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EPISTEMIC CONSIDERATIONS ON THE VALUE OF FOLK-WISDOM IN SCIENCE AND TECHNOLOGY

The cultural attraction to expertise is found in ancient and modern civilizations. In antiquity, the shaman, witch doctor, and medicine man provided the specialized care for the treatment of illness, injury, and disease. The role of the expert in industrialized societies is shared by many trained in highly developed disciplines. In medicine, engineering, and science, the degree of specialization is narrowing. At the same time, the quantity and fine structure of published information in any one field has grown so rapidly (de Solla Price, 1963) that even the foremost practitioners admit they cannot keep up with the scientific output. Nevertheless, within our technological culture we have nourished and advanced the idea of scientific and technical elites. The public sector depends on these individuals for special guidance through a labyrinth of complex decisions, where miscalculations or poor advice can adversely affect tens of millions of people.

Along with the tendency toward a greater dependency on expertise, the United States is also experiencing an opposing or contradictory tendency, namely, the public demand for increased participation in technical decisions. This phenomenon has been explained by Bell (1976) as a reaction against the growth of professionalism and the emergence of technocratic decisionmaking. These tendencies are contradictory in the following sense. The more specialized the knowledge requirements become for policy choices, the less legitimacy there is for the generally educated person to render a decision that takes into consideration the requisite complexity of the technologies in question (Nelkin, 1975). The simplification of technology in social decisionmaking is tantamount to narrowing options, an outcome that is at odds with our goals of deepening the knowledge base in policy choices.

One approach toward making these seemingly contradictory tendencies compatible is based upon a thesis which I shall call the separability principle in social decision analysis. The principle holds that policy decisions, where expertise plays a nontrivial role, are divisible into two components, one of a technical and scientific nature and one of a policy nature. Public participation is justified only in the policy component of the decision and only when the last vestiges of scientific controversy have been resolved. Certainly, one can always find disagreement among some experts in the so-called technical domain of a social decision. But, the argument goes, if consensus is possible on the scientific issues, it must be reached by those who have a mastery of the specialized knowledge. That knowledge includes an understanding of cause-effect relations, explanatory paradigms, probability assessment, complex dynamical systems, and risk-benefit analysis.

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According to the separability principle, the policy component of the issue contains all the value determinations. Are the risks worth the benefits? Is the decision just? What ought the distribution of risks and benefits be? What social resources should be allocated?

Resolving the opposition between a broader public role in technical decisions and the exclusivity of expertise would not present a difficulty were it not for the failings of the separability thesis. One problem with the thesis is that technical issues and policy choices are woven together to form a complex decision tapestry. Valuations are forever entering into the judgments of experts (Kasper, 1972). Yet divisibility of a technically grounded policy question favors the class of experts, affording them an opportunity to leverage their expertise beyond its legitimate boundaries into the normative sphere (Weinberg, 1972).

A solution to the dilemma of democracy and expert knowledge is possible within the framework of the separability thesis if we view the technical and policy spheres as overlapping. Under these circumstances, merely shifting the role of the technical expert to those questions, which are clearly outside of the intersecting region, might provide the answers.

But the next criticism shows the fallibility of this solution. Science must be understood as having political, economic, and ideological influences (Mazur, 1973). This position does not entail that every scientist responds to such influences or that scientists are even conscious of these effects. Nevertheless, they exist and have been aptly demonstrated as biasing the application of science to public affairs.

Since political and ideological factors enter into the function of science in human affairs, there is legitimacy in broadening participation in the technical domain of social decisions beyond that of the established experts. For it is in this domain that values are more easily hidden from public view. Since rationality in general, and scientific rationality in particular, is socially constructed, it cannot be reduced to a set of formal categories (Mendelsohn, 1978). As such, ideology may enter problem solving at its very foundations through the cognitive apparatus of the scientific paradigm, by the way in which the problem is conceptualized, or through the analytical instruments by which quantitative inferences are made. Failure of the scientific community to reach consensus on the technical dimensions of a problem is a signal to the lay community that politics and ideology may be at work (Krimsky, 1977). More frequently the ideological roots of scientific inquiry are revealed in retrospective historical studies when sociopolitical events can be correlated (Sahlins, 1976; Diamond, 1981).

The current debate on the proper role of nonexperts in technical decisions rests almost exclusively on principles of democratic theory and the separability thesis. Having discussed the latter point, I shall comment on the former. The view that broader sectors of society have legitimate rights to participate directly in a class of social decisions has its roots in the debates between Hamiltonian and Jeffersonian theories of democracy, where ideals of representative and direct forms of government are at stake. According to Rosenbaum (1978), "...the movement for expansion of citizen-participation rights and opportunities falls squarely within traditional concerns of democratic theory about equality of opportunity for political activity and influence."

