technology, he says, has altered the traditional framework for moral obligations. Originally conceived as pertaining to debts owed from man to man, from person to person, ethics must now analyze the debts owed from man to nature. This unique state of affairs follows from two major changes wrought by technological innovation and development. First, there is the ". . .*vulnerability* of nature to man's technological intervention." [1, p. 28] This vulnerability is manifest in the inability of the natural eco-system to overcome the effects of industrial pollution. Secondly, there is ". . .the excess of our power to act over our power to foresee and judge." [1, p. 35] The impact of technological development upon natural systems seldom admits of determination in advance. We find ourselves in a state of ignorance and uncertainty regarding the secondary and tertiary outcomes of most technological innovations.

Although he does not use the phrase, Jonas has stated the problem of technological risk. What is *morally* required of us when the results of our actions are not fully known? Jonas notes that this marks a departure from traditional ethics in that ignorance of consequences has previously been accepted as an

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excuse for persons who otherwise would be guilty of immoral acts. The magnitude of possible environmental consequences places contemporary agents in a new situation. Now we have a duty to know, and failing that, we have a duty to forbear action. When predictive knowledge falls behind technical knowledge, our duty is one of caution—to restrain technological development in advance of a clear vision of its consequences [1, pp. 27-29].

As sound and reasonable as this basic attitude appears at first glance, we must recall the advice of Sartre. In forbearance of actions, we choose a future just as surely as when we act in response to a positive decision. The consequences of forbearance are likewise unknown, and potentially as ponderous. The problem of soil erosion, for example, has been cited among the leading challenges to current agricultural methods and technology [2, p. 8, 3, pp. 280-281]. Failure to make some positive response to this problem, due to risk aversion, would represent a gross perversion of Jonas cautionary ethics. Some problems mandate caution; others mandate action.

As such, a simple ethic of caution is unacceptable.[1] The task of this article is to develop the ground work for an ethic of risk, relative particularly to problems arising from technological innovation in agriculture. I shall proceed by examining first some ethical concerns associated with consequences, and conclude by offering an initial sketch of responsibility as a function of uncertainty. Philosophical thinking on the problems of technology is a relatively new venture, as Jonas notes, and the extension of this thinking into problems related to agriculture is newer still. The remarks which follow are intended primarily to discover the scope of the problem. At several junctures, the problem of technological risk returns to well worn areas of philosophical controversy in ethics and in the philosophy of social science. Once a connection with traditional problems has been made, the argument below will typically stop short. The function of this article is thus to map the new terrain, that function having been fulfilled when the argument returns to familiar turf. The exposition, however, is intended also to be accessible to a wide audience, hence technical language and argument has been kept to a minimum.

SPECIES OF CONSEQUENCE

Risk is commonly defined as a function of the consequences of an action, and the probability of those consequences. Consequences are normally taken to include all undesirable outcomes associated with a given activity. In practice, risk analysts have tended to concentrate upon consequences to human health and safety to the exclusion of other forms of consequences. It may be justifiable to commit a greater portion of analytic resources to the study of impact upon

[1] I do not mean to imply that a reactionary attitude toward risk is advocated by Jonas. Indeed, Jonas has repeatedly defended a sophisticated view calling for more (but also more responsible) technology in response to technologically generated moral problems [4, p. 203].

human health and safety, but any complete attempt to evaluate risks should also include other categories of consequence as well. From the perspective of ethics, three categories of consequence can be distinguished. In addition to human health and safety consequences, a comprehensive theory of technolgocial risk should also integrate consequences to the social, cultural or ecological environment and should also recognize equity considerations as a third category of consequence.

Previous work on the ethics of risk has concentrated on consequences to human health and safety. In fact, a computation of deaths per unit time has become the dominant measure of risk for analyses of energy technology and waste disposal. Ethical questions, to the extent that they are addressed at all, are addressed in the analysis of the acceptability of risks. One widely applied strategy for determining acceptable risk was proposed by Channcey Starr in his article "Social Benefit vs. Technological Risk." [5] Starr developed a method for predicting a level of human health and safety consequences relative to a level of social benefit which would be publicly acceptable. Starr's function was derived from an assumption that society had "accepted" levels of risk associated with activities such as driving a car, commercial aviation, smoking, generating electricity with fossil fuels, and getting hit by a meteorite, among others. Starr assumed a positivistic attitude toward this function, claiming that it represented society's utility function for risky activities. To my knowledge, Starr has never interpreted his function to have normative significance; he has never claimed that it indicates a ratio of risk and benefit which *ought* to be accepted, in the moral sense. Starr's claim is predictive; risks falling within his guideline are acceptable in the sense that they will be accepted [5, p. 1237].

Starr's original function has been copied, cited and modified by many, including the authors of the controversial Reactor Safety Study, a risk analysis of nuclear power. The positivistic tradition in risk analysis has been criticized effectively by Kristen Schrader-Frechette, who notes that this strategy involves a rather clumsy is/ought confusion [6]. Schrader-Frechette, argues that this confusion is a symptom of a long running tendency to frame questions of obvious social and ethical import in terms of purely technical issues [6, pp. 37-40].

