Scientists and Policy Makers: An Ethnography of Communication

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Abstract

This paper is about scientists and policy makers and why these two groups seem so frustrated by each other's demands and advice. It will try to show the human problems in communication between academic scientists and policy makers. Eight areas of value conflict between the subcultures of basic science and policy-making are delineated. It is hoped, in this way, that some light will be shed on the relationships between science and policy-making. It is concluded that maximizing the casual relationships between scientists and policy makers is an effective means for maximizing both the input and the impact of scientific information on the decision-making process.

Les hommes de science et les hommes de politique: l'ethnographie de la communication

Cette étude considère pourquoi chacun des deux groupes, les hommes de science et les hommes de politique, paraît être contrecarré par les conseils et les demandes de l'autre. Elle essaiera de montrer les problèmes humains de la communication entre l'homme de science académique et l'homme de politique. Huit secteurs de conflict de valeurs entre les sous-cultures de la science fondamentale et de la politique sont examinés. La conclusion constate que de porter au maximum les rapports non formalists est un moyen efficace de porter au maximum à la fois la contribution et l'effet de l'information scientifique sur la prise des décisions de politique.

Los científicos y los que planifican la política a seguir: una etnografía de la comunicación.

Este trabajo trata de los científicos y de los que planifican la política a seguir y del por qué esos dos grupos parecen sufrir tanta frustración con los consejos y demandas mutuos. Se intenta mostrar los problemas humanos de comunicación entre los científicos académicos y la planificación. Se dan los rasgos de siete áreas de conflictos de valores entre las subculturas de la ciencia y de la planificación. Se espera, de este modo, traer a la luz la relación entre la ciencia y la planificación. Se concluye que la maximalización de las relaciones casuales entre los científicos y los que planifican es una manera efectiva de maximizar ambos la producción y el impacto de la información científica en el proceso del poder decisorio.

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THIS PAPER IS ABOUT scientists and policy makers, and why they are so frustrated by one another's advice and demands. By scientists, I mean academic, research-oriented scientists, who take advisory roles on a part-time, consultative basis only, and who view their primary career achievements as fundamental advances of science rather than as influences upon government decisions. By policy makers (or decision maker or bureaucrat) I mean the action-level, career personnel whose job it is to interpret and implement policy as it is made by the executive branch of government.

To appreciate the need for work in this area, consider that in Washington alone there are about 1,500 science advising committees, with at least 15,000 members. For the most part, recruitment is achieved through an "old boy" network reaching out through academia as well as industry. Approximately 3,000 replacement appointments are made to these committees each year (NAS:2). By any odds, the advising committee is the most important point of contact between science and government. There is, to be sure, a solid literature on the science advisory structures and process (see, for example, Dupree 1957; Gilipin 1964; Pelz and Andrews 1966; Schooler 1971; Skolnifoff 1967; D. Wolfe 1959). There is a major research tradition on the difficulties faced by scientists in industry (Glaser 1964; Kornhauser 1962; Scott 1966; Volmer and Mills 1966). By contrast, there has been little systematic work on communications problems between scientists and the government decision makers who ask scientists for advice. (See Hall 1956; Rothman 1970; and Terman 1955; U.S. Government 1969, for strong hints that the problem is well-recognized by both sides.)

Data were gathered during eight months of fieldwork (January-September 1972) at Scripps Institution of Oceanography, as part of a team study on the role of marine science in the formulation of U.S. policy on ocean pollution. Interviews were held with 25 marine scientists on the faculty of Scripps. Fifteen of those scientists were active on government advisory boards. Ten younger scholars (under 40) had no involvement in government advising beyond an occasional proposal review. Policy makers were interviewed in Washington (five days), at the Law of the Sea Conference in Rhode Island (four days), and during two workshops held at Scripps in the Center for Marine affairs (three days each). Three young decision makers in marine pollution were also invited to spend about a week each at the center.

Here is what these scientists and policy makers had to say about one another. Bureaucrats generally described scientists as

> unconcerned with the real world. I can never get a straight answer to my questions from most of them . . . If they're not using big words they're hedging. You know the line: "we need to study this more" or "well, there are several theories about this" (mimicking in a sarcastic tone of voice).

Another bureaucrat (a Foreign Service officer working in the Department of State) asked rhetorically:

> Why do we get these impossible schemes from these advisors? The answers to questions we ask would cost billions, and even then there is no guarantee they [the solutions] would work . . . . If it's one thing prima donnas [referring to research scientists] don't comprehend, it's the "art of the possible."

A rather less charitable bureaucrat in the Department of Defense characterized scientists as being

> afflicted by cranial rectitis. It's a common disease . . . you see it everywhere in Washington, but somehow academics seem to be particularly susceptible to it. It's caused by walking around with your head up your ass.

A State Department bureaucrat (who was trained as an engineer before entering government service) said:

> The trouble is that it's hard to get scientists pinned down. They know so much about their narrow field that they often can't just make a general recommendation. The trick is to find out what new information they have and translate it into useful knowledge for policy implementation.

He went on to point out how useful his own science background had been in "bridging the gap created by jargon."

The lack of unity among scientists concerning scientific matters was a particularly irksome factor to bureaucrats.

> When I get involved in an issue I get told "find out what the scientific community thinks about it." How the hell do you find out what the so-called "community" thinks when there's no goddam community?

A State Department lawyer, working on the U.S. position on oil pollution for the UN Law of the Sea Convention, articulated the problem this way:

> If (oil) companies and other private interests say "no" to a policy and the scientists say "well, yes and no," the companies will win hands down every time. The trouble is, you can never get these guys [scientists] to agree on anything. They're always begging off, with the excuse that they don't have enough information to take a stand. They expect to just do

what they can, give some advice on the state of the world as they see it, and have us take it from there. But every time I go to my boss with some evidence that supports a position I want to take, he says O.K., but the people at ______ (names an oil company) have scientists who will tear that to shreds. So what do you do? For the most part you really don't need scientific advice on most issues because they are really political issues. And even where you need the advice, all you ever get is conflicting information.

In general, then, decision makers perceived (or said they perceived) scientists as people with a lot of information on technical matters, who can be useful in practical problem solving, but who are "by nature" not very good at it because they are "off on cloud nine," "too concerned with detail to appreciate the real world," and "fooling themselves by thinking that scientific information is the only important consideration in making a political decision." The single most important improvement that scientists could make was said universally to be "information packaging"—i.e., putting their technical knowledge of details into units that are useable for practical political problem solving.