The notion of popular sovereignty is vulnerable on several counts. First, we must consider the political economy within which the democratic ideal is conceptualized. Economic and legal barriers set well-defined limits on change, particularly on how social resources are allocated. Even with mass social movements, little is accomplished to change the root causes of social pathology. That is the critique from the left. From the right, the criticism against increasing public participation is based upon notions of instability, indecision, and inefficiency in carrying out the functions of government. Additional arguments cite the possibility of special interest group totalitarianism.

All of this has questionable application to technical decisions. Even preceding the issue of political legitimacy for participation by a lay public in problems requiring specialized knowledge, epistemological concerns raise a glaring dilemma. Nonexperts, by definition, depend upon the knowledge and guidance of experts. By bringing the former into a decision process, we simply create an unneeded layer of cognitive input. The lay participant is an inefficient mediating link between experts. It is not reasonable to establish a right to participation if it cannot make a difference in decisionmaking or serves to obstruct the outcome--that is, if its sole purpose is to diminish rationality.

There are three responses to the dilemma. From the earlier discussion, if valuations are forever entering into technical judgments, then the experts, as a distinct class, may be in a less optimum position to render decisions in those areas than an informed laity. This is particularly true when external valuations reinforce the cultural norms of the professional elites.

A second point concerns the ideological role of science. Once it is established that such a role exists, here, too, there is legitimacy for broad participation into what falsely is alleged to be "pure technical matters."

The third response is the one this paper addresses. The thesis is the following. There are some categories of technical problems where a nontrivial contribution can be made by nonexperts. This contribution is central to a technical solution to the problem. The neglect of the types of contributions I shall call "folk wisdom" may result in inferior outcomes or lost opportunities. I shall argue that there is an epistemological justification for including nonexperts in certain classes of technical problems. To demonstrate this I shall show that (1) the socialization of experts and their cognitive structures can neglect some important components of knowledge, (2) the highly specialized and reductionist nature of scientific inquiry can be aided by more intuitive personal and holistic approaches to problem solving, (3) there are a multiplicity of examples which illustrate the thesis. The first task before us is to examine the generic forms of cognition associated with expertise.

EPISTEMOLOGY OF EXPERTISE

What does it mean to say someone is an expert? Presumably, he or she has mastery over a technique and/or a body of knowledge. People are experts in specific fields of disciplines when they have demonstrated their proficiency to a peer group. In science and technology, expertise is recognized through a guild system. One completes an apprenticeship and only then is admitted to a position of rank in the guild. Thus, the attribute of expertise is socially determined. Experts are those who have achieved mastery in a field validated by the subculture of professionals and given official recognition by society as a whole (Ziman, 1968).

There is nothing in this formulation of the term expertise that prevents us from saying experts can learn from nonexperts. Neither can we draw the conclusion that experts are epistemologically self-sufficient. For it may be that, in scientific and technological decisionmaking, there is significant value in reaching beyond the technical guild. Alternatively, this may be true for some fields or some problems and not for others. To pursue this question further, I shall examine the cognitive arsenal of the expert.

Among the intellectual skills that scientific or technical experts bring to a problem are the following:

1. a theoretical framework, including a lattice of concepts, laws, and explanations
2. acquaintance with a body of literature
3. proficiency with the use of specialized instruments
4. causal knowledge and the ability to frame testable hypotheses
5. A process of inquiry that enables them to collect, organize, interpret data for the purpose of:
   a. extending a theory
   b. developing a more comprehensive or detailed description of nature
   c. implementing some plan
   d. testing a hypothesis, theory, or explanation

The methods of science fall within a broad range of activities covering fields as disparate as sociology, meteorology, biology, and theoretical physics. But whether we are discussing the social, natural, or life sciences, all share a basic epistemological format: information gets transformed into structure, which helps investigators generate more information, expand and modify the structure, and so on. The information is not always independent of the structure; i.e., the choice and nature of data quite explicitly depend on the choices of theory (Hanson, 1975).

John Friedmann (1973), who writes about planning theory, developed the idea behind the dualism of information and structure to examine the role of experts in understanding complex social systems. Friedmann's discussion is particularly germaine to the thesis of this paper because it offers a theoretical argument for the use of nonexperts in social decisionmaking. He draws a distinction between direct and personal knowledge which is derived from other people's measurements and observations. Personal knowledge arises from a unique contextual setting, or set of historical associations. The test of its veracity is pragmatic which Friedmann contends makes such judgments vulnerable to false generalizations and myths.

