aspirations." As a banker he was naturally suspected of underhand skullduggery, and if no skullduggery could be detected, that only showed how cunning he had been. As a scientist he was clearly the rankest of amateurs, and science was becoming more and more professional. No one, it was obvious, could possibly have done all the work which appeared in his name. There was something rotten somewhere. It was better to forget him, to depreciate him, or to laugh at him.

And though no journalistic muckraking has ever disclosed enough muck to make the smallest item of news, it is not difficult to laugh at Lubbock. Even his name is faintly comic. With unusual insight he had written home from school at the age of eight telling his parents that he was quite popular because he did not mind being laughed at. It was true. Neither then nor later in life did he mind being laughed at, particularly if it served some cause he had at heart (though he was never so discourteous as to laugh at others unless he knew they were trying to be funny). He incurred a good deal of mirth among his contemporaries (including Ruskin) by giving in an address to a working men's college (and subsequently publishing) a list of the "100 Best Books." Such behavior seems to us both pompous and funny, especially in an eminent Victorian who had never been to a university and could hardly be supposed to know. And to cite it became the stock method of disparagement. But Lubbock knew what he was about. He was very rarely mistaken in his judgment of the state of public opinion or in his recognition of a business opportunity, and he knew that if he gave his list enough publicity, someone would find it worth while to publish the books on it at a price the workingman of those days could afford. And so it happened. Figuratively speaking, the last laugh was his.

Service in Many Causes

So I do not think Lubbock can be said to have failed. Though he was human enough to enjoy the honors showered on him in his life-time, he never sought fame for himself and would not have been distressed if it had passed him by. Of him, as much as of any man, it can be said: "If you require a monument look about you." The results of his life are unmistakably there—in science, in education, in the preservation of the countryside, in the less seamy aspects of the welfare state—and if others now get the credit, he would not have minded.

Perhaps the last word may be left to the late Aga Khan, who, writing to congratulate him on his peerage, said: "You have touched life at many points, done good service in many good causes and made wonderful use of your life and opportunities. Nor is it a light thing to have made no enemies."

Public Interest in Science News

Two surveys show a direct relationship between science education and assimilation of the news.

Hillier Krieghbaum

A typical American adult is curious about what scientists are doing, and despite the obvious difficulties of popularizing science information, a considerable portion of the general public is, at least, aware of the more dramatic activities of contemporary science.

These conclusions may be drawn from two recently released public opinion surveys made for the National Association of Science Writers, an organization of approximately 350 professional journalists, and New York University, which administered a substantial grant from the Rockefeller Foundation to finance these projects. Both surveys were conducted by the Survey Research Center of the University of Michigan.

The first of the public opinion surveys was made in the spring of 1957, among 1919 adults, to ascertain their responses to various media of communication and their attitudes toward science and scientists. The second was made a year later, in the spring of 1958, and included sampling of 1547 persons. Thus, the two surveys provide a comparison of habits and opinions for periods approximately six months before and six months after the launching of the first satellite, sputnik I.

Here are some findings that illustrate the potential curiosity about science. Two out of five newspaper readers (41 percent for both surveys) reported that they read *all* the medical and health news in their papers, and almost a third (30 percent in 1957 and 32 percent in 1958) said they read *all* the nonmedical science items. Of those interviewed in 1957, two-fifths (42 percent) wanted newspapers to print more medical news and a quarter (28 percent) wanted more space given to nonmedical science news. The question on this preference was not asked in 1958. Two-thirds of each sample (66 percent for 1957 and 62 percent for 1958) were willing that some other news should be eliminated in order that space might be provided for additional science news.

These surveys establish, probably for the first time on a carefully controlled basis of public opinion sampling techniques, that a national audience is waiting for and interested in news items that tell about developments in science. The Survey Research Center used generally accepted techniques of probability sampling, and the size of both samples insures a highly accurate reflection of the habits and opinions of adult Americans.

The amount of science news that was read was impressive, not only in itself but also in comparison with other categories. Only two groupings—"local events" and a human interest grouping for "people in the news"—ranked higher than medical and public health stories

The author is chairman of the department of journalism, communication arts group, New York University, and chairman of the Surveys Committee, National Association of Science Writers.

among the "reads all" percentages in both surveys. Nonmedical science items were close behind, in fifth place before the launching of the first satellite and in fourth place for the second poll. Nonmedical science surpassed the comics in postsatellite appeal.

In both surveys, medical and nonmedical science categories each had greater reader appeal than such categories as national politics, foreign events, sports, and society. As for society news, with its strong orientation for female readers, even the lower-ranking, nonmedical science ranked more than twice as high in "reads all" percentage. When women were asked what news they would give up to make more room for science news generally, one woman in eight (13 percent) was willing to cut space from society news. Twelve percent of the men would curtail news of sports for the same purpose.