Specifically, on the issue of marine pollution, we can see these general stereotypes in action. Here is an account by another State Department lawyer, on the role of marine science in the history of the international oil-dumping treaty.

> The 1954 Convention (that prohibits flushing of ships' fuel tanks at sea) is administered by IMCO (an agency of the UN). The scientific input there was minimal—and the result is that the standards are unworkable and unenforceable. They were revised in 1969 to so-and-so many parts per million—but no one demonstrated that the standards were necessary. So, now, since we don't know what's harmful and what isn't we're preparing to ask for zero discharge. That way at least the environment is protected and we can loosen up as we find out what the ocean can take. The only problem is that the current standards and the proposed zero discharge are economic hardships if they are enforced. Land-based storage and pumping facilities have to be built, tankers have to spend expensive days in port, and so on. When we go to the prep conferences for the U.S. position on oil pollution, the corporations will be able to show chapter and verse how the costs of the treaty hurt them but there will be no scientific evidence of serious harm from *some* oil discharge. So it is likely that the scientific community will have *no* influence on decisions made in this treaty. Public environmentalist pressure groups might, but the scientists won't.

One of the negotiators on the North Atlantic Fisheries Treaty reflected the bureaucrat's feeling that scientists do not understand the "limited value of rational information in politics."

> There are so many considerations that biological quotas are just another piece of evidence that has to be considered when decision time comes around. For example, we were told that if we didn't stop altogether the taking of a particular species of fish, that it was in danger of being extinguished. But our relations with Canada just wouldn't stand the strain of such a demand so we held out for a quarter reduction in the quota this year and we'll punt from there. Even some reduction will be beneficial to the fish and if we can hold off its disappearance, we'll have a better chance of working out a long-range agreement that will protect it perpetually. In the meantime, if the scientists say its endangered, then even a quarter reduction in fishing means they've had an influence on policy. Things like this take a long time to work out. You just can't come along and say "no more fishing." The politics of the situation are too complex for that.[1]

Finally, consider this statement by an exasperated official in the Department of Defense on the proposed development of international standards for ocean dumping of all substances.

> It is hard enough trying to get any standards passed at all. Monitoring them on a nationwide basis is next to impossible. The personnel and apparatus required to do the job is only just being put together. And imagine what the field of *international* pollution control is going to be? My God, if we start building separate standards for each city and state, imagine what it (a regime) will look like on a global scale! . . . what we don't seem to be able to get across to these people (scientists who advise government) is that the problem requires action and decisions; we don't have time to wait until New Orleans and Bangkok work out all their special requirements for dumping of toxic materials into the world ocean. We have to go on partial information—but we have to put something on the table.

The frustration is shared by scientists. From their vantage point, the decision makers (1) ask the wrong questions; (2) pay little attention to the advice they get even when they ask for it in the first place; and (3) have very little appreciation of the power of objective information. Here is what a fisheries biologist said when asked why a particular species of fish had been removed from the endangered list:

> I don't know why anything happens anymore. People in Washington ask for advice and I personally don't see much relationship between what we [referring to fisheries biologists] tell them and what they do. I'm a

population geneticist and when people in D.C. ask me how many fish there might be in the Caribbean I try to tell them. If I tell them a species is in danger sometimes they do something about it, sometimes you're talking to a wall.

Asked why he continues to advise decision makers, he went on to say:

Sometimes, like I say, I don't really know. You know, there are damned few times where you can see the stuff you put in as advice come out as action you wanted taken. But you never know if what you say isn't a piece of a lot of stuff that helps get decisions made. So you really don't know if you didn't give advice if the decisions wouldn't be worse . . . . It's a long process to educate people in Washington about the value of real information.

A senior ocean engineer at Sripps observed:

People in Washington ask us for the wrong advice. They want us to solve problems that creep up on them but they never ask the scientist if the questions they ask are important ones. So all we ever get asked to do is bail the bastards out of some political crisis . . . . There are thousands of chemicals polluting the ocean, but we only get asked about petroleum. Well, maybe the reasons we don't know how harmful oil is that we haven't spent much time worrying about it. And we didn't worry about it because it's probably not so bad. I know it's heresy to say such things, but there is evidence that a big oil spill can be beneficial to certain species. One [spill] wiped out all the sea urchins in a bay in Mexico and in two years the kelp beds [which had been destroyed by the urchins] were coming back. The only sea insect lays its eggs in oil droplets. There are some really dangerous things in the ocean that we don't get asked about . . . . This business of a bucket and shovel in back of the elephant gets pretty old, and we get called in to clean up faster and faster as society goes by. I think this is the biggest constraint to entering in enthusiastically to advising on any of the problems that face us. The problems are all thought out in advance and people don't listen to advice when they get it.

A physical oceanographer, agreeing with this general position, said:

I'd go so far as to say that they [bureaucrats] don't even know the few facts we have. Everyone knows that science is not the only important thing in the world. If a policy maker has the available information at his fingertips and if he makes a decision based on overriding political considerations, no one can fault him. But I don't have evidence that they know very much science at all.

In this case, the scientist appealed that he was "not naive about political information" and its relative power over objective information. An ocean engineer agreed:

The kinds of things political people say and do, says they don't pay much attention to research. They respond to public outcry and they fund the big research projects I'm working on. Then the Water Quality Control Board brags publicly [in the newsprint] that in five years they'll be dumping fresh water into the ocean from their sewage treatment plants! A lot of the sewage is good for the environment. And if they go to all the expense of purifying it unnecessarily to where it's pure water, why dump it in the ocean?

Here are two quotes, the first by a biologist-engineer, the second by a coastal geologist:

Take the case of the New York sludge disposal system. Everyone talks of the marine pollution problem but no one in government seems prepared to listen to even the most rudimentary advice where cost effectiveness is not involved. I mean that they dump all the sludge from the city on a piece of the continental shelf just outside New York. It isn't cost effective to go out beyond the shelf, but in the meantime they've created a marine desert over a large area. In Florida, the Turkey Point Power station pumps hot water out into Biscayne Bay. But it's only one or two meters deep and the water temperature change of five to six degrees is high enough to effect the whole biotic system. Meanwhile, the Hyperion outfall sends treated sewage into the Santa Monica Canyon, 3,000 feet deep, and the San Onofre plant pumps hot water into the Pacific Ocean at 60-80 foot depths. The reason silly things like this happen is because standards are set in Washington [and not on the spot].

