TRAINING OF THE SCIENCE WRITER

THESIS FOR THE DEGREE OF M. A.
MICHIGAN STATE UNIVERSITY

WILLIAM E. SMALL

1964

TRAINING OF THE SCIENCE WRITER

By

William E. Small

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

School of Journalism

1964

ACKNOWLEDGMENTS

This study was made possible through the assistance of many people and the insistence of a few.

Professor James Stokley, through many months of coaxing and patient guidance, inspired the final outcome of this paper.

To the National Association of Science Writers, its administrative secretary, Mrs. Howard W. Blakeslee, and particularly the nearly 80 members who participated in the survey, I owe my deepest gratitude.

The four men who offered the most help and consultation were: Nate Haseltine, Medical Writer, Washington Post, and Past-President of NASW; Pierre C. Fraley, Executive Secretary, Council for the Advancement of Science Writing; Earl Ubell, Science Editor, New York Herald-Tribune; and Hillier Krieghbaum, Professor of Journalism, New York University.

Partial financial support for the survey came from the Michigan State University Communications Research Center and statistical support from Jack Prather and his staff at the Center.

But the greatest force behind the survey, the paper, and myself was my wife, Ruth, who typed, edited, suggested, and otherwise assisted in my efforts.

CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

INTRODUCTION

In order to gather the data for this study, I made a survey in January-February of 1963 of professional science writers throughout the United States and Canada to obtain their views about science writing and the training programs for science writers.

The questionnaire (Appendix B) was sent on January 12 to the 180 active science writing members of the National Association of Science Writers (NASW)[1] with a letter of instruction (Appendix A) and an air-mail-stamped return envelope to insure a high number of returns.

The selection of survey subjects (science writers) was based on several factors. First, membership in the NASW is limited to those persons who are actively engaged in writing science for the lay public, devoting at least 50 per cent of their time to writing science, and who have been doing so for a minimum of two years.[2] Secondly, it is generally believed that a majority of the men and women who meet these qualifications

---

[1]National Association of Science Writers, Inc., Membership List, Lifetime and Active Members (Port Washington, N.Y.: Aug. 2, 1962). [Excluded were two with no address, four abroad and one deceased.]

[2]National Association of Science Writers, Inc., Constitution (Port Washington, N.Y.: August, 1955), p. 1.

have become members of the organization.[1] There are other organizations of science-oriented writers, but they are mainly for technical writers (who write for a special group of scientists or technicians rather than for the general public) or for specialized groups of science writers, such as the American Medical Writers' Association or the Nuclear Energy Writers Association. There is also a great deal of overlapping of memberships experienced by these organizations and the NASW. A third factor in subject selection was the fact that members of NASW are primarily newspaper, magazine or wire service science writers, as opposed to the associates who are mainly public relations writers.

A follow-up letter (Appendix C) to my survey was mailed on February 1st because computer time was not available for analysis of results at that time and we felt more subjects would be able to participate if the period was extended.

From the original 180 subjects, 72 validated returns were received by the termination date of the survey late in February. This was a healthy 40 per cent of the total subjects surveyed. The subjects were assigned arbitrary numbers in the order in which their returns were received.

The 72 returns were from writers in 17 states, the District of Columbia and Canada. Figure 1 is a map of the distribution of subjects. State distribution is summarized in

---

[1] James Stokley, "Opportunities in Science Writing," (Unpublished paper, School of Journalism, Michigan State University, East Lansing, 1963). (Mimeographed.)

DISTRIBUTION MAP OF RESPONDING SCIENCE WRITERS

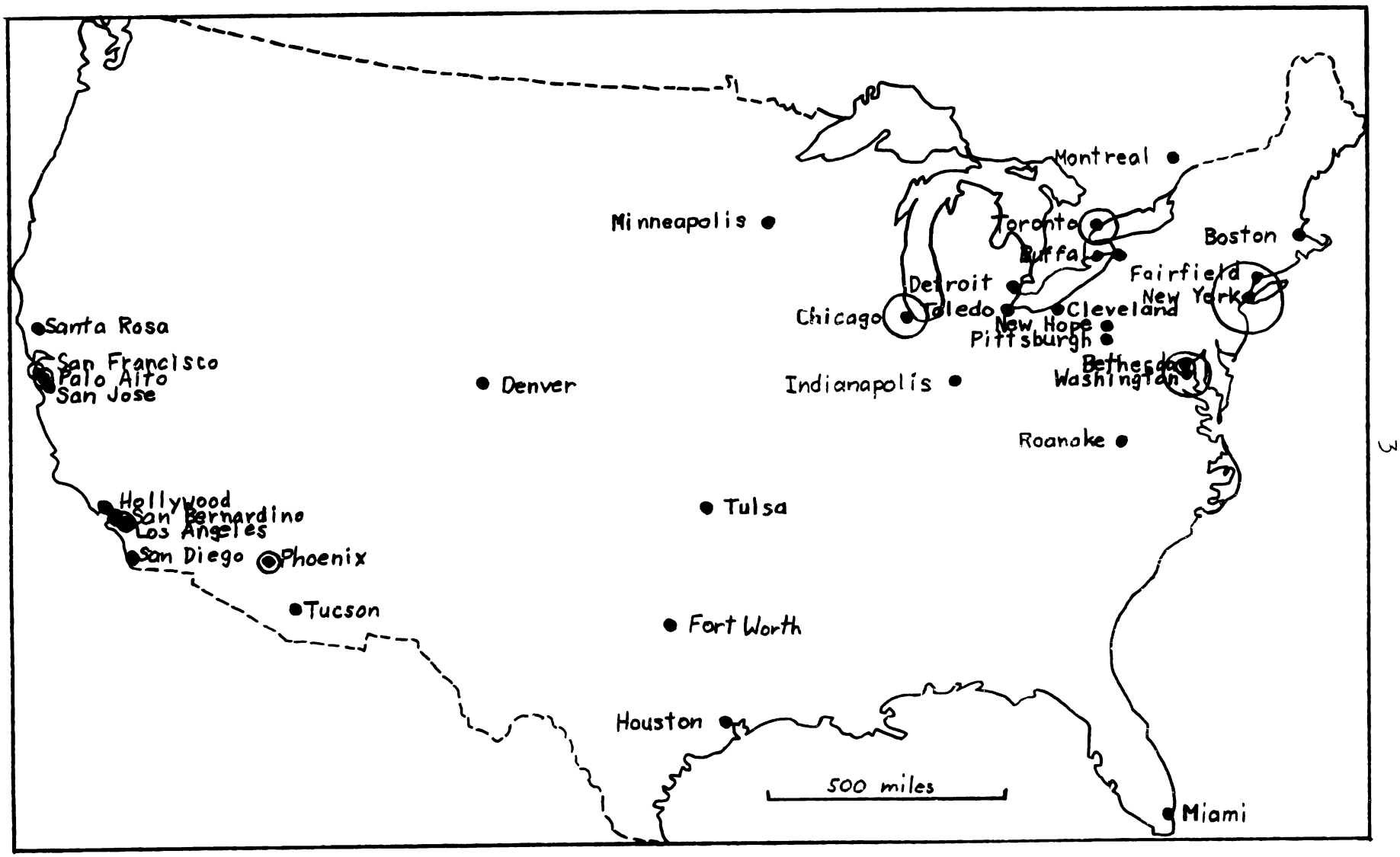


FIGURE 1

Table 1. Six persons, including Stokley, disqualified themselves or were disqualified from the survey, and two other returns were received too late to be included in the results.

TABLE 1

STATE DISTRIBUTION OF SUBJECTS SURVEYED

Arizona	3
California	10
Colorado	1
Conneticut	1
Florida	1
Illinois	7
Indiana	1
Maryland	2
Massachusetts	1
Michigan	1
Minnesota	1
New York	20
Ohio	2
Oklahoma	1
Pennsylvania	3
Texas	2
Virginia	1
Washington, D.C.	8
Canada	6
Total	72

Note:

Questionnaires were sent to 180 writers in 25 states, the District of Columbia and Canada. Returns were from 72 science writers in 33 cities in 17 states, the District of Columbia and Canada.

Answers were transcribed from the questionnaires onto a prepared form (Appendix D) from which Michigan State University Communications Research Center key punch operators could directly punch the results onto IBM cards. Three cards were prepared for each subject, including all of the data from each of the 72 questionnaires. These were fed into the Michigan State University computer, MISTIC, along with the program

compiled by Jack Prather and the Center staff.

Ages, salaries, education, suggested curricula, and the other information was tabulated. Percentages, means and standard deviations for each part of each question were computed. Cross tabulations and other manipulations intended to give an idea of how each subject felt about himself as a science writer, about science writing in general, and about the training of future science writers, were ordered from the computer. In addition, an audit list was requested in order to give general reference to all items in the survey and to verify each and every piece of information. Appendixes E and F were compiled and sent to all the subjects. These papers contained the initial machined answers for first reference to the survey. Appendix F offers an easy reference to the answers to questions in Appendix B. The answers are simply averages of the answers given by the 72 subjects.

This paper has been prepared to answer some of the following questions: What are science writers? What qualities do they have? How do they become science writers and why? What opportunities do they have? What training do they have? What training program or programs would they suggest for science writing students?

I hope this paper will serve as a guide to science writing students and to the schools of journalism in this country which are attempting to educate the science writer.

CHAPTER 1

HISTORY OF SCIENCE WRITING

A science writer is a Hybrid[1] whose curiosity for science and talent for writing are intimately blended to produce for the lay public, for "the man-on-the-street," a microscopic close-up of the scientific community in action. These Hybrids devote their lives to explaining the complexities of the sciences from astronomy to zoology, only to have their stories read over the breakfast coffee cup and rolled around the garbage before nightfall.

Science writers have been around for years, knocking about dusty laboratories, probing into the hearts of giant machines, and picking the brains of scientists in government, industry and universities of the world. They have explained the theories of physicist Albert Einstein, the perplexities of educator John Dewey's teaching psychology, the birth of the atomic bomb, the medical fight against cancer and the flights of the first men into space in the pages of the daily newspaper and the popular magazine, or on the speakers and screens of radio and television.

---

[1] Horace G. Loftin, "Science Reporting in the American Press" (unpublished Master's thesis, Florida State University, August, 1956), p. 100.

To those who doubt the importance of the layman's understanding of science, heed the words of the late Einstein when he said:

> It is of great importance that the general public be given an opportunity to experience--consciously and intelligently--the efforts and results of scientific research. It is not sufficient that each result be taken up, elaborated and applied by a few specialists in the field. Restricting the body of knowledge to a few people, to a small group, deadens the philosophical spirit of a people and leads to spiritual poverty.[1]

For the non-scientific reader, however, even if he has a curiosity about science, the progress of the sciences is inaccessible and unintelligible. A babble of specific scientific tongues has emerged so that even scientists often can't understand one another.

It was for this reason that the profession of science writing came into being.

Although science of sorts was reported sporadically in the first colonial newspaper,[2] real science reporting did not evolve until the twentieth century. Three separate events several years apart marked the birth and growth of science writing in this country.

The birth of modern science writing took place more than 40 years ago, as recorded by Horace Loftin:

> The year 1921 can be taken as the beginning of the new era of science reporting, marking the advent of the professional science writer. During that year, Science

---

[1] Science News and Newspapers, Report of the Science News Seminar for Southern Newspaper Editors (New Orleans: Tulane University, Feb. 5-7, 1962), p. 14.

[2] Loftin, op. cit., p. 1.

> Service, a unique non-profit organization whose prime objective is the popularization of science, began its activities. This new organization had a full-time staff of science writers including Dr. Edwin E. Slosson and Watson Davis. That same year, David Dietz was made science editor of the Cleveland Press and later of the Scripps-Howard chain; Alva Johnston was selected to write science for the New York Times; and John J. O'Neill, who later became science editor of the New York Herald-Tribune, was writing front page science stories for the Brooklyn Eagle.[1]

When the National Association of Science Writers was formed in 1934, twelve professional science writers became its charter members.[2] All of these men and women were dedicated to "foster the dissemination of accurate information regarding science through all media normally devoted to informing the public."[3] Five of the original 12 members are deceased.

Lawrence Lessing, the 1962 winner of the American Chemical Society's Grady Medal for science writing, describes this first period of science writing as the "Gee Whiz" age:

> It wasn't much to begin with. The first stage, extending into the Thirties, has rightly been called the Gee Whiz age. It was quite adolescent. Its most characteristic feature was the Sunday supplement story, in which scientific fact was mixed with lurid imagination and invariably lost the battle.[4]

The second burst of interest in science writing came

---

[1] Ibid.

[2] National Association of Science Writers, Inc., A leaflet bearing background information on the NASW, 1963, p. 1.

[3] National Association of Science Writers, A Handbook for Press Arrangements at Scientific Meetings, (Port Washington, N.Y.: NASW, 1962), preface.

[4] Lawrence Lessing, "The Three Ages of Science Writing," Chemical & Engineering News, XLI (April 22, 1963), 88.

late in the summer of 1945, when the United States dropped the atomic bomb on Hiroshima.

This second age, which Lessing calls the "reportorial age," began with the awakening of the public to the tremendous expansion of scientific and technical wealth which was generated during the war years. According to Lessing:

> The few science writers who had been struggling to get their work accepted as a legitimate and regular part of straight news reporting--men such as Bill Laurence of the New York Times and David Dietz of the Scripps-Howard press ...finally came into their own.
>
> In the age of the atom, the electron, the computer, the solid state, and all the new complex materials pouring out of chemistry, it became quite obvious that some new level of science reporting was needed. And the level through most of the country has been greatly raised.[1]

The great influx of science writers of that period is reflected in the comments by some of the active science writers around the country:

> In 1945, while serving in the Air Force in San Antonio, I read the first account of the dropping of the A-bomb on Hiroshima. I realized I didn't know what the writer was talking about. He did not know much more than I did. So I began reading books and magazines on science--Ralph S. O'Leary, Science Editor, The Houston Post.
>
> I was assigned to cover science in 1945 following the use of an atomic bomb at Hiroshima--George Dusheck, San Francisco News-Call Bulletin.
>
> I began writing science when science developed as a major aspect of American life--about 1946--or, rather, when I became aware of it as such--Richard S. Lewis, Science Writer, Chicago Sun-Times.

The third event which stimulated science writing was the first space shot; the Russian Sputnik. In 1957 the NASW

---

[1] Ibid.

and New York University surveyed portions of the public on readership of science news.[1] Six months before the first Sputnik they found that more than half of the public answered "no" to the question; "Have you ever heard of an earth satellite, sometimes called a man-made moon?"[2]

"This," Hillier Krieghbaum remarked, "is rather frightening when you think that Life magazine had two or three issues dealing with this, the news magazines had extensive coverage, the newspapers had coverage and radio and television had extensive coverage."[3]

However, six months later, at the time of the first Sputnik, knowledge of such a satellite rose to 92 per cent. In 1958, Krieghbaum wrote that "the typical United States daily newspaper increased the amount of space it devoted to science news by at least 50 per cent in the year since the Russian scientists put their first satellite into orbit."[4]

It is interesting to compare the general increase in science news over the past few years. Krieghbaum, in 1962,

---

[1]National Association of Science Writers, Inc., Science, the Press and the Citizen, Report of the Committee on Fellowships and Scholarships (Port Washington, N.Y.: NASW, 1957). (Mimeographed.)

[2]Hillier Krieghbaum, Science, the News, and the Public (New York: New York University Press, 1958), p. 32.

[3]Science and the Public, Proceedings of the Midwestern Science Communications Seminar for Public Information Specialists (Evanston, Ill: Northwestern University, March 21-23, 1962), p. 14.

[4]Hillier Krieghbaum, Impact of Space Age on Daily Newspaper Coverage of Science News, A Report of a NASW-NYU Survey of U. S. Managing Editors, 1958, p. 1.

compiled some figures on significant scientific events and the amount of coverage they had, shown in Table 2. Science news appears to be gaining more than a proportionate share of the swelling space in the mass media.

TABLE 2

NEW YORK TIMES COVERAGE OF RECENT SCIENCE EVENTS[a]

Event	Total News Space	Space on Page One
First atomic bomb (Aug. 7, 1945--38 page issue)	634	79
First Soviet satellite (Oct. 5, 1957--36 page issue)	331 3/4	66 1/2
Soviet moon shot take-off (Sept. 13, 1959--Sunday issue	238 1/4	37 3/4
Soviet moon shot landing (Sept. 14, 1959--60 page issue)	619 1/2	94 1/2
Col. Glenn flight (Feb. 21, 1962--92 page issue)	1,373 3/4	96 1/2

[a]Hillier Krieghbaum, "It's Later Than You Think," The Quill, L (November, 1962), 73.

Many young people have entered the field of science writing since 1959. A typical post-sputnik science writer, Carle Heintze of the San Jose News, explained that he came into the field "because it was a field uncovered on our papers and because of the upturn of interest in science following Sputnik I."

Lessing feels the third age of science writing, the

"interpretive age," has not yet arrived,[1] despite the substantial number of young people who have turned to science writing in the last five years. But each year the NASW elects several new members. As a university public relations man and ex-editor puts it:

> For some years now, it has been obvious that every good newspaper needs at least one of these qualified science writers on its staff. There was a period when the general assignment journalist was viewed as the type of man who could handle all of the planning, writing and editing chores which were confronted. But the explosion of knowledge--especially scientific knowledge--in the past two decades has decimated this long-held assumption.[2]

There were, in 1961, approximately 250 men and women in the United States who prepared science stories directly for the lay press.[3] Hundreds, perhaps thousands more work in public relations offices in industry, government and universities, helping to prepare the stories which finally reach the breakfast table. Scores of scientists and other journalists contribute enormously to the public knowledge of science through science fiction and scientific books, comic strips, radio and television shows. However, in order to prevent confusing the science writer with the hundreds of others who practice some form of science writing, the term "science writer" is usually taken to mean a person who is actively

---

[1]Lessing, op. cit., p. 89.

