THE INFLUENCE OF SCIENCE FAIRS ON THE CHOICE OF A SCIENTIFIC CAREER

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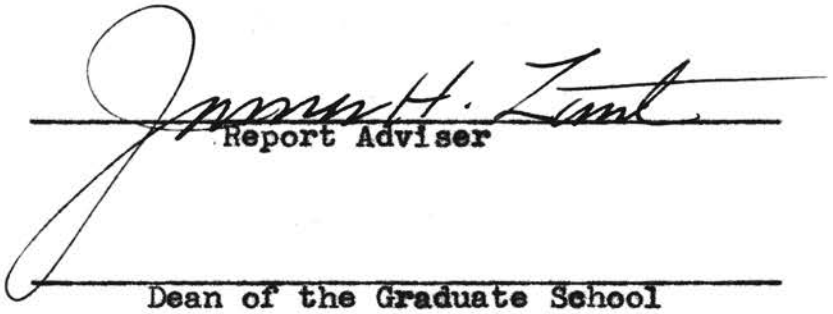

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CHAPTER I

THE PROBLEM

Introduction. The United States is facing a serious problem regarding scientific personnel. One has only to study the want ads of newspapers, scientific and engineering publications to find large numbers of requests for trained scientists and engineers. At the present time, our colleges and universities are not graduating enough scientists, science teachers, and engineers to fill the present needs, much less to meet the expanding needs of the very near future. It is obvious, therefore, that every effort must be made to stimulate capable students into scientific careers. Science fairs are an attempt to offer such stimulation.

Statement of the problem. It was the purpose of this study (1) to evaluate the science fair as a means for motivating students in science and (2) to compile some sentiments of former participents in National Science Fairs on this subject.

Importance of the study. Science and the application of science, technology, have become increasingly important to the American way of life. We have come to expect that each year our automobiles will be better, our washing

machines more efficient, our television pictures sharper and the set cheaper. If we are to be able to continue to make such progress, we must have a continuous supply of scientific personnel. This supply must come from students who have had their interest in scientific careers stimulated through every available means.

There is obviously a large number of students who have more than average interest in science and are capable of undertaking scientific careers who are going into other fields. Many of these, properly motivated and indoctrinated might become interested in a career in science and thus help to fill the ranks in this important field. It is suggested that science fairs can play an important part in this.

Scope of the investigation. This study included a sampling of the finalists (the term applied to all exhibitors) at the first four National Science Fairs. Questionnaires were sent to a group of these finalists, with the emphasis being placed on those who had indicated an intention of following a scientific career. The questionnaires returned were studied and classified in several ways as is shown in the tables in Chapter III.

The collection of data for investigation. The materials for this study were obtained from two sources.

First, an examination of published material dealing with the problem was made. There is a tremendous amount of such material which deals directly with science fairs and with our shortage of scientists and engineers, but little dealing with the effect of science fairs upon the choice of a career. Some of this material is included in the review of the literature in Chapter II.

Second, questionnaires were sent to one hundred thirty three National Science Fair finalists. A copy of the questionnaire may be found in the Appendix, page 32.

Organization of remainder of the report. The first chapter has given the introduction, the statement of the problem, the importance of the study, the scope of the investigation and the collection of data. The second chapter contains a brief résumé of the history of the problem; the third chapter deals with the questionnaire. Chapter IV presents some quotations from finalist's answers to the questionnaire. The fifth and last chapter presents a summary and conclusions.

CHAPTER II

A BRIEF HISTORY OF THE PROBLEM

A study of the literature pertaining to the problem reveals the unanimous statement of the authorities that the United States is failing to produce a sufficient number of scientists and engineers by a sizable percent. All express alarm at this situation.