Only a small fraction of major pollutants—oil, heavy metals, chlorinated hydrocarbons—are sea-based. Most lead, for example, comes out of people's cars. It goes into the atmosphere, gets blown about, and settles down. Since most of the world is ocean, it tends to settle in oceans. Other metals come out of factories. They go into rivers and underground water sources, and eventually wind up in the ocean. From the environment's point of view, the pollution of the ocean is a problem; the issue of how to stop it has to be dealt with on land. Of course, most rivers come out on coasts; so do most sewer systems. People live on coasts, and that's where the big problem is. It doesn't do any good to tell a small California resort town that 95% of all the oil pollution in the ocean is "out there" somewhere, when their beaches are black and gooey.

So much for differences in perception about the value of information. On the problem of information-packaging, a marine ecologist said:

> If a question calls for a general answer, then it depends on the state of the art whether I can give it. On most things we simply don't know enough to give general answers. People in Washington may demand easy answers but it's usually because they want us to take them off the hook on a political problem . . . .
>
> All these problems, these issues about pollution are easily solved by existing technology. Now, the punch to put the technology to work is up to government people, not us [scientists] . . . . The problems are getting bigger and the only way to fight them is with more information . . . and more political clout.
>
> But instead of *information* I might get asked to name the date and hour when the world will end if we don't stop dumping chlorinated hydrocarbons into the environment . . . .
>
> We may not know if DDT is bad for people. But we sure as hell know that increased crop yields are good for people . . . . How can I tell people "science says outlaw DDT" when this is the state of the art?

Another biologist said:

> Every once in a while someone [in government] will ask me what do I think of such-and-such [a policy]. They expect me to give them a scientific answer! They want quick answers but the questions they ask take expensive, long-term research.

An oceanographer said:

> If it were just a matter of me saying that PCB's are bad for the environment, then there wouldn't be much of a problem. I know and damn near everyone knows that chlorinated hydrocarbons can't do the environment any good. For one thing they just build up and never go away. But no one really expects to give up making plastics for the sake of the so-called environment when we're all still breathing . . . . I mean, everyone says, in effect, "PCB's are a sign of progress" and I can't demonstrate that the economic progress is not worth going for . . . . Eventually, we all have to pay the piper. But until we can say when and how much, we know no one much cares, no matter what they say.

The often-repeated charge by bureaucrats that scientists "couldn't get together on their advice" brought this response from a biochemist:

> All you can do is tell people what you know, not what you'd like to be the case. I really don't know if human feces is bad for coastal biota. Millions of people all over the world throw it on their tomato plants and it comes back bigger tomatoes. If you dump a lot of it near the shore you may ruin the beach and the skin diving. But, for all we know, some species of plants and animals may thrive on the stuff. So I may take one position and the next guy takes another. We can't sit down and discuss our differences and decide on which one of us is correct without experimentation. We just don't find truth by persuasion or by majority vote in science.

By contrast, bureaucrats felt that scientists did not appreciate their responsibility to make knowledge available for the public benefit. It was clear throughout the study that scientists and bureaucrats operated on different definitions of "responsibility" and "information." There was an obvious clash of norms.

Science and Policy: A Conflict of Norms

A number of authors have addressed the problem of defining the basic values, norms, and personal characteristics of scientists and policy makers. Robert Merton (1938, 1963, 1968, 1969) stands out as the pioneer in understanding the social system of science. An excellent overview of the early work in the sociology of science may be found in Barber (1952 and 1957). More recently, there have been numerous contributions that have considerably extended our understanding of the norms of science. Glaser (1964), Crane (1965), Hagstrom (1965), Storer (1966, 1967), Cole and Cole (1967, 1971), Barber (1971), Donald Price (1965), Derek Price (1965, 1970), Price and Beaver (1966), Krohn (1971), Schooler (1971), and Zuckerman (1972) have all shown the importance of basic scientific values in motivating the behavior of scientists.

In psychology, Anne Roe (1953) and Bernice Eiduson (1962) are particularly noteworthy for their empirical case approach to the study of the "scientifc personality." Caplow (1964), Merton (1957), Blau (1963, 1971), Scott (1966), and Gouldner (1952, 1959), have recently added much to our understanding of the personality, norms, and values of bureaucrats—an early and important focus in the sociology of Weber.

The literature and the ethnographic data suggest eight areas of value conflict between the subcultures of basic science and policy-making. They are as follows:

1) In policy-making, positive value is placed on "making a decision" regardless of whether or not there is sufficient objective evidence to support the decision.

2) Science values truth and the unfettered search for truth. It is the scientist's mission to *describe the universe* as it is, no matter how distasteful his findings. In fact, many scientists spoke with a certain devilish glee about

"disrupting the apple cart" of the people whose ideas were most accepted in their field. Scientists have an obligation to be critical of one another's work (Merton aptly calls this the norm of "organized skepticism") as a means for advancing the search for truth. By contrast, the mission of the government policy maker is to *fashion the universe* according to a set of desired characteristics. And, of course, the policy maker has to worry a great deal about the public acceptability of his actions. "Upsetting the apple carts" of those whose ideas are current rarely gets a bureaucrat anywhere but fired.

3) Scientists and policy makers were seen in this field study to be suspicious (even intolerant) of one another's career motives. Basic scientists universally held that doing good work and publishing in respectable journals was the proper means for career advancement. Jumping ranks by going to many universities, taking early positions in research administration, writing popular books, and becoming involved in political activities before about 40, were all seen as "grandstanding," "careerist," and generally "a drain on the creative energies of a lot of damn fine scientists." During the socialization process in graduate school, young scientists are enjoined to sneer at colleagues who display what is considered egregiously careerist behavior. In the bureaucratic world, on the other hand, "career orientation," infighting, and rapid upward mobility through the ranks are viewed positively (even if with jealousy).

4) Practitioners of science adhere to an "ethic of rationality." Scientists are encouraged to believe that rational information leads to the understanding of problems and to their ultimate solutions. Reason and data are the essential ingredients in the search for truth, rather than suasion and pressure. In policy making, the experiences of the moment, pressure from higher-ups in the organization, and persuasive argument may *be* the rational data applied to problems.

5) In science, emotional neutrality is the norm. A scientist should take a clinical attitude toward both data and conclusions drawn therefrom. Becoming emotionally involved in proving a particular point of view is considered "bad science." Many policy makers, by contrast, feel that "enthusiasm for an issue and emotional commitment to a point of view are essential qualities" in the bureaucrat "who really takes his public service mission seriously."