[2]Carl W. Larsen, "Science Writing--New Opportunities--New Problems," Paper read at the American College Public Relations Association Convention, Chicago, June 24, 1963.

[3]Science Service, Report, Conference on the Role of Schools of Journalism in the Professional Training of Science Writers (Washington, D.C., June 9-10, 1961), p. SWN 1.

engaged in, and devotes the majority of his time to, the preparation of science stories for the lay public. This is the definition which is used throughout this paper.

CHAPTER 2

WHY THE SCIENCE WRITER?

Man is a curious animal. He wants to understand himself and his environment. He has turned his microscope on the tiny living creatures and his telescope on the vast universe. He smashes atoms and cries for more energy with which to smash the pieces. And yet, he is attempting to cure the diseases which kill and cripple his fellow man.

All of these things have been done by man--man the scientist; man the humanist. It is the same man who opens the morning paper or snaps on the evening news report to learn more about the world around him. He desires more science information along with his politics, more knowledge of where his tax dollars are going and what is in it for him.

This need on the part of the public for more and more science information is pointed up by a series of surveys of the public's attitude toward science news. The 1957-58 NASW and New York University surveys, although not primarily intended for this purpose, do reflect the public's interest in science news. Results from the surveys are reported in Table 3. Notice that from all the media combined, 76 per cent of the average citizens surveyed could recall reading at least one of the science items which were suggested in the survey. In fact, more

than one third (37 per cent) could recall all the medical news which they read in their newspapers.[1]

TABLE 3

HOW THE PUBLIC USES MASS MEDIA TO OBTAIN SCIENCE INFORMATION[a] (RESPONSES OF PEOPLE WHO COULD RECALL AT LEAST ONE SPECIFIC SCIENCE OR MEDICAL NEWS ITEM)

All media combined	Total science	76%
	Medical news	69%
	Nonmedical science news	52%
Newspapers	Total science	64%
	Medical news	60%
	Nonmedical science news	36%
Magazines	Total science	34%
	Medical news	20%
	Nonmedical science news	21%
Radio	Total science	13%
	Medical news	7%
	Nonmedical science news	8%
Television	Total science	41%
	Medical news	25%
	Nonmedical science news	22%

(Sample size: 1919)

[a]Science and the Public, op. cit., p. 15.

Krieghbaum, in discussing the survey at the Midwestern Science Communications Seminar for Public Information Specialists, summed the public's interest in science:

"I think that it is perfectly obvious that (1) there is an interest in science, (2) that the public reads or sees it, and (3) the public desires more of it."[2] He points this out in his report of the survey by saying 42 per cent of the 1,919

---

[1]Krieghbaum, Science, the News, and the Public, p. 1.

[2]Science News and Newspapers, op. cit., p. 9.

subjects surveyed wanted newspapers to print more medical news and 28 per cent wanted more science in general. Sixty six per cent, he said, were willing to give up some other news to provide space for these stories.

The Southern Newspaper Editors recently added that "it is evident from various studies that people want science news and they want more than they are getting."[1]

How the public gets science news is evident in Table 3. Newspapers are far above all other media for distributing science information. Magazines, television and radio trail at some distance, but television is gaining more in popularity each year. The newspaper remains the trail blazer. As John E. Pfeiffer points out, however:

> When it comes to science news coverage, newspapers are doing the best job. However, even newspapers are not doing enough. Although a large portion of the public today may not be able to understand a science story which hasn't been carefully broken down for them, there are a lot of readers who understand a lot about science.[2]

One of the reasons the public desires more and more science news, of course, is the fact that they, themselves, through the Federal income tax program, are sponsoring more and more of the scientific research by government, industry and universities. Percy H. Tannenbaum makes this observation:

> With increasing amounts of public funds being spent in support of scientific undertakings and with scientific fact and opinion becoming increasingly significant in national and international political decisions, the wonder--and to

---

[1] Science News and Newspapers, op. cit., p. 9.

[2] Ibid., p. 8.

some commentators, the pity is that there is as little science reporting as there is.[1]

Perhaps the reason, as stated by J. Robert Oppenheimer some years ago, is that science is defined in words and phrases which are "almost impossible to translate" into conventional lay language.[2] Oppenheimer recently told a group of newspaper editors that almost everything that is known in science today was not known when they went to school. This is conceivable when, historians point out, 90 to 95 per cent of all the scientists who have ever lived in the history of the world are alive and practicing science today.

As Arthur J. Snider, Science Writer for the Chicago Daily News, so aptly put it:

> Science is bulking much faster than we are reporting it. This is of growing concern to those of us at the ringside of science. There is not much time to lose. Our position is well summed up by Dr. John R. Platte, Professor of Physics, The University of Chicago: "Man has suddenly found himself. He has explored all the earth and stepped outside it. He taps the sun's source of energy and stands ready to manipulate the weather and use the oceans. He measures back to the beginnings of time and out to the ends of space, and sees his own sudden emergence, a thinking creature spun out of light and air and water and holding power in his hand, yet probably only one of millions of such creatures on other worlds. And the power man holds is not only the technical power but something far greater still, evolutionary power. He creates new species of plants and animals, halts or speeds up evolution, manipulating heredity like chemistry and prepares to turn his own flimsy organism into whatever fantastic and brilliant and powerful form he most desires. The whole future is open-ended,

---

[1] Percy H. Tannenbaum, "Communication of Science Information," Science, CXL (May 10, 1963), 579.

[2] Editor and Publisher, 1958.

> waiting for us. From now, in every century, men will look back and say: 'This was the one...'"[1]

And what of the needs of the 2.7 million persons working in science and technology in the United States[2] for science reporting to the lay public? Does the scientist, whose work is as much the life-blood of the science writer as it is his own, need the Hybrid as much as the science writer needs him?

> The increasing prominence of science in world affairs has forced the scientist out of his laboratory on to the brightly lit stage of public life. This emergence of the scientist is a comparatively recent phenomenon, accelerated by World War II and dramatized by post war security investigations. By and large the scientific community has been unprepared for this sudden prominence, which many find distasteful, and is divided within itself as to the public role of the man of science.[3]

This reflected the views of scientists in 1955 and remains the feeling of many scientists today. Some of the larger organizations of scientists in America have gone on record to help promote a good public image of the scientist and to foster good public relations of their particular or collective sciences. However, many more organizations go out of their way to avoid any and all kinds of publicity.

The two diametrically opposing viewpoints are held by two great organizations which are considered by the general

---

[1]Arthur J. Snider, "A Writer's View of Science," Southern Regional Science Seminar for University Information Officers (Gainesville: University of Florida, Feb. 19-22, 1961), p. 49.

[2]"The Technical Society," Scientific American, CCIX, (September, 1963), pp. 82-83.

[3]Science Writing and the Public, A Report of a Pilot Study for the National Association of Science Writers, (Ann Arbor: Survey Research Center of the University of Michigan, September, 1955), p. 33.

public to be as close together as any of the organizations of science: the American Medical Association (AMA) and the American Dental Association (ADA). The physicians are concerned that the public be more than just informed about science; that they be educated to the point where they may play a part in the future drama of science, as expressed at their 1958 special meeting:

> The power of man through science is currently assuming a new order of magnitude. Power has always been sought avidly. Sometimes it has been used disastrously; often it has been used wisely. How the United States shall keep abreast of the developments in science and scientific technology; how it shall help avoid disaster; how it shall ensure that new knowledge (the age-old synonym for power) will be used for the benefit of mankind...are among the most important questions before the American public today...
>
> Man is breaking with the past, its limitations and its safeguards. The prize is greater than ever before--so are the risks. The question is not, "Do we like this?" The The question is, "What role do the people of the United States wish to play in the drama of the future?"[1]

The forward-looking views of the AMA with respect to public information are reflected in Table 3, with a high percentage of recall of medical news. It can be seen that, in general, doctors tend to cooperate with the press, and this gives the press an advantage it does not have in the so-called hard sciences. Many of the problems between doctors and science writers were ironed out in a series of meetings beginning in 1953.[2]

---

[1]Dael Wolfle, Science and Public Policy (Lincoln: University of Nebraska Press, 1959), pp. 3-4, quoting 1958 "Parliament of Science," Science, CXXVII (1958), p. 852.

[2]Hillier Krieghbaum, When Doctors Meet Reporters (New York: New York University Press, 1957).

On the other side of the coin, the ADA has an unwritten policy which prohibits dentists from at least making primary contact with the press, if not from cooperating on a news story. They view this cooperation as "publicity seeking" which would give the dentist an advantage in attracting patients. Often the license is in jeopardy if this policy is broken. This, then, somewhat inhibits the reporting of dental news.

There are many reasons why scientists have mixed feelings about reporting of their news in the mass media. One of the most frequently heard comments from scientists is that they have been "stung" by reporters in the past--usually reporters who have had no background in science or science reporting, reporters who will take very little time to get the facts straight. Arthur J. Snider recently extended the comments of a prominent scientist, Dr. Warren Weaver, who was trying to smooth the ruffled feathers of scientists who are reluctant to release information because of the lack of "communicative accuracy:"

> This concept rests on the fact--not often recognized--that the effective accuracy of a written statement depends primarily on the interpretation given it by the reader. A statement has communicative accuracy, Dr. Weaver says, if it takes the reader closer to the correct understanding--if it gains ground in the right direction.
>
> Scientists should make a distinction between scientific accuracy and literary accuracy. Scientists are asking of the press a degree of accuracy that is not necessary for the type of audience we are reaching. I think it can be said in some instances scientists may be more tolerant of inaccuracies on the part of their own colleagues than of inaccuracies in the press. There are inaccuracies inherent in the limitations of the methods of science. There are inaccuracies in the interpretations of results. There is a frightful amount of inaccuracy even in routine laboratory tests. There are inaccuracies in the over enthusiasm of a scientist in reporting his results, in his unrecognized

> bias, in his accentuation of positive factors and minimizing of negative factors. In the medical clinic, as we know, a physician may make a grave or even fatal diagnostic or therapeutic error and explain it away to his colleagues' satisfaction as resulting from his "best clinical judgement" at the time. Our errors are run off at the rate of 50,000 newspapers an hour for all to see.[1]

A second comment which scientists often make against reporting their research in the pages of the mass media is that their work is not exciting or important or it does not lend itself to popularization because it is too technical. It is indeed true that some of the research being done in laboratories currently does not have the significance that other research has. It is also true that the inherent difficulties in understanding such technical work as the periodic rotation of some heavenly body or the wave functions of diatomic molecules limits the reporting of such subjects to those writers who have specialized in that area of science or are willing to spend long hours reading and studying about the subject. However, any given piece of research, no matter how technical or seemingly insignificant, must be interesting to someone, at least the scientist, or else he would never have undertaken the study. If a science writer has enough interest in the subject to attempt doing a story, the scientist should have enough realization to see that a segment of the public would be interested.

Despite the handicaps which some scientists present to science writing, there are many, many more scientists who understand the need for popularization of their research. They know that a great deal of the research which their laboratories are

---

[1] Snider, op. cit., pp. 45-46.

doing is financed by the public. They also know that a well-informed public, in all fields of knowledge, is capable of making decisions far superior to an unsophisticated public. In fact, many of the organizations of scientists have a paragraph written into their constitutions which specifically announces the organization's goal to educate the public in its specific area of science:

> "In New York State, the [State Medical] Society's goals are set forth as follows: ...'to extend medical knowledge and advance the science and art of medicine; to promote the betterment of public health; and to enlighten and direct public opinion in regard to the problems of medicine and health for the best interest of the people..."[1]

A group of 100 leading scientists and physicians who met in New York recently to discuss this problem of public communications under the guise of the National Conference for Scientific Information agreed on the needs for strengthening the public image of science and scientists. In their resolutions, they drafted the following statement:

> The accelerating progress of science provides society with growing powers which can be used for destruction or for the enrichment of life. Under these circumstances every citizen is confronted with the continuing need to participate in momentous political decisions. To make these decisions citizens need to understand a growing body of relevant scientific information, for an informed judgement is otherwise impossible. Therefore it becomes the special responsibiltiy of scientists to serve their fellow citizens by providing the necessary information in an understandable form.
>
> In recent years increasing numbers of scientists have accepted this new challenge and have endeavored to provide the public with factual information on major issues, such as those associated with military and civilian uses of

---

[1]Krieghbaum, When Doctors Meet Reporters, pp. 85-87, quoting Dr. Arthur H. Master.

> nuclear energy. In performing this duty, these scientists, as represented at this conference, subscribe to certain guiding principles: (1) Information is presented unencumbered by political or moral judgements, which judgements are the prerogative and responsibility of all citizens. (2) Information is prepared with scientific objectivity, which includes attention to divergent studies and interpretations. (3) Information is freely available to all.[1]

Krieghbaum made this additional comment:

> Indeed, more and more, scientists are coming to agree with Dr. Frank Fremont-Smith, of the Josiah Macy, Jr. Foundation, who explained at a conference of science writers and doctors several years ago, "It seems to me that the medical profession, the universities, and hospitals have ignored too long the fact that they can be successful only with genuine public support and they are going to get genuine public support only if their story, their very dramatic and thrilling story, is appropriately told to the public. There is no better group to tell this to the public in terms that the public can understand--because, God knows, we cannot make ourselves understood to the public--than the intelligent, thoughtful science writers." The comment applies to non-medical scientists as well as M.D.'s.[2]

Science writers truly have a difficult task to perform, for the public and for scientists. But just what the purpose of science writing is, whether to entertain the public or to educate the public, even the science writers are not certain. Some of the answers to the question, "what is the role of the science writer?," revealed these varying views:

> Our job is simple. Tell the public what is going on. To inform the public we should entertain the public, so I believe in liberal use of analogy. The good gray New York Times style of science writing is bunk in my books. After all, the science writer is NOT the final source of information--he is the tribune to the common man--and if you

---

[1] National Conference for Scientific Information (New York: Scientists' Institute for Public Information, Feb. 16-17, 1963), p. 118.

[2] Hillier Krieghbaum, "Bouquets and Boobytraps for Science Writers," Paper read at the Howard W. Blakeslee Awards Luncheon of American Heart Association, New York City, Oct. 3, 1959.

want specifically accurate data you go to the scientists, not the newspaper--Charles B. Wheat, The Tulsa World (Oklahoma).

Like any reporter, the science writer must write to please his editor; that is, he must write his story as the editor thinks the public would like to see it. Ideally, the science writer should strive to inform the largest number of people--Arthur Hill, The Roanoke Times (Virginia).

Entertain and inform the public--Darell Garwood, Bethesda, Maryland.

Strangely enough, the role of a science writer depends on the public for which he writer--Earl Ubell, Science Editor, New York Herald-Tribune.

"Educating" scientists so specialized that all they know about what other disciplines are doing is what they read in the papers. So much of science is analysis that synthesis--i.e., "integration" of fragments of knowledge--is rarely attempted by scientists themselves, and the well-backgrounded science writer whose knowledge is in breadth rather than depth can bridge a gap in communications--Donald G. Cooley, Scarsdale, New York.

The role of the science writer is primarily to inform the general public and, only then, to inform the scientific community at large--Carle Hodge, Science Editor, Arizona Daily Star (Tucson).

In general, the science writers surveyed by myself agreed that the goal of the hybrid was to inform and educate the public on the advances of modern science. Since the adult population, after leaving school, can only receive its science information from the mass media, science writers and editors control to a great extent the knowledge of the masses in this rapidly increasing area of human conquest.

We are often told that this is a "two-culture" society. It seems relatively easy for scientists to understand what is taking place in other areas of endeavor--the humanities, literature, archaeology, languages, and so forth--but generally it is not easy for even the most educated humanists or social

scientists to understand what is taking place in the sciences. Perhaps, as Pierre Fraley recently said, the science writer really has two purposes, "to humanize the scientist and simonize the humanist."[1]

---

[1] Pierre C. Fraley, "Should Science Writers be Scientists?," Unpublished talk read before the Science Writers Seminar on Birth Defects, University of Michigan, Ann Arbor, Nov. 14, 1962.

CHAPTER III

WHAT IS THE SCIENCE WRITER?

The average science writer, based on my survey, is 48 years old[1] (see Appendix F). He receives between $10,000 and $15,000 a year. He probably works with at least one other science writer and devotes at least 79 per cent of his time to reporting scientific events.

He probably belongs to one scientific organization and at least two writing organizations, one of which is the NASW.

The average science writer has been a journalist for 24 years and has covered science for 14 years, indicating that he began reporting science 10 years after he became a journalist. He has also spent less than two years doing scientific research. (Only 14 of the 72 writers had actually done scientific research.)

Seventy six per cent of the science writers surveyed had completed at least four years of college and more than 47 per cent had taken graduate work. The average had more than 16 years of school, a bachelor's degree plus.