Rettaliata says that to meet the current needs of our domestic economy, industry should have an annual supply of thirty thousand new engineers--thousands more than graduated last year or will do so this year. He also quotes the National Education Association estimate that the present need for new science teachers is seven thousand seven hundred a year of which about one third is being supplied.[1]

Senior Scholastic quotes three different authorities on the gravity of the situation:

> 1. The National Science Foundation in its annual report to Congress, called the shortage of scientists "an urgent national problem". The Foundation asked Congress for a "substantial" increase in grants and scholarships to attract more students into science and engineering.
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> 2. Brigadier General David Sarnoff, chairman of the

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[1]John T. Rettaliata, "The Scientific Manpower Shortage," School and Society, 82:17-20, June 23, 1955.

board of the Radio Corporation of America, decried the shortage of qualified high school teachers in scientific fields. He suggested that private companies pitch in to help. These companies, he said, should release their experts to teach physics, chemistry, engineering, and related subjects in local schools. General Sarnoff added that the companies should continue full pay to such men, for at least a year, to avoid extra cost to the school.

3. Dr. James R. Killian, Jr., president of Massachusetts Institute of Technology pointed out that Russia is gaining on our present technological lead. Two years ago, for example, the Soviet Union turned out fifty thousand engineers. We turned out only twenty two thousand. He warned, however, that in our effort to step up scientific training the emphasis must be on quality rather than mere quantity.

Amid these warnings, the New York Times reported last week that about fifty thousand job openings will be available this June in scientific or engineering fields --all at high salaries. However, there will be only half that number of new, qualified graduates to fill them.[2]

The suggestion of General Sarnoff that practicing scientists and engineers help in high school teaching to relieve the shortage of qualified science teachers is also the recommendation of Lewis L. Strauss, Atomic Energy Commission chairman.[3]

J. W. Neckers and Ed Hawesy write that the declining number of young recruits for the fields of engineering,

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[2]"Needed--More Scientists," Senior Scholastic, 68:35 February 9, 1955.

[3]"Classroom Cold War: We Need Scientists and Engineers," Senior Scholastic, 67:16, December 8, 1955.

chemistry, and physics may eventually cost America its world leadership. They state that corporations have been spending thousands of dollars to advertise their needs for young engineers. A survey by the Engineering Manpower Commission indicates that one hundred seventy six business and industrial concerns could fill only sixty eight percent of their openings with the 1952 graduates of our engineering colleges. They blame poor secondary school teaching, teacher shortage, and the inevitable military service.[4]

In an article called "Science-minded Youth" in Science News Letter it is stated that the starting point for the needed scientists and engineers of tomorrow is in the high schools. Many schools are not doing what they should in solid basic courses in science and mathematics, inspiringly taught. Many boys and girls do not learn of the opportunities before them. They do not realize what the world needs. The youngster who does a science experiment or project as a hobby, outside the schoolroom, is often the scientist of the future.[5]

Dewey E. Large, Oak Ridge Institute of Nuclear

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[4]"Where Are Tomorrow's Scientists," American Mercury, 77:24, December 1953.

[5]"Science-minded Youth," Science News Letter, 65:62, January 23, 1954.

Studies, Oak Ridge, Tennessee, in discussing the need for scientists and engineers says:

> Primarily, the problem is one of education. Basically, the need can be met by elementary and secondary teachers and students being given opportunity, recognition, and compensation. A wholesome stimulation of interest in acquiring a knowledge of science, including mathematics, must be furnished not only to this country's pupils and teachers but to the entire general public. Opportunities for discovering and encouraging talent in all the fields of science are absolutely necessary in order that adequate numbers of scientists and teachers may be made continuously available to meet the country's increasing requirements.
>
> One of the relatively new programs of activity in science education concerns the medium of more and improved science fairs. A science fair is a collection of exhibits, each of which is designed to show a .... principle or process. It is a means whereby potential scientists may be sought out among our American youth and encouraged, to a great degree, to select a scientific career and obtain advanced training.
>
> The science fair provides opportunities for all participants and observers to advance their knowledge and appreciation of science and of those people connected with its applications and improvement. Most educators concerned with public, private, and parochial schools recognize science fairs as being of utmost importance in educational stimulation.[6]

Linked to school activities, the fair is beginning to make a visible impact upon America's youth. Allen Long quotes a seventeen-year-old Warwick, R. I., high school senior as saying, "If it hadn't been for the fair, I don't know that I would have become interested in science. But I

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[6]Dewey E. Large, "Science Fairs Stimulate Science Education," School Life, 37:76, February 1955.

