First publ. in: Alteration in Food Production / ed. by Dietrich Knorr and Tom R. Watkins. London: Van Nostrand Reinhold, 1984, pp. 223-237

13
The Reappropriation of Technology

Karin D. Knorr

THE IDEA OF POLLUTION

Ideas about purity and contagion appear over and over again in the history of cultures. Indeed, they seem to be so pervasive that we might rightly consider them as a basic organizing principle of human action. They lurk behind primitive dietary rules and laws of ritual avoidance (Douglas 1978), and they underlie our present respect for hygiene and distaste for uncleanliness in bodily and other matters.

Ideas about purity and contagion are not necessarily associated with food. The belief that one or each sex is endangered by contact with the other is a favorite expression of such ideas. But pollution may also result from birth or be consequent on death for the relevant kindred. It may stem from contact with blood or bodily emission such as spittle, from the glance or touch of an adulterer, or from dealing with a member of a lower caste. While it is hard to imagine the limits to which ideas about purity and contagion are confined, it is not difficult to identify areas of concern which are more prominent than others. In traditional societies, pollution ideas are frequently associated with food and its origin, or way or preparation.

Most familiar to us are perhaps Jewish and Islamic dietary rules which prohibit eating the meat of certain animals classed as "unclean." To quote form the abominations of Leviticus,[1]

> "3. You shall not eat any abominable things. 4. These are the animals you may eat: the ox, the sheep, the goat, 5. the hart, the

gazelle, the roe-buck, the wild goat, the ibex, the antelope and the mountain-sheep. 6. Every animal that parts the hoof and has the hoof cloven in two, and chews the cud, among the animals you may eat. 7. Yet of those that chew the cud or have the hoof cloven you shall not eat these: the camel, the hare and the rock badger, because they chew the cud but do not part the hoof, are unclean for you. 8. And the swine, because it parts the hoof but does not chew the cud, is unclean for you . . . "

The text continues to indict some sources of food "in the waters," as well as the birds, the "winged insects" and the "swarming things" for contagious "uncleanness," and to prohibit their touching or dietary use. In contrast among the Havik Brahmin, an Indian tribe, it is the processing of food rather than the origin of the material with which pollution rules arc associated. For example, a distinction is made between cooked and uncooked food as carriers of pollution. Cooked food is liable to pass on pollution, unlike uncooked food. Whole food (fruits and nuts) are not subject to contamination, broken or cut foods are. The process of eating itself is potentially polluting, and the manner determines the degree of contamination. Bathing, washing, and changing of clothes are required to ward off conditions of impurity which derive from—or are transmitted to—food (Harper 1964).

Recently, highly developed, post-industrial societies have also taken issue with conditions of purity and danger related to food on a public, societal level. They have identified an unprecedented and ever increasing number of sources of contamination in the most cherished parts of our menu, best exemplified perhaps by an impressive list of potential carcinogens and an equally impressive estimated number of 2,500 food additives that color, flavor, or preserve our food (Kermode 1972). They have begun to examine systematically the difference between appearance (look) and substance (content) of food, a difference which has long haunted—and helped to advance once it is taken into account—other sciences. To the lay member of these societies, the preliminary conclusions reached in these efforts are everything but encouraging. Danger has been reassociated with food to a degree that appears, to the sensitive listener of government recommendations and political argument over regulations, unprecedented (Hall 1976; Verret and Carper 1974; Hadwiger and Browne 1978).

In a sense, we have come full cycle. We have rediscovered the idea of pollution and the many facets it has in its full strength. We have come to believe that many traditional practices of purification and avoidance may not just be superstitious rituals to ward off evil spirits, but rather rules of hygiene which function similar to our own rules (e.g. Macht 1953).[2] At the same time, we have developed some of the religious overtones which have characterized traditional conceptions of purity and contagion for so long (Roszak, 1973). Of the many religious cults which riddle the technological-rational surface of our societies, quite a few operate with or proliferate around countercultural diet prescriptions. Finally, we have even recovered some of the feelings of fear and helplessness which anthropologists have associated with traditional societies' inability to effectively control their natural environment. These feelings of fear should not. only be seen in the light of perceived and publicly debated risks associated with modern "super"-technologies, but also in the light of an increasing awareness of small but presumably cumulative danger resulting from the pollution faced routinely in everyday life. The drastic increase of pesticide application and consumption in the last 25 years which is matched by a virtual stagnation of insecticide efficiency illustrates but one example of this kind of danger (Pimcntel et al. 1977).