In trying to pinpoint some of the qualities of a "successful" science writer qualitatively--without particularly

---

[1] Fifty eight per cent of the subjects were below 50 years of age, a significantly lower percentage than the 71.1 per cent found in 1961 (Science Service, op. cit., p. SWN1).

selecting those whom I believe to be outstanding--I attempted arbitrarily to base "success" in terms of salary, for this seems to be one of the most common measures of success in the Western World. However, there was no correlation between salary ranges and age, education, years of professional writing or science writing, or number of scientific and journalistic affiliations. These factors were, in fact, approximately the same average for the subjects in all of the salary groups.

One peculiar facet of the survey was found in the comparison of salary with the number of years of scientific research. Only 20 per cent (3 out of 15) of the subjects in the $5-10,000 salary range and 17 per cent of the subjects in the $10-15,000 (4 out of 24) and $15-20,000 (2 out of 12) ranges had done any scientific research. But 40 per cent (2 out of 5) of those in the $20-25,000 range and 30 per cent (2 out of 7) of those in the $25,000-and-above bracket had been engaged in scientific research. This could indicate that persons who have had first-hand experience in science have an advantage, at least salary wise, over those who have had none.

A second indicator of success in our society is longevity or age. But the only correlations with age which indicated anything were the obvious: as age increased, so did the number of years of writing experience, the correlation with salary showed no significant difference.

Competency of the Science Writer

> After knowledge is gained, it must be distributed to those who can use it. We shall not argue about which is more important, creation or use. Both are.[1]

This statement by Watson Davis, Director of Science Service, at a meeting of the American Association for the Advancement of Science, reflects the necessity of teamwork between scientists and the science writers in informing the public of the benefit of science. But, how much science information which comes from the cooperation of scientists and science writers actually reaches the layman, even under the best conditions? And how accurate is it?

The chart, Figure 2, created by J. Ansel Anderson of the Grain Research Laboratory, Winnipeg, Canada, shows the level of real scientific knowledge which finally reaches the pages of the newspaper under the best conditions--that is, when science articles are even used. Stokley describes the detail and communicative accuracy of the science which is reported as follows:

> The scientist must record all that he does and has full technical knowledge; his notebook represents 100 per cent knowledge and 100 per cent detail. He writes a technical paper about his work, addressed to other scientists who presumably have as much knowledge as he but they don't want all details, only the highlights: this is 100-50 per cent. The reader of a trade journal has still less technical knowledge and wants less detail, perhaps 50-12 per cent. Management provides the money and wants considerable detail as to how it's spent, but has still less technical knowledge, hence report to management may be 12-75 per cent.

---

[1] Watson Davis, "Writing and Science Presentation," Paper read before the Conference on Scientific Communication of the American Association for the Advancement of Science, Chicago, Ill., Dec. 30, 1959.

The reader of the popular article may have almost no technical knowledge and wants very little detail, only the main idea, so this might be 0-0 (or perhaps 0.1-0.1) per cent.[1]

DEGREES OF DETAIL AND COMMUNICATIVE ACCURACY

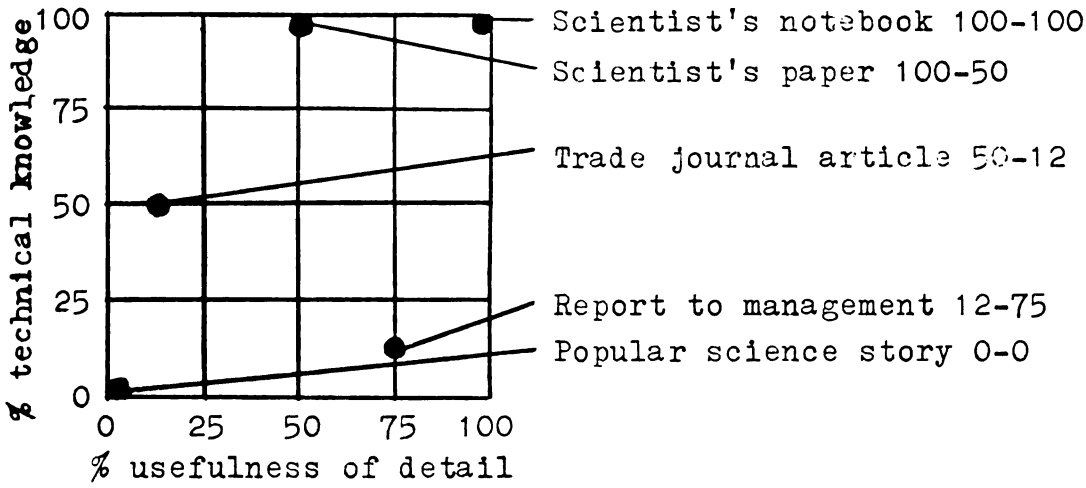


FIGURE 2

To a great degree this is true. The science writer can only report a small percentage of the information and knowledge that an individual scientist has obtained. The science writer must rather try to impart a general understanding of science to his reading audience.

To write even this 0.1 per cent, however, science writers must have a fund of knowledge themselves. Dr. Robert Oppenheimer, one of the physicists who helped create the atomic bomb, once remarked: "Nearly everything that is now known was

---

[1] James Stokley, Technical Writing Course Notes, Part 3, School of Journalism, Michigan State University, East Lansing, Fall Quarter, 1960. (Mimeographed.)

not in any book when most of us went to school."[1] Even the basic laws of science are constantly changing, presenting a formidable task to communications experts.

How science writers feel about this task of understanding and writing this small degree and small amount of science which is daily recorded in the scientific notebooks in the millions of laboratories across the world is reported in Table 4.

Question 14 of the Science Writer survey listed 23 specific science choices with fill-in blanks in which the subjects were to rate their relative competency, pertaining only to science writing. They were asked to rate themselves in each area of science on the basis of 5 for excellent (highly competent) down to 1 for no competency. Zero's were used for no answer.

The sciences for question 14, as well as for questions 15 and 16, were selected for various reasons, but primarily to attain a balance between the physical and biological sciences and to give as wide a range of general science areas as possible. The "basic" sciences were selected first: biology, chemistry, mathematics, and physics. Then medicine, space, astronomy, engineering, meteorology, geology, anthropology and psychology were added, based on the other major fields which

---

[1]Hillier Krieghbaum, "What the Public Reads," Science and the Public, Proceedings of the Midwestern Science Communications Seminar for Public Information Specialists (Evanston, Ill.: Northwestern University, March 21-23, 1962), p. 11, quoting Dr. Robert Oppenheimer.

TABLE 4

SCIENCE WRITING COMPETENCY

Field	Competency
Agriculture	1.64
Anthropology	2.01
Archaeology	1.89
Astronomy	2.25
Biology	2.67
Botany	1.81
Chemistry	2.26
Civil Engineering	1.26
Electrical Engineering	1.68
Geography	2.08
Geology	1.92
Home Economics	1.10
Mathematics	1.75
Mechanical Engineering	1.33
Medicine	3.38
Metallurgy	1.42
Meteorology	2.00
Oceanography	1.99
Physics	2.22
Psychology	2.42
Space Technology	2.22
Statistics	1.44
Zoology	2.04
Other	0.93

Note:

Based on a score of from 5 for excellent competency to 1 for no competency. A score of zero was given to those who gave no answer, which lowered the over-all average considerably.

science writers normally cover, and to be able to correlate with other similar surveys.[1] Agriculture was selected because it is a major science, taught in American colleges since 1862,[2] and because there is a large group of agricultural writers in

---

[1]Science Service, op. cit., p. SWN 8.

[2]U.S. Department of Agriculture, After A Hundred Years: The Yearbook of Agriculture 1962 (Washington, 1962), p. 13.

this country. The general term "biological sciences" was broken into the recognized subsections; zoology, botany and biology. Engineering was broken into civil, electrical and mechanical engineering and metallurgy. Archaeology and geography were selected to represent transitional natural-social sciences. Oceanography, as a field, has gained its own place among the basic sciences, as has meteorology. Home economics, although usually not considered a science, is finding itself more in the health and nutrition fields along with medicine.

The results of question 14 on competency are shown in Table 4. Several of the sciences stand decisively above the rest--that is, science writers feel more competent to write them. Medicine leads the field, with an average self-competency rating of 3.38 out of a possible 5 points. Biology, at 2.67, and psychology, at 2.42, follow medicine, trailed by chemistry, astronomy, physics and space technology. Home economics, as might be expected, was the field in which the subjects felt least competent. Most of the subjects were men. It may, however, reflect their distaste in having it included with the sciences. These results, Table 4, may be compared with the results of the Science Service survey of science writers in 1961, shown in Table 5. In the Science Service survey it may also be seen that medicine is the field in which science writers felt they had the most competence. Space and aviation, however, are second, followed by biology and psychology.

Perhaps the competency they show in medicine and biological sciences is due in part to what Hillier Krieghbaum

TABLE 5

FIELDS OF SCIENCE IN WHICH THE WRITERS JUDGED THEMSELVES RELATIVELY COMPETENT[a]

Field	Number of Writers	Per cent
Medicine	137	55.0
Space and Aviation	111	40.6
Electronics	40	16.1
Biology	107	43.0
Physics	83	33.3
Chemistry	61	24.5
Meteorology	57	22.9
Geology	60	24.1
Anthropology	59	23.7
Psychology	105	42.2
Other fields not listed including; Astronomy, Mathematics, Geophysics, etc.	70	28.1

[a]Science Service, op. cit., Table 7, p. SWN 3.

calls the "you" factor.[1] In the NASW-NYU surveys, Krieghbaum discovered that the "you" angle, particularly in medical stories, give some additional audience interest:

> I think that this is the reason medical news is so popular and applied science gets more play than basic science. The public takes the news and information and then adapts it to its own purpose.[2]

In Table 3 from Krieghbaum's survey it is clear that the public also reflects his observations with a greater desire for medical news, usually containing the "you" angle. Whether

[1]Science and the Public, op. cit., p. 15.

[2]Ibid.

the public's desire for more medical science news or the intuition on the part of writers of the greener fields in medical writing is the cause of this medical competency is another question. It may well be that science writers have used the "you" angle to write more medical news and have built up their own competency.

What He Writes

What are the fields which science writers cover? Question 15 used the same list of sciences as question 14. However, a simple underlining task was assigned to the subjects. Answers were therefore based on a simple yes-no system, with a 1 assigned to all positive responses and zero assigned to all negative answers or non-responces for computation. The answers which appear in Appendix F are the machined answers. A more significant summary may be seen in Table 6, however.

We may note in Table 6 that medicine is the science covered by a majority of the writers, which seems to correlate with their competency. Biology, physics, psychology, astronomy, space technology and chemistry follow. It may here be added that medicine and biology are generally covered by the same writer, being closely related as life or biological sciences.

The NASW-NYU and Science Service surveys found similar results, as seen in Table 7. From these two tables we can easily see that medical sciences, or medicine, is the field most covered by the writers. Perhaps this follows the old sales line, "give the customer what he wants."

TABLE 6

SCIENCES COVERED

Field	Number	Per cent
Agriculture	16	22
Anthropology	26	36
Archaeology	24	33
Astronomy	33	46
Biology	38	53
Botany	20	28
Chemistry	30	42
Civil Engineering	12	17
Electrical Engineering	18	25
Geography	14	19
Geology	25	35
Home Economics	5	7
Mathematics	19	26
Mechanical Engineering	14	19
Medicine	49	68
Metallurgy	18	25
Meteorology	26	36
Oceanography	25	35
Physics	36	50
Psychology	35	49
Space Technology	32	44
Statistics	13	18
Zoology	26	36
Other	14	19
Total surveyed	72	

The Road to Writing Science

How does a person happen to go into science writing? There are a great many ways, many reasons. A recent observation by James Stokley fairly well covers the major paths science writers have walked:

> Many science writers--including some of the best--were originally journalists who happened to be assigned to the science desk. Some had very little scientific knowledge when they took the post; they had to gain the necessary

TABLE 7

FIELDS OF SCIENCE COVERED[a]

Field	NASW-NYU Survey No.	NASW-NYU Survey Per cent	Science Service Survey No.	Science Service Survey Per cent
Medical Sciences	101	57.5	122	48.9
Biological Sciences	77	43.8	92	36.9
Physical Sciences	86	48.9	143	57.4
Social Sciences	60	34.1	88	31.3
Other Sciences	24	13.6	9	3.6
Total Surveyed	348		249	

[a]Compiled from: Science Service, op. cit., Table 10, p. SWN 5, and Table B, p. SWN 7.

background by their own reading and study. But others were trained in science and were interested in writing.[1]

Question 11, posed to science writers as "when and how did you become interested in science writing?," brought some very unusual and varied answers. Here are some of the reasons and the men and women who gave them:

> Have been actively interested in science since the age of seven. Started writing in 1922 as assistant Indiana Manager of the United Press and have written about science and medicine whenever possible ever since--Raymond A. Bruner, Science Editor, The Toledo Blade (Ohio).
>
> I became interested in science writing while still in college--Robert Goldman, Parade Magazine.
>
> The involvement with science writing stemmed more from a coincidental succession of similar assignments rather than any predilection for science writing--Charles Rae Corelli, The Toronto Star Weekly (Canada).
>
> When the managing editor ordered me to do it--Gilbert Cant, Time Magazine.

[1]Stokley, "Opportunities in Science Writing," p. 2.

> Only after covering all of the other beats on the paper and finding that the stories I enjoyed most, the ones that were the most challenging and interesting to me, the news contacts that I found most intellectually rewarding, were all in this field--Mildred Spencer, Buffalo Evening News.
>
> By slow transition from news writing, in the period when science writing was conceived as a specialty--Rennie Taylor, Santa Rosa, Calif.
>
> Interest in science from childhood. Writing on science evolved chiefly for coverage of polar expedition--Walter Sullivan, New York Times.

Throughout the answers to question 11 ran two streams of thought. One was that the three ways to science writing were: (1) a predilection for science writing from childhood or school days; (2) the interest came as the result of an assignment to science stories by the publication; (3) a coincident of sequential events which evolved an interest in science writing. The second was that there were three distinct times when science writing careers had been chosen: (1) about 1921, when science writing as a specialty first evolved; (2) about 1945, when the first atomic bomb was dropped; (3) about 1957, when the first Sputnik went up.

Education

The science writer is a fairly well-educated being. The average was found to be 16.1 years of education, neglecting the three persons who did not answer. That is, the subjects had the average of more than four years of college. Thirty four of the 72 subjects had completed at least one year of graduate work and one continued formal education six years beyond his B.A. degree. Only two of the 72 subjects had not completed high school, and two more had not entered college.

Two-thirds of the subjects had a bachelors or masters degree (16 to 19 years). Figure 3 is a bar graph which shows the number of subjects who had completed each year of education.

EDUCATION OF 72 SCIENCE WRITERS

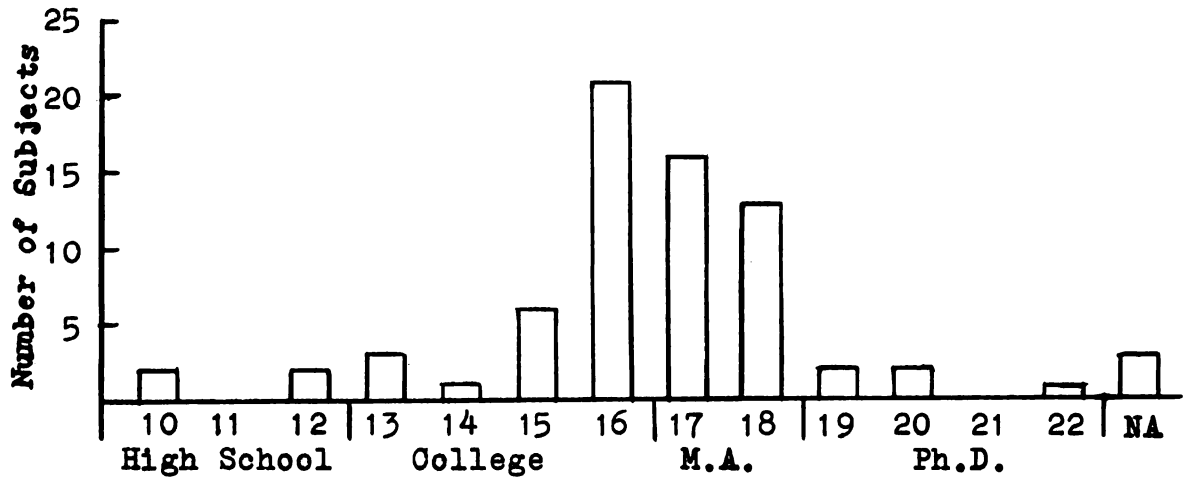


FIGURE 3

In the 1957 NASW survey results shown in Table 8, we

TABLE 8

COLLEGE COMPLETED[a]

No College		1 to 3 Years		4 Years		5 Years		6 Years		Over 6 Years		No Answer	
No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
12	6.8	21	11.9	57	32.4	27	15.3	20	11.4	19	10.8	20	11.4

[a]National Association of Science Writers, Inc., Statistical summary of the NASW survey of 176 members, Port Washington, N.Y.: NASW, 1957, Table 3. (Mimeographed.)

can see that the majority of the 176 science writers surveyed at that time had also finished at least four years of college and a large number had gone on to some graduate work.

How much of this education was devoted to training in the sciences, how much could be considered useful to the specific task of understanding and writing about science, is answered by the results of question 16, shown in Table 9.

