A DISSECTION OF ATTITUDES ABOUT SCIENCE*

Joye Patterson
University of Missouri

Findings from numerous studies and polls conducted since Sputnik should have boosted the collective ego of American scientists. With the funding agencies, educational leaders, and defense strategists giving increased attention to science, the studies suggest, the public has developed a new consciousness, and appreciation, of the men and women in science. Schramm (1962), in reviewing the findings of a number of such studies, noted that the public evidently retains a favorable image of the scientist, no matter how distorted the information they receive may be (cf. Abelson, 1964: 771; Etzioni & Nunn, 1974).

Yet a real involvement with science appears to be quite another matter. To some observers the recent federal budgetary cuts suggest that the public's apparent admiration for the work of the scientist may not continue to be reflected in generous allocations of public funds for the support of that work. By way of explanation many have pointed to the communications gulf which allegedly exists between scientists on the one hand and non-scientists on the other.

C. P. Snow, in his Rede lecture and *Second Look*

*This study is based on the author's dissertation (University of Missouri, 1966).

Operant Subjectivity, 1982(Jan), 5(2), 58-76.

(1963), did more than trigger over-use of the term "two cultures." He also criticized literary intellectuals for vocalizing what he called "anti-science attitudes." These attitudes, he said, seep into the public mind, and build resistance to the high promise that he feels science holds out to the world.

In his vehement rebuke of Snow's thesis, F.R. Leavis (1962) coined another term pertinent to continued discussions of the science communications problem. He labeled the mass magazines and newspapers as part of a "Sunday paper culture," in contrast to the traditional, classical culture of the literati.

At least in this regard, studies in communications research suggest that the phrase may be an apt one. Surveys show that the American public is largely dependent upon the mass media for news about science. A number of studies have concluded that the public would like to see more space and time in the mass media given to the coverage of scientific developments (National Association of Science Writers, 1958: 1; Dubas & Martel, 1975: 9). The media have responded by stepping up their attention to the news of science. In a survey eight years after Sputnik, more than three-fourths of the participating editors of daily newspapers in the United States reported they were giving at least twice as much space to science as in the previous decade, and a comparative study of American newspapers in 1947 and 1962 concluded that "The most striking new element was science" (Krieghbaum, 1965: 14).[1] But availability of information appears to be one thing, and understanding and involvement quite another.

If, despite some expanded coverage by both print and electronic media, the communications gap continues to exist, an intensified search for ways to stimulate a dialog between scientists and non-scientists would seem pertinent. What can be done to help the public to become somewhat conversant and engaged with matters that could be of import to them and in-

1. However, it should be noted that a later study (Nunn, 1979) indicates this increase did not continue apace after the space program began winding down.

deed to the future of man? The concern is not a new one certainly, but the problem continues.

Much has been written about how to make "popular" science more popular; careful empirical studies have been done on defining the science audience, and on the role of the scientist, the science writer, the editor and the public in the communication process (University of Michigan Survey Research Center, 1958; Tannenbaum, 1963; Robinson, 1963; Grunig, 1979). However, in light of the continuing concern, there would seem to be a need for other exploratory studies directed to this problem. Is it possible, for example, that there are key issues about science that are of keen interest to the public and scientists alike? If so, and if such topics could be delineated, is it conceivable that by giving increased attention to these issues, the mass media might help to stimulate a common and lively discourse between the scientists (the source of information about new developments in science) and the public, which is likely to be involved in decisions that may well be influential in determining future directions in science?

Such an emphasis would in no way negate the gatekeeping role of the press. Obviously with the rapid proliferation of new information, not all the news of science can be reported to the public. Limitations of time, of both reporter and public, make total coverage unfeasible. Reporters and editors make selections every day. The question here is one of possible guides to selection that might be more valid than the largely intuitive method currently followed. Journalists are not deaf to suggestions that prove effective. They wish to be heard and read. Unless their material reaches the audience for which it is intended, the journalists' efforts have been largely vain ones, no matter how accurate the facts or sparkling the prose.

