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ABSTRACT

While fact/value separation has wide support as a strategy for resolving science and technology controversies, both the possibility and desirability of separating facts from values have been challenged by recent work in science and technology studies. As debate has refined the issue, it is generally accepted that many aspects of scientific work are value-laden, that scientists after all are human, and their values, preferences and biases influence their work in numerous ways, thus rendering the thesis of fact/value separation untenable. The untenability of fact/value separation has implications for journalists and journalism educators: journalists should be wary, and students should be taught to be wary, of calls for fact/value separation that "sub rosa" limit the range of issues considered. (NH)

"JUST THE FACTS/VALUES, MA'AM"

An Inquiry Into the Desirability

Of Fact/Value Separation

In Science and Technology Controversy

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ABSTRACT

Fact/value separation has wide support as a strategy for resolving science and technology controversies. It is believed to simplify controversies, allow meaningful assessment of factual questions, and permit technically trained people to do what they are best able to do while reserving value-laden issues to the political process. The philosophical dispute over value-neutrality in science is reviewed. It is argued that, even if value-neutrality is possible within the context of validation in science, fact/value separation is not possible in science and technology controversy, where it is advanced not as a rational reconstructon but as a process for dispute resolution. It is argued that the alleged separation of facts and values itself requires a value judgment about the relative importance of issues relevant to the controversy, and that the value judgment often is made uncritically. The untenability of fact/value separation has implications for journalists and journalism educators. Journalists should be wary, and students should be taught to be wary, of calls for fact/value separation that sub rosa limit the range of issues considered.

"JUST THE FACTS/VALUES, MA'AM"

An Inquiry Into the Desirability
Of Fact/Value Separation
In Science and Technology Controversy

Separation of facts and values is a widely held professional norm among journalists, expressed in ethics codes, textbooks and journalistic practice.[1] Likewise it has wide support as a strategy for helping to resolve public controversies involving science and technology. Yet the possibility and desirability of separating facts from values in such controversies have been challenged by recent work in science and technology studies which suggests that fact/value separation, far from facilitating matters, may actually get in the way. In this paper I will summarize two influential presentations of the case for fact/value separation, then critically analyze them, drawing on the STS literature. Then I will suggest some implications for journalists and journalism educators.

Fact/value separation has powerfully influenced the conduct of science and technology controversies by seeming to support a widely held assumption -- that such controversies will be best resolved if value questions can be set aside so that a decision can be made on the basis of facts.[2] Facts, contrasted not only with values but with emotions, opinions and other subjective states, are thought of as "irrefutable descriptions of actual states of affairs in the world," as Shepard put it in a critical summary of habits of thought encouraged by the fact/value dichotomy. By contrast, values are seen as

> the mud in the water that stops us from seeing clearly to the bottom of things. So we come to believe that to resolve disagreement we must clear away the value questions that muddy up our attempts to get at the facts and to use them rationally to solve our problems.[3]

The assumption that facts are privileged is apparent in the title and promotion of a recent account of the dioxin controversy: Dioxin, Agent Orange: The Facts.[4] The book's purpose, according to its dust jacket, is to "arm you with the facts to weed out dioxin's real from its imagined threats." The primacy of facts is similarly implied in the offer of a scientist-author to provide "objective information" as a safeguard against interest groups who "want to mould public opinion." Such groups, he wrote,

> may be environmentalists, chemical manufacturers, food faddists, drug companies, religious organizations, government departments: all with a particular message. If you have not got the basic understanding of the technical questions involved, you will become the dupe of the best salesperson, the most attractive presentation.[5]

The assumption here is that value questions open the way to manipulation of issues by those with financial, political, ideological or even fraudulent aims. Related to that idea is a perception of a public unarmed with fact as easy prey to its own irrationality. A vice president of the Atomic Industrial Forum, Inc., in a foreword to a journalists' primer on nuclear energy, wrote that the "relatively straightforward" facts about nuclear energy, if presented in an uncomplicated way, "ought to go a long way toward clearing the underbrush of emotion, awe and, yes, irrationality that so often accompanies popular reporting on nuclear subjects."[6]

Similarly, a Chemical and Engineering News article on chemical companies' community relations programs reported that scientists who attend community meetings are "frequently greeted with fear, emotion, anger and resentment." However, the article continued, scientists who have first learned to put "data . . . into language ordinary people can understand" can then "try to put themselves in the position of people experiencing these emotions and then try to give them the answers."[7]

While on one level this prescription is a call for sensitivity to public concerns, on another it demonstrates how difficult it is to eliminate a patronizing attitude. The public is portrayed as afraid, angry or resentful and as incapable of understanding complex data. The task of the corporate scientist, in this view, is to simplify the language in which data are expressed, empathize with the emotion-laden public and communicate the necessary technical understanding, "the answers," in simplified form. This having been done, there is a greater chance that the public's fears will be allayed. Left unconsidered are the possibilities that the public may be capable of understanding the data, may have legitimate, rational concerns, or that scientists should try to understand and respond to those concerns on their own terms.[8]

The privileging of facts also points the way, as the article just discussed exemplifies, to a marking out of an appropriate role for scientists, engineers and other technically trained people involved in controversy. They are to supply value-neutral facts that are authoritative, because grounded in science, and necessary to guide establishment of policy through political processes. Thus is a distinction drawn between policy issues, which are assumed to be value-laden, subjective and political, and scientific and technical issues, which are assumed to be value-neutral, objective and apolitical. In the traditional view, technically trained people are assigned to the technical side, where their competence presumably lies.[9]

That scientists often have chafed at this role is a story often told.[10] That it continues to be told in relation to fresh events, however, suggests how entrenched within the culture of science is the commitment to fact/value separation in science and technology controversy. When a National Academy of