TABLE 9

SCIENCE COURSES TAKEN BY SCIENCE WRITERS

Course	Number	Per Cent	Average Semesters
Agriculture	4	5.5	0.14
Anthropology	16	22.2	0.46
Archaeology	7	9.7	0.22
Astronomy	16	22.2	0.43
Biology	31	43.1	1.29
Botany	13	18.1	0.42
Chemistry	43	59.7	1.80
Civil Engineering	5	6.9	0.18
Electrical Engineering	7	9.7	0.60
Geography	18	25.0	0.61
Geology	16	22.2	0.60
Home Economics	1	1.4	0.01
Mathematics	40	55.5	2.91
Mechanical Engineering	3	4.2	0.13
Medicine	16	22.2	0.72
Metallurgy	4	5.5	0.08
Meteorology	6	8.3	0.11
Oceanography	3	4.2	0.06
Physics	41	56.9	1.87
Psychology	31	43.1	1.19
Space Technology	5	6.9	0.11
Statistics	11	15.3	0.32
Zoology	15	20.8	0.50
Other (included was only: Rehabilitation and Public Health)	1	1.4	0.03

The subjects were asked to underline any of the 23 specific sciences in which they had received formal education and to indicate the number of semesters or terms of each. We see in Table 9 that chemistry was the course which was most frequently selected by science writers while they were in school, followed closely by physics and mathematics. Biology and psychology trail a significant distance behind the first three.

However, we may also notice that for the average number of semesters of courses taken, mathematics out distances the rest by a wide margin. Nearly three semesters of mathematics was taken by each science writer on the average. Semester hours in physics were more than they were in chemistry, which was third, even though chemistry had been taken by more science writers than any other course. Biology and psychology again drop considerably behind the first three courses in number of semesters, averaging only slightly over one semester per subject.

A significant point may be made for the education of science writers in general from Table 9. More than 50 per cent have had courses in chemistry, mathematics and/or physics. Nearly half had courses in biology and/or psychology. Nearly one-forth had courses in anthropology, astronomy, geography, geology, and/or medicine. In 13 of the sciences, 15 per cent or more of the subjects had taken at least one semester.

For comparison, Table 10 has been reproduced from the Science Service 1961 survey. Although the method of survey

was slightly different, there appear to be significant differences in the findings which can not be accounted for by the differences in survey methods. Mathematics, for example, was included in the low-rated write-in sciences under the category "other" while it rated top spot in my survey.

TABLE 10

SCIENCE CATEGORIES IN WHICH THE WRITERS HAD COLLEGE COURSES[a]

Field	Number	Per cent
Medicine	19	7.6
Space and Aviation	14	5.6
Electronics	8	3.2
Biology	108	43.4
Physics	82	32.9
Chemistry	94	37.8
Meteorology	21	8.4
Geology	68	27.3
Anthropology	33	13.3
Psychology	121	48.6
Other fields not listed including: Astronomy, Mathematics, Geophysics, etc.	33	13.3

[a]Science Service, op. cit., Table 7, p. SWN 3.

The results of this survey may be compared with a somewhat similar table reproduced in part from the 1957 NASW survey of science writers; Table 11. Again it seems important to point out that mathematics, far and above all the rest, tops the list of course credits which science writers answering the 1963 survey had taken, in contrast to the NASW or Science Service surveys. It seems only logical, however, that mathematics

should be the top rated courses, since most of science is build on mathematical foundation, and since mathematics is required of students in nearly every discipline.

TABLE 11

SPECIFIC COURSES TAKEN IN COLLEGE[a]

Specific courses	Number	Per cent
General Science	6	1.3
Biological Sciences	135	29.1
Physical Sciences	106	22.8
Engineering & Mathematics	102	21.9
Sociology & Anthropology	22	4.7
Political Science & History	12	2.6
Languages	6	1.3
Journalism, English & Literature	28	6.0
Other	48	10.3
All courses	465	100.0

[a]National Association of Science Writers, Inc., Statistical summary of the NASW survey of 176 members in 1957, Table 2.

The Composite

From this composite built from the 1963 survey and other observations, we might conclude that science writing is a pleasant, rewarding field of endeavor primarily for persons with a strong and healthy interest in science and a background which equips them specifically for the reporting of science. This, unfortunately, is a somewhat warped view due to the averaging of the traits and backgrounds of 72 of the professionals in the field.

Truly the field of science writing is generally rewarding and exciting. However, there have been men in the field who have never received more than $10,000 a year in their entire careers. There are also science writers who have never had the opportunity to go to national meetings of scientists, to interview the really top-grade scientists or to see a space vehicle launched. But more of them have had these reporting opportunities and received salaries above $10,000.

Educationally, science writers have as diverse backgrounds as could be found in any profession. A few were research scientists, others were teachers of science, others were journalists, English majors or majored in "liberal arts." A few have less than a high school education and have never had formal courses in science or journalism. A few have Ph.D.'s; some in science, others in completely unrelated fields. But the value of this diverse variety of backgrounds is evident. As Harland Manchester pointed out:

> Nothing in the liberal arts curriculum is ever wasted in the life of a journalist. The man who has been introduced to Greek will never say "helio-copter," and he will know what the "pter" means. The man who has learned humility from Beethoven's Ninth Symphony is in a better position to evaluate a scientist's theoretical structure in nuclear physics or the function of enzymes. The student of history is far better equipped to understand the relationships between government and science than the man who has skimped such study in his haste to acquire a wage-earning skill.[1]

On the other hand, the science writer should have some basic education or knowledge of science if he is to be able to intelligently report it.

---

[1]Science Service, op. cit., p. R 5.

What the basic qualities and qualifications of the science writer are, how he should be educated, where he should best be employed, what type of reporting he should do--these are factors which cannot be generalized. A variety of suggestions come from a greater variety of science writers. But who may say what is the absolute best? Probably, as Loftin says, the most direct and truest definition of the science writer remains that he is a Hybrid--part journalist, part scientist.[1] I hasten to add that he is part humanist. Primarily, the science writer is the man who is best equipped to weave the scientific community into the rest of the world's community and bring the public closer to science. As Margaret Kreig wrote in her questionnaire:

> The science writer is a synthesizer and sometimes a catalyst. He is not just a mirror or a sieve. He is the missing link.

---

[1]Loftin, op. cit., p. 100.

CHAPTER IV

EDUCATING THE SCIENCE WRITER

> There are a great many conflicting theories [about science writing education] and a wide variety of proposals--some sound and some apparently not so sound. But there is only one reservoir of facts on the basis of which these questions can be answered--and that is the accumulated experience of the best current science writers: the membership (both active and associate) of the NASW. Knowing how they were trained, the extent of their previous experience, the kinds of training (both academic and non-academic) that have proved most useful to them, the kinds of training that would be most useful to them now, should serve as a reliable guide to the development of future plans.[1]

These were the views of active science writers, the NASW Committee on Fellowships and Scholarships, in 1957 when they were faced with the problem of formulating effective proposals for the future training of science writers. They proposed that a survey of members be made to establish the needs of educational programs in this field.

Such a survey was undertaken by the NASW in 1957. As a result of the survey, the Council for the Advancement of Science Writing and several other movements toward the education of science writers, the public and scientists were instituted. The Council, established in order to increase the quantity and quality of science reporting to the public, has five major

---

[1]National Association of Science Writers, Inc., Science, the Press and the Citizen, p. 8.

activities: (a) to increase the number of science writers; (b) to increase the quality of established science writers; (c) to open the gates for science reporting in various publications and broadcasting; (d) to do research on the presentation of science news to the public; and (e) to develop new ways of reporting science to the public.[1]

Several types of training and education programs have been instituted by the CASW and NASW and by schools of journalism, private foundations, governmental agencies and industry in the past few years. But, based on the 1957 NASW survey and several other attempts to set up standard programs for science writers, there have emerged even more varied curricula, courses and seminars instead of more convergent ones. In fact, the NASW reached this conclusion as a result of its survey:

> No fixed and arbitrary decisions can be made at this stage as to the relative merit of the many possible techniques of training. The possibilities include academic course-work; contact with scientists and research centers; special short courses and seminars; and on-the-job training or 'working internships' under the guidance of competent science reporters.[2]

It appears that the basic reason for this lack of direction is the wide and diverse backgrounds of the science writers who generally have as many varied suggestions about the training programs as they have individual needs. Too much emphasis on individual suggestions of science writers has led to a confused state of educational programs.

---

[1]Earl Ubell, "Council for the Advancement of Science Writing," The Wiley Bulletin, IV (Fall, 1960), p. 6.

[2]National Association of Science Writers, Science, The Press and The Citizen, p. 17.

On-the-job Training

Most of the science writers in the nation have become such by self-education; they were at one time assigned to do a science story for their newspaper, or they read a great deal of science as a hobby, or they chose to write science when they joined a publication. Their primary or formal education was in journalism or some phase of the communication arts. Repeating Stokley's observation, "many science writers--including some of the best--were originally journalists who happened to be assigned to the science desk."[1]

This course of development of interest in science writing was reflected in the survey answers to question 11 (Appendix B), "when and how did you become interested in science writing?," such as:

> I was assigned to cover science, among other things, when I started working on a newspaper in 1958 and have been doing it ever since--Mary Grant, Life Magazine.
>
> When I was assigned to it--George Getze, Los Angeles Times.
>
> In 1937, while covering a meeting of the American Medical Association--Nate Haseltine, Medical Writer, The Washington Post.

Anyone can become relatively competent in an area of specialization if he is willing and able to devote time to reading and study. One of the writers surveyed made this comment to question 11:

---

[1]Stokley, "Opportunities in Science Writing," op. cit., p. 2.

> I began reading books on science, also magazines, starting with the Bulletin of Atomic Scientists, progressing in 1946 to Scientific American, later to Nature and Science. It became a hobby.

This man, Ralph S. O'Leary, found his home as Science Editor of the Houston Post. On November 13, 1963, O'Leary died during one of his best science assignments--a tour of the United States base in Antarctica during Operation Deepfreeze. And many more like him have become competent science writers in the same fashion.

The primary reason why science writers have drifted into the field rather than being educated for the profession is that the field is young and unusual. Until 10 years ago, schools of journalism did not see the need to teach anything more than the basic writing and editing skills required to become a general reporter.

Several of the nation's noted science writers of today still hold to the notion that science writing is no different than general reporting; that the same skills, the same knowledge holds for all cases. They argue that they became science writers by apprenticeship-type programs or on-the-job training or by dogged reading and studying and reporting of science, and that others can do the same. Some even go so far as to say that a high school education will suffice in these times when nearly everyone is forced through at least the eighth grade and usually complete the tenth grade, and when post-doctoral work is a minimum requirement for many scientific positions. Nate Haseltine said in his survey that he felt a science writer should be educated "enough to be able to think straight and

write clearly--at least completion of high school education for most persons." Haseltine was not alone in his beliefs. Four other subjects felt that experience was the only requisite for good science writing (see question 17, Appendix F). Ron Kenyon, a Canadian science writer, said "...there is a good argument for the idea of training science writers on the job."

On-the-job training for science writers has been advocated by several men in the profession. In 1961, one of the resolutions adopted at the Science Service conference was that:

> Since the educational background and practical experience of the reporter assigned to cover the science field is so varied, on-the-job training programs are of particular value and importance. The potentials of such programs should be vigorously explored and such activities should be encouraged and given active support.[1]

Henry W. Hubbard of Newsweek magazine makes this observation in his 1963 questionnaire:

> Journalism school is no more useful than on-the-job training. Science training, beyond basic courses in chemistry and physics, is superfluous for a general reporter. Too much formal training might actually harm the ability to communicate to laymen.

There are currently some on-the-job training programs offered to a very few young people in university public relations offices and technical information services offices of government and industry. In general, however, it is very difficult to sustain any sort of organized apprenticeship program for science writers. On-the-job training has also been attempted by some schools of journalism, but the lack of available experts, science writers who can devote time to help these

---

[1] Science Service, op. cit., Resolutions.

aspiring youths, has dampened these programs. Most of the active science writers are too busy covering meetings, meeting deadlines and tending to their own work. Teaching has always been a notoriously poor profession--too poor to attract active professionals in general.

The science writers surveyed by myself were asked where a beginning science writer should start (large newspaper, technical journal, public relations, scientific research, etc.) in question 20 (Appendix B). Although a variety of answers were given, the majority of subjects said the writer should begin on a newspaper. Many suggested that he have on-the-job training on a newspaper before he graduate from college.

The problems of the editor who takes on a young person as a science writer, or who turns a member of his staff into a science writer, are also inherent in the plan. Editors demand some degree of accuracy. They demand depth reporting on most assignments. To further complicate matters, they demand that the writer meet deadlines, limiting the amount of research which can be undertaken for a particular story. And, in general, other science writers or reporters have little time to spend helping the newcomer.

One recent development which the CASW announced may give impetus to this type of training, however. A grant was received for a three-year on-the-job training program for science reporters which was intended "to provide training for general assignment reporters on newspapers of moderate size to give

them skill in covering local science stories with confidence."[1] This should help to tighten the ranks of science writers, with a total of 80 journalists receiving this training in the next three years. The CASW has also proposed correspondence courses plus attendance at one medical and one non-medical science convention "for reporters who have established their journalistic competence but need additional background for science writing."[2] However, few of these on-the-job training programs are designed for the science writing student or new science writer.

Seminars for Writers

Other types of non-formal education of science writers are the science and science writing seminars, two distinctly different types of functions, which are gaining more and more importance in the training of science writers. The difference in the two types of seminars is that the science seminar is intended to provide background, in depth, in a particular science or group of sciences, while the science writing seminar is generally held to discuss science writing techniques and problems. In 1960-61, the National Science Foundation (NSF) alone granted 26 institutions a total of $621,595 for public

---

[1] "Carnegie Corporation," Understanding, Winter 1962-63, p. 2.

[2] Hillier Krieghbaum, "Training of Science Writers," Report of the First Inter-American Seminar on Science Journalism, Santiago, Chile, October 16-18, 1962, (Washington, D.C.: Pan American Union, 1963), p. 12.

understanding of science programs.[1] The NSF program "to support activities designed to increase the quality and quantity of science information that reaches the general public," was only inaugurated in 1959.[2] Many other organizations and foundations have also joined in with programs of their own or by sponsoring seminars at universities.

How professional science writers feel about science and science writing seminars is obvious in Figure 4, a summary of question 21. Asked to rate certain sources for their importance to the training of the science writer, "field reporting" was rated on top, followed by "science courses," "scientists" and finally "science seminars." Science writing seminars only rated as high as "colleagues," a selection intended to represent word-of-mouth or written communications between science writers or journalists.

It may be particularly significant that 28 per cent of the subjects surveyed answered question 17 on the amount of education desirable for students, that science writers should get as much education or training as possible; that the process should be continual. They put particular emphasis on frequent science and science writing seminars, along with lots of experience in dealing with scientists and scientific principles.

---

[1] "Summary: NSF Public Understanding of Science Program," Understanding, Summer 1962, pp. 2-3.

[2] Ibid., p. 1.

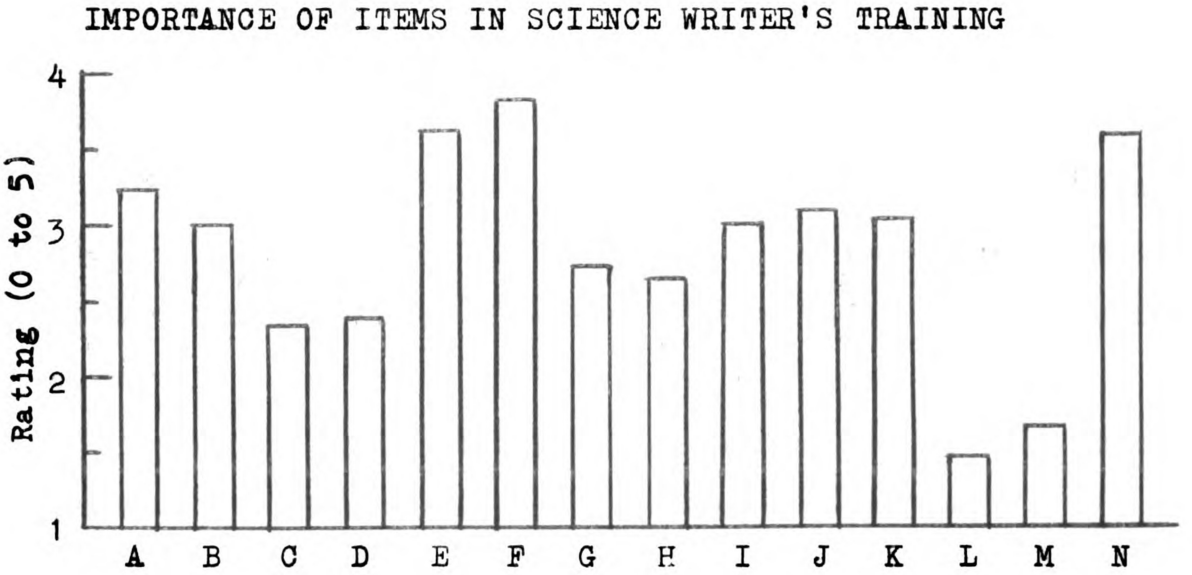


FIGURE 4

Notes:

A, Science Seminars; B, Science Writing Seminars; C, Science Writing Associations; D, Journalism Courses; E, Science Courses; F, Field Reporting; G, Conventions; H, Editors; I, Colleagues; J, Newspapers; K, Magazines; L, Radio; M, Television; N, Scientists.

Rating of items from 0 to 5 based on 1 for no help to 5 for excellent, with 0 given for no answer.