HOW WIDE THE GAP?

In order to determine the possible existence of commonalities shared by scientists and non-scientists, information first must be gathered regarding the at-

titudes of both about science. Despite the voluminous writings and numerous conferences under the encompassing umbrella title of "Science and Society," little concrete information about public attitudes is currently available. Even studies relating to the coverage of science are extremely limited, as Kreighbaum's (1967) early review clearly indicated. Valuable bits of information have been reported but research in the area has tended to be isolated and meager at best. The fragmentation continues (Bowes & Stamm, 1979).

The study reported here represents an effort to help provide pertinent data regarding the public's attitudes about science. A secondary purpose is more theoretical in nature: to look for possible key concepts concerning the values and purposes of science which, if spotlighted by the mass media, might help to stimulate a fruitful dialog between the two.

The investigation was prompted in part by the work of Lasswell and Lerner (1965: 41) who have attempted to defined "operational specifications for democracy." Their approach has been to locate, through analysis of international communications, "common desires which Americans share with other peoples of the Free World." Once these were determined, they reasoned, attention to these common desires might offer the best hope of stirring discussion among the peoples of the Free World. Similarly, the purpose in this study was to attempt to define operational specifications for the journalists who communicate the news of science to the public. The hope was to arrive at some informed speculation that might be useful to writers and editors interested in more effective reporting of a highly complex area.

ATTITUDES OF MIND

The first step was to examine the science communications complex for opinions about science. In the analogous study of international communications cited above the complex was defined as the inter-communication of diplomats, newsgathering agencies, political speeches, books, tourist impressions and the like.

This was the specimen, so to speak, to be dissected and analyzed. The assumption was made that the complex of science communication to the public would be found in newspapers, in radio and television programming, in the general magazines, in the news magazines, in papers presented at various conferences and symposia, as well as in books by men like Snow, Barzun, Bronowski, Ashby and others who have written about the role of science in Western culture.

The method of analysis was that of Q methodology (Stephenson, 1964), rather than content analysis as in the international study. Opinion statements about the purposes and values of science, both pro and con, were collected from the communications complex described above. A representative sample was selected to fit a balanced block design for the main effects that apparently are at issue.

PARTICIPANTS: SCIENTISTS, COMMUNICATORS, PUBLIC

In selecting a sampling of the population to be studied, a balance of three interest groups was sought. Forty-five persons participated, 15 from each of three groups: (1) scientists, (2) "communicators," i.e., those who communicate new developments in science to the general public, or segments of that public, and (3) members of the educated public who are non-scientists.

Scientists participating in the study represented various disciplines within the physical and life sciences. All held academic appointments, at the assistant professor level or above, although several had come to academe from industry, the private practice of medicine or government. Because, in the academic fields represented, men at the time of the study far outnumbered women, the sampling reflected this.

The communicators were a diverse group, sharing a common purpose--communication--but representing a variety of approaches. This group included a novelist, a poet, and an artist, as well as reporters, editors, and professors of literature and philosophy whose responsibility involves the communication of

ideas. In each instance the participant's formal exposure to science had been limited to basic courses at the undergraduate level.

In the sampling of the third group--the educated public--consideration was given to the element of personal influence. Previous studies in communications research have indicated that, because of their spheres of influence, opinion leaders within a particular setting are likely to represent larger segments of the population than their numbers alone might suggest (Katz & Lazarsfeld, 1964: 33). For this reason, influentials within their respective communities were asked to participate in the study, e.g., the president of a local League of Women Voters, a former mayor, a Rotary Club president, a public school superintendent and others in positions where they could be expected to exert considerable influence on the opinions of others.

Each person who participated in the study was asked to sort the 72 statements that had been selected as representative of opinions expressed in the "Sunday-paper culture." Afterwards, a structured depth interview was conducted with each participant. At this time he (or she) was encouraged to discuss his own thoughts about each of the opinion statements in the Q sort, as well as his feelings about science in general, and the communication of news about science in particular.