Areas of Interest

What are the areas of greatest interest in science from the standpoint of the general public?

Interviewers from the Survey Research Center asked each person in the 1957 sample to recall, if possible, some science items that he had recently read in the press, heard on radio, or viewed on television. Three quarters (76 percent) could recall at least one specific science or medical news item.

Since medical stories generally were more popular than nonmedical science, it should surprise no one to learn that the major killing diseases were mentioned most frequently. They get the bulk of space in print and considerable time on radio and television. Heart disease, which is the leading cause of death in the United States, was mentioned by 32 percent of the newspaper readers, 11 percent of the television viewers, 10 percent of the magazine readers, and 2 percent of the radio listeners. Cancer, the second leading cause of death, was cited by 31 percent of the newspaper readers, 6 percent of the magazine readers, 3 percent of the television viewers, and 2 percent of the radio listeners. Poliomyelitis, or infantile paralysis, which has received wide publicity because of Jonas Salk's vaccine, was mentioned by 20 percent of newspaper readers, 6 percent of magazine readers, 4 percent of radio listeners, and 1 percent of the television audience.

Mental illness, which fills approximately half the country's hospital beds, was cited by 5 percent of newspaper readers, 4 percent of television viewers, and 3 percent of magazine readers. It was all but omitted by radio listeners. Tuberculosis was mentioned by 3 percent of newspaper readers, and the recently much-discussed tranquilizers were cited by 2 percent of newspaper readers. Users of other media largely ignored both these latter topics.

One may conclude, on the basis of these statistics, that the medical stories recalled by most of the public center around a few well-publicized diseases.

Among the nonmedical science news items, an omnibus classification of technology, or the whole spread of practical utilization of scientific research, was remembered best by all but television viewers. Figures for those who recalled news items on technology were as follows: newspaper readers, 25 percent; magazine readers, 15 percent; radio listeners, 11 percent; and television viewers, 7 percent. For recall of news about atomic energy, the statistics were: newspaper readers, 22 percent; magazine readers and television viewers, 8 percent each; radio listeners, 4 percent. Ten percent of the audience for each medium, with the exception of radio, recalled items dealing with so-called "pure" science and research in such fields as physics, astronomy, biology, physiology, exploration, and the social sciences. The fact that this was true for television viewers would be impressive indeed except for the additional fact that 8 percent of the entire sample reported that they were viewing science programs when actually they were tuned to telecasts that could be described accurately only as science fiction. Although there are dangers in generalizing, this latter statistic would seem to indicate less sophistication among television viewers, generally, than among audiences for other media.

Media

For most Americans, the newspapers remain the most popular source of science news and general news. The mounting popularity of television in recent years has manifested itself primarily in the field of entertainment.

Table 1 shows the way in which respondents in the 1957 survey rated the four mass media. Noteworthy in these statistics is the sizable percentage (21 percent) of the public who cite magazines as their favorite source of science news. This is not true for anything like one-fifth of the total sample for either general news or entertainment. Dependence on magazines for science news increased with increase in level of education; 43 percent of those who had gone to college said their main source of science news was the magazine.

Table 1. Results of a survey made in 1957 to determine how respondents rated the four mass media. Number in sample, 1919.

Medium	Favorite for science news* (%)	Favorite for general news (%)	Favorite for entertainment (%)
Newspapers	34	57	5
Magazines	21	4	6
Radio	3	16	14
Television	22	22	74

* Seventeen percent did not mention science news at all.

"Touchstone" Areas of Information

When one turns to consider the public's information about science, he may concentrate either on the public's sometimes vague, sometimes astute, awareness of what is going on or on how much outright ignorance prevails. Certainly the mass media do a highly inefficient job of communicating technical details of science. Few communicators, however, would claim this as even a tangential responsibility of the press, of radio, and of television. In most cases, if such details are communicated, it is a gratuitous accident.

In an effort to ascertain what the public knew about several topics that had been in the news reports of science fairly recently, the 1957 interviewers probed around four "touchstone" areas. All four had been widely discussed in newspapers and magazines and on radio and television. Questions in the "touchstone" sections of the survey were these: (i) "Do you recall hearing anything about the vaccine for preventing polio (infantile paralysis)? What was it that you heard?" (ii) "Have you heard anything about plans to launch a space satellite, sometimes called a man-made moon? From what you've heard, what is the purpose of launching these space satellites?" (iii) "Have you heard anything about radioactive fallout or dust from atomic bombs? As you understand it, what is radioactivity like?" (iv) "In some places around the country fluorides are now being

added to the drinking water. Have you heard anything about that? What do you think is the purpose of adding fluorides to the drinking water?"