Formal Education Conflicts

Despite the fact that there are increasing numbers of on-the-job training programs and science and science writing seminars, science writing, as a profession, has not yet been formalized to any extent. The reason, in many persons' minds is the fact that there has been no direction in the few and varied formal education programs in science writing. Nor has there been any attempt to set up criteria for judging young science writers on the basis of education. As Dr. Herman M. Weisman, well-known educator-journalist, recently pointed out:

"As in any other profession, the source for science writers should be our system of formal education. The system is presently inadequate for the task."[1]

The question to be asked is, "how much education should the professional science writer have, and in what areas?" The answer has eluded educators, scientists and science writers for more that 40 years, since the first real organization of science writing began. This point was developed in the survey in question 17. The answers are presented in Table 12.

TABLE 12

SUGGESTED AMOUNT OF EDUCATION

Degree of Education	Number	Per cent
Experience only	3	4.1
High school	1	1.4
B.A. or 4 years of college	27	37.5
M.A. or equivalent	13	18.1
Ph.D. or equivalent	3	4.1
As much as possible	20	27.8
No answer	5	7.0
Total	72	100.0

Nearly 60 per cent of the subjects said that a college education is desirable for science writing students, and nearly 25 per cent suggested that graduate work be required. Another 27.8 per cent felt that the educational process should be continuous, although not necessarily on a formal basis. This large group, by not giving a specific answer for what they

[1] Science Service, op. cit., p. 27.

believe necessary, created an anomaly in the results of Table 12. Their answers ranged from a facetious "the more the merrier" to the seriously thought-out answer of Charles Rae Corelli, Science Writer on The Star Weekly (Toronto, Ontario, Canada), who said:

> I don't think there is a universally-applicable figure. How much any one individual should have would depend on his powers of absorption and retention, his general intelligence, the nature of his science specialty, the medium for which he writes and a host of other factors. All the education you can get is desirable, of course, but I believe it is a mistake to assume that science writing competence is in direct proportion to education.

In probably the first hard-cover book published on science writing, Dr. John Foster Jr., Director of the Advanced Science Writing and International Programs at Columbia University, writes: "it is not necessary to have a Ph.D. in one or more of the sciences to be a successful science writer."[1]

Few would disagree with Foster. In fact, it would probably be difficult to induce Ph.D. holders in the sciences into becoming science writers when they qualify for research or teaching. There are a few, like Biochemist Isaac Asimov, Physicist George Gamow or Astronomer Harlow Shapley, who do their share to popularize science. But generally, scientists write as an avocation, not as a vocation. Two of the science writers surveyed also have Ph.D.'s. But one, Dr. O. A. Battista, is "also a full-time scientist," as well as a free lance writer. The other, K. L. Boynton, majored in English and is a professional free lance writer in Chicago.

---

[1] John Foster Jr., Science Writer's Guide (New York: Columbia University Press, 1963), p. 2.

A college education should, by all standards, be a minimum requirement for Hybrids. As we can see in Figure 3, the science writers surveyed have good grounds for advocating the college degree, based on their own educational experiences. Two-thirds of the subjects had completed at least four years of college; nearly the same number as suggested that a degree was necessary in the profession.

Although many science writers agree upon the amount of education which is desirable for science writing, the widely disagree, sometimes quite heatedly, upon what kind of education the science writer should have. The reason, of course, is that no two have the same background or education.

Three major philosophies of science writing education are held by science writers and educators. The first holds that science writers are no different than any other type of journalist and that they should have the same training and education. The second concept is that if a person is writing science he should have the formal training of a scientist in order to understand what it is that he is reporting. The third philosophy advocates a split formal education of science and journalism--about half of each. This group most closely holds with Watson Davis' definition of the Hybrid--part journalist, part scientist.[1] There is also the small splinter group which believes, as has already been discussed, that formal education is not necessary for science writing.

It is this very same confusion which lead to the 1957

---

[1]Loftin, op. cit., p. 100.

decision of the NASW Committee on Fellowships and Scholarships that no decision could be reached on the best training technique or educational program. That is, even the experts were unable to agree. Table 13, the results of question 18, "what would you suggest that a prospective science writer should specialize in (journalism, science, both, neither)?," show this same degree of confusion, although one area appears to be stronger than the others.

TABLE 13

SUGGESTED CURRICULA

Curriculum	Number	Per cent
Journalism	12	16.7
Science	8	11.1
Journalism and Science	35	48.6
No specialization	12	16.7
No answer	5	6.9
Total	72	100.0

Backing the journalism-first idea over both the science-first and science writing backers is the Editorial Liaison Committee of the NASW in the yet unpublished "A Guide to Careers in Science Writing," and its chief editor, Mrs. Mae Rudolph, a free lance science writer. The draft makes these comments:

> The most important thing to know about a science writer is that he is a writer, not a scientist. He is not chiefly interested in discovering the crystallographic structure of insulin; he's interested in telling other people how a scientist did the job and what his discovery

means. He's a reporter, not a researcher.[1]

> The science writer "must equip himself with the same battery of skills that would make him a good reporter in such fields as politics, religion, industry, finance..."
> Science writing is too new a craft to be scientific about setting up guides to becoming a success. But on the basis of the experience of those who are already successful in the field, some general suggestions can be made. The future science writer should have a good general education and training in journalism; a broad grounding in the liberal arts, as much training as feasible in basic physical and social sciences, for example, chemistry, physics, physiology, psychology, mathematics. A good basic course in statistical methods wouldn't hurt. And it would certainly help to take a healthy interest in literature, particularly the classic literature of non-fiction and "observation," such as Darwin's Voyage of the Beagle, Caesar's Commentaries on the Gallic Wars, some of the works by Keynes, Galileo, Kepler, Margaret Mead, Jonathan Swift and Aldous Huxley.[2]

And further, in reference to schools of science writing which are in operation in the United States, the guide says that "two things must be understood: it may be wise not to over-specialize, and there are no short cuts to becoming a good science writer."[3] These views are surprising considering the general view of the NASW membership and the CASW is for combined science and writing courses.

Campbell and Wolseley, in their book on general journalism, also take space enough to deal with science writing, backing the journalism-first theory:

> Why not major in science? In some instances that may be desirable. At the same time it must be stressed that the newsman essentially is a reporter, not a scientist. He must do what many a scientist cannot or will not do--

---

[1]National Association of Science Writers, "A Guide to Careers in Science Writing," Draft of a brochure, NASW, 1963, p. 4. (Typewritten.)

[2]Ibid., p. 10.

[3]Ibid., p. 11.

> translate the achievements and possibilities of science into the lay reader's language.
>
> The science reporter, like any other specialist, needs wide experience in getting and writing news. Knowledge of police work, court reporting, social service agencies, politics, business, and other fields is invaluable on the health and medical beat, for science and these activities frequently are related.[1]

A few subjects also had strong feelings about the importance of journalism in the training of writers. Charles B. Wheat, Science Writer of The Tulsa World made this comment:

> The college degree is an economic asset in newspaper writing, but you learn by doing. Science background is often harmful, I believe, because I have seen my trained compatriots miss the obvious definitive question because they think they already know its answer. On several occasions they have been wrong. The sense of ignorant wonder is a fine armament for a science writer.

To question 18, Mildred D. Spencer, Science Writer on the Buffalo Evening News, replied:

> Not science. The science writer, when he specializes, becomes so immersed in his reading and constant refresher work, that he can become very subjective about science if he doesn't have more background. Preferably I think the prospective science writer should have a broad background in the humanities with some technical training in journalism and writing.

Miss Spencer, incidentally, holds a bachelor's degree in journalism with a minor in history and political science.

On the opposite side of the question of the type of training a science writer should have is a statement by Stokley on the qualifications of a science writer:

> With the increasing complexity of science it seems likely that fewer and fewer science writers will be able to succeed unless they have a good background of technical

---

[1] Laurence R. Campbell and Roland Wolseley, How to Report and Write the News (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1961), pp. 490-491.

> knowledge. This doesn't mean that he has to have the same training as if he were going into scientific research. However he ought to have at least as much as a high school science teacher. This gives a basis on which he can talk intelligently with scientists from whom he gets material; he has better comprehension of scientific papers; and, as future advances are made, he will have the foundations that will enable him to understand them. This should include astronomy, physics, chemistry and biology. As a minimum, the science writer should have a good knowledge (acquired with more advanced work after completion of the beginning courses) of one science and a general knowledge of at least two others.[1]

Several science writers agree with Stokley, especially many of the younger ones who have not yet met requirements for NASW membership or who are still moving around within the profession. From my own experience and those of many of my young science writing friends, I draw this conclusion.

I, for example, was a geology student who felt there was more to life than pecking on rocks or plotting well logs. In my senior year of college I happened to take a technical writing course from Stokley. This was followed by a course in science writing and then more journalism courses. I had already written for newspapers as a hobby, but I became more interested. I was reporting science for the student newspaper, the Michigan State News. After receiving my B.S. degree in geology, I went on into graduate studies in science writing. I was enthusiastic about learning "general science" as against learning a "specific science." During a nine-month period on the staff of Science Service, where I was the biology, geology and "nature" writer, I met several other young writers with similar backgrounds.

---

[1]Stokley, "Opportunities in Science Writing," op. cit., p. 2.

Some of the more established science writers are also in favor of specialization in science in the educational programs. Three of the subjects surveyed, averaging 57 years of age, were strongly opposed to journalism education. Julian DeVries, Science Editor of the Arizona Republic and Phoenix Gazette, criticized journalism schools, saying "I haven't much faith in journalism courses." Bruce Bliven of Stanford, California, said science writing students should have "as little journalism and as much science as possible." Carle Hodge went even further to say that the student "should seek a broad, interdisciplinary background in science, and expect on-the-job training to be sufficient journalistic training."

Some advocates of the science-first idea undoubtedly go a little too far. Take this statement which was recently published in a reputable scientific magazine about the lack of scientific detail in mass publications:

> Why is it that so much otherwise excellent "popularized" science writing lacks an essential ingredient, a lack that minimizes its lasting value? I have found that scientific publications can be qualitatively evaluated into those which include bibliographic citation and those which do not.
>
> Librarians and scientists spend hundreds of hours tracking down precise literature citations which are missing in articles published in otherwise reputable publications like Scientific American, the New York Times, or The Sciences, a task that could be eliminated if brief but complete citations were given.[1]

The author of this statement obviously missed the point to science writing. As Wheat put it: "After all, the science writer is NOT the final source of information--he is the

---

[1] Eugene Garfield, "Citations in Popular and Interpretive Science Writing," Science, CXLI (Aug. 2, 1963), p. 392.

tribune to the common man..."

One real difficulty in the science-first approach was recently pointed out very well by Pierre C. Fraley in his talk before doctors and science writers at the University of Michigan, Ann Arbor. He asked:

> Should the science writer be a chemist, a physicist, a biologist, a cultural anthropologist? Does the fact that a man is a darn good low-temperature physicist make him competent to report on the latest development in cultural anthropology, or zoology or astronomy? All these fields and many more the science writer has to cover. The last count I heard from a scientist was that there were 1,100 different sub-specialties within the physical and biological sciences alone without counting the behavioral sciences.[1]

Science Writing Curriculum

The third group of science writers who have expressed their ideas about education say that the student should not specialize in either journalism or in science, but take a combination of the two; a special program for science writers which offers training in both areas. This is a rather large group of writers, nearly 50 per cent of the subjects surveyed, as seen in Table 13.

In 1957, the NASW survey of members obtained some results which may be correlated with those of my survey. Table 14 indicates the type of training which was then recommended for undergraduates. It also shows what the subjects thought about the teachers of these courses.

What sort of program, what type courses, would a student be apt to take which would qualify him as a science writer?

---

[1] Fraley, op. cit.

Should he stress science courses or journalism courses?

TABLE 14

TRAINING RECOMMENDED FOR UNDERGRADUATES[a]

Type of training	Number	Per cent
Special curricula to produce science writers	34	14.2
No special curricula, but science courses	103	43.1
Courses in science writing	102	42.7
Total responses[b]	239	100.0

RECOMMENDED TEACHERS OF COURSES[a]

Teachers	Number	Per cent
Scientists	11	10.8
Journalism professors	9	8.8
Working science writers	59	57.8
Other	1	1.0
Combination of above	22	21.8
Total	102	100.0

[a]National Association of Science Writers, Inc., Statistical summary of the NASW survey of 176 members in 1957, Table 13.

[b]Total responses greater than total number of respondents because some noted more than one type of training.

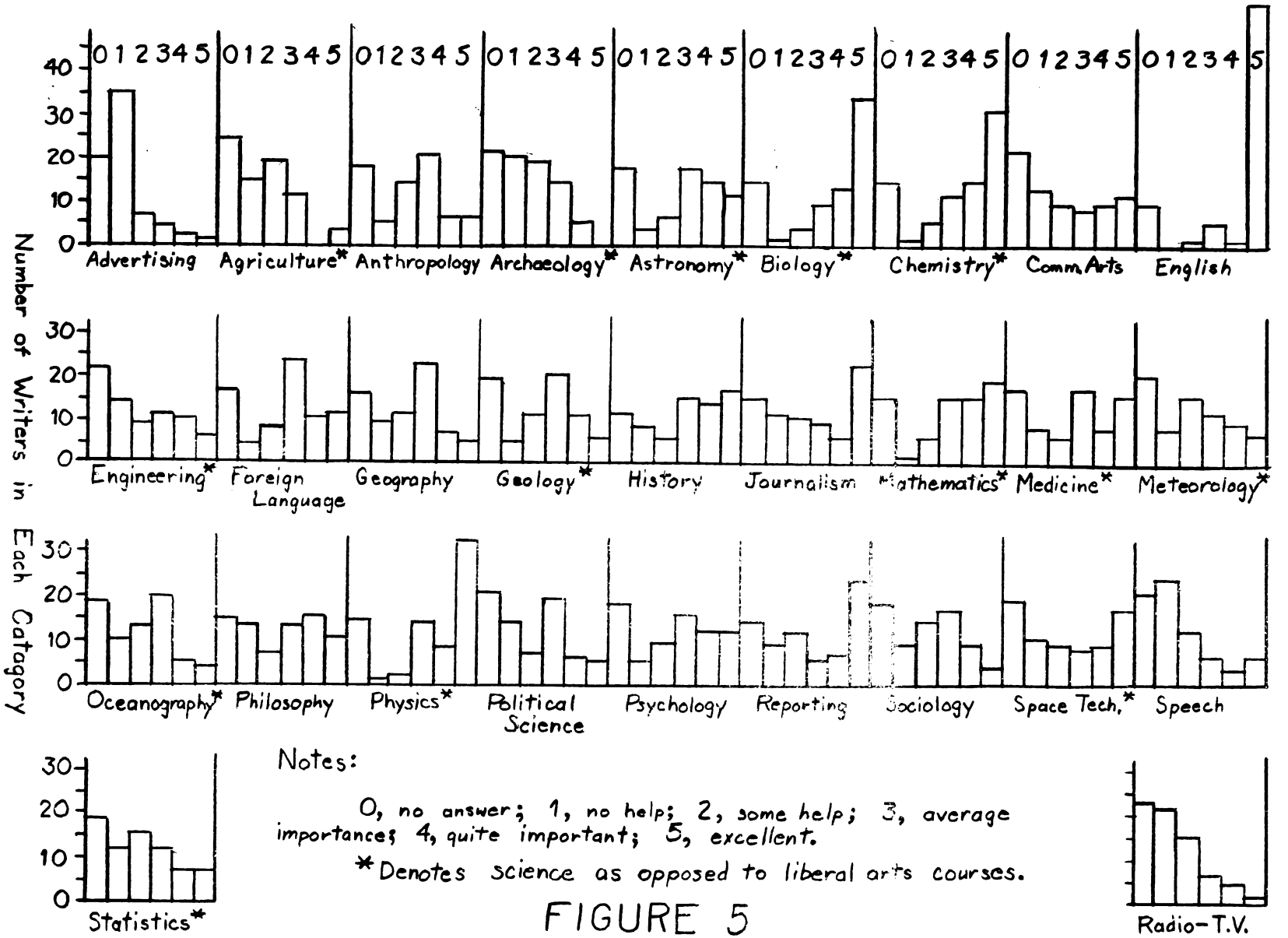
Subjects of my survey were asked these questions in 19 (Appendix B), when they rated 29 courses for their importance or potential in the training of a science writing student. The choices to question 19 were selected to give the subjects an even amount of science and journalism or communications courses

in order to: (1) pinpoint the specific courses which are considered to be the best curriculum for science writers; and (2) give an indication of how dedicated the three groups (science-first, journalism-first, or science writing curriculum advocates) were to their ideals. The results are shown in Figure 5.

The course which science writers felt was most important was English, obviously basic to all curricula but especially vital to the education of a writer. English received 4.22 points out of a possible 5.00 points (see Appendix F) in the machined grades with nine subjects not answering the question. One subject felt the course was only of a small amount of help, five felt it was average, and one other writer thought English was quite important. But 56 science writers, 78 per cent, felt that English was indispensible from the curriculum of the writing student, giving it a rating of five--excellent.

In the machine graded answers, the courses averaged highest in the following order: English, biology, chemistry, physics, mathematics, history, reporting, journalism, astronomy, and medicine. (A slight anomaly was created in the course called reporting, because several of the subjects specified they marked the course hoping it meant field reporting rather than a reporting course.) It might be pointed out that 33 of the subjects gave both biology and physics a rating of excellent and 31 rated chemistry as excellent. Reporting received the next highest number of excellent ratings with 24, and

COURSES RATED FOR SCIENCE WRITING CURRICULUM



Notes:

0, no answer; 1, no help; 2, some help; 3, average importance; 4, quite important; 5, excellent.