6) One of the absolute *musts* in science is what is called "colleague control" (see Hall 1968). A full professor of biochemistry, under this law, does not have the credentials to judge the scientific work of an instructor in physics. Both are colleagues, in the limited sense that they are both scientists. But in the community of science, a colleague is someone who has the right—indeed, the obligation—to criticize another scientist's work. Colleague control of science dictates that politicians have no right to direct the course of science. No one has the credentials for this, save other scientists, i.e., colleagues. In bureaucracies, public or private, hierarchy is the natural order of things. One expects orders from higher-ups; one expects to be judged by the higher-ups; and the definition of a higher-up is *anyone* who, by organizational definition, "has the right to tell you what to do."

7) In science, we find a high value placed on the *communality* and *universality* of knowledge and truth (these terms, introduced by Merton, are excellently treated by Storer 1966). A truth discovered in the United States is equally true in Russia, and vice versa. Moreover, a scientist's primary obligation is to make truth known—to make it the communal property of mankind by publishing it in public journals. Not to treat knowledge as universal and communal is to commit the grossest scientific error. Generally, the norms of communality and universality of knowledge are treated separately (as, for example, Storer 1966). I have lumped them here because they both clash with the same conflicting norm of the policy maker: nationalism. Imagine, for a moment, a discovery that showed a clear positive relationship between a Marxist view of the world among grade school teachers and their abilities to get children to read. It would be hard to imagine the American government initiating programs to teach grade school teachers the principles of Marxist thought—no matter what depended on it.

This fanciful pretense is not as bizarre as it appears. In Russia, under Stalin, there flourished a peculiar creed called "Lysenko genetics." It was often referred to by Russian and non-Russians alike as "Soviet" genetics. "Soviet genetics, indeed," a biochemist remarked to me. "Either Mendel was just as correct in Moscow as in Detroit, or he was not correct at all."

Admittedly, a science-policy clash over the universality of knowledge is not so common as the conflict over communality of knowledge. And it is easy to see how political decision makers might come to suspect the motives and patriotism of men and women who adhere strictly to the rule of communality. Hall (1956) suggests that this, coupled with the mystery and arrogant independence of science (the colleague control mentioned above) may be the major impediments to communication between scientists and politicians. It should be emphasized that Hall spoke of politicians and not of policy makers as I have used the latter term. Nevertheless, his astute description of the value clash inherent in communality vs. patriotism deserves lengthy quotation:

> The low intensity of scientists' feelings of loyalty and patriotism was also demonstrated to politicians by the fact that under the normal conditions of peace-

time, the ideal of basic scientific research was considered by scientists to conflict with work for the government—even though their services were vital—and was given preference. An additional factor in their decision to return to private life was that their work for the government had never been held in high esteem scientifically . . . .

Senator Magnuson reflected politicians' suspicion that scientists' primary allegiance was normally to the value system of science and scientific research and that such allegiance might conflict with the needs of government. To a witness's comment that every loyal American scientist would gladly join a proposed scientific reserve, Magnuson replied: "And now, during the war we had no such Reserve, but the scientists voluntarily came down here and did the job. Do you think that while the scientists might do that again, the Reserve would probably be to an anchor to windward?" (Sci., Leg., 1945, p. 176).

Another issue stemming from the same basic source of conflict that reinforced politicians' image of their attentuated loyalty and attachment to nation was the scientists' insistence on a more full and complete freedom to publish and exchange scientific information than politicians thought desireable. The vigor with which practically every scientist who came before the politicians insisted on their right to this article of their scientific faith was just one more proof of the dedicated nature of the scientific in-group. Politicians' concern was that granting this demand might well jeopardize the national security, since vital secrets whether inadvertently or deliberately, might be disclosed in the process.

The conflict on this issue was complicated by two factors. On the other hand, politicians feel that they are among the foremost champions and guardians of the national interest and security, especially as regards external sources of danger. As Congressman O'Hara said: "Personally, I am a nationalist; first, last, and always. I think when we get to the point where we are thinking about everybody else in the world and forgetting our own national welfare and our own people, we are in rather bad shape. Maybe that is isolationalism. Call it what you will; that is the way I feel" (NSF, 1949, p. 90).

On the other hand, they were confronted with the fact that the subject matter with which scientists dealt was, and always would be, a mystery to them. Politicians were permanently barred from gaining access to and knowledge of scientific matters. Consequently, in this one respect, they looked upon scientists as a sort of secret society from which they were excluded (Hall 1956:52).

8) Finally, consider the "norm of public service," which Hall (1970) and Snizek (1972) have shown to be of great importance among professional people in general. Both scientists and career bureaucrats insisted that public service was of paramount importance to their work, but the definition of public service differed wildly between the two groups. Policy makers openly stated that they are "instruments of the public will" and that their calling is to serve that will. Scientists claimed that their dedication to truth was tantamount to public service. Since "knowledge is beneficial to mankind," a scientist who pursues knowledge is performing a public service. For scientists, the public constituency to whom one is responsible is mankind; for bureaucrats, the constituency is more pragmatically defined.

I tested the norm of public service at Scripps using a Q-sort technique (see Appendix). Forty-eight actual statements were culled from the ethnographic and interview material. The statements were chosen to represent opposing points of view on a variety of issues concerning the involvement of scientists in the political process. The instrument (along with a questionnaire) was administered to a sample of 99, comprised of 27

TABLE 1. TABULATED DATA FOR Q-SORT, FIRST AND LAST FIVE PREFERENCES

	First	Last		First	Last
1.	5	1	25.	6	1
2.	–	5	26.	3	3
3.	–	1	27.	2	–
4.	–	2	28.	–	7
5.	1	–	29.	1	–
6.	1	2	30.	2	2
7.	1	3	31.	4	–
8.	2	4	32.	–	14
9.	–	–	33.	–	8
10.	13	–	34.	2	1
11.	11	–	35.	4	–
12.	1	2	36.	1	3
13.	1	2	37.	1	4
14.	5	2	38.	2	4
15.	–	2	39.	–	5
16.	–	8	40.	1	5
17.	–	1	41.	2	3
18.	–	2	42.	3	–
19.	5	–	43.	–	–
20.	2	2	44.	1	6
21.	2	5	45.	5	2
22.	6	–	46.	5	3
23.	5	–	47.	–	2
24.	5	6	48.	14	2