Processed knowledge, on the other hand, consists of theories about reality which include the construction of abstract models. "Models are necessarily partial and selective. They seize upon those elements of reality that are susceptible to modeling and about which information can be obtained" (Friedmann, 1973). Therefore, processed knowledge is identified with the contributions of experts who have mastery over the structures or theoretical frameworks within which information is organized. Neither processed knowledge nor personal knowledge is satisfactory on its own according to Friedmann; they are complementary to one another.

> Personal knowledge is totally inadequate as the sole approach to system guidance, yet processed knowledge is also severely limited in what it is able to do. . . .Models are useful and perhaps the only tools we have for learning rapidly in complex situations; but they reflect fictitious and distorted images of reality. In societal guidance, they must become connected with personal knowledge so they both, those who know primarily from experience and those who know the world chiefly through prismatic images of models, may increase their capacity for learning.

The interaction between expert and nonexpert, which Friedmann calls mutual learning, implies a new set of relations in social decisionmaking. Without this conjunction of primary experience and conceptual knowledge, we have mindless information or meaningless structure. When technical experts become distanced from personal knowledge, the social decisionmaker, says Friedmann, can "remain stranded in the lagoons of personal knowledge or turn his powers over to the lords of processed knowledge and put his faith in the geometries of reason." In offering a synthesis that reflects a Kantian approach, Friedmann posits a solution in his theory of transactive planning: "Processed knowledge would be thus joined to action through a series of personal transactions that would bring the rules of the two worlds into conjunction."

One can find many areas in science and technology where personal knowledge plays a negligible role. I shall not be concerned with such instances. Rather, I am examining the class of social decisions with a technological or scientific component for which personal knowledge is relevant. In some instances, personal knowledge may mean knowledge of particulars; in other cases, it may signify historical associations with certain events. It incorporates ideas such as intuition, direct experience, and trial and error.

The fact that personal or experiential knowledge may be relevant to a decision does not imply that nonexperts are needed to complement the role of technical decisionmakers. Whatever personal knowledge may contribute to technical problems, it is quite possible that it can be incorporated into the paradigm of the expert. A useful model by which to understand the distinction can be found in anthropology. To construct theories about the ontogeny and ontology of cultures, observations are necessary. Folk wisdom enters the process when the expert is aided by direct communication with the nonexpert. The nonexpert is a mediating link between the world and the expert. What circumstances make this mediation necessary or useful? I shall explore several cognitive categories that signify plausible contributions by nonexperts to technical problems. Following that, I offer a series of illustrations from different areas of human inquiry that demonstrates the role of folk wisdom in technical decisions.

COGNITIVE DOMAIN OF TECHNICAL CONTRIBUTIONS BY NONEXPERTS

This section introduces four cognitive areas where popular wisdom can make important and unique contributions to technical knowledge. These cognitive areas are summaries in Figure 1 under the general headings: (1) problem identification and causal awareness; (2) traditional knowledge; (3) evaluative understanding; and (4) intuitive and particularized knowledge.

Figure 1
Major Areas of Nonexpert Contributions
to Technical Knowledge

A. Problem Identification and Causal Awareness

- awareness that a problem exists
- diagnosis of social or environmental pathology
- formulation of explanatory hypothesis or causal connection

B. Traditional Knowledge

- intergenerational transmission of traditional ideas, i.e., folk remedies
- trial and error knowledge

C. Evaluative Understanding

- importance of cultural elements in social cohesion
- meaning and value of urban form
- needs of a community

D. Intuitive and Particularized Knowledge

- understanding of complex environments
- knowledge of particular events
- direct experience of the "commonplace"
- personal knowledge

Two decades ago, an unusual book was published entitled *Synectics*. The word's etymology, according to the book's author William Gordon (1961), is Greek. It means the joining together of different and apparently irrelevant elements. The author specifically had in mind the use of individuals of diverse backgrounds for the purpose of creative problem solving. The ideas developed in the work were put into practice by a consultant group with the same name. The author offers an excellent account of the limits of expertise. "The commonplace is the world of naive perception, free from sophisticated semantic rationalization. The specialized semantics of established knowledge constitute conventions which make reality abstract and second-hand."