Schrader-Frechette is surely correct in noting an is/ought confusion, but it is not merely a confusion on the part of a few philosophically insensitive authors. The confusion is part of an older problem: the distinction between positive and normative social science. Much of the research on acceptable risk has been conducted by political scientists, economists, sociologists, and psychologists. This work is important because policy decisions on technological risk must be administered in the real world, and this research reveals the patterns of practice which determine feasible policy choices. One version of naturalistic ethics can be interpreted as supporting the view that these patterns reveal the parameters for moral choice. If ethics is only the direct expression of desires or feelings, then why not accede to the general population's desires and feelings as revealed by

social science research? Linguistic analysis of moral claims shows why they cannot adequately be interpreted as expressions of feelings or desires. If Farmer Brown says, "The family farm preserves our agricultural heritage, it is therefore good," while Farmer Jones says, "The family farm is economically inefficient, it is therefore bad;" we would normally take it that Brown and Jones are expressing contrary opinions, at least with regard to their conclusions. When the claims of Brown and Jones are interpreted as expressions of feelings, however, the logical force of the claims dissolves. The naturalist analysis revises the opposing claims into statements about Farmers Brown and Jones: "Brown feels the family farm is good" and "Jones feels the family farm is bad." Such an interpretation is useful as an analysis of the politics of the dispute but directs attention away from the ethical issue at hand (whether the family farm is good or bad).[2] The problem of acceptable risk is similarly misconstrued when socio-psychology and economics are allowed to divert attention from the moral issue. The ethical analysis of acceptable risk will not be settled by knowing how people, in fact, do tend to accept risks. The ethical question is: How should we accept risks?

Obsession with human health and distribution of risks has shut out the analysis of other morally significant types of consequence. Properly conceived, risk should encompass all forms of potentially undesirable change. The introduction of improved refrigeration, for example, had an immediate and desirable consequence of reducing food spoilage and disease. Who would have anticipated that, together with the automobile and television, improved refrigeration would tend to make the home into an increasingly self-sufficient (and, hence, isolated) unit, breaking down the bonds of community by reducing the daily personal contact with neighbors? This isolation, in turn, breeds an increased dependence on members of the immediate family for recreation and satisfaction of psychological needs. The family structure, unable to support such a burden, ultimately weakens; a fact evidenced by statistics of psychological trauma and divorce [8, p. 161].

Technological change can contribute to undesirable changes in the social and natural systems which support on life and commerce. This type of change might be called 'cultural risk', but 'culture' should be understood in a very broad sense, indicating the social institutions, values and practices which define the quality of life for a given group, as well as the environmental and ecological systems which provide basic conditions for the growth and support of social systems. This form of risk is particularly important to agriculture, which is properly understood as a form of culture. Certainly, our agricultural practices are thoroughly interwoven with a social, political and ecological structure of institutions and organic systems which support (or fail to support) their success. Just as surely, the past 100 years

[2]The philosophical literature on this problem is extensive and rather technical. A highly readable introduction to the arguments is found in Raphael [7, pp. 11-22].

have demonstrated the potential for change within this structure, as the U.S. farm population has decreased from 44 percent to 3 percent of total U.S. population, and the number of man hours needed to produce 100 bushels of corn has decreased from 180 in 1880 to 4 by 1978 [9, pp. 13-15]. As a social entity agriculture has changed from a farm-based social structure in which a single large farm or a farm community could employ enough people to provide the basis for healthy social life. There can be no doubt that as machinery has reduced the drudgery of agricultural labor, it has also isolated the individual members of the rural community.

The impact of such changes must not be underestimated. The prospect of cultural risk calls first for an assessment of the cultural changes which can be anticipated, but more importantly it calls for philosophical reflection on the *value* of our social and ecological environment. One of Jonas' primary cautions is to resist the mindless commitments to ever larger and more extensive use of technology. Perhaps our mindlessness stems from a failure to contemplate and specify the qualities and characteristics of our present lives which we value most. These qualities cannot be identified as at risk until they become explicitly conceived as valued. You don't miss your water until your well runs dry; but we must learn to anticipate dry wells, or we shall surely miss much of what makes life worth living for us today.