* Denotes science as opposed to liberal arts courses.

FIGURE 5

journalism was next with 22. It may also be seen that mathematics, history, astronomy and medicine were rated high on the average because of the higher number of subjects who gave them a three or four rating.

The lowest rated courses in the survey were: advertising, radio-television, agriculture and speech. Other courses which did not even receive a two rating were: archaeology, engineering, political science, sociology, and statistics.

It appears as though science writers, in general, feel that students should have the basic courses in science and a solid grounding in English and journalism or reporting. Aside from statistics, the science courses, starred in Figure 5, were rated considerably higher than the so-called liberal arts courses. This tends to show that the over-all view of the professional science writer supports the science or science writing curriculum idea, with emphasis on science rather than humanities or social sciences. Indeed, despite their seeming differences, science writers hold most favorably to the vision of the true Hybrid--part journalist, part scientist.

Schools for Science Writers

There were 19 schools of journalism in 1961 which offered a concentrated special curriculum in science writing or technical writing, or having special courses or science requirements for students of journalism.[1] Fourteen of these

---

[1]Science Service, op. cit., p. 47.

offered the students a prepared curriculum, five others had only one or two special courses in science writing or science requirements for students of journalism. Since that time, other schools have picked up the challenge and begun programs designed to educate young men and women in the specialized profession of scientific journalism.[1] However, it must be pointed out that several of these schools are teaching primarily in the area of technical or trade magazine journalism. For the purpose of this paper, these must be eliminated from the discussion.

Of the more than half a dozen schools of journalism which do offer special training in science writing, none of their programs are the same. In fact, they are not even similar.

Dr. Herman M. Weisman, head of one of the technical writing schools in the United States and a science writer in his own right, made this comment about the science writing educational programs in 1961:

> The shortcomings of American education [for science writers] were identified long before Soviet technology thrust them into the front pages. In the last decade, there have been stirrings on many campuses and classrooms throughout the nation. However, American education is difficult and costly, and the weakness of science writing education is evident in quality and quantity.[2]

---

[1] "The Illinois Institute of Technology recently announced new undergraduate and graduate programs leading to degrees in science writing and science information--the programs will begin this fall," as quoted from the Chicago Tribune, August 25, 1963.

[2] Science Service, op. cit., p. 27.

It is true that science writing education is woefully lacking in this country. And what little there is is also woefully lacking in direction.

At Indiana University and Michigan State University, for example, students are handled on individual bases, fitting the student's needs to rather ill-defined programs or designing a program for a particular student.[1] These programs are not, however, without great merit, providing a very liberal education for the student. At South Dakota State College, a regular program is entered into by candidates of science writing, just as in any other discipline.[2] This leads to the bachelor degree in science writing. The University of Wisconsin has also begun a program of this type, leading to the B.S. or M.S. degree.[3] At Boston University there is a single course which is offered to potential science writers.[4] Columbia University, on the other hand, has had an entire section of its school of journalism devoted to science writing for several years. The Columbia program has, however, come under fire by educators, science writers and scientists. The

---

[1]Letter from John E. Stempel, Chairman of the Department of Journalism, Indiana University, Bloomington, May 25, 1963.

[2]"Curriculum in Science Writing," Department of Printing and Journalism, South Dakota State College, Brookings, Winter Quarter, 1961-62.

[3]Communications from Richard D. Powers, Associate Professor, Department of Agricultural Journalism, The University of Wisconsin, Madison, May 22, 1963.

[4]Letter from Don Somerville, Assistant Professor in the Division of Journalism, Boston University, May 21, 1963.

following is taken from a debate which has been running in a prominent scientific journal:

> The main value of his [the science writer's] added contribution to the public debate of issues in which science is a factor will lie in his grasp of the underlying facts and principles and in the concomitant greater objectivity of his presentation. Mr. Lessing[1] blames the lag in this development solely on the conservatism of the nation's newspaper editors and publishers who, it is true, act by and large on the premise that a good newspaper man can acquaint himself sufficiently with any subject to write about it convincingly. One would, however, think that this veiwpoint will be more and more difficult to maintain and that the need for science-trained writers will soon become imperative.
>
> What, then, has been done on the part of the scientific community and the schools of journalism to prepare the way? Apparently not very much.
>
> The only effort in this direction seems to be "The Advanced Science Writing Program" at Columbia University School of Journalism, and its shortcomings are obvious. It is a postgraduate course of study, geared mainly to exposing a small and select number of journalists to some of the science courses available on campus. But it makes very little provision for training scientists who have a flair for writing in the techniques of journalism.[2]

The Columbia program is still probably the largest and one of the best schools for science writing students today, with eight to ten professional journalists selected annually to engage in a year-long program with courses mainly in the sciences.

---

[1]Lessing, op. cit., p. 88.

[2]Alice K. Kantor, Letters, Chemical and Engineering News XLI (June 10, 1963), pp. 4-5.

CHAPTER V

PROSPECTS FOR SCIENCE WRITING

Science writers enjoy their profession for many reasons. They enjoy meeting and talking with scientists, educators and just plain people. They enjoy learning and reading and studying constantly. They enjoy the high salaries, good working conditions and pleasant companions which they encounter. Most of all, however, they enjoy imparting knowledge to their fellow men. In science writing, probably more than any other area of journalism, teaching is one of the most important tasks; wrestling with a vast wealth of knowledge and communicating its fascination to a lawyer, a garbageman, a scientist, and a store clerk in a common tongue.

In the survey of science writers in 1963, the question was asked: "What is the most important or interesting aspect of professional science writing for you?" The following comments reveal some of the reasons science writers have for staying in the profession.

> Doing a service without preaching a gospel--and doing with simplicity and some of the elegance science deserves--David Walker, Canadian Broadcasting Corp., Toronto, Ontario, Canada.

> You meet a lot of interesting people--most of them other science writers--Kenneth N. Anderson, Editor of Today's Health, Glen Ellyn, Ill.

> The most important aspect is in being able to further man's knowledge and understanding of the world he lives in, and of himself. Almost every aspect is interesting--that's why I'm doing it--David Spurgeon, The Globe & Mail, Toronto, Ontario, Canada.
>
> The methods scientists use in learning from nature--Raymond A. Bruner, The Toledo Blade.
>
> The fact that with my first interview with a scientist I felt that my real education was just beginning. With each subject, a whole new field, or aspect of a problem opens up. It is never boring--Mrs. Margaret Krieg, Free Lance Writer, New York.

Perhaps Earl Ubell best summed up the reasons why science writers like the profession when he said:

> Hard to say what is most important or interesting. I get a total feeling out of science writing compounded of the challenge of communication, the thrill of understanding, the income derived, the status achieved, the excitement of travel and the involvement in the greatest adventure in history--science.

The NASW guide to careers in science writing, yet to be published, is designed specifically for enticing qualified newcomers into the field of science writing. In it they suggest that anyone who can answer yes to a two-part question should consider science writing as a profession. The double question: "Do you find the spectacle of men 'wrestling with the mysteries of nature' more fascinating than any other human endeavor? and do you feel a powerful need to communicate this fascination to the largest number of people possible?"[1]

Employment Opportunities

Science writers, in general, seldom lack for job

---

[1]National Association of Science Writers, "A Guide to Careers in Science Writing," p. 3.

offers when they want them. This applies to established science writers and to the beginner. Even the beginning general journalist has little trouble in locating some sort of position. In 1961, the Newspaper Fund surveyed colleges and universities that had schools of journalism.[1] The executive director of the Fund, Paul Swensson, reported that enrollment in these schools is rising about 10 per cent per year on the average. Despite this fact, the Fund found that there were between 1 and 15 jobs available per graduate with an average beginning pay of about $90 per week. This was for the general journalist. For science writers there are more opportunities and higher wages than for the general journalist. Furthermore, the jobs are most often with the coveted "large newspapers." Stokley, in describing the opportunities for science writers, puts it this way:

> As advances in science are rapidly extending our knowledge of outer space, of the atomic nucleus, even the origin of life itself, public interest in science is continually increasing. Applications of such new basic knowledge have vastly changed our lives, and far greater changes are coming in the future.
>
> In recent years (mainly since World War I) "science writing" has developed as a journalistic specialty. The National Association of Science Writers, to which practically all belong, had 76 active members working for newspapers in 1962. Some papers have more than one (the New York Times has seven). As there are 1830 daily newspapers in the United States, less than 10 per cent have any staff members primarily responsible for covering the science field. [Usually, however, they have sports, religion, fashion, entertainment, and various other specialists.] These include the largest papers as well as some of medium size. Many others could very well

---

[1] "Job Opportunities for Journalism Graduates," Saturday Review, November 10, 1962, p. 69.

> support a staff science writer; doubtless many of them will recognize this in the coming years.
>
> In addition, the active membership of the NASW includes 16 science writers working for wire services (AP and UPI) or syndicates. These organizations supply a large part of the science material used in newspapers. There are also 36 science writers working for magazines, 35 on a free-lance basis, three with book publishers and two whose work is mainly for television.[1]

NASW adds to the list of job opportunities for science writers:

> Many other science writers are employed on semi-professional publications, such as Science, Modern Medicine, Chemical & Engineering News, Medical World News, Dental Times. In addition, there are large numbers of science writers who write news releases or newsletters for scientific associations, hospitals, foundation, colleges, research institutions, pharmaceutical firms, and government agencies.[2]

This last category, that of public relations science writing, cannot be neglected as a lucrative field. A National Aeronautics and Space Administration official recently said the agency had many good science writers, but was desperately in need of others. A past president of the NASW has found government writing highly rewarding for the past 14 years, although he remarked in his survey that he will "be back in journalism again before too long." And most of the associate members of the NASW are truely top quality science writers, although few of them write directly for the mass media. Some of these people are "spoon feeding" reporters, especially the general reporters who are assigned to cover science, on newspapers, magazines, radio and television.

---

[1]Stokley, "Opportunities in Science Writing," p. 1.

[2]National Association of Science Writers, "A Guide to Careers in Science Writing," p. 13.

Most areas of science writing are fairly lucrative. This is illustrated in the results of the survey, shown in Appendix F. The 72 subjects, writers mainly for newspapers, mostly received around $10-15,000 per year. Some received above $25,000. From my own experiences with employment, I have seen offers beginning at $6,000 and as high as $8,500 for the beginning science writer with a bachelor's degree. Many of the technical writing positions which are open are also available to science writers.

A major advantage in science writing as far as monetary reward is the opportunity for outside work. Freelancing, such as radio or film scripts in science, magazine articles, books, brochures, pamphlets or public relations pieces, are quite often undertaken by professional science writers. Books are especially in demand, with more paperback science books flooding the market each year. Occasional lectures, television appearances or meeting arrangements fill out the choices for extra earnings for science writers.

There are also many cash and honor awards for science writers: The American Association for the Advancement of Science annually presents the Westinghouse Award for Science Writing; the American Chemical Society offers the James T. Grady Medal; the American Heart Association has the Howard W. Blakeslee Awards; and several others including the coveted Lasker Award. Each of these is accompanied by a cash prize of $500 or $1,000 or more.

Science Writing Improved

Despite the money, prestige and other opportunities offered to science writers, there are surprisingly few. It has been proposed that every large newspaper and every medium-sized newspaper in the country should have a science writer on its staff. Magazines, syndicates, television and radio also need their share. Public relations offices employ many. This lack of qualified science writers to fill the rapidly amplifying needs, more precisely, the poor placement of unqualified persons in science writing positions, has led many of the top science writers to decry the general quality of science writing. Krieghbaum, in a recent article, warned science writers and editors to take heed of the familiar cover of the Bulletin of the Atomic Scientists with the hands of the clock so close to midnight, because "the bells in the clock tower may be ready to toll for science writers in a special way." Krieghbaum was warning of the dangers of poor presentation of science on the part of a few "science writers." He listed five ways in which science is being reported now-a-days. Despite the fact that there is more space in the newspaper for science, it is being handled in one of the following ways:

> 1. The police reporter approach. Stories of this type include the descriptions and the details that any good competent, inquiring reporter would gather on a fire, a bank robbery--or a missile launching.
> 2. The "What's-the-cold-war-score" angle. Americans seem to have become practically neurotic on the question of relating things to the cold war. I can't help but wonder what would happen to the U. S. Public Health Service's budget if we ever got a hint that the Soviets or the Red Chinese were on the verge of a "major break

through" on either a one-pill cure for cancer or the synthesis of living cells in the laboratory. (It would have to be a "major break through" to rate many U. S. headlines or much American public reaction.)

3. The "For he's-a-jolly-good-fellow" approach. This is especially good for astronauts, either United States or Soviet. Remember the stories about their wives and children that piled up column inches on the manned space flights. This approach did get a little tarnished, however, when Titov came over to the United States for a tour.

4. The Dr. Frankenstein touch. This is just the opposite of the one cited above. If the "good fellow" approach doesn't seem to fit, a writer can play on out-moded conventions and always trot out that terror-inspiring machine manufactured by Dr. Frankenstein, who was a scientist of sorts.

5. The science classroom teacher or the hard news science aspects. And this almost always gets left out or pushed back into a corner--of page 29.

In connection with this last point, I'd like to take a slight digression to argue that other news writers do provide background which could pass as "educating the reader" and there shouldn't be anything wrong with doing more of this very thing in science writing.[1]

Many of the science writers surveyed this year agreed that the quality and quantity needs to be improved. However, there is another side to the picture which Krieghbaum presents. Question 23 of the Science Writer survey asked: "Do you feel that most science writers achieve the goal of the science writer? If not, what would you suggest to improve the quality of science writing?" Charles B. Wheat gave this answer:

More sense of fun would improve science writing perhaps. More understanding that we are not writing for the ages, but for the breakfast coffee cup, and then the garbage pail. I'd rather read about drilling a hole to hell than investigating the Mohorovici Discontinuity.

Ralph S. O'Leary added his analysis of the lack of quality in science writing:

---

[1]Krieghbaum, "It's Later Than You Think," p. 72

> The chief difficulty I see facing the science writer is that he or she seems inevitably to end up writing in a technical manner which pleases the scientists but tends to frighten the present-day public away from reading science articles in the newspapers. There are some signs that this difficulty may some day in the future end as a result of better science education for coming generations in high school and college.

Ralph H. Clark, Valley Times Today, North Hollywood, Calif., sees two sides to the story:

> (1) Science writers are often lacking in background knowledge. This makes it difficult to interpret facts popularly for the public. Writers should spend more time accurately learning what the story is about before they write it. (2) On the other side of the coin, some science writers know their subject too well, and thus become too scientific in their news stories. The public can't understand what they're writing about. It's good to know a subject; better to write it clearly.

From these comments, it is easy to see the difficulties facing the science writer. If he knows too much, he may overwrite the story. If he knows too little, he can't explain it. He has to know the average intelligence of his audience too. The first director of Science Service, the late Edwin E. Slosson, once wrote: "Don't overestimate the reader's knowledge and don't underestimate the reader's intelligence."[1]

Editors Versus Science

The second, perhaps strongest, suggestion that science writers have for improving science writing is the improvement of editing, editors and the rest of the editorial red tape which science stories must pass. This suggestion of renovation is extended to the media, themselves. The science writers

---

[1] Edwin E. Slosson, "Don'ts for Would-be Writers of Science," Pamphlet printed by Science Service.

cited the dire need for "science-oriented editors," "constructive criticism from editors," "improved standards of the publishing industry," and "a better understanding by editors and publishers that science writing differs from other reportorial specialties."

There are many stories, some true, some exaggerated, of the lack of interest, knowledge and understanding on the part of editors toward science stories. Lessing cites an example which undoubtedly grew out of misunderstanding on the part of an editor:

> Not too many years ago I had an editor, grown impatient at our attempts to illustrate advances in chemistry with molecular models, issue an edict: "No more molecules!"
> That editor (in all other respects a great editor and a good man) is no more, but I am afraid there is no stopping the molecules. They go on and on. Indeed, most schoolboys now know--a measure of how far things have changed--that the very secret of life is bound up in the structure of a single large spiral molecule called DNA.[1]

Lessing's experience is not the exception, unfortunately. Gobind Behari Lal, one of the original NASW members, told about an interview he and John J. O'Neill, another of the old-time science writers, had with cosmic ray expert Arthur Compton:

> We agreed to publish the story on the same Sunday. Mine appeared. Not his. How come?--I asked him. J. shook his head and with a sad Irish smile said: "My managing editor said that he didn't believe in cosmic rays, nor in atoms...but conceded there could be molecules." So he wrote a piece on chemistry--some molecule stuff. Later on he had trouble in getting a big "atom" story published: they didn't publish that one too. Headached--in dealing with boss editors? Let's not talk about that sensitive subject.[2]

---

[1] Lessing, op. cit., p. 88.

[2] Gobind Behari Lal, "Fossil Tales," NASW Newsletter, II (December, 1954), p. 9.

Science writers quite often feel that science stories are different. Different enough so that they should not have to compete with sports or crime or fashions. "Look at the sports section," they say. "Why shouldn't science have its own section too?"

Editors do not share this feeling about science. In fact, they lean the opposite direction most of the time. At a seminar for southern newspaper editors, they resolved that "science news must be able to compete on an equal basis with other types of news in drama and significance in order to win attention and its share in news space."[1] No more than four of the 28 editors in attendance had a reporter specifically assigned to science. But sports? Well, they all had at least one sports writer, sometimes six. And two or three reporters covering the police, the jail, the county building and city hall. How, then, can science news "compete on an equal basis" with these other types of news? Who, on their papers, is equipped to make science stories as dramatic and significant?