The commonplace is often the source of primitive science. For example, people sensing a threat to their personal environment normally will react in a protective fashion that includes a demand for causal explanation. In these situations, lay people have generated clear and useful hypotheses correlating a suspected cause with an effect. Once postulated, these causal conjectures have provided the grist for rigorous scientific analysis of public health problems. The victims of disease have the greatest stake in understanding its etiology. They have been remarkable sources of research problems despite the formidable obstacles placed between them and the experts. Since experts are few in number, the masses of people who inhabit the commonplace have a clear advantage in identifying suspected causes of public health and environmental problems. As we shall see in the following sections, experts frequently are skeptical, arrogant, and paternalistic when advised by a lay person of a causal link between an environment factor and a human malady while, ironically, many of these links have folk wisdom to thank for their initial discovery.

Science has grown and has changed rapidly compared to the culture of aboriginal societies. In the latter circumstance, many generations of trial and error culminate in an accepted practice. Modern science has replaced the more primitive trial-and-error methods. Nevertheless, those methods have been a valuable source of knowledge for the aboriginal culture and for modern science. The study of folk medicines by ethnobotonists, biochemists, and pharmacologists for active ingredients has resulted in important modern medicines. A greater appreciation of primitive agricultural methods adapted to certain regions of the world has also provided scientists with insight into the fragile nature of ecological systems. In a culture without high-speed computers, abstract models of ecosystems, laboratory conditions, and controlled tests, incremental changes over hundreds of years, observed and transmitted through generations of peasant farmers, were the only reliable source for technological innovation. The folk wisdom of trial-and-error progress offers two important contributions. First, it suggests that there has been a technological adaptation. When some system works, we can begin to examine the conditions for success. Second, it also tells us something about the applied technologies that may have failed.

Architects and planners are trained to design physical environments. In the process, they make decisions about the cultural significance of the form and function of structures. Old buildings are razed; old spaces are redesigned. The experts bring to the problem the canons of their profession, the architectural fashions of the day, the desires of their clients, and their personal values. But those who have an intimate connection with the urban environment, who have walked and played in its streets and shopped in its stores, are uniquely qualified to discuss the meaning and value of its physical forms. A community, like a sensitive ecological system, takes years to develop. Nonetheless, its character can be changed abruptly by experts who fail to learn from those with a special relationship to the urban landscape. The folk wisdom of community life can alert the expert to the transcendent values of the commonplace and the elements of the past that are worth preserving for future generations. It is the social relations of communities that established their integrity. All it takes is one poorly planned project to begin the process of urban disintegration.

To an extent, we are all creatures of intuitive behavior. A certain degree of our understanding consists of tacit knowledge. We make choices in complex settings without reducing everything to its simplest terms and constructing a decision tree. Properly functioning intuitive behavior is a signal that there exists reliable tacit knowledge. The expert who is aware of the contribution folk wisdom plays in understanding complex interactive systems can benefit by exploring the tacit knowledge that underlies this special form of understanding.

The role of tacit understanding of indigenous populations is illustrated by the folk knowledge of peasant farmers. New seed strains developed in pristine laboratory settings do not always perform well as replacements for local strains. New seeds may be vulnerable to certain predators, plant diseases, heavy seasonal rainfalls, or high winds. Working farmers frequently have an intuitive grasp of the regional ecology that is invaluable to those developing new genetic strains. Because much of this knowledge is not systematized or recorded, communication with those working the land may be the only means of acquiring the information.

In summary, the cognitive contributions of folk wisdom to technical knowledge includes pragmatic knowledge obtained through the intergenerational transmission of trial-and-error experiences, intuitive understanding of complex interactive systems, the generation of scientific hypotheses, and causal links such as the identification of the environmental sources of human disease or ecological degradation and an understanding of meaning and value in urban form. Experts are trained to follow predetermined frameworks for guiding their inquiry. In many instances these frameworks--in conjunction with the elitist character of the technical mind--shut out potentially useful contributions from sources other than conventional ones. There are cases where the "lived-experiences" of indigenous peoples have a unique edge over the detached, abstract, and formalized understanding of technical experts. These special contributions are not to be seen in opposition to or in competition with science, rather they should be viewed as complementary to it. By neglecting the contribution folk wisdom can make to technical problems, society misses important opportunities. The cognitive areas of lay contribution to technical problems are illustrated in several examples for which there is documentation.

Problem Identification and Causal Awareness

A variety of American experiences demonstrate how ordinary citizens have developed important hypotheses far in advance of scientific investigators on the etiology of environmental damage. Their efforts to link chemical contaminants to disease or ecological disruption frequently were neglected, rejected, or damned by the community of technical experts. In some cases, this meant a loss for society of valuable time in responding to a serious problem.

In 1973, the state of Michigan fell prey to a catastrophic mistake when the industrial chemical polybrominated biphenyl (PBB) was mixed into the cattle feed of the major supplier to the state. It resulted in the slaughter of tens of thousands of cattle, thousands of sheep, steers, and pigs, and millions of chickens. The food chain had been contaminated by a chemical capable of causing birth defects, cancer, and genetic mutation. An estimated nine million people were exposed to the chemical; ten thousand exposed to fairly high doses.