A theory of cultural risk is offered in the recent book, *Risk and Culture* by Mary Douglas and Aaron Wildavsky [10]. The central thesis of the essay is that the concept of risk is a collective construct; the particular selection of dangers and uncertainties which a particular society elects to consider under the conceptual rubric of 'risk' is a function of organizational patterns, particularly with regard to how the social group sees itself in regard to the rest of the world, and to the future. Douglas and Wildavsky argue that perceptions of risk must be evaluated in light of the cultural background. Even rather straightforward worries about human health and safety arise from implicit challenges to the structure and continuity of culture as a whole. The authors suggest that the selection of dangers characterized as risks is determined, at least partially, by the structure of the society in which the selection evolves. The particular areas taken to be at risk reflect vague or oblique expressions of concern for the viability of the culture or way of life itself. The authors cite an agricultural example. They note the nomadic, cattle herding people known as the Hima. The Hima have a strict taboo against women associating with the cattle. Douglas and Wildavsky argue that this apparently silly selection of risk is actually deeply imbedded in the Hima economy and way of life. The fear of women coming in contact with cattle is rooted in a cultural ideal of feminine beauty and sexuality which would be eroded if women were to undertake the physical labor of herding cows. Sexual practices are, in turn, important to the structure of the nomadic economy. Although the selection of risk appears to be an irrational fear for the health of the cattle, Douglas and Wildavsky argue that it has an oblique kind of rationality in that

the taboo may be justified in light of the Hima value of free and nomadic life [10, pp. 40-44].

Risk and Culture offers an important addition to the literature on risk in that it gives the clearest picture of how entire ways of life can be at risk. The book is also important in that it offers an explanation of why fears for culture are poorly articulated, often finding expression in opposition to projects and practices which, objectively, present no apparent danger to human health and safety. The largest number of examples in the book are drawn from the environmental movement in the United States. Douglas and Wildavsky show why risk analysts who have defended the safety of pesticides, food additives or nuclear power have missed the point. The environmentalist's identification of such practices as risky is founded not on a concern for human health and safety, but for a concern for nature, and for the broad system of values and commitments which a respect for nature entails.

In deriving a social group's selection of risk from structural, rather than ideological, components of group organization, Douglas and Wildavsky stop far short of a theory of cultural risk which would be of great help to the ethicist. Indeed, they admit to a subjectivism regarding systems of value, and express reluctance to evaluate one perspective to a position of dominance above all others [10, pp. 191-192]. As such, *Risk and Culture* concludes in a quandry over the subjectivity of value systems closely akin to the subjectivity of acceptance of risks noted above. Thus, one might profitably analyze the conflict between environmentalists and developers as a political conflict by understanding how competing claims arise from different organizational structures and different world views, but this would provide no grounds for a moral evaluation of world views.

The road to relativism is well trodden in the twentieth century, and several options are available to the ethicist. One is cynicism and/or nihilism: give up the project of ethical argument entirely. Another is to reject or refute theories of language which originally gave rise to the sort of critical, cultural analysis offered in *Risk and Culture.* Either of these alternatives sacrifice the positive moral gains made by Douglas and Wildavsky. The authors have shown that entire systems of interaction and meaning are valued, and that perceptions of risk can be profitably interpreted in light of background values and way of life. If we are to do ethics, we must draw upon the cultural background of values which we have inherited; but it does not follow that this cultural background is constitutive of right and wrong. It is constitutive of our *perception* of right and wrong, but that perception is not something fixed and unchanging. Our theories of what is right and wrong are continually evolving.

Critical analysis of the sort offered by Douglas and Wildavsky takes its place among the influences which form and inform our ethical judgments.[3] Ironically,

[3] Douglas herself has argued a vaguely similar position [11, pp. 177-179].

Risk and Culture may itself be seen as a risk to the cultural background which supports our moral framework precisely because it successfully articulates the function of that background in determining moral attitudes toward risk. A deeper understanding of the issues initially raised in this book will almost certainly change the way we evaluate risks, but it is not clear whether this change will be a clarification consistent with the historically prevalent goals of ethical discourse, or a philosophical revolt which disestablishes that discourse.

The second component to the ethical analysis of consequences is a particular and individual one. Certain risks must be accepted, but they must not place unfair burdens upon particular individuals. With regard to agriculture, the particular individuals at stake are almost certainly individual farmers. At this moment, we find ourselves in the throes of economic transition which, we hope, will result in a positive change in cultural support systems. Such changes, however, are being accomplished at great economic cost to the individual farmers. This is patently unfair; it represents a challenge to the foundations of our political authority. The response to this risk must involve first a sharpening of the concept of exposure so that individuals who suffer will not become lost in the faceless non-identity of a statistical population. Analyses of risk which stress the identity of exposed parties will provide an opportunity for the theoretical apparatus of Rawlsian social theory to have an impact on the distribution of a risk in society.

The distribution of risk in society can be broken down into two problems which have familiar analogs (if not solutions) in traditional areas of moral and social philosophy. First, given the propensity to analyze risk in terms of disutility, the distribution of risk can be analyzed as a problem in distributing negative utility. That is, given a situation in which someone must suffer, how can we derive standards of fairness in the allocation of suffering? But this is not really a different problem from the traditional problem of distributive justice. Nicholas Rescher describes the original Aristotelean formulation of this problem as that moral principle which ". . .requires the state to act equitably in its distribution of goods (and presumably, of evils) among its members." [12, p. 6] Rescher's well known study, thus, would provide some initial clues as to how risk might be distributed across an agricultural population.