saw a lot of my classmates preparing their scientific exhibits for our local fair, so I decided to make one too. The more I worked on it the more I got interested in science. Now I've about decided to be an engineer." Mr. Long says that while listening to a young man or woman explaining the whys and wherefores of his or her exhibit, it is not hard to catch a glimpse of the future. It is comforting to imagine John Smith designing a better rocket engine, or Mary Smith working on a new vaccine.[7]

In discussing the quality of the work being done by high school students in their science projects, Herbert Yahraes says that adult scientists often find it hard to believe that young people can be so talented. He quotes Dr. Remington Kellogg, director of the National Museum of the Smithsonian Institution, who was chairman of the board of eleven judges in 1952 as saying, "the whole fair was a great surprise to all of us. We were impressed by the efforts, interest and excellence of the exhibits. It was extremely difficult to select the winners."[8]

In a Cedar Rapids, Iowa, Parent-Teachers Association

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[7]Allen Long, "Science, Youth and Tomorrow," Science News Letter, 65:282 May 8, 1954.

[8]Herbert Yahraes, "Young Scientists Win What They Want," Popular Science, 164:150 April 1954.

sponsored fair, a student exhibitor said the fair "proved that science is not a dull book subject but a field of adventure and excitement. It also gave recognition to students who have done serious work in a scientific subject."[9]

Science projects are frequently prepared by high school students in connection with work in science clubs. Watson Davis, director of Science Service, in discussing science clubs says that all this reading about science in newspapers, magazines, and books or hearing and seeing it on radio and television is spectator science. So, unfortunately, is much of our science teaching. You must actually play science to understand and appreciate it. He continues by saying, "What 4-H clubs are to agriculture, science clubs are to science education. If the future belongs to youth and to science, then there is a vastly more important place for science clubs in the scheme of things that are to be."[10]

The question is frequently asked whether the local science fairs really find the boys and girls today who will

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[9]Doris E. Van Note, "Council Fair Wins Community Acclaim," National Parent-Teachers, 50:35 May 1956.

[10]Watson Davis, "Communicating Science," Bulletin Of Atomic Scientists, 9:337-40 November 1953.

be the nation's future scientists. The answer is an emphatic, "yes!" given by Science Clubs of America, sponsors of nationwide science fairs under Science Service and local newspaper auspices. Figures on finalists to the first four National Science Fairs show that local judges boast a .800 batting average when it comes to singling out the boys and girls most likely to become scientific leaders. Four out of every five finalists are pursuing scientific studies.[11]

This was further pointed out in an address by Dr. Alan T. Waterman, director of tne National Science Foundation. He said:

> So perceptive are the judges who evaluate your exhibits that I am able to read your futures. Would you like to know what you will be doing in the next few years? Of the 213 present at this Seventh National Science Fair, 187 of you will actually become scientists or engineers.....So expert has been the selection of former judges that we know that eighty eight percent of those whom they sent to the national competition will go on to make science or engineering their career.[12]

There can be no doubt that a large percent of the National Science Fair finalists go into scientific careers but no literature was found which gave any indication as to

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[11] "Local Science Fairs," Science News Letter, 65:62 January 23, 1954.

[12] Allen T. Waterman, "Scientists and Engineers For Tomorrow," Address at the Seventh National Science Fair Awards Banquet, Oklahoma City, Oklahoma, May 11, 1956.

the effect science fairs had in motivating them into these careers. This led to the sending of questionnaires to a group of the finalists at the first four National Science Fairs in an attempt to get some evaluation of this factor. The questionnaire and the responses to it make up Chapter III.

CHAPTER III

THE QUESTIONNAIRE AND THE RESPONSES

A questionnaire was devised for the purpose of discovering certain facts relative to National Science Fair finalists, their choice of career, and the effect of science projects on their choice. Four main items were included in this questionnaire. Each of these is considered during the course of this chapter and the responses analyzed.

Questionnaires were sent to one hundred thirty three of the finalists attending the first four National Science Fairs. Table I shows the distribution, by years and sex, of the questionnaires and the responses received. The exceptionally high response (eighty two percent) is most unusual and gratifying, indicating to the writer the interest these young people have in the advancement of science. It is interesting to note that a slightly higher percentage response was made by the young women.