Sciences panel in 1988 issued a report on homelessness in the United States, ten of thirteen participating scholars signed a supplementary statement criticizing it as "too limited" in language and approach. As reported in the New York Times, the statement called homelessness "an outrage, a national scandal," and said the scholars had tried to present the facts and figures of homelessness, but were "unable to capture the extent of our anger and dismay."[11] The academy, however, refused to publish the statement under its aegis, President Frank Press saying it was rejected because its language was "charged and polemical and emotional." The academy, he said, "has a certain credibility to maintain and must assure Congress and the executive branch that it will stick to the data and minimize the intrusion of values as much as possible."[12]

In some of its elaborations -- Crone's distrust of any group with a "particular message," for example -- the call to separate facts and values borders on outright distrust of value issues as such: Values are indeed seen as "intrusions." In others, however, value questions are accorded more legitimacy. In defending the decision of the academy, for example, Press was reported to have said he was glad the angry scholars made their views known independently. Members of the panel were "so repelled by what they saw," he was quoted as saying, "that they wanted to go beyond their charge and give their views. We told them that was not our process. If they wanted to do it, they had to do it independently."[13]

Press implied not that values are an inappropriate "intrusion" into the overall process of determining policy, but rather that they are inappropriate to the role scientists are called upon to play as scientists. Rather than implying distrust of value questions, Press implied a respect for them -- when they are kept on the policy side of the technical/policy dichotomy. Similarly, in their investigations of the structure and dynamics of science and technology controversy, Lowrance and Mazur emphasized the importance of both value questions and fact questions, even while maintaining the usefulness of deciding them separately. More than some of the foregoing examples, in which fact/value separation is more or less uncritically assumed, their arguments for the position are careful and authoritative, offering the opportunity to examine the case in its best light. I turn now to an analysis of their positions on fact/value separation.

II

William Lowrance, a Ph.D. chemist and scholar of science and technology policy, wrote Of Acceptable Risk (1976) with the encouragement of the National Academy of Sciences and in consultation with an *ad hoc* panel of the academy's Committee on Science and Public Policy.[14] That the book was written with one eye on improving media coverage is apparent from the foreward by the panel chairman, University of Illinois chemistry professor H. S. Gutowsky. Gutowsky wrote that the safety of the public has become

> the subject of extensive reporting in the daily press and other media. It has been our observation that some of this reporting is not sufficiently informed, especially as concerns the scientific basis -- and limitations -- of the determination of safety and of the role of scientists in this process.[15]

Hoping to clarify these issues, Lowrance argued for a fact/value distinction between the measurement of risk, which he characterized as an "empirical, scientific activity," and the judgment of safety, which he characterized as a "normative, political activity." The difference between risk and safety, Lowrance wrote, is often forgotten, a failing that is "often the cause of the disputes that hit the front pages."[16] However, Lowrance also stressed that both empirical and normative activities, fact questions and value questions, require careful attention from decision makers. In dealing with the risks of modern life, he wrote,

> we continually have to seek a proper balance between the comprehensive, rigorous, rational approaches that seem so essential, and the subjective, less quantifiable but not necessarily less valid approaches characteristic of political and social confrontations with the unknown.[17]

Nonetheless, scientists, engineers and other technically trained people have an important, even decisive, role to play, Lowrance argued, not only in measuring risk but in some policy areas as well. Lowrance believed that scientific work not only provides factual knowledge but instills habits of systematic thinking that make technically trained people better fitted than others to apply scientific knowledge to value-laden decisions. Such decisions come up in what Lowrance described as the "any-man's land" of overall risk assessment, which connects the scientific determination of risk with the political determination of safety. Scientists who recommend exposure limits, doctors who prescribe medicine, and engineers who design dams and toasters are all making decisions that are "heavily, even if only implicitly, value-laden," according to Lowrance.[18]

Noting the reluctance of some scientists to presume to make value-judgments on behalf of society, Lowrance nevertheless warned against defaulting "the appraisal of complex technological issues onto non-technically trained political leaders," lest the leaders make decisions with inadequate expertise or "fall prey to the influence of strongly biased special interest lobbies."[19] In the "any-man's land" of judging safety, he wrote,

> technical people are presumably as capable as others are, and in many cases more so, because of their breadth of experience, and their habit of systematic thought. Not only can they understand the

> technical details and appreciate the nature of the uncertainties, but from experience they can often provide historical perspective on the problem, anticipate the public's acceptance of the risks fairly accurately, and think of alternatives and consequences that nontechnical people would miss.[20]

Lowrance mapped out a procedure for settling risk and safety controversies. It could be described as a continuum along which the task of risk and safety determination should take place, moving more or less from one end to the other. First there are objective, value-neutral, scientific activities -- the measurement of risk -- carried out by technically trained people. In this part of the continuum there are three lines of inquiry: 1) defining conditions of exposure; 2) identifying adverse effects; and 3) relating exposure and effect.[21]

Although there are numerous sources of potential uncertainty in the first three lines of inquiry, Lowrance counseled researchers to rely on their experience, make the best estimate possible and hope for better data to be produced in the future. For example, he discussed the uncertainties of extrapolating from animal tests to humans, the problems of inferential adequacy involved in using small numbers of animals in laboratory tests, and the uncertainties of extrapolating effects into the low-dose range of a dose-response curve, where there are relatively few data points to guide the researcher in drawing the curve.[22] "Until the curve can be defined better in the low range," Lowrance counseled, "the best we can do is apply experience from related extrapolations and sketch in an extension. . . ."[23]

A fourth line of inquiry for technically trained people is the overall assessment of risk. Located in the middle of the continuum, overall risk assessment takes place in "any-man's land" and "edges up to being political as well as scientific. . . ."[24] The first four lines of inquiry "need not be sequential," according to Lowrance, although the fourth is the "pay-off stage, building upon all the preceding inquiries."[25]

On the other side of "any-man's land" are subjective, value-laden, political/social activities, carried out by lay people or their representatives. It is here that safety determinations, as opposed to risk determinations, are made. On the technical side of the continuum the question has been, How much risk is there? On this side it is, How much risk is acceptable. Determinations of safety can involve such criteria as "reasonableness," custom of usage, and prevailing professional practice, and often involve balancing such considerations as the degree to which risk is voluntarily borne, the availability of alternatives, and whether or not the risk is encountered occupationally.[26]

To summarize: While allowing for uncertainties and estimates on the technical side, for the likelihood of a non-sequential research process, and for the existence of the "any-man's land" of technical participation in value-laden decisions, Lowrance's scheme in the main recommends that fact questions be separated from value questions, that fact questions be determined by technically trained people, and that value questions be settled through political processes. Lowrance focused his discussion specifically on risk and safety issues. A similar approach, expanded to include science and technology controversy in general, was taken by Allen Mazur, a leading proponent of the "science court" idea.