EVIDENCE OF FOUR GENERAL ATTITUDES FOUND

In the analysis, four factors emerged, i.e., four rather definite attitudes-of-mind could be seen among the study's participants. No serious fear of science was found, nor was there any evidence of substantial opposition to the growing power of science. Indeed the general appreciation of science so glibly discussed in papers, speeches, and the like appear to be substantiated. However, certain subtle differences were found to distinguish each factor.

Perhaps the most interesting finding relating to the two-culture debate is the presence of scientists on each of the four factors, suggesting that scien-

tists may be more in the mainstream than some observors have thought. However, the scientists do show some signs of clustering. One factor (D) is composed entirely of scientists, with one exception--a reporter for a national news service who had been assigned to a large medical center during Army service and subsequently had developed a strong interest in science.

Two of the factors (A, B) have members of the non-academic public on them. The other two (C, D) are composed almost entirely of academics. By further abstraction, and thereby effacing all fine points and qualifications, the attitude-of-mind modeled by each factor might be summarized as:

A - Science is fine, but not all-sufficient
B - Science promotes progress
C - Science is our best hope for the future
D - Everybody ought to love science

Factor A ("Broad Viewers")

Factor A cuts across the range of representative interests. Participants on this factor, for example, include the local president of the League of Women Voters, an editor, and a minister as well as two scientists (one a professor of microbiology, the other a pediatrician with strong research interests). While not exclusive to the public, communicators or scientists, this factor includes more representatives of the public than the other two groups.

All give evidence of broad interests, a kind of tolerant thoughtfulness, and a concern for human problems, in the United States and around the world. One person on this factor explained during the interview, "Political and social problems must be the concern of us all. No matter how hard it is, we have to try. We must carefully evaluate our leaders and get rid of those who have archaic notions." Although some registered a rather casual acquaintance with science, they seemingly see science as a great asset in building the better world they hope for.

The statements to which they give the highest

scores relate to their desire to understand more of the big concepts that characterize science, rather than to "be inundated with facts." They also agree that while science has contributed greatly to man's well being, "Decisions regarding the use of new knowledge are the responsibility of society, rather than scientists alone." They indicate an idealistic view of freedom for all men and share a belief that poetry transcends the factual world of science.

Yet factor A's appreciation of science is plainly evident when they strongly reject any suggestion that science may be more a curse than a blessing, or that the extension of scientific knowledge is likely to give a coup e'tat to the humanities, or that the scientific method should have no place in our attempts to solve human and social problems.

More than any of the other factors, factor A thinks the mass media do a poor job of keeping people informed about science. "The problem," one said, "is not simply a problem of communications per se, but in selecting news that is relevant to large numbers of people." Another confessed "I'm interested in science, but, to be honest, if the articles are heavy and I've had a busy day, I'll turn to something easier." Still another explained, "I think it's understanding that people need, not more and more facts that don't have much meaning for people without a scientific background."

In regard to science more generally, all have questions to ask, accepting science conditionally and attempting to keep it in perspective. For A, the individual scientist has no special aura: "They're just wiser maybe about certain things; it's their business to be. But when they take off that white coat they're just another guy, like everybody else."

From their comments one might surmise that they find science not bad, but rather dull. There are so many other things to think about. The explanation expressed by the person with the highest loading on factor A reflects sentiments expressed by every other person on this factor, in one way or another, and perhaps can be said to sum up this group's attitude-of-mind about science and its place in the world: "I

guess I want to understand our world better and I welcome science as part of this search. The more we know, the richer our lives, the inner life included."

Factor B ("Pragmatists")

By comparison with the many-faceted A, factor B's responses appear considerably less complex. With the exception of an engineer, this group is composed entirely of people with business interests. There are no academicians, but all are college educated and, to some degree, self-educated. All give evidence of being successful in their respective fields, conservative in viewpoint, and diligent and purposeful in achieving goals they have set for themselves.

Theirs is a practical world with a pragmatic view of science. For this group, science and technology appear to be synonymous. "Science is the number one concern in this country, both in numbers of people and money involved," according to one person on this factor. Another declared, "Science is essential to keeping us on top as a nation."