Graduate Students N = 25

TABLE 2. TABULATED DATA FOR Q-SORT, FIRST AND LAST FIVE PREFERENCES

	First	Last		First	Last
1.	4	5	25.	2	4
2.	3	3	26.	3	5
3.	2	–	27.	1	5
4.	–	2	28.	–	–
5.	–	–	29.	1	2
6.	2	3	30.	4	1
7.	–	2	31.	9	1
8.	2	–	32.	1	17
9.	1	–	33.	1	4
10.	6	–	34.	2	2
11.	15	–	35.	12	–
12.	–	5	36.	1	9
13.	3	–	37.	–	5
14.	1	2	38.	7	2
15.	–	2	39.	1	6
16.	0	11	40.	1	6
17.	–	1	41.	2	2
18.	2	–	42.	2	–
19.	3	–	43.	–	5
20.	5	1	44.	–	2
21.	–	3	45.	5	–
22.	5	–	46.	1	1
23.	3	–	47.	1	9
24.	5	2	48.	11	–

Faculty N = 26

graduate students and 72 members of the faculty and research staff of the institution. Statements were ranked in groups of 2, 3, 5, 8, 12, 8, 5, 3, 2 and ranked within groups, with the exception of the middle 12, which were reserved for ambivalence or lack of information on which a decision could be made. A thorough statistical analysis of the Q-sort and the relationship of the answer matrix to social indicators of the respondents is presented elsewhere (Bernard 1973). The tabulated responses are given in Tables 1-3. The statement "compared to other sciences, oceanography has an excellent record of public service" was placed in the middle 12 by 48% of the graduate students and 60% of the faculty. Contrast this with the statement "oceanography is really a very important science insofar as cleaning up our environment is concerned," where 56% of the faculty and 66% of the graduate students placed it in the top 12.

Sixty percent of the faculty placed the statement, "The best way to serve the public good as a scientist is to do the best damn science possible without worrying about whether what you're doing is 'useful,'" in their top 12. (Note, however, that only 20% of the graduate students gave this statement such approval.) Among the professional oceanographers, the evidence was very strong that autonomy of science, rather than public service (in the lay definition of that term), was the overriding norm. They were very concerned about public pressures to involve the university in political issues. Sixty percent of the faculty placed the statement, "Individual scientists, as conscientious citizens, should certainly involve themselves in political issues. But the university must never be politicized as an institution. It must remain free," in their top five choices. Many scholars saw any threat to the political disembodiment of the university as a threat to their own autonomy. One marine physiologist observed: "We are increasingly obliged by so-called public pressure to do so-called relevant research. It seems that science is too important to be left to the scientists." He continued that: "If we have to take sides on political issues like pollution, no

TABLE 3. TABULATED DATA FOR Q-SORT, FIRST AND LAST FIVE PREFERENCES

	First	Last		First	Last
1.	11	–	25.	1	6
2.	6	6	26.	1	9
3.	5	–	27.	–	2
4.	1	6	28.	2	7
5.	2	2	29.	2	2
6.	2	7	30.	3	6
7.	4	6	31.	6	–
8.	4	4	32.	–	27
9.	2	1	33.	4	7
10.	10	2	34.	12	1
11.	20	–	35.	17	–
12.	5	4	36.	1	9
13.	5	1	37.	–	8
14.	1	8	38.	9	5
15.	3	3	39.	–	10
16.	–	13	40.	2	12
17.	1	3	41.	–	7
18.	6	1	42.	9	–
19.	7	2	43.	–	4
20.	2	–	44.	3	12
21.	–	2	45.	11	1
22.	4	3	46.	3	1
23.	11	3	47.	–	2
24.	7	9	48.	22	3

Research Staff N = 46

real science is ever going to get done." A less vehement statement, but one that reflects the feelings of many oceanographers came from a chemist:

> It used to be that we didn't have to justify our research to NSF, but ONR—being military—required that our research be of some use to them. It all seemed so reasonable. After all—the NSF was founded to promote science. Now it's the other way around. You have to jump through so many social relevance hoops to get NSF money these days, I'm beginning to wonder if it's worth it.

By far, the statement on the Q-sort that drew the greatest unanimity was, "People like the Sierra Club are very harmful to our efforts to clean up the environment. Most of them are from Detroit or someplace and they have a romantic memory of a childhood Boy Scout hike. That's all they're trying to protect." Seventy percent of the faculty, 60% of the research staff, and 56% of the graduate students placed it in their five *least* favorite of the 48 statements. Consider, however, that the statement was actually uttered by one of the foremost policy advisors at Scripps. In private, a number of scientists said they felt the statement was too strong out of context, but that they had similar feelings themselves.

Finally, consider the difference in response to the following two statements. The first statement, referring to individuals, said: "When a scientist sees a public works project, such as a dam that threatens the environment, it is his obligation to fight it. If people who understand the ecological consequences of public policy don't get into it, then who will?" Fifty-nine percent of the faculty, 58% of the students, and 46% of the research staff placed this statement in their top 12 choices. (The graduate students, as expected, were the strongest supporters of this statement. Fifty percent placed it in their top five choices.) The second statement, referring to institutions, said: "Universities should take sides on the issue of the maintenance of our environment. Pollution effects everyone and it's the University's corporate responsibility to combat it." Thirty-two percent of the graduate students placed this statement in their top 12, while 20% placed it in the bottom. Only 16% of the research staff similarly agreed, while 54% rejected the statement. Commenting further on the role of science in combatting pollution, a biologist said:

> As far as I'm concerned, there are a lot more important things to do than chase around after pollutants. Polluters should be stopped with strong laws and monitoring of the coastal zones where monitoring is possible. But why waste a multimillion dollar lab facility on such scientifically uninteresting nonsense. Plow Handle State College—or any of the service-oriented schools—can do the same hack work I can to trace pollutants to the polluters.

One might reasonably conclude from all this that it is a miracle that science-advising goes on at all! Yet, the facts of the case are manifestly quite different. There are at least two reasons for this.