III

Mazur, a sociologist of science and technology with a background in engineering, presented the case for fact/value separation in journal articles and in The Dynamics of Technical Controversy (1981). Unlike Lowrance, Mazur did not maintain that technically trained people are better equipped to make certain kinds of value-laden decisions by virtue of their "habit of systematic thought." Indeed, he explicitly rejected that view, asserting that scientists "are best able to deal with scientific issues, but they are no more qualified to render value judgments than any reasonable layman."[27] But like Lowrance, Mazur proposed a procedure to simplify science and technology controversy, the key feature of which was separation of fact questions from value questions.

Total separation is not necessary, Mazur argued: Values shared by all sides or values too subtle to affect practical decisions may be left harmlessly intertwined with factual statements. However, when "blatant evaluative or normative statements" are intermixed with factual statements, the result is an unnecessarily complicated controversy. Mazur's purpose was to "explore the practicality of simplifying these arguments by treating contentious scientific issues apart from the non-scientific issues with which they are usually intermeshed."[28]

One benefit of doing so is that scientists can concentrate on doing what they are best qualified to do -- determine the facts -- while value issues would be reserved for the political process, whose participants presumably have both political skills and a public mandate.[29] Additionally, untangling matters of fact from matters of value would permit the factual questions to be settled properly because it would permit them to be framed in a way which would allow "meaningful assessment through scientific methods."[30] For Mazur, the danger is not that adversaries in a dispute will purposely distort facts to support their positions (although he said it would be "naive to believe that this never occurs[31]). Rather the danger is that in the heat of controversy, "an adversary may find it rhetorically useful to state his factual hypotheses in terms which make them difficult to evaluate." Particularly, adversaries going up against a powerful, well financed establishment have a tendency to take a defensive posture and to state their technical position "in a manner that provides little opportunity for a clear refutation by the other side."[32] Mazur's concern here appears not to have been with clearly identified polemics but with rhetorical tactics hidden in ostensibly factual statements.

Mazur's scheme for untangling facts and values was the "science court," similar to the "institution for scientific judgment" proposed in 1967 by Arthur Kantrowitz.[33] As outlined by Mazur, a science court would work like this: Controversial technical issues would be referred to the court, perhaps by the legislature, by lawsuit in an ordinary court or by referendum. Adversaries, or "case managers," would be selected for each side, and they would be asked to state and document the scientific facts they considered most important for their case. Statements and documentation would be exchanged and examined, and each case manager would specify points of agreement and disagreement. A referee acceptable to both sides would attempt to arbitrate the differences.[34]

Agreement might be reached on some points by changes in wording or removal of ambiguities. If both adversaries agreed on all points, the agreed-on statements of fact would be issued as the science court's report. In case of continued disagreement, an open, public hearing would be held in which the adversaries would present their cases before a panel of expert scientists acceptable to both sides. Debate would be restricted to matters of fact. At the conclusion of the hearing, the panel of experts would issue its report, "attempting to provide a relatively sophisticated and relatively unbiased statement of these facts as they appear at that moment."[35]

It is possible that the judges could decide that either or both of the adversaries were wrong, Mazur wrote, or, alternately, that the differences were legitimate and irreducible because of ambiguous or insufficient data. The judges might also suggest research to clarify disputed points. But Mazur emphasized that the judges

> would not make a decision of policy, such as whether x cases of cancer for y amounts of electricity are acceptable. . . Judges' duties would be limited solely to clarifying the factual, strictly scientific issues and writing a report on the decisions on those points."[36]

Mazur tried to test a portion of the science court idea in a controversy in New York and Minnesota over construction of high-voltage tramsmission lines. This he did by offering to serve informally as a referee between two groups of experts on either side of a dispute over whether such transmission lines pose threats to human health not realized or acknowledged by the utility companies.

Mazur wrote to each of the experts involved, asking their help in putting together a list of disputed statements of fact. Only opponents of the transmission lines responded with lists, which asserted the following points:

> 1. Extremely low frequency (ELF) electric (and magnetic) fields can cause biological effects in human beings exposed thereto.
> 2. It is likely that ELF electric (and magnetic) fields associated with high-voltage transmission lines will cause biological effects in human beings exposed thereto.
> 3. No biological effect that is likely to occur in human beings exposed to the fields of high-voltage transmission can be shown to be nonhazardous.[37]

Mazur sent the list to proponents, who criticized the allegations as vague and untestable. In the first statement, "biological effects" was criticized as too broad a term to be empirically meaningful. The statement that the fields can have biological effects and the statement that no biological effect could be shown to be nonhazardous were held to be irrefutable because of the impossibility of proving nonexistence. The second statement was criticized for not containing clear criteria for assessing whether an effect is likely.[38]

One misconception was cleared up when opponents discovered they had "attributed to a pro-line expert the view that it was impossible to produce biological effects from low-intensity fields" -- a view the expert denied having held. On other points, opponents of the line revised their statement of facts in line with the criticism, rephrasing their allegations "in the form of epidemiological hypotheses with a degree of specificity that is common in standard journals. . . ."[39] The revised list now read as follows:

> People exposed for a period as short as five years to the electromagnetic field created by a 765 kV transmission line (as specified, for example, in "Application to the State of New York Public Service Commission for Certificate of Environmental Compatibility and Public Need," submitted by Rochester Light & Electric Corporation and Niagara Mohawk Power Corporation, January 1974) will be more likely to differ from a control population not so exposed in the following characteristics:
> 1. Growth, as measured by rates of change of physical parameters (e.g., height, weight).
> 2. Biological stress, as measured by physiological indicators (e.g., corticoids, serum proteins, circulating lymphocytes, blood pressure) and incidents of stress-related diseases (e.g., gastrointestinal and cardiovascular disorders).
> 3. Functioning of the central nervous and cardiovascular systems, as measured by neurohormone patterns, EEG, EKG, and the ability to adapt to blood volume changes.
> 4. Psychological behavior, as measured by decision-making capability, rates of acquisition of learned responses, gross activity level, reaction time, short-term memory, and motor coordination.[40]

One pro-line expert still objected, saying the revised statements remained untestable. Another did not comment, but two others found the revisions "sufficiently specific that they could disagree that the allegations were true for humans."[41]

As a result, Mazur felt that his effort to "separate the factual disputes of the transmission line controversy from its value disputes" had been "largely successful."[42] However, he drew an additional, disquieting lesson from the experience. After the task of fact/value separation had been accomplished, the pro-line side refused to debate its position on the factual issues in a science court setting. One pro-line expert objected to the idea of an adversarial science court as "anti-science," while another objected to one of the anti-line experts on personal grounds. Others refused to participate because they thought that to do so might undermine their cause. "Why, after all," Mazur acknowledged, "enter the debate if it is more likely to improve the relative position of the other side than of one's own side?"[43]

IV

After one has "the facts," what then? That is a question raised by several researchers, Mazur among them, who have examined science and technology controversies and found that facts are often less than compelling factors in the outcome. The response of the pro-line experts, Mazur wrote, "emphasizes that many technical controversies are primarily disputes over political goals and only secondarily concerned with the veracity of scientific issues which are related to these goals."[44] Science and technology controversies, he wrote in an earlier article,

> often arise because of strong moral and political convictions. . . . Controversies over nuclear power plants, the ABM, and recombinant DNA have a similar character, involving political and theological beliefs and anxieties about physical survival in which the resolution of a factual ambiguity one way or the other might be of little significance.[45]

Nevertheless, Mazur argued, factual disputes should be settled, if for no other reason than just in case anyone is willing to be guided by the outcome. His point is normative: There are situations, he wrote, "in which scientific knowledge will have no influence on those who make policy, <u>even though it</u>

should do so, but there are also situations in which the science court might have some impact on policy."[46].

This impact, Mazur wrote, is less likely to come about through any change of heart among partisans than because previously uncommitted people found their minds made up by the resolution of factual matters. A sophisticated, unbiased eport on disputed factual matters, Mazur wrote,

> could have an important impact on that portion of the public which has not yet taken a side in the controversy, but whose interests are at stake. . . . If the technical objections raised against tra smission lines or nuclear power plants were found to lack any scientific basis, and this was reported by a credible source, then political power would most likely shift to the proponents of these technologies as electricity became scarcer and more expensive, and previously nonaligned citizens became involved. The resolution of factual disputes may not serve the interests of those directly involved in the debate, but it would be in the best interests of the public at large.[47]

For Mazur, political commitment limits one's openness to persuasion by the facts. Similarly, Nelkin suggested that disputants' commitments to one side or the other may override their willingness to be influenced by facts. There is little evidence, she observed,

> that technical arguments change anyone's mind. In the disputes over fetal research and even in . . . various siting controversies no amount of data could resolve value differences. Each side used technical information mainly to legitimate a position based on existing priorities."[48]

Another line of research, by Paul Slovic and colleagues, suggests that humans are psychologically limited in their ability to carry out difficult cognitive tasks -- in other words, they are subject to "bounded rationality" -- and that they employ a number of devices to simplify matters, some of which may lead to biased perception. In these researchers' view, facts in a dispute over risk, for example, might be disregarded or distorted by a variety of heuristic devices, including the tendency to "judge an event as likely or frequent if instances of it are easy to imagine or recall."[49]

In some case studies, scientific evidence seemed to have little impact on the outcome not only because of the bounded rationality and involvement of participants but also because the evidence was nonexistent or incomplete. In their study of the Michigan "bottle bill" controversy, for example, Snow and Wright found that

> such empirical evidence as existed was not crucial. Studies were used to buttress rather than to form or reshape opinion, partly because of an unavoidable inadequacy in the studies themselves. There were significant gaps in the relevant economic and environmental data. In addition, all the studies were based, of necessity, on challengeable assumptions about future technological developments, economic patterns, and consumer behavior."[50]

It may also be the case that the evidence is less than compelling because it is ambiguous, arising out of research done in differing scientific specialties or occupational contexts.[51] A biochemist, for example, might be expected to produce a completely different set of "facts" relative to a controversy than would an industrial hygienist. Indeed, the two might not be able to reach agreement on what constitutes a "fact." And although gaps in knowledge may be filled and ambiguities may be clarified in time, there are cases in which a decision to wait until factual matters are settled even provisionally is itself a policy decision.

For example, in the 1970s U.S. regulators decided as a policy decision to ban Aldrin/Dieldrin, while British regulators found the evidence that the pesticides were causing harm was insufficient to justify a ban. Gillespie, Eva and Johnston concluded that the British demand for evidence of causality concealed "that the decision to wait for definite evidence of harm to accumulate is just as much an ethical and political choice as the decision to treat risk determination as a policy issue."[52] In the presence of "inconclusive scientific evidence that may be variously interpreted," Trachtman observed of science and technology controversies generally, "the economic, political, social and ethical dimensions of the problem are critical. . . ."[53]

Finally, the facts adduced in a controversy may be less than compelling to some participants because they are wholly or partially beside the point in regard to issues important to those participants. Casper and Wellstone, in a study of the same Minnesota power-line controversy discussed by Mazur, found just such a displacement of the focus of the controversy. The dominant concern of protesting farmers, they found, was "the sacrifice of their land without their consent for an allegedly greater social need whose validity they question(ed). . . ."[54] While many farmers did "express a degree of concern about health and safety problems," such concerns were peripheral. Nevertheless, the protest movement itself paid "considerable attention" to the human health effects issue,