A farmer named Rick Halbert, with two thousand acres, was one of the earliest to experience the effects of the chemical. "Most cattle died slowly, after becoming hunch-backed, bald and sterile, scarcely able to walk from monstrous overgrown hooves, sometimes a foot long. Before dying the cows invariably passed on the poison through their milk and, on slaughter, their meat, usually sold as hamburger, further infected the food chain" (Thames Television, 1977).

Halbert suspected something was wrong with the feed and designed a crude experiment to test his hypothesis. He fed a dozen calves only on this feed for about two weeks; when they wouldn't eat it anymore, he changed their diet. Most of the calves died over the next two months.

When Halbert reported his primitive experiment to the Michigan Department of Agriculture, they weren't impressed. They wouldn't accept the hypothesis that the feed was contaminated. Farmer Halbert devoted the next six months and five thousand dollars hiring independent researchers to investigate the feed. Mass spectograph readings showed it contained bromine. About eight months after Halbert first became aware of the problem, it was learned that Michigan Chemical supplied the Michigan Farm Bureau with sacks of the fire-proofing chemical PBB instead of the regular feed. In that eight-month period, considerable contamination of the human population of Michigan had occurred. Traces of PBB were found in nursing mothers who were breast-feeding children. The first official action was taken in May, 1974, nine months after the causal link was made by Rick Halbert. Throughout that period, agricultural experts and public health officials resisted the connections between the feed and the death to farm animals and human illness until the evidence and the public outcry mounted.

The Missouri dioxin story illustrates a similar case of an ordinary citizen playing an effective but neglected role as environmental sleuth. In 1971, horse-owner, Judy Piatt, began an investigation into the bizarre death of her prize steed. Piatt began to suspect there was something in the oil that was used to keep down the dust in her stable. For over a year, she followed the route of the salvage oil dealer who had sprayed the stable, compiling lists of sites where waste oil and chemicals were dumped. The list was sent to state and federal officials (Reinhold, 1983). Most ignored the information.

A state veterinarian who worked with Piatt also traced the source of the illness to the salvage oil dealer. It took the Center for Disease Control in Atlanta three years to identify traces in the oil of trichlorophenol (TCP) used in the manufacture of the herbicide 2,-4,5-7. It was only then that dioxin, a by-product of the manufacturing process, was identified as the contaminant. Dioxin is one of the most toxic materials known and is considered dangerous to humans in amounts greater than 1 part per billion. The soil in Piatt's stable contained 30,000 parts per billion. The people living in the dioxin-contaminated area knew that their health was threatened. Their knowledge was phenomenological--the result of direct sensory awareness of themselves and other life forms in their environment. Technical experts working for the state and the federal government demanded more and more evidence that people were at severe risk. The result was that "more than 11 years after animals began to die and humans fell ill from dioxin, the Missouri Division of Health issued its first public 'health advisory' on the effects of dioxin" and the heavily contaminated arena formerly owned by Judy Piatt was closed to the public (Reinhold, 1983).

These cases emphasize the invaluable role that ordinary citizens can play in monitoring the environment. Similar examples are available in the history of occupational disease. Asbestos and vinyl chloride workers were first to know that co-workers were getting cancer at an unusually high rate. They had to approach medical experts with their hypotheses when industry failed to act on their suspicions. Likewise, those who worked with the pesticide DPCP connected the exposure to the substance with their own infertility in advance of scientific determination. The importance of worker participation in occupational epidemiology has been recognized by Howard (1983) and the U.S. Department of Labor (1980).

Rachel Carson (1962) wrote that ordinary people began to report the disappearance of certain animal species and connected it to the spraying of insects. The direct awareness of bodily misfunction and sensory attack or deprivation is a highly sensitive barometer for environmental contamination. That experiential knowledge, in conjunction with rigorous scientific analysis, has resulted in the identification of many ecological problems and environmental determinants of disease.

To summarize, there are two arguments raised in this segment of the analysis. First, scientists may be treated as experts in areas for which they have no special advantage over the educated lay person. Second, because of the socialization of scientists, including their educational background, they may distort the nature of the problem under consideration. The former is a situation where scientific primacy is illegitimate. The latter requires the perspectives of non-technical minds.