Oliver W. Brown Jr., of the Dayton Daily News (Ohio), pointed out the extension of the editorial problems of science stories down through the ranks of the newspaper:

> Most national and state science and medical stories which are published are those received by the wire services, New York Times service, etc.--and are handled at the "wire desk" by copy readers who may have no background in science, no interest in it nor be aware of the potential significance of stories in these fields--whereas, a field such as business has an "editor" across whose desk the wire stories flow before appearing in the newspaper.[2]

---

[1] Science News and Newspapers, op. cit., p. 10.

[2] Science Service, op. cit., p. 2. A letter entitled "Six Pages of Sports, Not Even One for Science."

Talking about the problems which face the science story is a favorite of Watson Davis. In "The Rise of Science Understanding," based on an article in Science back in 1948, Davis made this point:

> Even when there was a publisher who understood the news value of science, there were pitfalls. About a year before the organization of Science Service, when I was on the staff of the National Bureau of Standards, after sundown I wrote science news for the old Washington Herald, then owned by Julius Barnes and Herbert Hoover. The fact that ragweed, not goldenrod as most people believed, causes hay fever was reported at a local meeting. My story was slugged for page one, much to my delight. Imagine my chagrin the next morning to find that a friendly copyreader had "corrected" the story to read that goldenrod causes hayfever! Frequently even today copyreaders, and others, have to read something new three times or more before they believe it.[1]

Many times science writers are accused of using terms over and over which could easily be replaced by the scientific term, which becomes familiar in lay language. "Atom-smasher" for accelerator, "stuff of life" for molecules or chemical compounds, and "visitors from outer space" for meteorites or cosmic rays could be abolished after a few uses. But these "descriptive" phrases often remain not because of the science writer but because of the editor. Editors do not understand, or do not wish to understand, words like accelerator or molecules. They insist on "atom-smashers" because they "think" the reader does not understand.

How to improve on this situation is discussed by some of the subjects surveyed in 1963. What is needed, they suggest, are "better and more sensitive media," "greater editorial

---

[1]Watson Davis, "The Rise of Science Understanding" (Washington, D.C.: Science Service, November, 1960), p. 8. Based on an article in Science, September 3, 1948.

interest in reporting on science and medicine," and "more appreciation from both editors and publishers."

"The biggest drawback to good science writing," according to Mildred Spencer, "is the city editor who was once a police reporter, has no interest in science writing and doesn't think anyone else has."

What we need is "more sympathy from editors, who consistantly underestimate the needs and education of the reader and demand that every science story be a simple, lighthearted thing, preferably 'look what these crazy scientists have done now,'" says Arthur Hill of the Roanoke Times (Virginia).

The final blow to editors comes from Margaret Kreig, a free-lancer from New York, who said:

> I believe the [science] writers are doing a good job. I have seen their copy before it was published. And I have seen what was published after a committee of editors, advertising people, art department consultants and Aunt Mamie got into the act. Usually, in cases like this, well...read some of the fluff in the magazines.

Both the NASW and the CASW are trying to solve the editorial problem of science news. Occasional seminars are held for "gate keepers" in various parts of the country to discuss this very problem. But it is a long way from being solved. Perhaps the only solution is to accept an idea presented at the American Association for the Advancement of Science meeting in December of 1962 which proposed the establishment of media, a large newspaper in particular, which would be devoted primarily to lay science reporting. Even the editor would be science oriented. At least this might stimulate science reporting on other newspapers.

Better Science Writing Education

A third factor which science writers felt affected the quality of science writing is the education received; both the education level and the content. Particularly, they felt, the knowledge level of the general reporters who have been assigned to cover science either part time or full time, mainly against their wishes, is much lower than it should be. Carl F. Heintze, Science Writer on the San Jose News (California), said:

> The quality of most science writing in newspapers is pretty good, especially among most members of the NASW. What hurts is when incompetent reporters who don't know what they are writing about tackle scientific subjects and either write down to their audience or make a mess of trying to explain their subject. I'd say, with pardonable pride, that newspaper science writing on the whole is better than it is in a lot of magazines, particularly women's magazines where it is a sort of pseudo-medical home medical adviser.

Other remarks ranged from: "what is needed is more and better education in the sciences at colleges and universities" to "more humility, education and talent." Still others mentioned that science writers need more education and training in science. A very few thought that on-the-job training would help improve the quality of science writing.

Henry W. Hubbard of Newsweek magazine gave this side of the picture:

> Formal scientific training is not too necessary, but there are too many of us who are totally ignorant in too many fields. This is presently gained only through experience--talking to scientists, exposing yourself at conventions, seminars, lunches, and so on, and soaking up background. It can also be gained by reading any number of excellent books in all the fields, if the newspaper makes them available, or if you can afford to buy them. It would also be nice if more colleges and universities would

> institute survey courses in the sciences, such as Columbia's Physics for Poets. John Foster's gang up there is also an effective way to improve, but that is simply on-the-job training, with an able colleague available for guidance. I got the same thing here at Newsweek, and was paid for it to boot.

From Figure 3, it would appear that the science writers are comparatively well educated, with the majority receiving between 16 and 18 years; a bachelor's or master's degree. These, however, are the experienced, qualified science writers. Their education is in a variety of fields, usually NOT science. In fact, in Table 9 it can be seen that less than three semesters of any science was taken, on the average, by science writers during their average four years of college. Only five science courses had been taken more than one semester.

It would appear necessary for men and women who are reporting science, or any specialized field, to be well versed in the subject. Science, particularly, is advancing so rapidly that it is hard for even teachers to keep up. I recall an experience while in junior college of taking biology from a professor who was forced the next year to step aside for a new faculty member who taught the "modern biology." The old classification type of biology courses, where taxonomy of plants and animals was taught, is no longer important in the curriculum. "Modern biology," including molecular chemistry and radiation biology, is now being taught in high schools. Ritchie Calder, reporting a meeting of atomic scientists and science writers at The University of Chicago, amplified this point for other areas of science when he wrote:

> With the Space Age superimposing itself directly on the Atomic Age, public instructors, like the responsible science writers, have never been able to "catch up with the back-log" of information.[1]

---

[1]Ritchie Calder, Living With The Atom (Chicago: The University of Chicago Press, 1962), p. 41.

CHAPTER VI

A PROPOSED TRAINING PROGRAM

All of the programs of the NASW and the CASW, of schools of journalism and specialized schools of science writing and technical writing, and of the many seminars and meetings of persons devoted to outlining the path which a prospective science writer could and should take have not given any one substantial outline which a student could follow. It may be the case that there is no one particular path into science writing. It is obvious, if fact, that there have been many.

This lack of direction, this confusion, has provided headaches to many of the young people who have indeed entered the profession, at least through educational programs. The ones who have become science writers by assimilation have had problems which were not similar, although perhaps more difficult.

What is needed is for science writers to stop pulling in separate directions and unite under a common cause; that of truly educating and training young people who can lend the profession more quality; that of giving youngsters a chance of selecting a profession which has the same professional standards as other professions, at least educationally. We can no longer afford to "pick up deadwood" or "let students wander through the maze" of non-directional programs which are available.

I propose a training program which should bring us closer to the qualifications of a professional status than most others. It has been consolidated from the many suggestions, experiences, programs and curricula of many individuals, groups and institutions in order to most closely fit the needs of science writers. And with it, I propose the institution of a recruiting effort on the part of science writers and schools of journalism or science writing.

For the Bachelor's Degree

A high school graduate should be introduced to the field of science writing by recruiting programs similar to those in other areas such as engineering or medicine or journalism. He should also be able to select a program leading to the bachelor's degree in science writing when he enters college. Whether this program is under the division of sciences or taken from the school of journalism should make no difference; which ever would like to administer the degree would be the best.

During the first two years of college, regardless of the field, most of the program would be devoted to survey courses in the four major areas: humanities, natural sciences, communication skills, and political or social sciences. In all degree-granting programs, these courses are required, with the remaining electives usually taken up in the field of specialization or related areas. Thus, the high school graduate becomes a junior without specializing.

In the junior year of college, nearly any student could qualify for almost any degree. That is, a non-preference

student at the end of his second year could become an astronomy major, a journalism major, or major in nearly any other field, providing he selected some of the basic courses in the first two years. Therefore, a student at this stage could easily select science writing as his major.

The junior and senior years would be devoted to a program which combines science and journalism. Four survey-type courses should be taught in the junior year which would round out the individual in both science and journalism. These could be called: Earth Sciences, Physical Sciences, Biological Sciences, and Communications.

Earth Sciences would be an intensified year-long course similar to the one now taught at National Science Foundation Academic Year Institutes for science teachers. It would devote classroom and laboratory time to geology, astronomy, meteorology, oceanography, archaeology and some anthropology. It would include such things as learning to identify rocks and clouds and stars, the history of the earth and the solar system, paleontology, weather prediction, rotations of planets and similar subjects. It would give a familiarity of terminology and a basic understanding of the laws of nature.

Physical Sciences would include mathematics, physics, and chemistry, the basic courses in the physical sciences areas. Mathematics is fundamental to all sciences, but the mathematics usually required in most science curricula is not necessary to the science writer. What he needs is enough trigonometry, geometry, algebra and a slight amount of calculus to grasp

fundamental physics and chemistry. A few problems in statistics would be helpful. Chemistry and physics are so similar in the fundamental stages that they can easily be taught together; intertwined. The periodic table of elements, fundamentals of radiation and atomic and nuclear physics or chemistry, the differences between molecules and atoms, the difference between organic and inorganic compounds, laws of matter, and fundamental mechanics should be understood by the science writer. A laboratory section should be included in this course.

Biological Sciences would naturally include modern biology and some of the taxonomy of the plant and animal kingdoms. Medical science would be included in this course, with study of all the systems of man and animals, the understanding of genetics and an overview of population and health problems. This might naturally include a section on growing of food along with a section on life on other worlds. It should definitely have a laboratory section.

The fourth area, that of Communications, would be a survey course of journalism; of science and technical writing, copy editing, history of journalism, and general reporting. It would naturally help the student with English and basic reading and writing skills. It would give the student a feeling for writing and editing in the area of science, as well as other areas. Writing assignments should be made primarily in the sciences. The course might also include a section on communications surveys and advertising or marketing. It would be desirable to require assignments for local newspapers.

The last year of college could be mainly open to electives of the student's choice in several areas. The student should take at least one year of a particular science, a year of higher mathematics, a year of English and journalism, and a course in social or political science, psychology or humanities. But he should be required to fill the requirements for both a major and minor in science writing; that is, in a combination of sciences and of communications, a major in either, a minor in the other.

In some colleges and universities, the above program might cause some problems at first. Fitting a program such as this into the university's requirements might seem a task, especially when the student must use his physical sciences course as the first year requirement to take a second year course in physics, for example. But educators are generally interested in giving students what they need, not in remaining rigid and unflexable. I have found, for example, that to fill certain needs, they will offer advanced credit for undergraduate courses which are more necessary for the program.

A program such as this for undergraduates would certainly give the student knowledge in both journalism and science and give confidence and competence in both. I feel it would best agree with the requirements suggested by professionals.

For the Graduate Student

A college graduate, whether fresh from campus or with thirty years of journalistic experience, would also benefit

from a survey-type program in journalism and the sciences. A graduate degree, master's or doctorate, could be obtained by a program similar to that offered in the junior year; that is, survey courses in each of the three science areas. However, an extra year of one science could be substituted for Communications for men who have been editing and writing professionally.

At the graduate level, the courses in science would not be the same level as at the junior level, however. They would necessarily have to contain more advanced information. In the Biological Sciences, for example, the detailed structure of deoxyribonucleic acid (DNA) and the chemical reactions of photosynthesis should be taught. Details of celestial mechanics and advanced atomic and nuclear physics could be taught in the other areas. In other words, general specifics could be taught. It wouldn't have to include the mathematics which accompanies advanced courses in the sciences, but the specific subject matter should be advanced enough that a freshman engineer wouldn't understand. Science writers should be at the same level, knowledge-wise, as the high school teacher--or more.

Conclusion

Science writers are the transmitters of knowledge. They stand between scientists and laymen. Without them, the masses and the scientists would be living in separate worlds.

Science writing should be regarded as a difficult but honored profession, a profession of Hybrids. Without some standard of educational quality, science writing will become a

nebulus curiosity, a field into which the failing scientist or the general journalist falls, its decline inevitable.

Science writers should and must begin to agree on the way or ways in which science writers are recruited and trained. They must set up a program which can perpetuate the profession. I hope they will take notice of the situation and, whether they accept my program or another, come to a direct and definite conclusion and institute a sound program for the training of the science writer.

APPENDIX A

MICHIGAN STATE UNIVERSITY East Lansing

January 12, 1963

Communications Research Center

Dear Science Writer:

You have the interesting opportunity of influencing the curricula of schools of journalism offering science writing and, at the same time, comparing your beliefs about a science writer's training with those of your colleagues.

The question, "What is a science writer?", has long been a topic of discussion. Should the science writer be first a scientist or primarily a journalist or some combination of these? Should he have a college education or is on-the-job training the answer? Should he write to inform the public or to entertain scientists?

The Michigan State University Communications Research Center is inviting you to answer these and other questions.

The accompanying questionnaire is not an attempt to solve the educational problems, but to obtain the views of active science writers and pass them on to schools and individuals interested in this field. Your answers will be held confidential and used in tabulated form in a paper on the training of the science writer.

Answer each item as fully and thoughtfully as possible. Please return the forms in the self-addressed and air mail stamped envelope by January 25, 1963 (or within two weeks of receipt). We plan to mail the results of the survey to all participants as soon as they become available.

Thank you for your cooperation.

Sincerely,

William E. Small
Graduate Researcher

APPENDIX B

THE SCIENCE WRITER

Please answer each item as fully and thoughtfully as you feel possible. If additional space is necessary for answers or comments use the reverse side of the paper.

1. Name

2. Address

3. Age

4. Salary range (thousands per year) (circle one):
   (1) Below $5; (2) $5-10; (3) $10-15; (4) $15-20;
   (5) $20-25; (6) Above $25.

5. Number of science writers in your organization?_____.

6. What per cent of your writing deals with science?_____per cent.

7. Number of years of professional writing?_____years.

8. Number of years of professional science writing?_____years.

9. Number of years, if any, of scientific research?_____years.

10. List your scientific and/or journalistic affiliations:

11. When and how did you become interested in science writing?

12. Last year of education completed (circle one):
    6 7 8 9 10 11 12 / 13 14 15 16 / 17 18 19 20 21 22 23 24
    high school college graduate studies

13. Degrees held: University: Major: Minor:

14. Rate your relative competency in the following sciences (from 5 for excellent to 1 for no competency; 0, don't know, no answer.)

(1)___Agriculture
(2)___Anthropology
(3)___Archaeology
(4)___Astronomy
(5)___Biology
(6)___Botany
(7)___Chemistry
(8)___Civil Engineering
(9)___Electrical Engineering
(10)___Geography
(11)___Geology
(12)___Home Economics
(13)___Mathematics
(14)___Mechanical Engineering
(15)___Medicine
(16)___Metallurgy
(17)___Meteorology
(18)___Oceanography
(19)___Physics
(20)___Psychology
(21)___Space Technology
(22)___Statistics
(23)___Zoology
(24)___Other (specify)

15. Underline the sciences in the above list which you normally cover. (0, don't know, no answer; 1, positive response.)

16. Underline those sciences in which you have received formal education and indicate the number of semesters or terms:

(1)___Agriculture
(2)___Anthropology
(3)___Archaeology
(4)___Astronomy
(5)___Biology
(6)___Botany
(7)___Chemistry
(8)___Civil Engineering
(9)___Electrical Engineering
(10)___Geography
(11)___Geology
(12)___Home Economics
(13)___Mathematics
(14)___Mechanical Engineering
(15)___Medicine
(16)___Metallurgy
(17)___Meteorology
(18)___Oceanography
(19)___Physics
(20)___Psychology
(21)___Space Technology
(22)___Statistics
(23)___Zoology
(24)___Other (specify)

17. How much education do you believe is desirable for the science writing profession? (0, don't know, no answer; 1, experience is sufficient; 2, high school; 3, B.A. or 4 years of college; 4, M.A. or equivalent; 5, Ph.D. or equivalent; 6, as much as possible.)

18. What would you suggest that a prospective science writer should specialize in (journalism, science, both, neither)? (0, don't know, no answer; 1, journalism; 2, science; 3, both journalism and science; 4 neither.)

19. Rate the following courses for their importance or potential in the training of a science writing student (from 5 for excellent to 1 for no help): (0, don't know, no answer.)

(1)___Advertising
(2)___Agriculture
(3)___Anthropology
(4)___Archaeology
(5)___Astronomy
(6)___Biology
(7)___Chemistry
(8)___Communications Arts
(9)___English
(10)___Engineering
(11)___Foreign Language
(12)___Geography
(13)___Geology
(14)___History
(15)___Journalism
(16)___Mathematics
(17)___Medicine
(18)___Meteorology
(19)___Oceanography
(20)___Philosophy
(21)___Physics
(22)___Political Science
(23)___Psychology
(24)___Reporting
(25)___Sociology
(26)___Space Technology
(27)___Speech
(28)___Statistics
(29)___Television-Radio
(30)___Other (specify)

20. What do you consider as the most effective type of position for the training of a beginning science writer (large newspaper, technical journal, public relations, scientific research, etc.)? Please explain.