Table II shows the distribution as to divisions in which the finalists exhibited. Again an interesting fact is noted in that twice as many men entered the physical science division as the biological while slightly over one third as many women entered the biological division as the physical. Whether this distribution continues throughout college and

TABLE I

DISTRIBUTION OF RESPONSES

YEAR	SEX	NUMBER SENT OUT	NUMBER OF RESPONSES	PERCENTAGE RESPONSES
1950	men	13	10	76.8
	women	7	6	85.7
1951	men	11	9	81.8
	women	8	6	75.0
1952	men	21	17	81.3
	women	14	11	78.6
1953	men	38	31	81.6
	women	21	19	90.5
totals	men	83	67	80.7
	women	50	42	84.0
		133	109	82%

TABLE II

DIVISION IN WHICH FINALIST EXHIBITED

	men		women	
	physical	biological	physical	biological
1950	8	2	2	4
1951	7	3	5	2
1952	11	7	4	8
1953	22	12	9	13
totals	48	24	20	32

later into careers might provide an interesting study.

The primary purpose of the present study was to find whether former National Science Fair finalists who are now engaged in scientific work, or are in training for such work, had considered some career other than science before they became interested in science fair projects. Table III shows the distribution of responses to this important question as well as the distribution of those in scientific positions or in training for such positions.

The responses, as shown in Table II are most revealing. Twenty and seven tenths percent of the young men in the above catagory and twenty nine percent of the young women indicated that they had considered other careers. The significance of this will be discussed in a subsequent chapter.

A large majority of those answering the questionnaire added comments. Some of these were lengthy, indicating a sincere interest in the subject. Several asked to be informed as to the results of the present study. Some of the comments are quoted in Chapter IV.

TABLE III

DISTRIBUTION OF SCIENTISTS AND TRAINEES

WHO HAD CONSIDERED OTHER CAREERS

year	sex	column 1	column 2	column 3	column 4	column 5
1950	men	5	1	6	2	33.3
	women	3	1	4	2	50.0
1951	men	5	4	9	2	22.2
	women	2	3	5	0	0.0
1952	men	9	5	14	5	35.7
	women	7	3	10	4	40.0
1953	men	16	13	29	3	10.3
	women	5	7	12	3	25.0
totals	men	35	23	58	12	20.7
	women	17	14	31	9	29.0
		52	37	89	21	23.6

Column 1---Finalists in scientific positions

Column 2---Finalists in training for scientific positions

Column 3---Sum of columns 1 and 2.

Column 4---Finalists in column 3 who had considered careers other than science

Column 5---Percentage; column 4 of column 3

CHAPTER IV

STATEMENTS OF FINALISTS

The remarks and comments made by some of the finalists answering the questionnaire are of particular interest. Several of these are quoted in this chapter. Part of these quotations indicate that the writer thinks that most of the finalists who go into scientific careers had already made their decision while others indicate that they, personally, had not made their decision prior to their working on science fair projects. One of these is D. J. H. who says, "Before becoming interested in science fairs, I had no thoughts of a career. Science fair participation made the decision for me."

Also, W. R. H. states, "I am presently at L----- College majoring in chemistry and mathematics. This I became interested in deeply while on the tour at the National Science Fair to the National Bureau of Standards. I think the National Science Fair had a lot to do with my going on into advanced work in science. It gave me confidence and I learned a lot at the Fair also. I think the National Science Fair and Science Service have done a lot to accelerate the development of scientists in the United States."

From R. R. C., "The science fair was definitely the deciding factor in my choice of an engineering career."

An interesting comment is made by K. D. "I feel science fairs are doing a tremendous job in bringing out science abilities and interests. I know my trip to National at Oak Ridge was a fabulous experience, one I will never forget. Talking with the great scientists was a wonderful thing; it really fixed up my scientific interest, not only in my own biological field, but also in the great work being done at Oak Ridge in physical fields. Keep up the good work in National Science Fair. It's needed, I know, as several of my friends I met at National Science Fair are now in scientific work as a result of the Oak Ridge trip."