TRADITIONAL KNOWLEDGE

Ethnomedicine has been defined as those beliefs and practices relating to disease which are the products of indigenous cultural development and not explicitly derived from the conceptual frameworks of modern medicine (Hughes, 1968). The contributions that ethnomedicine has made to contemporary pharmacology have been remarkable. We are reminded by anthropologists of the missed opportunities that result from disregarding treatments used in non-Western cultures. Vogel's (1973) classic study of folk medicines of the American Indian reports 170 drugs used by North American Indian tribes that have played a role in U.S. pharmacology. He contends the contributions of folk cultures have been a rich addition to modern science and technology.

> As scientists we cannot afford the luxury of an ethnocentric snobbery which assumes *a priori* that primitive cultures have nothing whatsoever to contribute to civilization. Our civilization is in fact a compendium of such borrowings, and it is a demonstrable error to believe that contacts of "higher" and "lower" cultures show benefits flowing exclusively in one direction.

Over many centuries, primitive forms of experimentation fashioned through tiral-and-error methods produced effective remedies. Some of these were later recognized by modern science. The therapies are easily dismissed because they are identified with unscientific patterns of discovery. Without historical documentation, it is difficult to know what form of rudimentary experimentation took place. Clune (1976) argues that "experimentation in the old-fashioned trial and error system is not unique to Western European societies or even to 'civilized societies'."

We know today that modern science has vastly underestimated the knowledge available in primitive medicine. According to Vogel (Grollig and Haley, 1976): "It is our civilization that has been hurt by this cultural bias, by this unwillingness to admit that primitive peoples might have something to offer scientific medicine." The attitude expressed toward the folk wisdom of primitive cultures is merely a reflection of the hubris of modern science against indigenous knowledge of all types in which the canons of verification and the pathways to discovery fall outside of prescribed norms.

To punctuate this point, it will be sufficient for our purposes to highlight some areas where folk medicine has been the precursor to modern pharmacology. In many cases, cultural bias has obstructed the transmission of the useful information. Vogel (1973) documents such a case. The American Indians used many herbal substances as oral contraceptives. The white settlers, however, convinced there could be no such thing as oral contraceptives, dismissed such uses without investigation. The Indians also used the plant foxglove (*Digitalis purpurea*) as a stimulant for hundreds of years before it was recognized by modern medicine as a heart stimulant. In Peru, an unknown witch doctor developed the use of quinine as a treatment for malaria (Clune, 1976). The Lulua women of Kasai Province of Zaire gave pregnant women, just before childbirth, a drink made up of the stems and leaves of a plant (*Oldenlandia affinis*) to ease the contractions and shorten the time of delivery. Biochemists have been able to isolate active chemicals from the plant species and confirm their uterine behavior. The periwinkle (*Catharanthus roseus*), native to the West Indies, has been the source of antitumor compounds that have been very successful in treating acute lymphocytic leukemia and Hodgkins disease (Meyers, 1979).

Ethnobotanists Lewis and Elvin-Lewis (1977), contend that, while hundreds of plants are used by expectant mothers around the world, the modern medical world knows very little about them. They argue that, since generation after generation of women continue to use the plants, they must have some efficacy beyond a placebo effect.

It is sufficient to learn about some of the outstanding achievements of such folk traditions to realize that trial-and-error methods used over centuries have something unique to contribute to modern medicine. Vogel remonstrates us for our neglect (Grollig and Haley, 1976): "Primitive medicine is too often regarded as merely a 'quaint' branch of folklore. Yet it was from primitive medicine or folk medicine that we learned of digitalis, oral contraceptive pills, inoculation, the dietary basis of scurvy, cinchona, and discovered medical uses for South American curare." The study of folk medicines is a rich source of hypotheses about the pharmacologic activity of potentially clinically useful substances, the effectiveness of which can be tested ultimately through animal or human studies (Hansel, 1972).

What is true of folk medicines is true also of all types of tropical forest species. The knowledge that aboriginal peoples have of useful species is a more efficient way to exploit their economic and medical potential than random screening. The recognition of this indigenous knowledge places value on the thousands of years of cognitive adaptation.

EVALUATIVE UNDERSTANDING

The architectural and planning professions have become transformed by contemporary research methodologies. From urban renewal to natural resource management, planning has become a complex affair often involving computer modeling, input-output tables, market studies, and environmental impact analysis. The modern planner is a social engineer who employs a variety of technological instruments but must also communicate to the laity, who often are confounded by the logic that has given rise to the final plan.

The literature on planning cites instances where elite planners neglect to hear the voices of the oppressed, where the planner is an instrument of an insensitive bureaucracy, or where the mission and values of planning have lost touch with the needs of the people for whom plans are generated. The question of interest for this paper is not how a captured planning sector may distort human needs. But, given a well-intentioned and honest planning unit with the full array of technical methodology and well-trained professionals, are there epistemic limitations or constraints in the process? Specifically, are there areas of knowledge for which nonprofessionals have an advantage over professionals?