The second division of the problem concerns compensation for activities which expose persons to risk, when it has been conceded that some element of exposure is a necessary evil. Here the ethical problems are contractual problems, and risk is taken to be an element which entitles one to some sort of consideration. Following this line of reasoning, entitlement for compensation would have to be based on some concept of rights. The source for a discussion of this issue is Robert Nozick, who develops such a theory in *Anarchy State and Utopia* [13, pp. 54-87].

All three consequence categories revolve around the problem of identifying circumstances in which it is moral or not moral to accept a risk. As noted briefly

above, discussion has revolved around a criterion of acceptability which stresses comparison of risk and benefits. Such criteria are consistent with a simple act utilitarianism. Risk is interpreted to have negative utility (or disutility). Hence when R represents the disutility of risk and B represents the utility of benefit, an act P is acceptable when

$$R_p + B_p > 0$$

and P is unacceptable when

$$R_p + B_p < 0$$

The elegant simplicity of this analysis belies the compexity of the determinants R and B. It will not be easy to agree upon which consequence factors are to be included in the tabulation of R (and the probability factors have yet to be introduced at all). The notion of benefit will surely inherit the two century dispute over the nature of utility; we will certainly want to know who gets the benefits and at whose risk. Indeed, the distribution of risks and benefits presents an insurmountable problem for the act utilitarian analysis of acceptability. If there are such things as rights, or if there are minimal duties owed to persons (simply because they are persons), why can't we find a practice unacceptable precisely because it violates a right or fails to respect a person?

These are important objections to the act utilitarian thesis. The answer, however, is *not* to devise a deontic theory of acceptability. The concept of acceptability can be analyzed on a meta-ethical level which need not commit us to a specific theory of value. In fact, an assertion of acceptability does not commit one to a moral judgement at all. For example, when I return a student's illegible homework assignment, insisting that only typewritten homework is acceptable, I do not intend to be passing moral judgment on the student, his handwriting or the practice of typing.

'Acceptable' should mean 'complies with a specified standard.' In the case of the homework assignment the standard is 'all homework must be typed.' There are good reasons for such a standard, but from a moral point of view it is fairly arbitrary. Much of the confusion in discussions of acceptable risk has followed from a failure to specify the standard for acceptability. Thus, authors like Starr have defined acceptability according to a standard of political feasibility, rather than a standard of moral value. One errs when he or she assumes that an analysis of such a complex phenomenon as technological risk can be completed by reciting a single standard of any sort. Philosophers, on the other hand, have erred in interpreting all remarks on acceptable risk according to a standard of moral acceptability–a view which interprets the technicians feasibility analysis wrongly.

An act or practice P can, therefore, only be judged acceptable in respect to a specified standard, or set of standards S. A practice can be acceptable relative to one standard, but unacceptable relative to another. The substantive dispute turns upon which standards are taken to be relevant. A practice P might be said

to be totally acceptable when the set S contains all relevant standards; but in many cases this may be practically and even logically impossible. Disputes may also involve setting a priority of standards. When S is intended to include all relevant *moral* standards (or perhaps only the right ones) we say that P is *morally acceptable.* Morally acceptable alternatives may be rejected on non-moral grounds; and this is consistent with our common sense. One implication of the act utilitarian definition of acceptability is that practices which are acceptable become moral obligations. When $R_p + B_p > 0$, there is net social benefit, hence if we are good utilitarians, we accept an obligation to perform P. A theory of value which makes an identification between 'good' or 'right' and 'acceptable' will be fraught with this difficulty; but, intuitively, the concept of acceptable risk is designed to show us which options are allowed, and not which options must be taken.

These remarks on acceptability are included among the remarks on consequences because the concept of acceptance seems to imply an idea of living with potential consequences. Of course, there are occasions where we accept potential consequences not because we feel we could live with them should they materialize, but because we feel their potential for realization to be exceedingly remote (or at least, remote enough). A reasonably complete analysis of technological risk in agriculture must, therefore, also involve some discussion of probability.

SPECIES OF UNCERTAINTY

Ernest Partridge closes his anthology on *Responsibilities to Future Generations* with an intriguing extended quotation from the *Ethics* of Nicolai Hartmann entitled "Love of the Remote." [14] The quotation reads in part:

> The difficulty inherent in love of the remotest is easily solved, provided its moral value is independent of its success or failure, of whether it attains or misses its objective goal, indeed provided it is also independent of the valuational height of what it aims at. However much man may err and fail in his intended object, the moral quality of his intention can nevertheless be right and possess the higher value. Indeed, it is a distinctive moral quality, in which love of the remotest on this account excels brotherly love and every other virtue: greatness of moral spirit, intensity of spiritual energy, which is required in the taking upon oneself of what is inherently uncertain. The venture is great. Only a deep and mighty faith, permeating a person's whole being, is equal to it. It is a faith of a unique kind, different from trust between man and man; a faith which reaches out to the whole of things and can do no other than stake all it has. It is faith on the grand scale, faith in a higher order, which determines the cosmic meaning of man. When it becomes active and carries out its schemes, its work is of historic import. In a pre-eminent sense the expression "Remove mountains" may apply to it. And this energy is harmonious with a similar feeling-hope, when it is raised to its highest power, the basic feeling of ethical idealism,

> which bears all things and gladly suffers for an Idea, never despairing hope, the peculiar assurance which takes hold on one who risks all on a single issue. . . .