These statements echo the leitmotif of the factor. "Science is important because it makes living easier." To factor B the matter seems fairly simple. The complexities that bother A are missing here. Like A, B gives evidence of an appreciation of science, but largely for different reasons. While A applauds the intellectual stimulation that science has encouraged, B cheers the tangible fruits of science.

Another contrast with the views of A can be traced. Every statement relating to the wonder and mystery of science receives a high score from A. But B rejects these. For B, scientists simply "...seek the Truth."

B's attitudes toward the mass media set this factor apart from all the others. Alone among the four factors, B believes the public is well informed about science. As one person pointed out, "Every scientific breakthrough gets heavy newspaper, television, and magazine coverage...." And another reminded, "The newspapers and the magazines are generally devoting more space to science, and publishers are becoming more knowledgeable about science.... We read

articles now in *Reader's Digest* we wouldn't even have heard of 10 years ago."

The news media thus report to them the dramatic advances of science, and this coverage is apparently sufficient to satisfy their interest. Only factor B gives a low score to the statement "What is needed, I suspect, is not more knowledge about science, more facts and principles, but some understanding of science that is required by the general public." Yet despite their apparent feeling that they are adequately informed about science, they give little evidence of more than a superficial acquaintance.

Undoubtedly B is pro-science, but apparently in a rationalized sense. There is no suggestion of emotional or internal involvement with science, nor any indication of a desire to become so engaged. For B, scientific progress is "...the distinctive sign of our improving civilization" and merits approval for this reason. Since they credit the mass media as their primary supplier of information about science, the source of the imagery for this group seems apparent.

Factor C ("Optimistic Backers")

The people on factor C vary in occupation and interests like those on factor A, but more in this group hold academic positions. The group includes an artist, an editor and a professor of English literature, but also senior scientists in physics, biochemistry and genetics.

Like the factors previously described, C voices approval of science and the benefits it has brought to man. More than all the other factors, including D (which is composed primarily of scientists), C feels that science offers the best hope for the future. Reminiscent of Snow's thesis, one said "I feel strongly that scientific facts and concepts would, if communicated well, contribute to better relationships between nations, groups and individuals." They are committed to science, all of them, and pleased to see it developing on a broad front.

The major theme of this factor is revealed in its

repeated reference to the social involvement of the scientist. One explained "So many of our social values are based on archaic notions. Science has a bit of a revolutionary tradition.... It is always looking for the novel, the new. To overthrow the present concept is the very lifeblood of science. So, scientists do, I think, have an open mind on most problems. And this has a beneficial influence on eradicating archaic ideas."

They have an unswerving loyalty to science, and look to science as the catalyst for the changes they anticipate. Repeatedly they remarked on the need for traditional values and customs to be challenged, and to replace those that are emotionally-based with more rational ones.

Factor C is militant in its defense of science. To C, the truths science uncovers are potentially beneficial. If the new knowledge is misused, this is the fault of technology, or of society.

Although C is much like factor A in desiring an open society, one crucial difference between these two factors can be seen. At every opportunity A applauds the humanities, whereas C accepts them, but without adulation. Factor C has no doubts about who is king--and devotion merely his due.

Factor D ("Cheerleaders")

Factor D is the strongest of the factors. As indicated earlier, everyone on this factor is a scientist or especially informed about science and seems preoccupied by it. This is not to say they are oblivious to anything but science. On the contrary, they indicate a variety of extracurricular interests, as diverse as climbing mountains and collecting art objects. But this is always a personal and qualified interest. There is never any doubt of their primary concern: science. As one said, "The kind of things the humanities are concerned about are great fun to think about. I read a lot, I go to art galleries and plays and concerts every change I get. These are pleasurable diversions. But they don't move people forward necessarily. I don't accept the thesis of

the artist suffering and elevating people into glory .... This is all circular, leading to metaphysical problems that are never really solved."