To summarize the findings, less than one American in 11 (8.7 percent) was unaware of at least one of these topics. Forty-three percent had some knowledge either of three or of all four of these subjects, and nearly twice as many knew about all four (16.7 percent) as knew of none of them.

What segments of the public were best informed? Men recalled more information than women. By age groupings, the information level rose quickly to a plateau and remained fairly constant from the late 20's through the late 40's. The best informed groups were those in the late 20's and the late 30's; the least well informed were those past 65. A strong positive relationship between education and information exists. For example, one person in 20 (5 percent) among those who never got beyond grade school knew something about all four topics, but more than a third (39 percent) of those who went to college were aware of all four subjects. Thus, deficiencies in education, rather than age, probably accounted for the generally poor showing of those past 50.

Possibly the most significant finding (significant because it offers a clue for future action) was the direct positive relation between science education and the ability to recall information about all four "touchstones." Of those who could "play back" at least some information about all four of these subjects, 78 percent had taken at least one science course in high school and 30 percent had studied some science in college. In fact, those who attended college but took no science courses in either high school or college were as poorly informed on these four "touchstones" as those who never got beyond grade school.

The fact that exposure to science courses makes a difference in recalling science information seems incontrovertible, on the basis of these statistics. With mounting emphasis on science in high schools and colleges, the outlook would appear to be hopeful for science popularization in the future. Recall of news items about both science and medicine was greater, at every educational level, for those who had studied science.

Now let us turn to the individual results for each "touchstone." As for Salk vaccine, only 4 percent said they had never heard of it. The scope of this awareness of the existence of a vaccine for infantile paralysis was due in part to the tremendous amount of space and of time on the air that had been given to the dramatic and suspenseful story of Salk's research and of the large-scale testing of the vaccine. Few, if any, medical stories in recent years have aroused and sustained such public interest. Forty percent could recall at least some specific nontechnical details, and another 48 percent knew of the vaccine's existence, of its successful testing, or of its availability.

As for fluoridation of drinking water, 40 percent said that it prevented tooth decay, while another 11 percent gave such vague replies as, "it helps teeth." Twelve percent confused fluoridation with chlorination and 26 percent said they had never heard of fluorides. Thus, although dozens of American cities had held referendums on this topic during the past decade, only a bare majority (51 percent) of a national sample possessed valid information on which to base opinions. On the other hand, only 4 percent indicated opposition to fluoridation programs, and few of these expressed wild and emotional opinions such as had figured in some antifluoridation fights.

In 1957, one-third of the sample (33 percent) had never heard of radioactivity, although it had been discussed during the presidential campaign of the previous year. Twenty-five percent gave vague statements such as "it's dangerous," "it kills," or "it's like dust or fog from the bomb." A quarter (28 percent) made at least specific nontechnical replies, and 7 percent of these provided more or less technical information about fallout. Approximately a tenth (11 percent) reported having heard reports without having any idea what they were about. Apparently even the heat of debate in a presidential campaign cannot sear scientific information deeply into the minds of large segments of the population.

Either through extreme good luck or through intuition, the science writers included a question about "launching a space satellite, sometimes called a man-made moon," in the 1957 survey. With the successful launching of the first Soviet satellite some six months later, these figures became of special interest, and the Rockefeller Foundation provided additional funds for a postsatellite survey. Thus, it is possible to make a "before" and "after" comparison.

Table 2. Response to survey questions about satellite launchings, before and after the launching of sputnik I. Number in sample for 1957, 1919; for 1958, 1547.

Response	1957 (%)	1958 (%)
Had heard something and knew purpose	21	64
Had heard something but did not know purpose	14	23
Supplied misinformation	11	4
Had heard nothing	54	8
Not ascertained	Less than 0.50	1

The dramatic thing here is that within a matter of months, possibly within weeks, almost half of the United States public became aware of satellites. The space age was launched in the minds of men as well as in the skies. Details of the two satellite surveys show the breakdown given in Table 2.

Personal Bias

Analysis of the results obtained from a probing question—"From what you've heard, what is the purpose of launching these satellites?"—in the postsatellite survey illustrates how various segments of the public take the same information and transform it to fit their own frames of reference. Almost two-thirds of the 1547 individuals in the 1958 sample were aware of the general purposes of satellites, but when they were asked the probing question, their answers showed that they thought of them in terms of their own backgrounds or, as Walter Lippmann called them years ago, "stereotypes"—the pictures in their minds. This breakdown is given in Table 3.

Science communicators thus face this further barrier: Even if the information is presented accurately and without bias, the "consumers" of a story, broadcast, or television program still may convert and transform it to fit their prejudices and biases.

Table 3. Response to a question on the purpose of satellite launchings included in a survey made after the launching of sputnik I. Number in sample, 1547.