This Quixotic vision may accurately reflect the perspective of the individual farmer, cast adrift amidst uncertainties natural and economic, who must find some force of moral direction within that stance. For social ethics, the consequences must be paramount. The ethics of technological risk are quite dependent on our success or failure, hence we must acquaint ourselves with our uncertainties and prepare some guidelines for dealing with them.

Probability is now a science (or more precisely, a mathematical theory). It is, in principle possible to place a numerical value on the likelihood of a given event. The actual practice of assigning such values is subject to many sins and vagueries: a fact I shall address below. Aside from the weak data bases and statistical fallacies which sometimes plague a probability analysis, the number, once derived, is clear in its implication. A probability of 1 is certain occurance of an event; a probability of 0 is certain non-occurance. All probabilities between 1 and 0 represent a state of uncertainty.

The use of a numerical probability representation of uncertainty has two important cases. One is the statement of a likelihood for an undesirable event; the second is in comparison of risky options. In the first case, our uncertainty of a negative outcome may provide grounds for discounting a moral responsibility to actively avoid the outcome. In the latter case, probability of the various outcomes can be factored in with their utility according to decision theory. The result is an assignment of utility to the options themselves, each of which may have two or more possible outcomes. This is called 'decision theory' precisely because the derivation of utility for options provides a ground for choosing one option (by maximizing utility).

The example of low probability-high consequences risk provides an example of the first case. Waste storage and energy technologies such as nuclear power are acknowledged to have potentially disasterous consequences. Nevertheless, these practices are taken by some to be acceptable in light of the low probability of these consequences. Such practices promise a degree of social benefit which, aside from potential risk, would make them unarguably acceptable. The question for ethical theory is this: does the potential for an unacceptable consequence render the practice unacceptable?

I will argue that any determination of acceptability should account for probability, and that the improbability provides justification for discounting the harm of an unacceptable consequence. Following the work of Von Neumann and Morgenstern, this position has been received largely on the assumption that the theory of games provides the definitive model of rationality [15]. Any rational agent will discount improbable consequences as a means to maximization of utility.

The assumption involved is twofold. First, normative application of the game theoretic approach demands that the notion of mathematical rationality—a partial ordering of preferences—be consistent with the concept of rationality used by ethicists. This dimension of the assumption is preceded by Von Neumann and Morgenstern's claim that since events can be combined with probabilities, ". . .the same must be assumed for the utilities attached to them." [15, p. 20] This assumption begs the ethical question; the theory of probability is just incorporated into the notion of utility by fiat.

The combination of consequence utility and probability to form a rating of act utility is so commonplace, and so basic to decision theory that it may be difficult to see how it can even be called into question. A justification for the assumption should almost certainly start from the observation that ethical choice requires *some* way of discounting the moral importance of events or consequences which are unlikely.

Another application of probable knowledge is in the comparison of two or more options. A given act or practice P has potential negative consequence C. If the likelihood of C is N, and if $0 < N < 1$, then the risk of P is determined by

$$R_p = C_p \times N_p$$

The simplicity of this formula conceals the complexity of real P's. Actual practices seldom have a single consequence, while some of the multiple consequences will be mutually exclusive, some not, some dependent, and some not. Nonetheless, these difficulties are fully within the purvey of probability analysis if one assumes that the probability of each consequence is known.

The decision theoretic approach to risk provides positive insight into ethical analysis in that, to the extent that consequences can be ranked in a partial ordering, R_p provides a framework for comparison of uncertain events. A practice X, loss of one life with a probability of .6, becomes defined as a risk of $1 \times .6$ or .6. A practice Y, loss of 10 lives with a probability of .07, becomes defined as a risk of $10 \times .07 = .7$. Thus

$$R_x = 1 \times .6 = .6$$
$$R_y = 10 \times .7 = .7$$

Since $R_x < R_y$, X is preferable to Y with respect to utility.

It has not been established, however, that this justification of action is the right one from the moral point of view. The issue is this: given the need for a method of discounting outcomes according to their consequences, is the single combinatory relation of probability and consequence a morally adequate way to discount uncertainty? One reason for thinking that it is not is that excessive quantification of risks and benefits obscures morally relevant differences; in particular, frequency discounting of consequence commits one to an implicit utilitarianism regarding the value of life, of community, of personal freedom, or of any other impact.