21. Evaluate the following for their importance in the training of a science writer (from 5 for excellent to 1 for no help): (0, don't know, no answer.)

(1)___Science Seminars
(2)___Science Writing Seminars
(3)___Science Writing Associations
(4)___College Journalism Courses
(5)___College Science Courses
(6)___Field Reporting
(7)___Conventions
(8)___Editors
(9)___Colleagues
(10)___Newspapers
(11)___Magazines
(12)___Radio
(13)___Television
(14)___Scientists
(15)___Other (specify)

22. In your opinion, what is the role of the science writer? Should he write to entertain the public primarily or to educate scientists, to please the editor or to fill a given space in the publication? Please air your opinion.

23. Do you feel that most science writers achieve the goal of The Science Writer?_____ If not, what would you suggest to improve the quality of science writing?

24. What is the most important or interesting aspect of professional science writing for you?

APPENDIX C

MICHIGAN STATE UNIVERSITY East Lansing

Communications Research Center

February 1, 1963

Dear Science Writer:

You received a questionnaire from the Michigan State University Communications Research Center some three weeks ago entitled "The Science Writer."

The results of this educational research program will constitute a thesis for a graduate degree in Science Writing. Since we have scheduled the returns to be run through the college computer on February 18, we would appreciate receiving your answers before then.

You were selected for the survey because, as an active member of the National Association of Science Writers, you are most qualified to suggest how colleges may plan the training of future science writers.

Please help us complete the survey by sending your copy of the questionnaire to the Center. If you have misplaced the first one, please write the Center for another.

Thank you for your cooperation.

Sincerely,

William E. Small
Graduate Researcher

APPENDIX D

THE SCIENCE WRITER STUDY

1-3)_____
4-6)_____
7-8)_____
Q3 9-10)_____
Q4 11)_____
Q5 12-13)_____
Q6 14-16)_____
Q7 17-18)_____
Q8 19-20)_____
Q9 21-22)_____
Q10 23)_____
24)_____
(end page one)
Q12 25-26)_____
Q:14
27)_____
28)_____
29)_____
30)_____
31)_____
32)_____
33)_____
34)_____
35)_____
36)_____
37)_____
38)_____
39)_____
40)_____
41)_____
42)_____
43)_____
44)_____
45)_____
46)_____
47)_____
48)_____
49)_____
50)_____
Q:15
51)_____
52)_____
53)_____
54)_____
55)_____
56)_____
57)_____
58)_____
59)_____
60)_____
61)_____
62)_____
63)_____
64)_____
65)_____
66)_____
67)_____
68)_____
69)_____
70)_____
71)_____
72)_____
73)_____
74)_____
75-79)Blank
80) 1
(end of card one)

Duplicate Columns 1-8 from card one.

Q;16

9-10)_____
11-12)_____
13-14)_____
15-16)_____
17-18)_____
19-20)_____
21-22)_____
23-24)_____
25-26)_____
27-28)_____
29-30)_____
31-32)_____
33-34)_____
35-36)_____
37-38)_____
39-40)_____
41-42)_____
43-44)_____
45-46)_____
47-48)_____
49-50)_____
51-52)_____
53-54)_____
55-56)_____
57-79)Blank
80) 2

Q:19

9)_____
10)_____
11)_____
12)_____
13)_____
14)_____
15)_____
16)_____
17)_____
18)_____
19)_____
20)_____
21)_____
22)_____
23)_____
24)_____
25)_____
26)_____
27)_____
28)_____
29)_____
30)_____
31)_____
32)_____
33)_____
34)_____
35)_____
36)_____
37)_____
38)_____

Q:21

39)_____
40)_____
41)_____
42)_____
43)_____
44)_____
45)_____
46)_____
47)_____
48)_____
49)_____
50)_____
51)_____
52)_____
53)_____
54)_____
55)_____
56-58)_____
59-61)_____
62-79)Blank
80) 3

APPENDIX E

7830 S. Colfax Avenue
Chicago 49, Illinois
May 10, 1963

Dear Science Writer:

My sincere thanks for participating in The Science Writer survey some weeks ago.

I am sending a statistical answer sheet for your review. It quantitatively records the machined averages of the survey. You may compare your opinions with those of other science writers.

The Master's thesis is well under way. From these answers and the fine suggestions and essay answers which I received, the paper will, I feel, prove to be a strong guide for schools of journalism with science writing courses.

Seventy two science writers from across the country replied to the questionnaire. This was 40 per cent of those asked to participate. I think this indicates a keen interest in the education of our future colleagues.

The final paper, based on this survey and the existing literature, may be available on request when completed.

If you have any comments, questions or suggestions about the survey results or the final paper, please drop me a card or letter.

Again, many thanks for your cooperation.

Sincerely,

William E. Small
Science Writer

APPENDIX F

THE SCIENCE WRITER

All answers to the survey are empirical averages, based purely on the machine results as coded directly from the answer sheets. No attempt has been made here to quantitatively analyze the results. Underlining of the most significant answers was based on an arbitrary cut-off point for each question. The results will be analyzed in the final paper.

Age: 48 years, average.

Salary range--percentage of writers in each catagory:
(thousands per year)

No answer	$5-10	$10-15	$15-20	$20-25	Above $25
12%	20%	37%	16%	6%	9%

Number of science writers in your organization? 2.6 avg.

What per cent of your writing deals with science? 79% avg.

Number of years of professional writing? 24 years, avg.

Number of years of professional science writing? 14 years, avg.

Number of years of scientific research? 1.7 years, avg.
(Only 14 of the 72 replied that they had done research.)

Scientific and journalistic affiliations:

	Scientific							Journalistic						
No. Organizations	0	1	2	3	4	5	6	0	1	2	3	4	5	6
No. Affiliations	34	19	8	7	2	2	0	0	22	28	15	2	3	2
Avg. no. of affiliations						1.0								2.2

Last year of education completed--number of writers:

	(high school)			/ (college)				/ (graduate studies)					
No answer	10	11	12	13	14	15	16	17	18	19	20	21	22
3	2	0	2	3	1	6	21	16	13	2	2	0	1

Rate your relative competency in the following sciences (from 5 for excellent to 1 for no competency), average of answers in each catagory:

1.64 Agriculture	1.68 Electrical Eng.	2.00 Meteorology
2.01 Anthropology	2.08 Geography	1.99 Oceanography
1.89 Archaeology	1.92 Geology	2.22 Physics
2.25 Astronomy	1.10 Home Economics	2.42 Psychology
2.67 Biology	1.75 Mathematics	2.22 Space Tech.
1.81 Botany	1.33 Mechanical Eng.	1.44 Statistics
2.26 Chemistry	3.38 Medicine	2.04 Zoology
1.26 Civil Eng.	1.42 Metallurgy	0.93 Other

Underline the sciences which you normally cover; most frequent answers (averages based on 0 for no and 1 for yes):

0.22 Agriculture	0.25 Electrical Eng.	0.36 Meteorology
0.36 Anthropology	0.19 Geography	0.35 Oceanography
0.33 Archaeology	0.35 Geology	0.50 Physics
0.46 Astronomy	0.06 Home Economics	0.49 Psychology
0.53 Biology	0.26 Mathematics	0.44 Space Tech.
0.28 Botany	0.19 Mechanical Eng.	0.18 Statistics
0.42 Chemistry	0.68 Medicine	0.36 Zoology
0.17 Civil Eng.	0.25 Metallurgy	0.19 Other

Underline the sciences in which you have received formal education and indicate the number of semesters, averages:

0.14 Agriculture	0.60 Electrical Eng.	0.11 Meteorology
0.46 Anthropology	0.61 Geography	0.06 Oceanography
0.22 Archaeology	0.60 Geology	1.87 Physics
0.43 Astronomy	0.01 Home Economics	1.19 Psychology
1.29 Biology	2.91 Mathematics	0.11 Space Tech.
0.42 Botany	0.13 Mechanical Eng.	0.32 Statistics
1.80 Chemistry	0.72 Medicine	0.50 Zoology
0.18 Civil Eng.	0.08 Metallurgy	0.03 Other

How much education do you believe is desirable for the science writing profession; percentage of answers:

No answer	Experience Only	High School	B.A.	M.A.	Ph.D.	As Much As Possible
7%	4%	1%	38%	18%	4%	28%

What would you suggest that a prospective science writer should specialize in; percentage of writers in each catagory:

No answer	Journalism	Science	Neither	Both
7%	16%	11%	17%	49%

Rate the following courses for their importance in the training of a science writing student (from 5 for excellent to 1 for no help); average of answers in each catagory:

1.08 Advertising	2.56 Foreign Language	3.39 Physics
1.43 Agriculture	2.15 Geography	1.86 Political Sci.
2.21 Anthropology	2.24 Geology	2.49 Psychology
1.82 Archaeology	2.86 History	2.72 Reporting
2.60 Astronomy	2.65 Journalism	1.96 Sociology
3.49 Biology	2.97 Mathematics	2.40 Space Tech.
3.47 Chemistry	2.54 Medicine	1.49 Speech
2.03 Communication	2.03 Meteorology	1.99 Statistics
4.22 English	2.01 Oceanography	1.33 TV-Radio
1.89 Engineering	2.43 Philosophy	0.10 Other

Evaluate the following for their importance in the training of a science writer (from 5 for excellent to 1 for no help); avg:

3.21 Science Seminars	3.81 Field Reporting	3.04 Magazines
2.99 Sci Writ Seminars	2.71 Conventions	1.47 Radio
2.33 Sci Writ Assoc	2.64 Editors	1.68 Television
2.38 Journalism Courses	2.99 Colleagues	3.60 Scientists
3.61 Science Courses	3.07 Newspapers	0.49 Other

BIBLIOGRAPHY

Public Documents

Pan American Union. Report of the First Inter-American Seminar on Science Journalism (Santiago, Chile, Oct. 16-18, 1962). Washington: By the Pan American Union, 1963.

_____, Organization of American States, and Inter-American Press Association Technical Center, Inc. Science Journalism--Periodismo Cientifico. Washington: By the Organization of American States, 1963.

U.S. Department of Agriculture. After a Hundred Years: The Yearbook of Agriculture 1962. Washington, 1962.

U.S. Public Health Service, Surgeon General's Conference on Health Communications: Nov. 5-8, 1962. Publication No. 998. February, 1963.

Books

Calder, Ritchie. Living with the Atom. Chicago: The University of Chicago Press, 1962.

Campbell, Laurence R., and Wolseley, Roland. How To Report and Write the News. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1961.

Foster, John, Jr. Science Writer's Guide. New York: Columbia University Press, 1963.

Krieghbaum, Hillier. Science, The News, and The Public. New York: New York University Press, 1958.

_____. When Doctors Meet Reporters. New York: New York University Press, 1957.

National Association of Science Writers. A Handbook for Press Arrangements at Scientific Meetings. Port Washington, N.Y.: NASW, 1962.

Weisman, Herman M. Basic Technical Writing. Columbus, Ohio: Charles E. Merrill Books, Inc., 1962.

Wolfle, Dael. Science and Public Policy. Lincoln: University of Nebraska Press, 1959.

Articles and Periodicals

"Carnegie Corporation," Understanding (Winter 1962-63), 2.

Garfield, Eugene. "Citations in Popular and Interpretive Science Writing," Science, CXLI (Aug. 2, 1963), 392.

"Job Opportunities for Journalism Graduates," Saturday Review (Nov. 10, 1962), 69.

Kantor, Alice K. "Training for Interpretive Science Writers," Chemical & Engineering News, XLI (June 10, 1963), 4.

Krieghbaum, Hillier. "American Newspaper Reporting of Science News," Kansas State College Bulletin, XXV, No. 5, Aug. 15, 1941.

_____. "It's Later Than You Think," The Quill, L (November, 1962), 71.

_____. "Public Interest in Science News," Science, CXXIX (April 24, 1959), 1092.

Lal, Gobind Behari. "Fossil Tales," NASW Newsletter, II (December, 1954), 9.

Lessing, Lawrence. "The Three Ages of Science Writing," Chemical & Engineering News, XLI (April 22, 1963), 88. (Based on the Grady Medal Address at the 144th American Chemical Society National Meeting in Los Angeles, Calif.)

Negus, Sidney S. "Public Information Service," Science, CXXXIX (Feb. 15, 1963), 629.

"Plan Classes for Writing about Science," Chicago Tribune, Aug. 25, 1963.

"Summary: NSF Public Understanding of Science Program," Understanding (Summer 1962), 2.

Tannenbaum, Percy H. "Communication of Science Information," Science, CXL (May 10, 1963), 579.

"The Technical Society," Scientific American, CCIX (September, 1963), 82.

Ubell, Earl. "Council for the Advancement of Science Writing," The Wiley Bulletin, IV (Fall, 1960), 6.

Brochures and Pamphlets

"Curriculum in Science Writing." Department of Printing and Journalism, South Dakota State College, Brookings, Winter Quarter, 1961-62.

Davis, Watson. "The Rise of Science Understanding." Washington: Science Service, November, 1960. (Based on an article in Science, Sept. 3, 1948.)

National Association of Science Writers, Inc. Constitution. Port Washington, N.Y.: NASW, August, 1955.

_____. A leaflet bearing background information on the NASW. Port Washington, N.Y.: NASW, 1963.

_____. Membership List. Port Washington, N.Y.: NASW Aug. 2, 1962.

Slosson, Edwin E. "Don'ts for Would-be Writers of Science." Washington: Science Service. (Printed pamphlet on "How Science Service Covers the Science Front.")

Reports

Krieghbaum, Hillier. Impact of Space Age on Daily Newspaper Coverage of Science News. A report of a National Association of Science Writers-New York University survey of United States Managing Editors. Port Washington, N.Y.: NASW, 1958.

National Association of Science Writers, Inc. Science, The Press and The Citizen. Report of the Committee on Fellowships and Scholarships. Port Washington, N.Y.: NASW, 1957.

_____. Statistical summary of the NASW survey of 176 members. Port Washington, N.Y.: NASW, 1957. (Mimeographed.)

National Conference for Scientific Information. New York: Scientist's Institute for Public Information, Feb. 16-17, 1963.

The Public Impact of Science in the Mass Media. A report on a Nation-wide Survey for the National Association of Science Writers. Ann Arbor: Survey Research Center of the University of Michigan, 1958.

Satellites, Science and the Public. A report of a National Survey on the Public Impact of Early Satellite Launchings for the National Association of Science Writers. Ann Arbor: Survey Research Center of the University of Michigan, 1959.

Science and the Public. Proceedings of the Midwestern Science Communications Seminar for Public Information Specialists. Evanston, Ill: Northwestern University, March 21-23, 1962.

Science News and Newspapers. Report of the Science News Seminar for Southern Newspaper Editors. New Orleans: Tulane University, Feb. 5-7, 1962.

Science Service. Preliminary Material, Conference on the Role of Schools of Journalism in the Professional Training of Science Writers. Washington: Science Service, June 9-10, 1961.

_____. Report, Conference on the Role of Schools of Journalism in the Professional Training of Science Writers. Washington: Science Service, June 9-10, 1961.

Science Writing and the Public. A Report of a Pilot Study for the National Association of Science Writers. Ann Arbor: Survey Research Center of the University of Michigan, September, 1955.

Southern Regional Science Seminar for University Information Officers. Gainesville: University of Florida, Feb., 19-22, 1961.

Unpublished Material

"Academic Year Institute in General Science for Secondary Teachers." Sponsored by the National Science Foundation at Michigan State University, East Lansing, 1963-64. (Mimeographed.)

Davis, Watson. "Writing and Science Presentation." Paper read before the Conference on Scientific Communication of the American Association for the Advancement of Science, Chicago, Dec. 30, 1959.

Fraley, Pierre C. "Should Science Writers be Scientists?" Unpublished talk read before the Science Writers Seminar on Birth Defects, University of Michigan, Ann Arbor, Nov. 14, 1962.

Krieghbaum, Hillier. "Bouquets and Boobytraps for Science Writers." Paper read at the Howard W. Blakeslee Awards Luncheon of American Heart Association, New York City, Oct. 3, 1959.

Larsen, Carl W. "Science Writing--New Opportunities--New Problems." Paper read at the American College Public Relations Association Convention, Chicago, June 24, 1963.

Loftin, Horace G. "Science Reporting in the American Press." Unpublished Master's thesis, Florida State University, August, 1956.

National Association of Science Writers, Inc. "A Guide to Careers in Science Writing." Draft of a brochure, NASW, 1963. (Typewritten.)

Scheer, Julian. "Science Writing; New Opportunities--New Problems." Paper read at the American College Public Relations Association Convention, Chicago, June 24, 1963.

Stokley, James. "Opportunities in Science Writing." Unpublished paper, School of Journalism, Michigan State University, East Lansing, 1963. (Mimeographed.)

Other Sources

Results of Project 099 of the Michigan State University Communications Research Center, East Lansing. MISTIC computer machined pages of the results of the survey "The Science Writer," under staff supervision of Jack Prather. Final pages run April, 1963.

Small, William E. "The Science Writer." Mail surveys of 72 science writers in the National Association of Science Writers, Inc. Taken between January 12, 1963 and February 28, 1963.

Stokley, James. Technical Writing Courses Notes, School of Journalism, Michigan State University, East Lansing, Fall Quarter 1960. (Mimeographed.)