That we have come full cycle constitutes something of a surprise. Do we not live in a technological meritocracy which many have characterized by its very concern with—and *success* in—instrumental control of the environment? Note that we cannot simply dismiss the present concern with pollution as an irrational revival of archaic, quasi-religious beliefs, despite the religious overtones which I have mentioned above. The consumer who searches the label of a supermarket product for known carcinogens and other undesirable ingredients such as sugar, fat, or artificial preservatives cannot be considered irrational. On the contrary, as in the case of the person who stops smoking in front of an overwhelming evidence testifying to dangerous consequences, it is reason itself which we must credit for prompting the respective behavior. Yet we cannot deny that there are valid grounds for our concern with with pollution without at the same time renouncing vast parts of our highly esteemed scientific knowledge. It is the very rationality of science which has contributed to the articulation of the malaise. While countercultural religious movements have stylized this malaise to their liking, the data and arguments which testify to a modern problem of pollution have largely been supplied by science itself, often without being solicited.[3] What, then are we to make of the situation?

SCIENCE AND FAITH

At least since the Second World War, science has lost its virtue. As many have noted, the heavy involvement of some sciences in the production of war technologies during and after the Second World War and the potentially disastrous consequences of this involvement have led to a very mundane picture of science whose details are only now beginning to fill in.[4] Rather than seen as an autonomous, curiosity-driven search for the laws of nature, science is now seen as a non-autonomous *part of* industrialized societies, whose features it helps to articulate. And rather than seen as a pure and disinterested attempt to achieve understanding of the world for its own sake, science is now seen to be embedded in trans-scientific (industry-, government-) connections within which the constraints and interests manifested in the kind of knowledge produced are negotiated, as, for example, in the recent asbestos case (Kotelchuk 1974). Close observation of scientists at work reveals science to be subject to the same social processes and the same opportunistic logic of reasoning found in other areas of social life.[5] The age of the "story-book" image of Science (Mitroff 1974) has come to an end.

The visible expression of our revised understanding of science is what is often called the "legitimation crisis" of science. In 1971, a *Science* editorial stated that the "period of faith in science and technology as an engine of social progress has come to an end" (Schmandt 1971). In 1979, "scientific credibility" was considered "one of the first casualties of the Three Mile Island nuclear accident" (Wcingart 1979). If these and other similar diagnoses (e.g. Brooks 1971) are correct, then public support for science—and as a consequence, political/economic support for science—can no longer be taken for granted. Science has not lost the right to speak authoritatively on relevant issues, but both its results and the kind of approach it represents no longer go unquestioned.

The differences of opinion and outright controversies in which experts tend to get entangled when they speak authoritatively in public are likely to contribute to a loss of public confidence (e.g. Nelkin 1975). They also indicate that the politicization of a scientific or technical problem will result in a polarization of expert opinions, whatever the original state of agreement has been. Examples of scientific products which have become the target of public debate come readily to mind. Nuclear power is only one of these examples, albeit one which is highly visible through public response and political discussion. Controversies regarding the risks involved in recombinant DNA research and in the increasingly popular artificial insemination are other recent examples (e.g. King 1977; Singer 1977). Nearly as debilitating is a kind of creeping disillusionment with science and technology, which afflicts many areas of immediate everyday concern such as nutrition and health (e.g. Wylie 1978).[6]

Let us focus, for a moment, on the area of health. If opinion polls can be believed, then medical technologies and medical knowledge are by far the strongest bastion of public confidence in science. According to the Science Indicators of the National Science Board (1977), among those who think that science and technology do more good than harm, the large majority (81% in 1976) refer to improvement in medicine as the basis of their judgement.[7] At the same time, it is evident that technological sophistication, in medicine as well as other areas, may reach a turning point of diminishing returns and increasing unreliability. In medicine, this turning point may have come with a new awareness of the constitutive role played by social and psychological factors in the genesis of illness as well as in the effectiveness of cure. If social and psychological factors account for a substantial part of the complexity of medical conditions, then increasing the sophistication of medical technologies will not necessarily be the most appropriate way to cure these conditions. In addition, the cost explosion of medical technologies is such that they impose an economic barrier to further technological development of a conventional kind, whatever other reasons there may be (Schonback 1980).