S. D. says, "Althouth I had been interested in a scientific research position for some time before the National Science Fair had started, I believe it further increased my desire, to say nothing of the fine personal contacts I have made. It has often been stated that there will be a drastic shortage of engineers and scientific-minded personnel in the future, but from my own views and those of my acquaintances, this will be disproved."

From R. B. comes this comment, "It is my opinion that the very participating in a National Science Fair gives

young girls and boys an incentive to pursue a scientific career. I don't think any boy or girl ever forgets the wonderful days as a National Science Fair finalist. The encouragement and interest shown by everyone is truly a rewarding experience."

"I do wish to say that being a finalist at the National Science Fair gave me the encouragement at a most valuable time which I needed to definitely decide upon a medical career," says J. C.

Also from L. C., "I believe the National Science Fair is of great value in the motivation of students into scientific fields."

E. E. L. states, "I feel that the experiences I gained while in Oak Ridge, Tennessee, have helped me very much in preparing for my college studies--those in which I am now engaged. Any young person who has interests in the science field should be encouraged to continue those interests because there are so many opportunities for the young person interested in science today."

The following quotation is from W. L. M. "I feel the National Science Fair is of great importance in helping students develope an interest in science, in keeping that interest once it has started, and in developing it to a

higher level."

R. P. O. says, "I feel at the present time that these fairs are deserving of high praise in promoting the growth of young scientists and in aiding these young people in finding a suitable profession."

"The only remark that I have to make is that if a student has any interest toward science, these interests should be exploited to their greatest degree. I think that the science fair, even on its local level, is a great help in that direction. I think that there should be more done in this direction," says N. G. C.

From R. D. F. comes this comment, "I feel that the local science fairs and especially the National Science Fair are an important contribution to the development of scientific talent. The spirit of competition and the opportunity to delve into areas of science and engineering which would ordinarily be beyond the scope of the average high school curriculum are excellent vehicles for the development of motivation in the above average high school student. So much has been said and done for the average or below average student in the high schools that often the superior student becomes bored by the lack of challenge in the ordinary high school work. Often the student who is not particularly

interested in science as it is presented by an all too often inferior or disinterested high school physics or chemistry teacher, will find the challenge and intricacies of a science project to his liking."

A further comment on the stimulation of science fairs comes from D. D. who says, "I, of course, would certainly like to see the science fair program expanded even more, as I believe that participating in these events has helped me a great deal. It would be extremely rewarding to the nation as a whole, I believe, if science fairs could be observed by the majority as the most honored and most publicized event that a high school student could possibly compete in during the year. I am, incidently, studying for my Ph. D. in the same field (entomology) in which I had my exhibit."

Some finalists indicate that National Science Fairs had no perticular influence in their choice of career. One of these is G. M. H. who says, "I would seriously hesitate to say the National Science Fair motivated me to achieve in the field of science. I already had strong indications to do so. However, I feel that the greatest contribution the National Science Fair made for me, and probably for many others, is that it gave a feeling of achievment and confidence in one's self and a heightened interest in all fields

of science."

This comment in the same vein comes from J. W. N. "My interests have been very varied throughout my entire life. I have always, however, as far back as childhood, considered that my life's work would be in science. I do not feel that my being a finalist in the National Science Fair played a very great role in my choosing a scientific career. Certainly many times afterwards I considered entering non-scientific fields but my interests and abilities in science always brought me back to my true field, chemistry."

Expressing somewhat the same idea is the comment of C. A. F. "At present I am a senior at P---- University and I expect to receive a B. S. degree in chemistry this June. Next September I plan to begin graduate school to work for a Ph. D. degree in chemistry, barring interference by the military. I probably will specialize in biochemistry. The National Science Fair didn't start me on my scientific interests, since I have been interested in sciences since grade school. However, I received a great deal of stimulation and encouragement through my participation in the National Science Fair, and my selection as a finalist made me feel more than ever before that I was entering the right career."