Another sees science as the great emancipator that snaps all chains and sets man free: "In the past, religious reasons for objections to things were taken for granted...: it was 'against God's will.' This thwarted man's independence." And another explained, "I think progress is inevitable in science; they coexist."

One element clearly visible here is the aspect of "fun" in the scientist's work. One exclaimed exuberantly, "I was made for this job: time to read, time to do research, time to study difficult clinical problems. If I'd been born a few years earlier, this wouldn't have been possible for me.... I'm a product of my time, and this time suits me just fine." Another admitted, "I think most scientists take a kind of neurotic pleasure in their work.... They're learning to do things, to manipulate them, for the sheer fun of it." Still another explained, "Science is fun. You see things happen. You hope you can find a way of doing things no one else has. You're in control. What you do may not be great, but at least you were the first to do it."

There were few references to the possible moral implications of scientific work. The scientists seem to prefer to talk about the new knowledge they are finding and how this information can be made available to the vast public they envision. They are much more concerned about making science understandable to the public than are the other factors, and give high scores to every statement relating to the communication of science to the non-scientists. The conception is that of society wanting all the knowledge it can get about what scientists are doing, and scientists should see to it that the public receives this information in an understandable form.

They evidence little concern with the supposed gap between the humanities and science: "It's just a part of the increasing specialization.... Sometimes we can't talk with people in other areas of science either." And they are cheerful about prospects for the

future: "I don't see increasing division. Kennedy, for example, at the height of the national emphasis on science, called attention to good art by having poets and musicians perform at the White House." Another mused, "As we delve deeper into the science, both physical and social, we begin to see there's not really a hard and fast dichotomy between the two. On many points we agree.... Actually there's quite a bit of overlapping."

Considerable substantiation was found for Snow's description of scientists as "...the optimists in the contemporary world." Factor D seems to be characterized by an air of confidence--in themselves and their abilities, in the future of science, and in people solving the problems that face them, whatever their nature. Their remarks suggest they are not unaware of the practical problems of the world, but confident of their solution. "Maybe I'm the eternal optimist," one admitted, "but I can't get too concerned about these predictions of great catastrophes, like over-population and water problems and dwindling food supply. I know these are big problems in some parts of the world now and these are tragedies..., but I think when enough people feel strongly about these things they'll be concerned enough to solve them.... They'll find a way. What people want to do they can."

For the scientist on factor D, it is great fun to probe into mysteries and, one might surmise from their comments, the more remote these are from social problems the better. Unlike B, who cannot accept the idea of mystery in science, the scientists on factor D seem to see this as the most stimulating aspect of their work: "When a group of you are working on a problem that may come up with some information that hasn't been known before, you get personally concerned. It's great to be involved in discussions about some of the so-called secrets of the universe. You get interested in something beyond yourself, in discovering things man has never known before."

On the matter of communicating with the public, D joins C in recognizing a need for more attention to science in the mass media, but the factors apparently take a stand for different reasons. For C, the con-

cern seems not so much for the sake of science as for the potential advancement of society. Once people become really acquainted with what science has to offer to the world, C reasons, this information can be put to use in helping to solve the pressing problems. "International scientific cooperation can help to break down national boundaries and narrow confines of self-interest and make possible more constructive universal concepts, like the World Health Organization." But with D, the attitude appears to be that the public should be told all about the new discoveries, not so much for the practical uses that can be made of these but more simply because the public should be informed.

When confronted with the 72 statements, D, in contrast to the other factors, emphatically selects those statements which suggest that scientists have a responsibility to make their information available to non-scientists. One explained, "If you have the intelligence to do creative work in the lab, then you have the responsibility to explain your finds to the public.... All scientists should do so."

Areas of Consensus

Among the 72 statements, a few were ranked similarly by all factors, suggesting areas of general agreement and interest. Since these particular statements seemingly do not conflict with basic beliefs held by any of the factors, the assumption is that these topics would both find a ready audience and encourage general discussions about science and its activities.

All factors agree, for example, that a remarkable age of science is currently in progress, and none rejects the statement that it is the responsibility of society to use this new knowledge for the good of mankind. Thus articles in this context might be expected to attract large groups of readers.