Given the need to discount uncertain outcomes, however, some sort of systematic method for doing so is required. One alternative to probabilistic combinations of utility and uncertainty is a model of rationality which stresses sorting of options according to rough estimates of probability. On this general approach, the rational decision-maker is identified as the one who is able to simplify a complex decision situation according to a rough and ready set of categories, saving exhausting computational comparisons and selecting the option which is clearly indicated [16, pp. 84-89]. The key phrase is the last one: "clearly indicated." The ethicist requires some way to discount for uncertainty; but in the absence of more information about the actions contemplated, it is impossible to prefer one model for discounting over another. Among the relevant points are the adequacy of the data base for developing a quantification, and the overall importance of combining probabilities and utilities in a precise way. The value of knowing what an ideally informed and rational decision-maker would do may be less than the cost of finding out.

The question of uncertainty, however, is far from answered by the notion of relative frequency. The fact is, our knowledge of probabilities is itself far from certain. Frequency distribution of outcomes will be founded upon statistical and decision models which are themselves subject to uncertainty. Basic data may be insufficient to establish a sound statistical basis for a frequency distribution. Collection of data is itself subject to extensive assumptions. Data derived from polls or questionnaires, for example, are notorious for being characterized more by sampling technique than by reality. In addition, the mathematical, economic and physical models used to analyze a phenomenon may be subject to many levels of uncertainty. Economic models are at best plausible representations of reality and can be applied only with the qualification of *ceteris paribus* clauses. As such, a model is also subject to uncertainty regarding its applicability within a specific situation [17, p. 31].

From a formal perspective, these uncertainties can, to a large extent, be incorporated into the frequency distribution themselves using an approach to probability suggested by Ramsey and deFinetti which assumes an ability to incorporate "intuitive" probability estimates within the apparatus of the theory. On this assumption, it becomes meaningful to define the probability of a hypothesis H relative to a body of evidence E. If H is believed to be true p(H/E) = 1, if false p(H/E) = 0. Degrees of confidence in H are represented by other points in the interval between 1 and 0. The important features of this approach are those which allow one to incorporate one's initial state of ignorance or lack of confidence within a probability estimate, and then to "learn by experience" using Baye's theorem to update the estimate as objective data becomes available [17, pp. 33-34].

There are doubts as to whether this approach truly quantifies the specific forms of uncertainty noted above, but the quarrel here is with the ethical implications of combining objective frequency distribution with degree of

confidence uncertainties. The upshot of this technique is a measure of risk which obscures the distinction between uncertainty which is known in the sense of frequency distribution, and uncertainty which is unknown in the sense of modeling validity and applicability. In the former case, rational choice demands that we order our choices in accordance with options that have a high probability of success. Modeling uncertainties, however, require that we understand what is at issue, what makes the model uncertain. To be sure, the analysis of modeling uncertainty is not a problem for ethics; it is a problem for the philosophy of science. In the end, we will choose the model in which we place the greatest confidence, and we will realize that this choice is limited by the state of our knowledge. Ethical responsibility to know the results of our acts in some measure requires us to ask: How is it we know that we know? At best, the subjective approach to probability makes this inquiry more difficult to launch. Confidence estimates collapse the uncertainty of our knowledge with the uncertainty of its object. At worst, it suggests that this inquiry is unnecessary since experience will dominate initial uncertainties in the end. This is a plausible assumption in the abstract, but in moral practice, the whole point is to avoid "the end"—hence our learning from experience may come too late.

There is a third and final form of uncertainty that turns us back to Hartmann's love of the remote. After we have made our best estimates and brought the best of our rational models to bear, life is still an uncertain proposition. Finally, we face uncertainties which are total, which we cannot anticipate, whether for lack of skill or lack of perspicuity, or perhaps even for a genuinely unpredictable, metaphysical randomness which may pervade an otherwise rational universe. I call this bland uncertainty. It is faceless: indistinct and impossible to anticipate. We may concoct scenarios (as science fiction writers have done for decades), but in the face of bland uncertainty we can offer little more than the idlest of speculation as to their likelihood.

The unknown itself, however, is no idle thought. Early agricultural applications of pesticides, for example, were made in atmosphere of blissful ignorance. Their effects were truly unforseen. At the point of their initial use, the eventual undesirable side effects of pesticide use may well have been characterized by bland uncertainty. In hindsight, we can say that pesticides should not have been used as indiscriminantly as they were; furthermore, we can say that agriculturalists were late in recognizing the emerging contours of a problem. Can we say, however, that the entomologists of the 1950's, facing a total unknown, should have decided against development and application of agricultural pesticides?

The same problem arose in the 1970's with regard to uncertainties regarding the technology of recombinant DNA. The biologists in question, having learned from the example of entomology, ordered a pause in their research, enabling them to ponder dimensions of the uncertainty before them. The result of this pause, represented by the Asilomar conference of 1976 and the publication of

guidelines for research, was a close delineation of the known, the anticipated, and the truly unknown. The guidelines serve as responses to anticipatable uncertainties and risks. But the truly unknown remained precisely that. The DNA researchers fulfilled at least a minimal criterion of Jonas' cautionary ethic, but what about the truly unknown? Since 1976, research on agricultural applications of DNA has accelerated despite the looming possibility of a disasterous (but totally unforeseen) consequence.