> in part, because the institutions available to the protesters, such as environmental impact statements, . . . channeled them in this direction; and in part, because uncertain threats to health and safety (made) good organizing issues for a protest movement."[55]

Thus the focus of the controversy was displaced from protesters' genuine concerns partly for tactical and partly for institutional reasons. For their part, the pro-line electric cooperatives also found a tactical advantage at certain points in the proceeding in trying to limit the focus to health and safety issues.[56] Politicians also stood to gain. The science court idea, Casper and Wellstone concluded, "is a politician's dream -- it focuses public attention on peripheral technical issues and delegates the decision to the 'experts'"[57] It is an example of what Fay called the "sublimation of politics," or the effort to overcome the limitations and uncertainties of politics by replacing it with positivist science. "Questions not accessible to a so-called technical analysis are thought to be irrational, and therefore essentially undiscussable."[58]

Facts, then, can be less than compelling in science and technology controversies not only because participants' rationality is boundeo or their passions are aroused, but also because the facts themselves are unavailable, incomplete or ambiguous, or because a fundamental question -- What are the issues? -- has been answered narrowly and the facts brought forward are irrelevant to many participants' concerns. Appeals to scientific authority in public disputes are often misplaced, Shepard and Hamlin concluded, "because the question of relevance . . . is often contentious and loaded with moral and political implications."[59] And because questions of relevance are often begged, "the facts" function less as information and more as symbols in wide-ranging disputes over deeply held cultural values. The Michigan bottle battle, Snow and Wright found,

> was fought in two different but interpenetrating contexts. In the first, the environmental costs versus the economic benefits and convenience of the throwaways were debated -- the same kinds of issues that had already been confronted hundreds of times in the 1960s and 1970s in environmental legislation and litigation. But in a larger, symbolic context, the throwaway and its slogan, 'No Deposit, No Return,' had become the focus of a battle over opposing technological styles and the values supporting them."[60]

Similarly, Douglas has argued that in the final analysis pollution is less a matter of hygiene than a matter of social order: A dirty pair of boots left on a clean dining room table may not pose a threat of disease, but would amount to a flouting of the values of order and appropriateness of the household. Do the boots "pollute" or not? It depends, in Douglas' analysis, on the moral commitment one has to the values of the household.[61]

It seems things are more complicated than the fact/value separation model allows for. Having separated facts and values, we may find ourselves with facts that do little to help us. How does this state of affairs come about, and what are its implications? Does it mean that science and technology controversies are political through and through, with the victory to the side that can maneuver "the facts" most shrewdly? If so, what role is there for the journalist? To begin to answer these questions we must examine the philosophical foundations of the idea of fact/value separation in science and technology controversy.

V

The possibility and desirability of separating facts from values in science has been widely debated among philosophers of science.[62] As debate has refined the issue, it is generally accepted that many aspects of scientific work are value-laden -- the decision to "do science" in the first place, for example, as well as the choice of research problems and decisions about how to apply scientific knowledge. Scientists after all are human, and their values, preferences and biases influence their work in numerous ways. Nevertheless, logical positivists have argued that there remains a core aspect of science -- the "context of validation" as opposed to the value-laden "context of discovery" -- in which one can maintain that the correctness of scientific inferences can be and should be assessed without reference to scientists' attitudes, preferences, temperament or values.[63] This is the thesis of value-neutrality in science.

The thesis of fact/value separation in science and technology controversy is related but different in important respects. The thesis is that questions of fact and questions of value can and should be separated in the process of trying to resolve controversy. Mazur says this has been accomplished when questions of fact have been asked in such a way that "allows meaningful assessment through scientific methods."[64] Such a separation also suggests a division of responsibility, with fact questions best settled by technically trained people and value questions best settled through political processes.

Clearly the thesis of fact/value separation depends on the value-neutrality thesis. If the latter cannot be maintained, neither can the former: If facts and values can't be separated at the core of science, they can't be separated in science and technology controversy, because separating them in the latter depends on the possibility of the existence of value-free facts. The value-neutrality thesis has been challenged, perhaps most substantially by philosopher Richard Rudner, who tried to demonstrate that even within the context of validation, scientists as scientists necessarily make value judgments.

Rudner's argument was this: It is a part of science to accept or reject hypotheses; yet, as logical empiricists generally agree, no hypothesis is ever completely confirmed or disconfirmed by the evidence. Therefore, in accepting or rejecting a hypothesis, the scientist makes a decision that the evidence is sufficiently strong to warrant acceptance or rejection. Such a decision, Rudner argued, required a value judgment about the seriousness of the consequences if the decision is wrong. For example, a scientist should require a higher level of confidence for work involving toxicity of a drug used by humans than for work assessing the number of defects in a lot of belt buckles.[65]

To apply Rudner's argument to the fact/value separationist thesis, recall Lowrance's discussion of the uncertainties involved in the empirical and scientific activities of measuring risk. For example, there is uncertainty involved in extrapolating effects into the low-dose range of a dose/response curve, where there are relatively few data points to guide the researcher in drawing the curve. "Until the curve can be defined better in the low range,"Lowrance advised, "the best we can do is apply experience from related extrapolations and sketch in an extension. . . ."[66]

To imagine this advice being applied, say a scientist has conducted an experiment in which a suspected carcinogen, a trace contaminant in a pesticide, is given to laboratory rats.[67] Rats given larger doses experience more cancers, but there are fewer cancers associated with lower doses. The scientist finds that the dose/response curve almost seems to "draw itself" in the high-dose area, because of the plenitude of data. But in the low-dose range, plotting the curve is less obvious because of the paucity of data points. Applying experience from related extrapolations -- a kind of tacit knowledge or "feel" for the situation that nevertheless is not based on this experiment's data -- the scientist makes an estimate of where the curve should be drawn. Has the estimate required a value judgment?

According to Rudner's argument, yes. The scientist might have sketched in a curve in such a way as to minimize or maximize the inferred response, or she might have sketched it in somewhere between the two.[68] Indeed, she had innummerable choices, some preferable to others in terms of her tacit knowledge but all equally supported by the data. At the point of making her choice, she was required to either make or default on a value judgment about the seriousness of estimating wrongly.