1) The advisory system tends to select scientists and policy makers who are personally amenable to the exigencies of the process. This would necessarily mean that scientists are a very heterogeneous bunch, among whom it is possible to locate a sufficient number of "political types" who are reasonably comfortable in "the Washington Merry-Go-Round." Scientists agreed. Thirteen percent of the research staff, 25% of the Ph.D.-oriented students, and 36% of the faculty placed the statement, "Whether or not oceanographers get involved in government advising is mostly a matter of individual personality," in their top five on the Q-sort. On another scale, 79% of the graduate students and 60% of the faculty felt that innate political orientation was of importance in determining whether or not an oceanographer would become involved in public policy advising. By contrast, only 21% and 30%, respectively, felt that scientists in public-policy roles were seeking recognition from fellow scientists.

2) In spite of the inherent conflict between the two, scientists and policy makers have worked out a modus vivendi based on a compromise of the values in either science or policy-making, or both.

Each and every one of the basic science values and norms are apparently quite easily compromised. While decisions in science per se may only rarely be made on partial evidence, the willingness of scientists to espouse political positions based on partial evidence needs no documentation. (In a curious and ironic way, of course, all scientific decisions are, by definition, based on incomplete evidence.) Judging from the behavior of Nobel laureates in the natural sciences, many of the best researchers harbor dedicated interests in fashioning the universe as well as in describing it. In spite of the mandate to explore truth no matter how painful, debates range openly on the morality of conducting cross-racial intelligence tests. Having "known sin," as Oppenheimer put it, other researchers now avoid certain kinds of biochemical and nuclear studies. As Merton has shown again and again, scientists are by no means immune to vanity and the search for prestige, power, and money. "Creeping careerism" is as much a reality in science as in business or policy-making. While scientists insist on the overriding benefits of rational information for the solution to problems, their private comments show that some are neither naive nor above turning away from scientific evidence in order to help achieve a political goal in which they believe.

The most tenacious values in science are those of communality of knowledge, colleague control, and organized skepticism. At least two of these sacred tenets are quite flexible. Many scientists continue to do classified research–the antithesis of communality–and there is a serious question as to how much scientists actually control science and its direction when they depend on government financing for research. Only the norm of organized skepticism seems to flourish unabated by political circumstances–and this is a source of tremendous conflict with government decision makers. A bureaucrat asks: "Why can't they ever issue a white paper or some such thing? You ask three scientists what they think of damn near anything and you get five opinions." And a scientist answers with the familiar line, "You don't get at truth by majority vote . . . . If a man claims that eating fish filled with mercury is bad and my evidence says it may not be so bad, and if anyone asks me, I have only two choices. Either I refuse to answer because I want to hurt the swordfish industry maybe, or I tell it like I see it. If I don't, I have to repudiate my own publications. God knows I have to do that often enough for good reason not to have to do it because some bureaucrat wishes I would agree with him and his pet 'expert.' "

From all the above it would appear that scientists, rather than policy makers do all the compromising of values–an interesting turnabout, considering that diplomacy is a prime ingredient of the successful bureaucrat. Policy makers, however, by their own claims, "give in" a great deal to the demands of the scientists. A Defense Department executive said:

> The fact is, I probably listen to scientists a lot more than I should. If you get right down to it, on the marine pollution issue, for instance, the influence of science has been far greater than the evidence deserves . . . . I mean, I trust the opinion of some of these guys more than the facts they have really warrants . . . when you figure how uncoordinated they are, scientists probably have an influence out of all proportion to the evidence they really have to present.

Another bureaucrat observed:

> These guys really have it made, don't they? Anything they want they get. No clocks, no bosses, secure positions in nice comfortable laboratories in nice comfortable universities. And all they have to do is say they need a bunch of money to study something and they get it . . . when the study is over and you ask for help to get something done, then you don't get back what you put in. I mean, say you want to make a point about dumping some toxic substance and you know that Dr. X has just spent a million dollars studying the stuff and you ask him to help out in the push to get it banned and he says, "well, we need another million to study it some more," and they get it!

Bureaucrats, in fact, do a lot of the compromising. They need to make a decision *now*; and they wait. They need pontifications; and they settle for conflicting evidence from different experts. They must implement policy and are well-advised not to contradict their superiors; and they often accept new evidence, stall on implementing policy, and try to pass the new information upstairs. It is not at all clear to what extent all this compromise behavior and conflict behavior is motivated by career self-interest. Bureaucrats may very well choose to jeopardize themselves by "going upstairs with new evidence" because they believe it will advance their own standing. (One policy maker said just this, in so many words.)

The science advisory process has become, like all integrated systems, a balanced machine, working to the advantage of its elite participants. As it turns out, the elite participants are generally male, white, and over 50 years of age. The mean age for holders of the doctorate is 40. A great concern for this apparently unjust demographic structure, prompted a major study by the National Academy of Sciences (NAS 1972). The recommendations of the report include the recruitment of more women, more ethnic and racial minorities, and more young people to serve on the science committees which advise the government.

Women, for example, hold seven percent of the doctorates in this country and constitute only one percent of the National Research Council committees. Although the data were not available, it is safe to say that Blacks, Chicanos, Puerto Ricans, and other minorities probably fare no better. The report, however, was particularly concerned with the underutilization of young scientists and engineers on science committees. (In fact, the report was written by the NRC "Committee on the Utilization of Young Scientists and Engineers in Advisory Services to Government.") The authors note, for example, that only three percent of all NRC advisors were under 35 years of age in 1969, while that age group held about 27% of the doctorates in this country. They recommended that

> appointing agencies throw the net more widely in seeking nominees for committee service; particularly, that more younger people (35 years old and younger), women, and members of ethnic minorities be included in committee memberships; and specifically, that every committee, unless there is compelling reason to the contrary, include at least one younger person of ability and promise as a way

of providing experience and education for the oncoming generation of advisers (NAS 1972).

There is a certain confusion here. Women and ethnic minorities are probably excluded from advisory committees for the same discriminatory reasons that they are excluded from most elite aspects of our society. The same cannot be said for young scientists. Their exclusion must be seen in terms of the culture and social system of science, itself. While it is very tempting to endorse wholeheartedly the committee's recommendation that young (under 35) scientists be included on all committees, this may not be in the best interests of the advisory process. There are three reasons for this.

1) People between 36 and 40 hold about 20% of the doctorates in this country and constitute a respectable 10% of the NRC committee membership. If they are the "senior-advisors-in-training," then they are not as under-represented as the report contends.