Most important, perhaps, in regard to the symbiosis between science, technology, and health is that explanations of the causes of illness and disease are sought not only in the social location and individual make-up of patients, but in general conditions of industrialized societies. It is here that we return to the concept of pollution. The pollution of the air we breathe, of the food we eat, of the environment in which we live, and of the conditions under which we work is probably the main factor held accountable for the origin and proliferation of the diseases by which we are struck. Oncological and respiratory diseases, heart conditions and obesity, even the common flu are linked to these general conditions. And not only are they linked to these conditions by the medical sciences, it is the sciences in general which are made co-responsible for the very *production* of these conditions (Schönbäck 1980).

The role of science which emerges from the sphere of health is ambiguous, to say the least. It is well reflected in public response to science, which seems to be marked by *ambivalence* rather than revolt (Etzioni and Nunn 1974). In some traditional societies, to possess authority is to possess "Baraka" or "Mana," the power to bring good fortune and luck. Yet these powers entail a large potential for conflict and rebellion since their only proof lies in their success (Firth 1940). It has for a long time been the success of science with which its authority and power has been associated. What if the "progress" of science is reconsidered in the light of the pollution, the danger and contagion produced by science? It is clear that an institution like science cannot be overthrown by a simple act of murder like the chief of a native tribe whose reign is not a fortunate one, and which hence contradicts his supposed possession of "Mana." Part of the fortune of those who arc credited with being successful is that the interpretation of their actions is informed by their reputation, which means that these actions are more likely to be seen as successes than as failures. For these and other reasons, the power of science in post-industrial society will not easily be undermined.

It is in light of such an unbroken power in parallel with a crisis of legitimation of science that we must see the public reaction of ambivalence. A phenomenon perceived as needed but uncontrollable will stimulate ambiguous reactions. At best, and here I draw again on the analogy of traditional cultures, ambivalence is overcome through ritual and magical practices which convey a sense of meaning, balance, and control. Anthropologists have often interpreted

such practices in native cultures as a means to cope with the fear and anxiety aroused by an essentially uncontrollable environment full of potential disasters and unexplained "chance" effects. It is not far-fetched to associate the revival of quasi-religious cults in the most technologically advanced of post-industrial societies with a similar sense of powerlessness in front of all-embracing institutions which constantly confront us with a "babble" (Bell 1976) of contradictory messages and effects. Lacking control and being unable to understand the meaningfulness of a technological "progress" which appears to create more problems than it solves, the individual person may hold on to reality by joining a quasi-religious world which explains (or bypasses) the original concerns.[8] To be sure, the issue of meaning and control refers us not only to the puzzles created by science and technology, but also to the larger context of societal institutions (Habermas 1975).[9] Yet in as far as science is associated with the development of industrialized societies, it can be held accountable for the crisis and contradictions produced by these societies.

THE REORIENTATION OF SCIENCE

Let us switch metaphors now and turn from the analogy offered by traditional cultures to one of the most advanced systems of knowledge, thermodynamics. Recent developments in thermodynamics (and in information theory) suggest that an increase of entropy, of disorder or fluctuation, must not only be seen as an inevitable by-product of the evolution of physical and biological systems, but also as a potential *source* of order and organization (Nicolis and Prigogine 1977). For example, fluctuations building up in chemical reaction systems through positive feedback may force the system through an instability into a new regime. In biological evolution, chance disturbances of a stable genetic order (mutations) result, if selection occurs, in reorganization and ultimately in the evolution of species (Jantsch 1980). The lesson to be learned from these analogies is that the dynamics of natural systems are based on principles of self- organization which cope with disorder and fluctuation by modifying the structure of the system.