I argue that Hartmann was right in ordering us to face such prospects with hope, and I concur that the justification for this is somewhat existential. Our plight with regard to bland uncertainty is akin to Pascal's wager, particularly with respect to the version of it offered by William James. We can regard bland uncertainty with dread or with hope. If we are to sanction research and development of agricultural applications of genetic technology, we must opt for hope. What are the reasons for choosing hope?

Dread is here defined as an aversion to uncertainty which motivates us to forbear all risky actions. Hope, on the other hand, is taken to motivate prudent action and acceptance of risks in the faith that something, be it God or the ingenuity of future generations (if in fact these are distinct), will see us through. Either position may devolve into *argumentum ad ignorantiam,* but let us discard the fallacious forms of dread and hope for the sake of argument. Either dread or hope can be overtaken by the uncertainty they anticipate. Neither is a guarantee against it, and since the uncertainties are faceless, we have no evidence which will weigh in favor of one rather than the other. According to James, in such instances we are free to choose by act of will; objective evidence will not support either alternative. As such, we may turn to the implications of the choice for us as agents, and away from the worldly implications of our acts and their consequences [18, p. 723].

In a state of dread, we place ourselves at the mercy of events. We define ourselves as patient; we come to know ourselves as an object of the natural forces which will determine our fate. In a state of hope, we acknowledge that we certainly *are* at the mercy of events, but we do not accept this as the definition of our ontological significance. In hope, we take ourselves to be agents. We act; we take the risk actively and by force of will. From the perspective of hope, we grasp the problem of risk as a problem of moral decision; from the perspective of dread, it is a problem of natural process.

While neither perspective provides a guarantee of success, the attitude of hope has this advantage: If there is some human action which will avert disaster, the perspective of hope provides the ground for taking such an action. Dread provides no ground for positive action, since *any* positive action could result in disaster. This argument for hope thus parallels James in suggesting that the justification for hope is not in the ultimate vindication of one's faith, but rather in the immediate existential transformation of subjectivity which empowers us to act, to do. The person who adopts an attitude of hope on the pragmatic ground that

it enables him or her to break the malaise of dread and to do something, may as, James suggests, be led to a psychological identification with hope that serves as genuine faith [18, pp. 723-724]. Let us hope also that this faith does not become facile.

CONCLUSION

The division of technological risk into species of consequence and probability provides a topology of philosophical problems, and shows how they are connected to traditional areas of philosophical inquiry. The division into species is also useful as a guide to some of the places that technological risk is a problem for the practice of modern agriculture. In Figure 1, the species of consequence are outlined according to the areas of philosophical and agricultural contact. Although there is considerable overlap in the categories outlined, the figure shows several problems in agriculture which call for philosophical thinking. Similarly, the agricultural problem areas should serve as resource areas for examples and contexts which may serve to clarify and sharpen issues in traditionally established areas of philosophical inquiry.

It is appropriate that the consequence category of human health and safety impacts should appear at the head of the listing. The Kantian tradition in ethics stresses a duty to fellow human beings above all other moral maxims. Similarly, agricultural science in the twentieth century has devoted much effort to improving the quality of agricultural products for human consumption. Production techniques have been improved in terms of our ability to control contamination of food products, and also in terms of the nutritional content of food products. Research to increase crop yields should also be included among the agriculturalist's attempts to insure human health and safety, since a larger food supply is a prerequisite for the elimination of starvation and hunger related disease. Ironically, techniques for improving the quality and quantity of agricultural production figure prominently in the rise of technological risk. The most obvious example is the overuse of pesticides and other agricultural chemicals. The initial ethical issue is one of conflicting moral obligations. The use of modern agricultural technology is not morally pure: it increases food quality and quantity, thus securing human health, but it involves risk as well. Agricultural production is, thus, an area in which the mixture of good and bad, and the necessity of a minimal evil appears to be an irreducible fact. As one attempts to legislate the proportions of good and evil, one is led naturally from an ethics of absolute respect for persons to an ethics of calculating and comparing utility. Regulatory policy for agricultural production thus faces the traditional problems of utilitarian social and ethical theory.

Once the necessity of certain risks has been conceded, a different ethical problem arises in determining a just distribution of these risks. Distribution of risk is a particularly critical problem for U.S. agriculture owing to its unique

	RISK PROBLEM AREAS	PHILOSOPHY PROBLEM AREAS	AGRICULTURE PROBLEM AREAS
SPECIES OF CONSEQUENCE	HUMAN HEALTH AND SAFETY	RESPECT FOR PERSONS VALUE OF HUMAN LIFE	PESTICIDE, AG. TECHNOLOGY
	DISTRIBUTION OF IMPACTS	DISTRIBUTIVE JUSTICE UTILITARIANISM	ECONOMIC POLICY, RURAL DEVELOPMENT
	CULTURAL IMPACTS	PHILOSOPHY OF SOCIAL SCIENCE	AGRICULTURAL VALUES, FARMING AS A WAY OF LIFE
SPECIES OF UNCERTAINTY	STATISTICAL PROBABILITY	DECISION THEORY	FORECASTING, AGRICULTURAL PLANNING
	MODELING UNCERTAINTY	PHILOSOPHY OF SCIENCE	AGRICULTURAL POLICY
	BLAND UNCERTAINTY	EXISTENTIALISM	HOPE FOR THE FUTURE