To be more concrete, urban planners and architects frequently determine the meaning of urban forms. But that meaning is arrived at through intellectual categories and usually at some distance from the life experiences of the residential community. It is not unusual to find divergence between professionals and the indigenous culture on matters of the deepest philosophical significance, such as the scale of development or the nature of structural forms. Jane Jacobs wrote about the intellectual impoverishment of the architectural and planning professions when the concepts of elites are divorced from the personal knowledge of the city dwellers. Were the city planners and architects to communicate more effectively with neighborhood residents, they might understand why some ideas of urban form fail.

> Most city architectural designers and planners are men. Curiously, they design and plan to exclude men as part of the normal, daytime life wherever people live. In planning residential life, they aim at filling the daily needs of impossibly vacuous housewives and preschool tots. They plan, in short, strictly for matriarchal societies. (Jacobs, 1961)

The role of the professional planner is to obfuscate the knowledge base that propels him/her to an elitist position (Selwyn, 1973). Jacobs (1961) demurs: "The processes that occur in cities are not arcane, capable of being understood only by experts. They can be understood almost by anybody. Many ordinary people already understand them; they simply have not given the processes names, or considered that by understanding these ordinary arrangements of cause and effect, we can also direct them if one wants to."

Planning has become dominated by deductive models and abstract formalisms. However, inductive reasoning is more available to ordinary citizens. Therefore, it is not surprising that a schism has developed between inductive and deductive methods of inquiry since it has benefited the status of professionals. But in urban planning, a combination of particularized knowledge and generalized knowledge is essential. Jacobs reiterates the story of the Boston planner who advanced the false idea that the North End had to be a slum because the theoretical presuppositions that define his expertise say it is.

> Inductive reasoning of this kind is, again, something that can be engaged in by ordinary, interested citizens, and again they have the advantage over planners. Planners have been trained and disciplined in deductive thinking, like the Boston planner who learned his lessons only too well. Possibly because of this bad training, planners frequently seem to be less equipped intellectually for respecting and understanding particulars than ordinary people, untrained in expertise, who are attached to a neighborhood, accustomed to using it, and so are not accustomed to thinking of it in generalized or abstract fashion.

Jacobs emphasizes the importance of "pinpoint clues" or "unaverage events." Statistical studies can mask essential meaning:

> This awareness of 'unaverage' clues--or awareness of their lack--is, again, something any citizen can practice. City dwellers, indeed, are commonly great informal experts in precisely this subject. Ordinary people in cities have an awareness of 'unaverage quantities which is quite consonant with the importance of these relatively small quantities. And again, planners are the ones at the disadvantage. They have inevitably come to regard 'unaverage' quantities as relatively inconsequential, because they are statistically inconsequential. They have been trained to discount what is most vital.

Planning, like many other technical activities, requires a knowledge of particulars and generalities. Too often the planner is too distant from the source of the particular knowledge. Benveniste (1972) views the epistemological dichotomy as a consequence of socialization: "The experts and planners come from one social milieu, while their clientele includes different ethnic and social backgrounds. The planners do not have access to the communities they think they serve." The result is a distortion of the knowledge of particulars.

INTUITIVE AND PARTICULARIZED KNOWLEDGE

Farmers have a special relationship with the ecological niche within which they harvest their crops. What they have learned about their environment, its complex organization, its fecundity, its obstinacy, and its diversity has been achieved through years of intimate association with natural processes.

A great surge of agricultural research in the 1960s was focused on hybrid seed strains and advanced technologies to increase crop yield.

The development planning that went hand-in-hand with the "Green Revolution" took it for granted (a) that primitive farming methods had to be changed for yields to be increased, (b) scientific research applied to hybrid crops like corn, wheat, and rice could develop superior seeds in conjunction with pesticides and chemical fertilizers that would be suitable to different locales, (i.e., soil conditions, rainfall, wind), (c) the local ecology must be adapted to "advanced" agricultural technology, (d) the transmission of knowledge must take place in one direction, from the experts (agronomists, economists, rural development planners) to the farmers.

Notwithstanding the highly acclaimed results of applying plant genetics directly to improving agricultural yield, it hasn't always resulted in the improvements of living conditions. Trade-offs were made between higher yield and equity, or productivity and dependency.