Similarly for the statement, "It may be that the most important thing to transmit about science is not facts but concepts." All factors agree, strongly, with this assertion. While this is a relatively

innocuous statement, still it does suggest that readers may be more interested in articles that connect facts for them, rather than in those that merely report the latest finding from the laboratory.

In the matter of imagery, all factors strongly reject the statement that "The modern scientist is no longer the scientific revolutionary, but the laboratory manager." Apparently the image of the seeker-after-truth remains intact, and articles supporting this image are likely to attract a wide audience. One of the more strongly felt of the consensus statements is the one that says "How man behaves to man is an ethical problem and outside the realm of science.... The scientist has no business concerning himself with problems of this kind." All factors reject this suggestion, indicating their acceptance of the role of the scientist in social issues. While scientists and others have spoken publicly and often of these matters, the implication appears to be that the mass media might well pay more attention to these matters, too. So, also, with the statement, "The scientific method of dealing with situations should have no real place in our thinking about human and social problems." This statement is soundly rejected by all factors, indicating that application of scientific methods to such problems might well be of broad interest.

The initial assumption about the public's source of science news was substantiated by the interviews. The influence of the "Sunday-paper culture" was everywhere apparent. Even among the scientists, the mass media were cited as a means of keeping up with the news of science outside their own immediate areas. When specifics were requested to test the extent of exposure and recall, magazines were indicated as the primary source.[2] This supports earlier studies that show magazines as the preferred media

2. This study pre-dated the current rash of science magazines (e.g., *Discover*, *Science 80*, *Omni*, etc.). The magazines read most often by the non-scientists at the time of the study were *Saturday Review*, *Atlantic*, *New Yorker* and *Harper's*.

choice among the higher educated segments of the public (University of Michigan Survey Research Center, 1959: 17).

In keeping with previous findings, also, newspapers were found to be the secondary source and the electronic media the least preferred for information relating to science. However, a number of television specials on science subjects were referred to and interest was expressed in the visual explanations offered of some rather complex procedures and processes.

In review, *factor A* seems to suggest that scientists, humanists, and members of the lay public alike can share an attitude-of-mind and live with the central idea that though science is important and necessary, it is not enough or sufficient for mankind. They see no reason to quarrel about science, nor to belittle it, nor to be defensive about it. They appear to be interested in science, but as one aspect of the larger world they see around them.

Nor is there conflict for *factor B*. The people on this factor appear to accept science with pat phrases and cliches, but somehow seem above science and the humanities, too, intent on carving places for themselves but welcoming the conveniences and economic assets that science--and technology--bring.

The controversy raised by Snow seems to center on *factor C*, which sees a need for changes in social patterns and values, and looks to science as the stimulus for that change. Science, C suggests, can solve the problems of the world, if we will let it.

The "pure" scientist of *factor D* is above the conflict, riding high on the rising tide of prestige. What is a little surprising is the need for D to let the public know about his work. Gone is the concept of the scientist busy in his laboratory, indifferent to the public. He apparently now wants the public to know about what he does. Not that the idea is a new one. Charles Lyell, the nineteenth century British geologist, said as much: "It is the responsibility of patrons of the physical sciences to bring oral instruction just as the clergy brought theological dog-

ma; otherwise they have no right to complain of the apathy or indifference of the public" (cited by Feuer, 1963: 367).

So today's scientist, too, qua factor D, appears to want his information, perhaps his significance, to be widely communicated.

COMMUNICATION POSSIBILITIES

Communication theory suggests that the best chance of making headway in the complex system of science communication is to steer clear of existing belief systems, and to deal instead with what people are concerned about in common (Bauer, 1964: 321; Stephenson, 1965: 286). In the model described here, this is represented by the consensus statements. Certainly not all of these are equally important, but a few, indicated by the saliency of the scoring, would appear to *matter* to the college-educated groups included in this study. How to bring these issues to public attention, and thus stimulate public discourse about them, is another question, more within the purview of interpretative reporting than the scope of this paper. But a number of clues can be clearly detected.