The lengthiest response came from C. L. K. who says in part, "Inasmuch as I have been connected with the ---- Science Fair since 1949--for three years as a participant and for five years as a member of the planning staff for the fair--I have developed a sincere belief that science fairs definitely do motivate students into scientific careers, or at least into college-level science education. Not that a large number of the students who enter science fairs are not interested in science prior to entering the fair--far more times than not the contestant has a definite inclination toward scientific work prior to entering the fair. However, the science fair seems to retain that interest by providing the student with contacts among scientists who are willing to teach, or at least guide the student through phases of science which are only inadequately covered at best by the average secondary school classes in science and further by giving the student some tangible goal for his work in his basement or attic "laboratory".

Thus, essentially, I feel that while the science fair principle does not add appreciably to the number of students basically interested in or inclined toward science, it does provide a stimulus to the student to continue his natural curiosity about scientific subjects from the grade school level through the junior high school and senior high

school years where such curiosity is seemingly lost, only to be aroused again, too late, when the student reaches the point of having to select a college career, being able to see the great demand for scientific and engineering personnel and feeling completely unprepared and inadequately trained in secondary schools for continuation of education in these fields."

Thus, while some of the finalists feel that science fairs contributed to their choice of career and others do not, there is almost complete agreement that they did receive stimulation which was invaluable to them.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this chapter is to summarize the findings and to present the conclusions drawn in this study.

The need for an increased supply of scientists and engineers is obvious. The present shortage, while serious, is mild compared with the prospect for the near future. Consequently, every means by which this supply may be supplemented must be explored. The science fair method is one such means.

To properly evaluate the effect of science fairs upon career choices, it would be adventageous to question a large number of participants at all levels; local, regional, and state. However, it was impossible in a study of this scope to investigate as fully as might be liked. Therefore, it was felt that a reasonable representation could be achieved by questioning National Science Fair finalists. As was mentioned previously, the response was tremendous. A questionnaire is seldom returned in such high percentage.

As was shown in Chapter III, Table III, twenty and seven tenths percent of the young men who are either in scientific positions or are in training, and twenty nine

percent of the young women stated that they had considered careers other than science. While the percentages are not especially significant with such a small sampling, it is the opinion of the writer that this indicates a definite value in science fairs. An increase of twenty percent in our scientific personnel would help make up the deficiency we are now feeling in this area.

Inasmuch as our society is becoming more scientific, we need to have a better basic understanding of science. The average citizen has too vague an idea of science due largely to a lack of interest in the subject. Our schools must attempt to stimulate more interest through better science teaching, more emphasis on science fairs, and other extra-curricular activities. Whether science teaching improves in the future will depend, to a large extent, upon the interest of the general public, which, in turn, must be stimulated through better teaching. Young people, whose early interests have been enhanced through science fairs, may well become the stimulating science teachers of the future. Thus science fairs may serve another important function.

It is, no doubt, obvious that the writer is firmly convinced as to the great value and the benefits to be derived through expanded science fair activity. From this

activity may develop a better informed public as well as an additional number of scientists, teachers, and engineers to help in the future scientific expansion of our nation.

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A P P E N D I X

Stillwater, Okla.
December 18, 1956

Mr. John J. Doe
1234 Fifth Street
Bigtown, New York

Dear Mr. Doe;

I am processing an evaluation of the science fair as a factor in the motivating of students into scientific careers. As a former N. S. F. Finalist, your help is needed. To aid you in answering certain questions, I have prepared a simple questionnaire which can be checked in a very few minutes. Will you please do so and return to me in the enclosed self-addressed envelope? I will be grateful for your assistance and will appreciate your returning this information as soon as possible.

Sincerely yours,

L. K. Requa

1. Year(s) you were N. S. F. Finalist _____
2. Division in which you exhibited: Physical__ Biological__
3. Are you engaged in scientific work? (Science Teaching included) Yes___ No___
4. If still in training, do you plan a scientific career? Yes___ No___
5. Had you considered a career in some field other than science before you became interested in projects for science fairs? Yes___ No___
6. Remarks. (Please add any items you feel are pertinent, using the back of the page if necessary)

VITA

Lyle Keith Requa

candidate for the degree of

Master of Science

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Biographical:

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Professional experience: Taught high school science in Glasgow, Missouri prior to service in the United States Navy from 1943 to 1946. Following military service, taught science in high school in Jal, New Mexico until 1956.