The top-down planning model discounted the indigenous knowledge of those who worked the land. Some observers acknowledge the detrimental effects of the model. Speaking about the science and technology of agronomy, Chambers (1981) substantiates the ideas about personal and processed knowledge developed by Friedmann:

> The most difficult thing for an educated expert to accept is that poor farmers may often understand their situations better than he does. . . .
>
> A medical doctor, an agronomist, an engineer, an economist and a sociologist, visiting the same village will see and inquire about very different things. They will gain very different, and partial, views of a whole that is seen differently, and more holistically, by the villagers themselves.
>
> Modern scientific knowledge and the indigenous technical knowledge of rural people are grotesquely unequal in leverage. . .it is difficult for some professionals to accept that they have anything to learn from rural people, or to recognize that there is a parallel system of knowledge to their own which is complementary, that is usually valid and in some respects superior.

Some of the examples cited by Chambers illustrating the transmission or blockage of useful knowledge from indigenous people to "experts" and the dualistic expression of agricultural epistemology are:

- In east Africa, it took decades before western scientists realized that primitive practices were efficient.
- Tribal people in the Philippines have the ability to classify more plant varieties than those in expert botanical surveys.
- Rural people often make finer categorical distinctions and have more detailed knowledge of soils, plant indicators of fertility, weather patters, and pests and weeks.

> The calendar system of the Bihari farmers in India is particularly valuable for describing changes in climate and the sequences of cultivation, more so than the traditional calendar.

The local knowledge of tribal societies or rural farmers is characterized by its utilitarian nature. Ideas, concepts, and information are incorporated into the local social epistemology if they are adaptive to the culture and its technological base. Local fishermen may have a keen understanding of the coastline and its marine life forms. Marine scientists have benefited from such knowledge in their inventories or mappings of coastal areas.

Miller (unpublished) tells how local fishermen in the Caribbean aided scientists in developing maps of coral reefs. "We showed it [the maps] to some marine scientists who said they would have to spend months confirming the data. We would often have to look up the name of a particular species in illustrated guides because the fish have a different local name on each island, but their [fishermen's] information proved to be very sound."

Jacobs (unpublished) describes how important the indigenous laity can be in environmental planning:

> One particular municipality (in rural Quebec) had to generate a development strategy to meet a deadline which was about three weeks away when they contacted me. We got the best hunter in the municipality to tell us where all the wildlife was. . . .He drew a map which 18 professional ecologists working at $1000 a day for six months could never have delivered. The hunter was also one of the better conservationists I have known. He did not want to ruin his livelihood. . . .There are an enormous number of people with expertise in every community.

It is not simply factual details, or historical development, that characterizes the indigenous knowledge. There is a tacit understanding of complex ecological systems. The systems are organized within a conceptual system that meets the needs of the community. Thus, they see the world differently. They select different parts of the world for demarcation and identification. Events are organized according to a unique set of boundary conditions. There is more in local wisdom than the opportunity to fill in the empty spaces of the scientific paradigm. There are new ways to organize nature (Chambers, 1981):

> Unfortunately, many of those who are bearers of scientific knowledge have been trained away from being able to learn these different ways of seeing the environment, or to understand the problems and rationality of small farmers. They do not realize that small farmers are professionals too.

CONCLUSION

The thesis of this paper is that folk wisdom forms a complementary or antagonistic relationship to technical expertise in a variety of learning environments. I have discussed the ways that useful knowledge has been transmitted from the laity, primitive cultures, or indigenous populations to the modern technosphere. The examples illustrate the cognitive components of folk wisdom and their role in and contributions to scientific epistemology.

We have developed separate spheres in our modern society distinguishing those who generate knowledge from those for whom it is applied. The educational system and the class of professional elites germinating from it helps to reinforce and sustain this division. The result has been that the generators of knowledge seek an epistemological self-sufficiency. A close examination of some areas of inquiry shows that scientific and technical decisions can be aided in nontrivial ways by folk wisdom. In certain instances, the connection is stronger. Indigenous peoples develop an intimate relationship with their environment that provides a phenomenological basis for guiding change. Technical elites are frequently deficient in areas for which the "lived-experience" finds no easy substitute.

Scientific knowledge is supposed to transcend particularities without negating them. The emphasis placed on abstract formal systems, logical inferences, and imposed rational order on nature does just that. Folk wisdom derives from the particulars in space and time. It thus offers an appropriate check against the tendency toward the primacy of the universal or processed component of knowledge.

The thesis I have developed has important implications for public policy. Most accounts that establish a legitimacy for the public's role in technical and scientific decisions are based upon two ideas, either democratic theory or the appearance of divisiveness within the technosphere. My conclusions offer an epistemological basis for expanding the role of indigenous knowledge.

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