In a sense, of course, we have always known that sources of danger can at the same time serve as a *ferment* for the development of practices which incorporate—and neutralize—the source of danger. Mary Douglas (1978) called the beliefs of the Lele, an Australian aboriginal culture, a "composting religion": that which is normally rejected as unclean and polluting is ploughed back (reverently eaten) at certain occasions for a ritual renewal of life. Literal rather than symbolic renewals have been described by Kuhn (1970) for science itself. The anomalies which regularly accumulate in periods of normal science[10] lead to situations of crisis and disorganization which then serve as a ferment for paradigm change, which means the development of new experimental and theoretical approaches, including new problem definitions and new definitions of relevant observations. However, the trouble with the current conception of science is that new theories and research programs often occur without a clearly recognizable crisis preceding the event. In other words, scientific crisis and symptoms of disorganization often accompany and follow upon the emergence of new orientations rather than precede them.

The issue is interesting in that it points to the frequent co-occurrence of ferments for change and resistance to change in social systems, which suggests that a renewal of the system involves a *struggle* between alternative orientations. In the history of science and technology, vigorous resistance to new conceptions that later turn out to become accepted is a well-known phenomenon." Like other members of society, scientists appear to have vested interests in the orientations they represent. Hence, they are not likely to change these orientations readily in face of the challenge of a new conception. Indeed, it was once said that new scientific orientations become accepted because those scientists who hold a different orientation slowly die out, not because they are converted to the new concepts (quoted in Kuhn 1970).*

This conservatism of the scientific community can be seen as quite functional to the development of knowledge. It prompts scientists to explore in depth the potential of a particular approach by holding on to this approach in spite of contradictory evidence (which almost always exists), and in spite of eventual challenges through new approaches (Lakatos 1970).[12] If new scientific concepts were readily given up in face of every contradictory evidence and logical inconsistency discovered, and in favor of every new alternative conception for which a case could be made, none of these conceptions would survive for any period of time sufficient to assess their power and validity. Yet this apparently functional trait of scientific behavior has the consequence that desirable new conceptions are often not recognized, or that they arc rejected and fought against. If the latter happens, symptoms of crisis and disorganization in a scientific field are symptoms of the struggle which accompanies the birth of a new orientation.

"Challenge of a new conception. Indeed, Max Planck once said surveying his own career that "a new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up **that** is familiar with it" (quoted in Kuhn 1970).

The German philosopher Arthur Schopenhauer (1788-1860) summarized the situation when he said that each problem passes through three stages until it is recognized: in the first it appears to be ridiculous; in the second it is fought; and in the third it is taken for granted. However, new orientations struggle not only with established conceptions to which they arc opposed, but they also struggle with themselves. By this, I mean that the emergence of a new orientation has to be seen as something which is brought about through conscious effort and which takes shape only in the very process of its own development. Theories intended to replace a traditional view develop their character and potential in their process of articulation, often in controversial arguments with those whose interests side with the received conception. Reorientations of high consequentiality do not hit and strike ready made. In fact they can often be identified as a coherent system only *after* they have replaced a previous conception and become fully articulated in normal science* In the process of reorientation, not everything which is said is equally warranted or has equal weight. Furthermore, polemical and programmatic statements on all sides unavoidably accompany the polarizations which occur. While their face value may be questionable, they often reinforce and accelerate the preliminary process of articulation. The issue in a process of reorientation is not to close the debate by providing some definite (alternative) answers to new questions raised, but to literally open up the discussion about topics which are held to be ignored or misconceived in previous scientific practice.

Granted that science must struggle through periods of reorientation, what does all this have to do with the issues raised in the first section of this chapter? We have said that compared with many traditional cultures we have come full cycle in recognizing a link between impurity and danger within science itself, in the form of the concept of pollution. Recognition of the scientific relevance of this concept as a principle of scientific explanation marks a shift in general scientific orientations that has only recently begun. This shift is characterized, for example by: a focus on dynamic systems of relationships rather than on isolated effects; the realization that homologous principles may be at work both in physical and biological systems; a recognition of the historicity of nature in connection with the impact of man, and particularly of modern technology, on our environment; and the shift toward a logic of consequences rather than of pure antecedent conditions and functions.[13] Such a shift is also indicated by the symptoms of crisis of legitimation that disturb the relation between science and society, a crisis which seems as yet to be far from reaching a turning point.