Figure 1. Species of consequence according to areas of philosophical and agricultural contact.

economic and geographical position. Heavy industry has been able to protect itself against the economic consequences of technological regulation through lobbying and through its ability to pass costs on in the form of price increases. The micro-economic structure of American agriculture makes individual farmers highly vulnerable to these economic effects, however. Furthermore, the farm population has become vulnerable to physical risks from technology not directly related to agriculture as dangerous technological facilities and waste disposal sites are increasingly located in rural areas. The demographic and economic characteristics which result in these inequities for distribution of risk are not currently well understood. An improved understanding of the way that farm life and values at risk will also result from attention to the third category of consequence, cultural risk.

Developing a theory of cultural risk will require refinement and development of ideas in the philosophy of culture. To the extent that such a theory follows the initial indications of Douglas and Wildavsky in *Risk and Culture,* the ethicist must resolve the apparent antagonism between action and understanding which arises in *Verstehen* approaches to the philosophy of social science. This problem is a very active area in contemporary metaphysics and hermeneutic philosophy; hence, discussion of cultural risk shows promise of lively philosophical interest. Cultural risk is important for the philosophy of agriculture since the opposition to broad cultural changes is symptomatic of the conflict between agricultural fundamentalists, like Wendall Berry, who stresses the moral and aesthetic values of the small family farm and the exponents of scientific agriculture, represented by agricultural extension services and the land grant universities, who stress productivity and efficiency. The agricultural fundamentalist extolls the virtues of a simple farm life, appealing to a philosophically grounded interpretation of the human being's right relative to nature. The agricultural scientist is committed to the ideal of feeding the world, and appeals to standards of nutritional well-being revealed by scientific discovery. The roots of this conflict need to be traced to very broad philosophical systems of value and truth. It will certainly contribute little to remain entrenched within one perspective, launching missiles at the other.

Species of probability all raise a basic philosophical question regarding uncertainty. The most recent three hundred years of philosophy may be characterized as a headlong pursuit for the roots of certain knowledge. The unique philosophical problems which arise when knowledge is uncertain were shunted aside, perhaps in the faith that relative ignorance was a temporary condition. The quest for certainty has wound down in the twentieth century, and decision theory may be seen as the first serious attempt to deal with risk as a fundamental fact of human knowledge. The turmoil and activity in connection with the problem of uncertainty is reflected in the large number of philosophers writing on the concept of rationality. Some are attempting to merge traditional ethical concepts with quantified concepts; others work to extend the initial

assumptions of Von Neumann and Morgenstern. The area of implication for agriculture is in the use of mathematical models as policy tools. If policy objectives are to be defensible as ethical objectives, the methods for arriving at decisions must be defensable as well.

A second level policy problem arises with regard to the uncertainty of the models themselves. As noted above, there are attempts to resolve this difficulty with the framework of decision theory itself. From the standpoint of ethical policy decision, the value of openness calls for less quantification rather than more in this instance. The underlying philosophical question concerns the dialogue between expert and constituent which must form the basis of sound policy decision. The idea of the two cultures, scientific and ordinary, raised initially by C. P. Snow suggests that the second species of probability problems may be closely related to the problem of cultural risk. Is there a communications problem between the agricultural specialists and the farm constituency? If so, is it a problem of philosophical language barriers?

The final species of uncertainty, bland uncertainty, is a problem for any human being who must make decisions in a world which is beyond the ken of human mind. The philosophical problems are existential, hence they are universal problems faced by anyone who must make a choice. Bland uncertainty may be a special problem for agriculture, but only in the sense that agriculture is an activity which requires many choices made in situations where the extent of human ignorance has become acutely apparent. From the standpoint of agricultural ethics it is important to acknowledge this uncertainty lest its pervading gloom negate the possibility of acting ethically at all.

Few of the philosophical and agricultural problems noted herein admit of obvious solution. With the problem of technological risk, agriculture awakens like the proverbial sleeping giant to discover itself thoroughly embroiled in some of the most difficult moral and intellectual issues of the age. This initial map of the territory is humbly submitted as an invitation to those who will take up the problems which have here been indicated so tentatively. The nexus of problems arising from just one initial starting point, the concept of technological risk, shows that the field of agricultural philosophy exists. It arises less from the application of philosophy to agriculture (or vice-versa) than from genuine and often novel problems in the practice of agriculture in our time. The resolution of the problems will thus require more than the application of extant philosophical theories. Agricultural philosophy will draw upon traditional philosophy, but it will be new philosophy, exhibiting an integrity and tradition of its own.

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