2) Most young scientists are not demonstrably interested in serving on committees as active members. At Scripps, young scholars were overwhelmingly against involving themselves in activities which would threaten their ability to pursue creative research. They generally agreed that committee work was such a distraction. There are young scientists who want to serve government policy makers as information brokers and packagers, and they are finding their way into government (especially in these difficult times for the academic market place). There is evidence that they interpret their roles well. A Ph.D. biologist working as a bureaucrat said:

> Once, when I came home from a trip, my wife said she had taken our little girl down to the beach . . . . My daughter asked her "mommy, what is this stone made of?" and my wife said "I don't know, dear. Ask your father about it when he gets home." And with that she threw the stone as far as she could into the ocean. My wife asked her, "Why did you do that?" and she said "I don't want to know *that* much about it!"

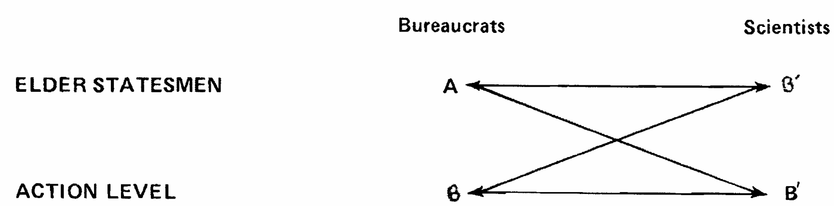
Another type of young scientist, however, wants to make an input only of information rather than total self into the policy-influencing process. At a meeting of scientists and policy makers at Scripps a 31-year-old ecologist asked, "What do I do if I find something really significant for pollution abatement? Who do I go to? The trouble is, I really don't have any *contacts* to the policy people." In answer, a veteran bureaucrat in the Department of Defense said: "Just go to Dr. W. here. He and I are old friends and I'm sure he'll see to it that whatever you have to say gets plugged into the system. It's the "old buddy" system. But it works." There can be little doubt about the scenario here. If the young ecologist does indeed go to Dr. W. often enough, one day the young researcher will be asked to serve on a committee. He will be groomed into the system by the gerontocracy of science itself.

3) This brings us to the third, and final, reason for supposing that the age structure of the science committee may not be so bad: gerontocracy is the natural outcome of the norms and values of science. Only those scientists who have established their credentials as researchers can risk the kind of action required for effective science advising—strong and convincing assertions based on limited evidence. Moreover, those same established researchers are the most respected voices of authority to policy makers who need information. "It is well known," as one policy maker phrased it, "that the amount any piece of advice is heeded is directly proportional to the authority of the man giving it."

My findings suggest that a more direct approach would facilitate the process of information transfer from scientists to policy makers. Consider the following diagram, where A are senior policy makers, B decision makers, A′ the gerontocrats of science, and B′ the young scientist active in research.

Curiously, the least important lines of communication in this scheme may be A ⟶ A′ and A ⟶ B′. The most important lines, I suggest, are between B ⟶ A′, and B ⟶ B′. This is so for several reasons. First of all, there is very little likelihood that A ⟶ B′ can be

FIGURE 1. INFORMATION TRANSFER FROM SCIENTISTS TO POLICY MAKERS



productive. Reasons for this are obvious. Second, the personal, casual links between A and A′ are probably in no need of fostering. They occur spontaneously and with great enough frequency to be dependable as renewable roles in the science advisory process. More emphasis needs to be placed on development of casual relationships between B and A′, and between B and B′. Top-level policy makers usually turn to their junior staffs for alternatives when considering policy. They do not turn directly to scientists. The science advisory committee makes information "available." But availability often depends on a personal assessment. Who does the young bureaucrat call when he wants to know what information (in the form of committee reports, for instance) is available? Who does he call when he wants to clarify or evaluate a committee recommendation based on evidence he doesn't understand? Sometimes such calls are simply not made. A State Department bureaucrat said:

> For the most part, I don't ever feel that I *need* scientific information. But I can see that to some extent, at least, it's because I don't understand it. Scientists don't understand that most of us are terrified of scientific information because we don't understand it. So we avoid it.

Another bureaucrat in the U.S. Coast Guard concurred, adding, "Most of us wouldn't know a first-rate scientist from a crackpot." The State Department worker also said: "I don't find scientists easy to talk to. Maybe they hide in committees so they don't have to do any fact-to-face advising."

On the other hand, a Defense Department bureaucrat noted that he has acquired a group of acquaintances in various scientific fields over the years. "When I need to find out if there are any scientific data on a particular subject, I call one of them . . . . I would say that such people have had a considerable influence on my decisions over the years, *probably more than the quality of their information deserved*" (emphasis in the original).

Another bureaucrat, from the Science and Technology Office of the State Department, said, "I have trouble knowing what the so-called 'scientific community' thinks about something and I ring the NAS. They may give me the names of three scientists with fourteen opinions on one subject . . . . I might as well have my own science committee, a few people I can trust."

Institutional arrangements (committees) are probably the best way to *mobilize* and *concentrate* available scientific information on an issue. Recent work in social network theory (Mitchell 1969; Henry 1958; Gulliver 1971; Bott 1957; the Canadian Review 1970; and Bernard and Killworth 1973) has shown that institutional arrangements may not be as effective as a sophisticated network of casual relationships for transfer of information. Maximizing casual realtionships between B and B′ has the added advantage of creating a core of action-level individuals who will, one day, reach the "elder statesman" level in their respective hierarchies. Also, government service is apparently attracting more and more scientifically trained young people. These action-level bureaucrats have a better chance of personally assessing the political value of scientific information because they can understand it. When I discussed this with one gerontocrat in marine science he said: "Seems like a good idea; sort of like having kid scientists and kid bureaucrats grow up to be old goats together."

Conclusion

We may consider the total science advisory function in government as a system. Maximizing the impact of science on decision making requires the maximization of all the components of the system. These components are: (1) production of data; (2) mobilization of data; (3) input of data; and (4) the use of political and personal forces to make the data influential. The frustration of scientists over the lack of impact of rational data on government decision making may be more apparent than real. To the extent that their complaints are justified, this situation probably results from not maximizing (3) and (4). The suggestion of this study is that maximizing the casual relationships between scientists and policy makers is an effective means for maximizing both the input and the impact of scientific information on the decision-making process.

This suggestion should not be misconstrued. It means that scientists and policy makers might learn to trust each other's motives and thus work more effectively together *in spite of* the incompatibility of the social norms of science and those of organizational bureaucracy. It does not mean that the incompatibility of those norms will be decreased. On the contrary: my opinion, based on the evidence in this study, is that the frustration which results from such incompatibility is healthy both for science and policy alike.