Pollution as a phenomenon of industrial societies lies at the core of this discrepancy. Pollution is co-produced by modern technologies and articulated by science; but for the participants in society, it is a lived experience and an everyday concern. The distinction is simple, but consequential. To smoothe the relations between science and society, pollution must not only be a topic of scientific investigation, but *pollution-avoidance* will also have to become a practice of science. Science is self-referential in that it articulates and determines its own conditions of reproduction. In that sense, the articulation of the idea and the empirical constituents of pollution pave the way for a reorganization of scientific practice which *takes into account* the dangers of pollution as articulated by science. To the lay observer of science, the stage of articulation of relevant concepts appears to be well advanced. Yet without further incorporation of these concepts in a *reorientation* of scientific *practice,* the social ferment contained in the scientific discovery of pollution can tip the scales against science and technology.

CONCLUSIONS

To conclude, let me address directly the question of reappropriation of technology to which 1 have alluded in the title of this chapter. From what was said before, it will be clear that the reappropriation of technology by society at large is not just a question of developing

technologies of appropriate scale, or costs, or labor intensity. With all due respect for the economic importance of such factors in post-industrial as well as in developing countries, I do not think that they get to the heart of the matter. The question of reappropriation of technology touches upon the *substance* and content of technologies themselves and not just upon economic adequacy or adequacy of scale. It is a question of developing technologies whose rationality is measured against the danger they inflict upon the *conditions of reproduction* of social and natural systems rather than against productivity returns. Note that these conditions of reproduction *include* the conditions under which science and technology will operate in the future. Science, like other social systems, has always been self-organizing in the sense that it willy-nilly adapts to the conditions it has unwittingly helped to produce by reorienting and restructuring itself. It has yet to become *self-reflexive* in the sense of developing its skills of time-binding, which means anticipating the future consequences of today's scientific action. Note that in the present situation, one sector of technology often hurts another because of this failure to correctly anticipate the consequences of scientific action. For example, tomatoes, specially grown to facilitate mechanical harvesting turn out to actually increase processing costs because of the higher water content of these tomatoes than that of the ones originally used (Pcrclman 1976).

It should be understood that this is not a plea for installing new disciplines such as futurology or technology assessment, or for reinvesting authority in our traditional philosophical specialities in self-reflexivity. What counts in practice now is the danger bred by the selection that is concretely embodied in the kind of technologies we employ. In other words, it is the consequences of concrete, everyday laboratory selections made by individual scientists, and the decision criteria employed, that have an impact on ecology and which thereby change the conditions of reproduction for science itself. It is only through changing the selection criteria embodied in the *content* of modern technologies that alternative consequences—and thus alternative futures—can be realized. Such reorientation of science and technology is a matter of restoring the faith that science and technology can, and will indeed, work toward the "progress" and "survival" that they have always proclaimed. To restore this faith, what is done by science has to become more accountable for its conscquences rather than for the intentions by which it has been brought about. The reappropriation of technology is a matter of appropriating a future which is to our liking.

To be sure, futures are not generally the result of planned goal-oriented action. Phrased differently, the cumulative effects of lime- and space-bound social action cannot easily be foreseen, which means that we are not in a position to control the kind of future produced in social action. Despite modern science and technology, we are obviously not able to guarantee that all will be won. However, with science and technology, we may be in a position to assure that not all is lost. Scientific attention to, and avoidance of, danger similar in spirit to the ritual attention to, and avoidance of, danger found in traditional societies appears to be a simple and effective means to give such an assurance which is both practically successful and confidence-restoring.[14] Moreover, it is a means which is feasible within the knowledge which we currently possess. Technologies today can be obstrusive or unobstrusive, hard or soft, eroding or cultivating, micro- or macro-rational. However, they will not become the latter without a thorough reorientation of science.