One final point should be noted. The study also explored the possibility of a "watchdog" role for the media concerning science. While this theoretical factor was not found, further investigation is in order. Certainly articles on public policy matters appear frequently in publications within the scientific community and, since science has become a power by virtue of money and manpower involved, a watchdog role seems appropriate. Indeed, increasing evidence of this is being seen in the "Sunday-paper culture" as more controversial issues surface in which science figures. This whole area merits expanded research attention (Cohn, 1965: 16).

In conclusion, findings from this study strongly suggest that the most promising path for improved communication between scientists and the public lies not in enlarging the flow of information, which the scientists seek, but rather in directing more thought

to the *kind* of information to which the media give time and space.

"The division of culture," Snow (1963: 91) predicated, "is making us more obtuse than we need to be; we can repair communications to some extent...."

At least on this point, all can agree.

Joye Patterson, School of Journalism, University of Missouri, Columbia, MO 65205

REFERENCES

Abelson, P.H. Prestige. *Science*, 1964, *145*, 771.

Bauer, R.A. The obstinate audience: the influence process from the point of view of social communication. *American Psychologist*, 1964, *19*, 319-328.

Bowes, J. & K. Stamm. Science writing techniques and methods: what the research tells us. *Journal of Environmental Education*, 1979, *10*, 25-27.

Cohn, V. Are we really telling people about science? *Quill*, 1965, *53*(12), 12-16.

Dubas, O. & L. Martel. *Media impact.* Vol. 2. *Science, mass media and the public: a research study on science communication.* Ottawa: Ministry of State for Science and Technology, 1975.

Etzioni, A. & C. Nunn. The public appreciation of science in contemporary America. *Daedalus*, 1974, *103*(3), 191-205.

Feurer, L. *The scientific intellectual.* New York: Basic Books, 1963.

Grunig, J. *Research on science communication: what is known and what needs to be known.* Proceedings, National Agricultural Science Information Conference, Ames, Iowa, 1979.

Katz, E. & P. Lazarsfeld. *Personal influence.* New York: Free Press, 1964.

Krieghbaum, H. At Sputnik plus 8: more science news. *Editor & Publisher*, October 30, 1965, 14, 47.

Krieghbaum, H. *Science and the mass media.* New York: New York University Press, 1967.

Lasswell, H.D. & D. Lerner (Eds.). *World revolutionary elites.* Cambridge, MA: MIT Press, 1965.

Leavis, F.R. The significance of C. P. Snow. *The Spectator*, March 9, 1962, 297-303.

National Association of Science Writers, Inc. *Science, the news and the public.* New York: New York University Press, 1958.

Nunn, C. *Readership and coverage of science and technology in newspapers.* New York: Newspaper Advertising Bureau, Inc., 1979.

Robinson, E. Analyzing the impact of science reporting. *Journalism Quarterly*, 1963, *40*, 306-314.

Schramm, W. *Studies in communication.* Stanford, CA: Stanford University Institute for Communications Research, 1962.

Snow, C.P. *The two cultures, and a second look.* London: Cambridge University Press, 1963.

Stephenson, W. Application of Q-method to the measurement of public opinion. *Psychological Record*, 1964, *14*, 265-273.

Stephenson, W. Definition of opinion, attitude and belief. *Psychological Record*, 1965, *15*, 281-288.

Tannenbaum, P. Communication of science information. *Science*, 1963, *140*, 579-583.

University of Michigan Survey Research Center. *The public impact of science in the mass media.* Ann Arbor: University of Michigan Survey Research Center, 1958.

University of Michigan Survey Research Center. *Satellites, science and the public.* Ann Arbor: University of Michigan Survey Research Center, 1959.

Sir Orpheus. *Yes: that is a very fine attitude and quite a correct one. But have you nothing better to propose than an attitude?*

Bombardone. *Has anyone anything better to propose than an attitude?*

Shaw
Geneva, Act III