APPENDIX

Q-Sort Deck

1. On issues of major social concern, such as biological warfare, environmental degradation, and the like, the professional societies should use their prestige and power to influence positive change.

2. Scientific associations have no business passing political resolutions at their meetings. All that does is lower our credibility as scientists and weaken our ability to influence government decisions.
3. International advising on pollution control policy is a complex field because a great deal more than just science is involved. At any meeting the shyness of the Japanese or the way older German scholars feel about young scholars may seriously effect the outcome.
4. Cultural differences in international pollution control negotiations are highly overrated. The facts of science are not determined by what language you can speak or the kind of food you eat.
5. A great many scientists of high calibre advise local and national government bodies. If government doesn't implement the advice they get on how to combat pollution it's not because we don't do our part.
6. Working on marine pollution in the local area is making an important contribution to a trivial problem. We need to attack marine pollution on a global scale even if it's only making a trivial contribution to an important problem.
7. By and large, legislators are open to everyone and everything on the issue of pollution. They really want to hear what scientists have to say and they listen, too.
8. Scientists always want exhaustive studies before making recommendations. Government decision makers can't afford to wait that long. So it's up to us to make recommendations more rapidly, even without complete information.
9. In the area of marine resource management there are too many panels working in complete ignorance of each other.
10. When a scientists sees a public works project, such as a dam, that threatens the environment, it is his obligation to fight it. If people who understand the ecological consequences of public policy don't get into it, then who will?
11. Individual scientists, as conscientious citizens, should certainly involve themselves in political issues. But the University must never be politicized as an institution. It must remain free.
12. If your career is dependent on continued research, and marine pollution studies are being funded, then it's only prudent to do that kind of research. It may sound like a sell-out, but those are the facts of life.
13. A lot of the recommendations marine scientists make on pollution problems are having a positive effect.
14. Scientists are only asked by policy makers to give advice because it's the thing to do to consult experts before doing what they damn please anyway.
15. These days good young Ph.D.'s who go into government do so because there are too few jobs in academia, not because they really want to.
16. Serving on national level panels is probably a good way to insure continued grant support for one's research projects, but otherwise they're a waste of time.
17. The reason good scientists don't go into government advising is that there are no rewards for it in the academic sphere. In the university you have to make it on science or you don't make it.
18. We need to personalize science advising more. The only way to get a policy maker to trust a particular scientific fact is if he trusts the scientists who propound it.
19. Since the developed countries are the ones who have polluted the environment it is only fitting that they should be the ones to pay for cleaning it up. It just isn't fair to ask a country like Peru to pay for our mistakes.
20. Compared to other sciences, oceanography has an excellent record with regard to public service.
21. Many sincere political decision makers are interested in doing something about pollution, but they can't get enough cooperation from the knowledgeable scientists who can help them make rational decisions.
22. Politicans pay no attention to science if it contradicts their political interest of being re-elected.
23. We need to train a new breed of people who can handle both science and policy making simultaneously.
24. The best way to serve the public good as a scientist is to do the best damn science possible without worrying about whether what you're doing is "useful."
25. All the scientific resources we need for managing the environment are there. The dereliction of duty has not been among the scientists but among the political people.
26. Universities should take sides on the issue of the maintenance of our environment. Pollution affects everyone and it's the University's corporate responsibility to combat it.
27. At the international level the problem of negotiating pollution control is that everything is left to the U.S. The other countries want us to stop polluting but they don't want to stop themselves. They're more interested in development than a clean environment.
28. There is no lack of trust or desire to listen between scientists and policy makers. The problem is that there are too many people, like Barry Commoner, in the middle clouding up the issues with cries of doom.
29. The world of science-advising in politics is dominated by older men whose social ideas are outmoded. We need a lot more young men in this area.
30. Good political advising requires very general knowledge. The trouble is that most scientists are so specialized they can't really make any contribution to policy making.
31. Whether or not oceanographers get involved in government advising is mostly a matter of individual personality.
32. People like the Sierra Club are very harmful to our efforts to clean up the environment. Most of them are from Detroit or someplace and they have a romantic memory of a childhood Boy Scout hike. That's all they're trying to protect.
33. Young scientists need to be protected from distractions during the first decade or so after their degree. They shouldn't be enticed or brought into the field of government advising until after they've had a chance to become accomplished scientists.
34. Money from the military is no more "contaminated" than money from NSF. It depends on what you do with the money that makes it good or bad to accept it.
35. Oceanography is really a very important science insofar as cleaning up our environment is concerned.
36. Oceanographers tend to have "separatist" tendencies from the rest of science. They don't really see themselves as coming under the same social and political restraints that other scientists have to face.
37 Politicians with conflicting points of view are always able to find scientific experts to support their particular position on pollution. So it's basically useless to try and convince anyone of anything; all that does is succeed in setting colleagues at each other's throat.
38. We can't allow the public to dictate what kind of science is important and what isn't.
39. Science and policy making are two separate fields and you can't be good in both. Science is a full-time job.
40. The big interest in ecology among college students is surely connected to an interest in health foods, flowers, and

American Indians, and they know as little about those things as they do about pollution.

41. Many of the governmentally sponsored reports which are issued by scientific experts on marine pollution are simply incompetent.
42. Entirely too little money is currently being spent to study the effects of marine pollution.
43. The availability of grant funds is an important factor in whether or not oceanographers are inclined to do a lot of government advising. That is, when grant funds are scarce then a lot of people become advisors to government decision makers.
44. Actually, marine pollution is not as much of a problem as the alarmists make it out to be. We have a lot more high priority studies to make than that.
45. What makes policy makers decide things is public political pressure. The best thing that ever happened, as far as the environment is concerned, is that millions of people are for it even if they don't have a clue about what it's about.
46. Political decisions are based on the will of some powerful constituency. If scientists could unite as such a constituency, we could be more effective in bringing about change.
47. All scientists have excess energy to burn beyond their research. Some people sail or collect stamps. But since the university encourages public service, advising government on scientific matters is a good way to spend your free time.
48. Any scientist who can't explain what he is doing to an intelligent layman doesn't know what he's doing himself.

NOTES

1. When it is politically expedient to do so, of course, total withdrawal from a fishery may be advocated. This occurred at the UN Conference on the Environment at Stockholm, where the U.S. supported a ban on the taking of cetaceans (against the protestations of the Japanese), in spite of the lack of scientific evidence for such a ban.

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