Response	(%)
For scientific information	27
Competition with the Russians	20
Future possibilities, such as space travel	17

That attitudes toward science do not exist in a vacuum also seems to be demonstrated by the marked decline in 1958 of mention of a "higher standard of living" as a major reason for a favorable evaluation of science. In the reasonably prosperous spring of 1957, 45 percent of all those questioned cited better living standards as a good effect of scientific activity. In the somewhat economically depressed spring of 1958, this percentage fell to 30 percent. Probably economic conditions were primarily responsible for this new skepticism about the scientific basis of living standards. If this is a correct hypothesis, then scientists and those concerned with science should realize that the public's recent high regard for and faith in science could still bend under harsh economic and political winds.

Coverage and Presentation

Regardless of whether or not the general public realizes how it twists science news to its own uses, it does have some uneasy doubts about the accuracy and methods of the four common media of communication in their presentation of science news.

Each respondent who mentioned a science news item presented in any of these media during the 1957 survey was questioned further about his opinions on the manner in which it was presented. Each was asked whether he thought the item was complete, easy to understand, interesting, and accurate. This technique restricted the gathering of opinions to those who actually used each medium.

Television, youngest of the media but the only one to combine both visual and oral presentation, was cited most often as being "very complete," "very easy to understand," "very interesting," and "very accurate." Seventy-one percent (the highest rating on this question) found television presentations "very interesting." Forty-three percent ranked television as "very complete."

When all the favorable votes—those for "very" plus those for "rather" for each medium—were combined, the votes for magazines moved up to those for television in the categories of ease of understanding, interest, and accuracy and moved slightly ahead in that of completeness.

Newspaper readers had some misgivings about the completeness and comprehensibility of newspaper coverage, and members of the radio audience had doubts about the completeness of radio coverage. Approximately one quarter of newspaper readers and radio audiences felt that these media gave too few details in reporting science news. Statistics for those who ranked these media "rather incomplete" or "very incomplete" are as follows: for radio, 26 percent; for newspapers, 23 percent. A fifth (20 percent) of newspaper readers found science items either "rather difficult" or "very difficult."

Some scientists have voiced this same complaint about the completeness of newspaper reporting of science news. Possibly the general public was echoing what it had heard said by the scientists. In any case, mass communicators may well search their souls and review their techniques.

In evaluating the media for accuracy, the public also expressed some doubts. This showed up among those who thought the medium was "rather accurate" rather than among those who actually believed the medium was inaccurate. Percentages for this "rather accurate" (instead of "very accurate") rating ranged from 48 percent for newspapers, which received a rating of 27 percent under "very accurate," to 33 percent for television, which got a rating of 51 percent under "very accurate."

Is the difficulty here primarily one of complexity of material, or do science reporters need to improve their techniques and develop new ones to present these complicated facts?

The 1957 survey showed fairly conclusively that the way a reporter writes his science story does make a difference in the amount of interest it will generate in the reading public. To obtain information on this point, half the respondents were asked whether they would be "very much interested" in reading about a set of fairly abstract science topics and the other half were requested to rank concrete ideas or headline-type wordings that dramatized comparable material.

While the results were not wholly consistent in the nine comparisons made, generally they did show that those presentations considered more alluring by the science writers did get more attention from readers. This was true for individuals of all educational levels, from college men and women right down to those who never got beyond grade school. The *average increase* in rating for the dramatized or headline types of presentation was 7 percent.

Thus, the way in which science news is packaged helps to determine its impact on the public. Scientists should consider this finding before they object too vigorously to the way writers have handled news the scientists wanted to be sure the public would receive.

Implications for the Space Age

These findings have added pertinence for the space age because a survey of managing editors on United States newspapers showed that three-quarters of the nation's dailies increased the space allocated to science stories by at least 50 percent during the first year after the launching of sputnik I.

The National Association of Science Writers and New York University sent questionnaires to every fourth managing editor in the country. Approximately 60 percent of those queried sent back answers. When editors were asked to compare the amount of space currently allocated to science news in their papers with that devoted to science a year or two before the launching of the first satellite, almost two editors out of every five (38.3 percent) reported that their publications were now allocating twice as much space, or even more, to science. A slightly smaller percentage (36.7 percent) said their papers were using between 50 and 100 percent more space for science news than they did a year or two ago. Not a single editor reported that his paper had curtailed the amount of space given to science news. Only 11, or less than one in 20, estimated that the space allocation had not increased.

Four-fifths of the editors said their papers had "special interest" in "satellites and outer space." More than half listed "medicine and public health" as well as "atomic energy."

With more and more funds for science coming from the public, either as grants from tax money or through public subscriptions, scientists have an enlarging stake in helping science reporters tell their stories so that the basic facts get through and are remembered. The public is curious, and if information is dramatized so that it can be comprehended and assimilated, then readers, listeners, and viewers will acquire that understanding of science that is becoming more and more important in a democracy.