If she minimized the inferred response, for example, her decision could have led to approval for use of the pesticide. The value judgment required of her was the acceptability of human cancer resulting from her estimate being in error. Alternately, she might have maximized the inferred response. In that case, the value judgment required was the acceptability of the consequences if her estimate had kept the pesticide off the market.

Fitting a curve to a set of data points is equivalent to accepting a hypothesis, that x will be the response at dose y, or x = f(y). Curve-fitting estimates are therefore an example of Rudner's problem, as is the extrapolation of animal-study results to humans.[69] One implication is a breakdown in Lowrance's and Mazur's division of responsibility in science and technology controversy. If value judgments are intrinsic to science, then value questions cannot so neatly be left to the political process, nor can scientists always stick to their empirical tasks and eschew policy questions.

Another implication is that scientists following Lowrance's advice on making estimates in areas of uncertainty would be making value judgments without consciously or critically doing so. The pursuit of objectivity is one of science's most precious ideals, Rudner pointed out, and the "positive horror" which scientists have of intrusion of values into science is understandable. Still, he argued, for scientists to close their eyes to the fact that "scientific method intrinsically requires the making of value decisions" cannot bring them closer to the ideal.[70]

VI

Rudner's challenge to the value-neutrality thesis was and remains controversial.[71] Even if it is not adopted, however, objections can be raised to the thesis of fact/value separation in science and technology controversy. The thesis seems reasonable, but as we have seen, case studies raise questions about its applicability. I turn now to an analysis of the thesis in light of these questions.

First, it can be objected that fact/value separation is useless because facts are weak compared to the power of interest and advocacy: Disputants' minds are made up, they are in the grip of their passions, and they won't be swayed by the facts; instead, they will use whatever facts suit their purpose as weapons to advance their cause. Mazur answered this objection normatively: It may often be the case that facts are drowned out by the clamor of interest and emotion, but it shouldn't be the case, and by separating facts and values one is at least keeping alive the possibility that some will attend to the facts -- particularly those who are as yet uncommitted.

Granting the validity of that response, what about those cases in which the scientific evidence is less than compelling not because of interest or involvement but because the evidence is non-existent, incomplete or ambiguous? Controversies don't unfold neatly, with all the evidence authoritatively determined before policy must be made or action taken. A defender of fact/value separation, however, might respond persuasively that the untidiness of the process of controversy is itself an argument for fact/value separation. It's true, she might argue, that fact questions can be settled only provisionally, and that action and inaction can sometimes be equally value-laden policy decisions; all the more reason to make one's decisions armed with the best factual data available at the time. All a scientist can do, after all, is her damndest.

What then about those cases in which the facts seem to be beside the point? After all, data about the human health effects of high-voltage transmission lines are at best peripheral to the concerns of farmers upset about land condemnation. A fact/value separationist might respond, again normatively, that valid issues may be ignored in particular cases, but that does not refute the case for fact/value separation; deciding what the issues are is a matter best decided in the political arena. (Even when scientists get involved in such decisions, as they routinely do in trying to influence federal funding for research, for example, they are acting not as scientists, but as social and political beings). Once the issues are defined, the fact/value separationist might argue, the task of science is to try to ascertain facts that will aid in their resolution.

To this argument, a critic might object that issues, like facts, are often only provisionally determined. In her study of the Cayuga Lake nuclear plant controversy, for example, Nelkin found that a controversy originally focused on thermal pollution of the lake shifted to concern with health risks after the Three Mile Island nuclear accident. Similarly, Milch found issues in a Toronto airport siting controversy changing in response to both technical and political developments.[78] In fluid situations like these, how do scientists know what to investigate, what questions to try to find factual answers to? Granted, the fact/value separationist might respond, the unfolding of science and technology controversy is messy and unpredictable. Still, a provisional formulation of the issues at least allows the scientist to get to work. If the issues change, new research problems can be added to the old.

A critic might respond, however, that scientists do not investigate all issues, but only certain ones. Social scientist Mazur, for example, chose to concentrate his efforts in the power-line controversy on the human health effects issue, even though he acknowledged the presence of procedural and political issues in the dispute.[73] A fact/value separationist might respond that scientists do indeed pick and choose their issues, and they do so for any number of reasons, ranging from theoretical interest to availability of funding to political predilection. After all, if society through the political process -- say the election of an extremist administration -- proposed a new generation of nuclear weapons as the nation's top scientific priority, scientists would hardly be expected to turn unreflectively to the task. They would, however, make their views known as citizens, not as scientists, and it is as citizens that they pick and choose their issues. What they do as scientists is to warrant the validity of their research.

However, what fact/value separationists have proposed, with fact/value separation as its centerpiece, is not an epistemology for assessing the correctness of scientific inferences, but a procedure for resolving science and technology controversies.[74] The two are different: In the assessment of scientific inferences (granting Rudner's critics their case for the sake of argument), value judgments are either irrelevant or agreed on. What is at stake is the validity of the work, which is assessed through rational reconstruction of empirical evidence and logic.

However, a procedure for conducting science and technology controversy differs significantly from a rational reconstruction of the evidence and logic supporting a scientific inference. It is a proposal for carrying out a social/political process aimed at resolving a controversy -- or as some have suggested, maintaining its creative tension.[75]

Issues are intrinsic to controversy, and the choice and definition of issues can have a substantial impact on the outcome, as the power-line dispute discussed by Mazur and Casper and Wellstone suggests. Who decides what the issues are, and on what basis? The two fact/value separationists whose work I have analyzed approach the question differently..For Lowrance, whose book is explicitly concerned with risk and safety controversies, the question of how risk and safety become issues lies outside his topic. Risk issues simply "arise" or "pop up."[76] For Mazur, whose topic is the dynamics of technology controversy in general, particular technological issues like nuclear power arise out of general public concern over "larger issues" like the environment.[77] Thus they have their origins in the value-laden political and social realm.