FOOTNOTES

1. The quote is taken from the New Revised Standard Translation of the Old Testament (Ueut. xiv). For a selection of relevant quotes from Leviticus and Deuteronomy and for a collection of interpretations of Moses' dietary rules see *Douglas* (1978, chapter 3).
2. This is not necessarily to say that primitive rules of hygiene function with the same degree of efficiency (measured by our present standards) which we presuppose for our own rules of hygiene. Note that the efficiency of our own rules of hygiene continues to be controversial. For a rcinterprctation of many of the successes attributed to the discovery of antibiotics as due to improved hygienic conditions in general see *Systemanalyse* (1978).
3. To quote but one example of a sustained effort to gel governments to recognize the intensity and impact of the problem of pollution let me refer to the NGO Report on the United Nations Conference on Science and Technology for Development in Vienna, Austria (1979).
4. Sec *Salomon* (1977) for an overview of this development which links the worldwide emergence of science-policy institutions to the role science played in the Second World War.
5. Studies of the work of science based on direct empirical observation are still rare. These studies arc interesting in that they allow for the first time (o empirically assess beliefs about the logic and methodology of research. For a summary of **the** published results of these studies, including my own, see *Knorr* (1981).

6. See the issue of *Daedalus* on the "Limits of Scientific Inquiry" (Spring 1978) for a general discussion of public apprehensions about the risks involved in certain kinds of research and of potential restrictions that could be politically imposed upon science.
7. For a review of opinion-poll results relevant to the public assessment of science and technology, including the question of what the public actually knows about science, see *Weingart (\919).*
8. See *Bell* (1976) for a general discussion of the problem of meaning in post-industrial 'societies. Note that our scientific attitude toward nature, which many have qualified as "exploitative" and thereby as responsible for current ecological problems, can also be seen as rooted in religious beliefs and those of Christianity itself White (1967).
9. In particular, *Habermas* (1975) has diagnosed a crisis of legitimation and of "motivation" in regard to political institutions. The "crisis of motivation" refers to the loss of interest people display in participating and endorsing the traditional institutions of our societies.
10. *Kuhn* (1970) considers periods of "normal science" periods of relatively uncontrovcrsial .scientific activities which fill in the details of new theoretical/empirical orienlalions emerging in periods of "scientific revolutions^1
11. See the historical examples provided by *Kuhn* (1970) or the present controversies which accompany a reorienlation of science and technology in medical and food research (e.g. *Kotelchuk,* 1974; *Hall;* 1979). Kotelchuk, in the case of medical research, documents industry resistance; Hall, in the case of food additives, exemplifies the controversy between government and industry.
12. According to *Lakatos* (1970), scientists construe a "protective belt" around a research program which allows them to sustain confidence in the program despite contradictory evidence or theoretical puzzles.
13. The scientific developments which form a general background for this reorientation arc summarized in *Jantsch* (1980).
14. In as far as the public and economic support of science depends on this confidence, the last aspect can hardly be overestimated.

REFERENCES

Bell, D. 1976. *The Cultural Contradictions of Capitalism.* New York: Basic Books.

Brooks, H. 1971. Can Science Survive in the Modern Age? *Science* 174 (4004), 21-30.

Daedalus. 1978. Special Issue. Limits of Scientific Inquiry, vol. 2 (Spring).

Douglas, M., 1978. *Purity and Danger: An Analysis of the Concepts of Pollution and Taboo.* London: Routledge & Kegan Paul.

Etzioni, A. and C. Nunn. 1974. The Public Appreciation of Science in Contemporary America. *Daedalus* 3 (Summer): 191-205.

Firth, R. 1940. The Analysis of Mana: An Empirical Approach. *Journal of Polynesian Society* 48 (4), 483-508.

Habermas, J. 1975. *Legitimation Crisis.* Boston: Beacon Press.

Hadwiger, D. and W. Browne. 1978. *The New Politics of Food.* Lexington, MA: Lexington Books, D.C. Health and Co.