The proper procedure, Mazur suggests, is to disentangle matters of fact from the value context in which they arise so that the controversy can be simplified, scientists and politicians can do what they are competent to do, and factual matters can be framed so as to allow "meaningful assessment through scientific methods."[78] In order to be consistent, a fact/value separationist would have to argue that the process of recasting questions so that they can be meaningfully assessed does not in itself require value judgments. i.e., that the process of fact/value disentanglement is value-neutral vis a vis any issues society cares to raise. But is it? Let's look again at the recasting of the anti-line experts' original statements of fact that resulted from Mazur's "neutral" intervention as referee. (The statements are on pages 11 and 12 above.)

The original statements are not capable of assessment by scientific means, as Mazur points out. Nevertheless, the recasting of them is not the only way they could be reformulated so as to be capable of rational assessment.[79] For example, implied in the statement that no likely biological effect from the fields can be shown to be nonhazardous is a concern that technological change too often takes place incautiously. That is a value judgment, presumably the one Mazur sought to separate from the factual question with which it was entangled. However, the statement might also be recast this way: "Technological change in the past has often had unforeseen negative consequences, yet there has been a tendency to proceed as if this were not the case, and to disrupt established social arrangements in the process; the cooperatives urging construction of the power lines have proceeded similarly, and this is evidence in favor of reconsidering the project." This statement of alleged fact deals with an issue more central to the farmers' concerns, the sacrifice of their land for an alleged social benefit whose validity they questioned. Moreover, it is open, if not to scientific assessment, then nevertheless to rational assessment, on the grounds of logic and evidence.

The reformulation brought about by Mazur's intervention, it now appears, was not value-neutral. Framing the factual assertion in epidemiological terms required a value judgment that the health effects issue was more important than the issue of unforeseen consequences and social impacts of technological change. Moreover, the value judgment was made implicitly, without conscious, critical consideration. Far from simplifying and clarifying the power-line controversy, the separation of facts and values begged the important question of relevancy and contributed little to the resolution of the dispute.[80]

VII

The untenability of fact/value separation has implications for journalists and journalism educators. This analysis suggests that reporters and editors should be wary -- and students should be taught to be wary -- of moves by any side in a controversy to urge fact/value separation in a way that sub rosa limits the range of issues considered. "Let's look at the facts," may often mean, "Let's look at the facts that are relevant to the controversy as I have defined it, and let's put outside the pale the controversy as defined by the other side."

Such moves may be cynical, but they also may stem from a genuine failure to understand the grounds of the other side's position.[81] A journalism that "gets both sides" merely by communicating facts brought forward by each side not only contributes less than it could to public understanding, it also contributes little or nothing toward mutual understanding between the antagonists. What is necessary, this analysis suggests, is a journalism that explores competing values at least as vigorously as it digs for facts. Shepard and Hamlin have suggested a somewhat similar role for social scientists as intervenors in agricultural controversy.[82] The extent to which journalists could and should attempt such a role in science and technology controversy in general involves difficult questions that themselves deserve exploration.

1.See for example: "American Society of Newspaper Editors Statement of Principles," in Conrad C. Fink, Media Ethics in the Newsroom and Beyond. New York: McGraw-Hill, 1988, pp. 287-88; Brian S. Brooks, George kennedy, Daryl R. Moen and Don Ranly, News Reporting and Writing. New York: St. Martin's Press. 1985, p. 20. For studies of the ideal of objectivity in practice, see Herbert Gans, Deciding What's News. New York: Pantheon, 1979; and Gaye Tuchman, Making News. New York: The Free Press, 1978. Historical studies of the rise of the ideal of objectivity include Dan Schiller, Objectivity and the News. Philadelphia: University of Pennsylvania Press, 1981; and Michael Schudson, Discovering the News. New York: Basic Books, 1978.

2. The kinds of controversy under discussion here are variously referred to as, for example, "technical controversy," or "technical decisions." Such terminology seems to suggest that technical differences are at their heart, a view that will be disputed here. In the fullest sense, the controversies I want to consider could best be referred to as "public controversies involving science and/or technology" -- both to make clear that they are not "internal" to science and to leave open the possibility that non-technical issues will be important and perhaps even crucial. For the sake of brevity and style, however, I refer to them as "science and technology controversies."

3. Philip T. Shepard, "Moral Conflict in Agriculture: Conquest or Moral Coevolution?" Agriculture and Human Values, 1 (Fall 1984): 17-25.

4. Michael Gough, Dioxin, Agent Orange: The Facts. New York: Plenum Press, 1986.

5. Hugh D. Crone, Chemicals and Society: A Guide to the New Chemical Age. Cambridge: Cambridge University Press, 1986, p. 3.

6. Paul Turner, "Foreword," in Edward Edelson, The Journalist's Guide to Nuclear Power. Bethesda, MD: Atomic Industrial Forum, 1985, n.p.

7. Marc S. Reisch, "Firms Boost Community Programs to Fight Chemicals' Poor Image," Chemical and Engineering News, Dec. 5, 1988, p. 15.

8. See Daryl E. Chubin and Sal Restivo, "The 'Mooting' of Science Studies: Research Programmes and Science Policy," in Karin D. Knorr-Cetina and Michael Mulkay, eds., Science Observed: Perspectives on the Social Study of Science, Beveraly Hills, CA: Sage, 1983, pp. 53-83.

9. See for example, Allan Mazur, The Dynamics of Technical Controversy. Washington: Communications Press, 1981, p. 125.

10. See for example Joel Primack and Frederick von Hippel, Advice and Dissent: Scientists in the Public Arena. New York: Basic Books, 1974.

11. Philip M. Boffey, "Homeless Plight Angers Scientists," New York Times, Sept. 20, 1988, pp. 1, 12.

12.Ibid., p. 12

13. Ibid.

14. William W. Lowrance, Of Acceptable Risk: Science and the Determination of Safety. Los Altos, CA: William Kaufmann, 1976.

15. Ibid., pp. vii-viii.

16. Ibid., pp. 75-76.

17. Ibid., pp. 10-11.

18. Ibid., p. 79.

19. Ibid., p. 110.

20. Ibid.

21. Ibid., p. 16.

22. Ibid., pp. 38-41, 61-67.

23. Ibid., p. 39.

24. Ibid., p. 27.

25. Ibid.

26. Ibid., pp. 75-94.

27. Allan Mazur, "Science Courts," _Minerva_, Vol. 15, 1977, p. 4.

28. Mazur, _Dynamics of Technical Controversy_, p. 8.

29. Ibid., p. 125.

30. Ibid., p. 36.

31. Ibid., p. 36, Mazur's emphasis.

32. Ibid.

33. Mazur, "Science Courts, pp. 6-9.

34. Ibid., p. 4

35. Ibid., pp. 4-5.

36. Ibid., p. 5

37. Mazur, _The Dynamics of Technical Controversy_, pp. 38-39, Mazur's emphasis.

38. Ibid., p. 39.

39. Ibid.

40. Ibid., p. 40

41. Ibid., pp. 40-41.

42. Ibid., p. 41.

43. Ibid., pp. 41-42.

44. Ibid., p. 42.

45. Mazur, "Science Courts," p. 14.

46. Ibid., my emphasis.

47. Mazur, Dynamics of Technical Controversy, p. 42

48. Dorothy Nelkin, "Science, Technology, and Political Conflict: Analyzing the Issues," in Nelkin, ed., Controversy: Politics of Technical Decisions. Beverly Hills, CA: Sage, 1979, p. 19.

49. Paul Slovic, Baruch Fischhoff, and Sarah Lichtenstein, "Rating the Risks," Environment, 21 (April 1979), p. 15.

50. Robert E. Snow and David E. Wright, "Analysing Symbolic Dimensions of Technological Disputes: The Michigan Container Controversy," Science, Technology & Human Values, Fall 1979, p. 13.

51. David Robbins and Ron Johston, "The Role of Cognitive and Occupational Differentiation in Scientific Controversies," Social Studies of Science, Vol 6, 1976, p. 362.

52. Brendan Gillespie, Dave Eva and Ron Johnston, "Carcinogenic Risk Assessment in the USA and UK: The Case of Aldrin/Dieldrin," in Barry Barnes and David Edge, eds., Science in Context: Readings in the Sociology of Science. Cambridge, MA: MIT Press, 1982, p. 330.

53. Leon A. Trachtman, "The Public Understanding of Science Effort: A Critique," Science, Technology & Human Values, Summer 1981, p. 13.

54. Barry Casper and Paul Wellstone, "Science Court on Trial in Minnesota," in Barnes and Edge, eds., Science in Context, p. 288.

55. Ibid., p. 285.

56. Ibid., p. 286.

57. Ibid., p. 288.

58. Brian Fay, Social Theory and Political Practice, London: George Allen and Unwin, 1975, p. 61.

59. Philip T. Shepard and Christopher Hamlin, manuscript draft of book tentatively entitled "Ideology and the Prospects for Consensus in U.S. Agriculture," East Lansing, MI, 1988, Chapter 3, p. 12.

60. Snow and Wright, "Analysing Symbolic Dimensions of Technological Disputes," p. 11.

61. Mary T. Douglas, Purity and Danger: An Analysis of the Concepts of Pollution and Taboo, London: ARK Paperbacks, 1984, pp. 35-36, and "Environments at Risk," in Barnes and Edge, Science in Context, pp. 260-275.

62. Classic arguments are presented by Thomas S. Kuhn, The Structure of Scientific Revolutions, 2nd ed., enlarged. Chicago: University of Chicago Press, 1970; and Israel Scheffler, Science and Subjectivity. Indianapolis: Bobbs-Merrill, 1967.

63. See Richard Rudner, "The Scientist Qua Scientist Makes Value Judgments," pp. 540-546, and Isaac Levi, "Must the Scientist Make Value Judgments?", pp. 559-569, both in Baruch Brody, ed., Readings in the Philosophy of Science. Englewood Cliff, NJ: Prentice-Hall, 1970.

64. Mazur, Dynamics of Technical Controversy, p. 36.

65. Rudner, "The Scientist Qua Scientist Makes Value Judgments," p. 540-546.

66. Lowrance, Of Acceptable Risk, pp. 38-41.

67. This analysis is based on Shepard, "Moral Conflict in Agriculture: Conquest or Moral Coevolution?" p. 18.

68. For the sake of stylistic simplicity, I adopt the generic "she" to refer to human beings of either sex.

69. See Alvin M. Weinberg, "Science and Trans-Science," Minerva, 10 (1972): 209-222.

70. Rudner, "The Scientist Qua Scientist Makes Value Judgments," p. 545.

71. See Levi, "Must the Scientist Make Value Judgments?"

72. Dorothy Nelkin, "Nuclear Power and Its Critics: A Siting Dispute," pp. 49-68, and Jerome Milch, "The Toronto Airport Controversy," pp. 25-47, both in Nelkin, ed., Controversy.

73. Ibid., p. 37.

74. Philip T. Shepard, "Impartiality and Interpretive Intervention in Technical Controversy," in Edmund F. Byrne and Joseph C. Pitt, eds., Technological Transformation: Contextual and Conceptual Implications, The Netherlands: Kluwer Academic Publishers, 1989, pp. 47-65.

75. Philip T. Shepard and Christopher Hamlin, "How Not to Presume: Toward a Descriptive Theory of Ideology in Science and Technology Controversy," Science, Technology & Human Values, 12 (Spring 1987), pp. 19-28.

76. Lowrance, Of Acceptable Risk, pp. 102, 105.

77. Mazur, Dynamics of Technical Controversy, p. 99.

78. Ibid., p. 125.

79. See Shepard, "Impartiality and Interpretive Intervention," pp. 7-10.

80. See Shepard and Hamlin, "Ideology and the Prospects for Consensus," Chapter 3, p. 12.

81. Ibid., Chapter 1.

82. Ibid., Chapters 4-6.