Hal, R. H. 1976. *Food for Nought: The decline in Nutrition.* New York: Vintage Books.

Hall, R. L. 1979. Food Ingredients and Additives, In: F. Clydesdale (ed.), *Food Science and Nutrition. Current Issues and Answers.* Englewood Cliffs, NJ: Prentice-Hall, Inc.

Harper, E. B. 1964. Ritual Pollution, as an Integrator of Caste and Religion. *Journal of Asian Studies* 23 (June-Sept.), 151-197.

Janlsch, E. 1980. *The Self Organizing Universe. Scientific and Human Implications of (he Emerging Paradigm of Evolution.* Oxford: Pergammon Press.

Kermode, G. O. 1972. Food Additives. *Scientific American* 226 (3), 15-21.

King, .T. 1977. A Science for the People, *New Scientist* 16 (1056), 634-637.

Knorr, K. D. 1981. The Ethnography of Laboratory Life: Theoretical Challenges and Empirical Results. *International Society for the Sociology of Knowledge Newsletter* (March).

Kotelchuk, D. 1974. Asbestos Research. *Health/Bulletin* 61 (November/December): 1-27.

Kuhnv T^ST~1970-r/ie *Structure of Scientific Revolutions*^ Chicago: Univ. of Chicago Press.

Lakatos, I. 1970. Falsification and the Methodology of Scientific Research Programmes, In: I. Lakatos and A. Musgravc (cds.). *Criticism and the Growth of Knowledge.* Cambridge, England: Cambridge Univ. Press.

Macht, D. 1953. An Experimental Pharmacological Appreciation of Leviticus XT and Deut. XIV. *Bui. Hist. Medicine* 27, 444-459.

Mitroff, I. 1974. *The Subjective Side of Science.* Amsterdam: Elsevier.

National Science Board. 1977. *Science Indicators 1976.* USGPO, Washington, D.C.

Nclkin, D. 1975. The Political Impact of Technical Expertise. *Social Studies of Science* 5, 35-54.

NGO Report, 1979. NGO Report on the United Nations Conference on Science and Technology for Development in Vienna 1979. Study Group of the NGO Committee on Science and Technology for Development, New York.

Nicolis, G. and I. Prigogine. 1977. *Self-Organization in Non-Equilibrium Systems: From Dissipative Structures to Order Through Fluctuations.* New York: Wiley-Interscience.

Perelman, M. 1976. Efficiency in Agriculture: The Economics of Energy, In: R. Merill (ed.), *Radical Agriculture.* New York: Harper & Row Publ.,

Pimcntel, D. et al., 1977. Pesticides, Insects in Foods, and Cosmetic Standards, *BioScienceH* (3), 178-185.

Roszak, T. 1973. *Where the Wasteland Ends; Politics and Transcendence in Post-Industrial Society.* Garden City, New York: Anchor Books.

Salomon, J. J. 1977. Science Policy Studies and the Development of Science Policy, In: I. Spiegel-Rosing and D. de Solla Price (eds.), *Science Technology and Society.* London: Sage.

Schmandt, J. 1.971. Crises and Knowledge. *Science* 174 (4006), 231.

Schönbäck, W. 1980. *pesundheit im gesellschaftlichen Konflikt.* Munich, Vienna, Baltimore: Urban & Schwarzenberg.

Singer, M. 1977. Scientists and the Control of Science. *New Scientist* 74 (1056), 631-634.

Systemanalyse. 1978. *Syslemanalyse des Gesundheitswesens in Österreich.* Vienna, Austria: Montan Verlag.

Verret, J. and J. Carper. 1976. *Eating may be hazardous to your health.* New York: Simon & Schuster.

Weingart, P., 1979. Science and Technology in a Legitimation Crisis. Hypotheses and Indicators. *Communication and Cognition* 6, 378-393.

White, L., 1967. The Historical Roots of our Ecologic Crisis. *Science* 155 (3767), 1203-1207.

Wylie, P., 1978. Science has Spoiled my Supper, in: J. D. Gussow (ed.), *The Feeding Web: Issues in Nutritional Ecology.* Palo Alto, CA: Bull Publishing Co.