HOW SERIOUS IS OUR SCIENCE PROBLEM?

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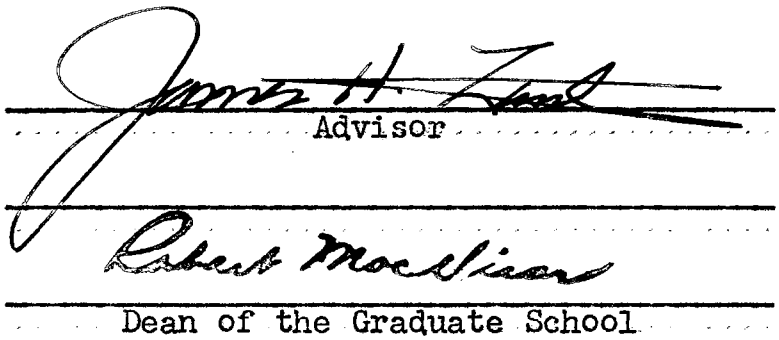

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CHAPTER I

INTRODUCTION

In the last few years, many articles have been written and there has been much talk about the shortage of trained science teachers, engineers, and scientists. This problem has been given much attention, not only by educators and industries, but also by governmental officials. There have been several remedies suggested for this situation, and some are now in operation. It will take time to see the effects of these actions.

This study is an attempt to determine, by reading and studying many sources, how serious this situation really is, and what effect it may have upon this country's future. Due to limited time, this study will be concerned only with the seriousness of the shortage of trained science teachers, engineers, and scientists and the effect of this shortage upon the industrial power of the United States. No attempt will be made to set up a curriculum of science studies, nor to suggest methods of attracting and training engineers and scientists, although these topics deserve much study and consideration in order to help formulate a solution to the science situation.

The science situation is a very important part of national defense. It is a known fact that the nation with the strongest industrial strength will be a nation of great military power. The supremacy of the industrial power of the United States is being challenged by a strong and opposing nation. In the last few years, Russia has surpassed the United States in training scientists and engineers. The design and construction of airplanes and guided missiles of today require the labor of many thousands of engineers and highly skilled craftsmen.[1]

Another reason for concern of the science problem is that the everyday jobs have become more technical. Television, wonder drugs, miracle fibers, and air conditioning are all products of new fields which did not exist until recent years and all require technical training.

The job of training these needed engineers and scientists falls upon the schools. As can well be seen, the first step would be to equip our schools with well trained science teachers. Under present conditions this is hardly possible. Industries are consuming well trained science students and are leaving the schools with many poorly trained science teachers. The Russian secondary schools are built around a science curriculum centered upon training scientists and engineers. This is definitely not true of the public schools

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[1]J. T. Rettaliata, "Scientific Manpower Shortage," School and Society, Vol. 82, July 23, 1955, pp. 17-20.

of the United States.

The material for this study was obtained from pamphlets, magazines, and newspaper articles. The first part of the study was devoted to a survey of statistics showing the contrast between the number of engineers and scientists that are trained by Russia and the number trained by the United States. The situation regarding the shortage of trained science teachers and reasons for this shortage are discussed. The last part of this study consists of a summary of the effect this situation may have upon the United States, according to the authorities the writer has studied.

CHAPTER II

THE SHORTAGE OF SCIENTIFIC AND TECHNICAL MANPOWER

It is an undeniable fact that the United States is falling behind Russia in training scientists, engineers, and technical manpower. In the last several years this fact has been overshadowing school officials, industries, and governmental representatives with, it appears, somewhat a paralysing effect. Each has been standing back waiting for the other to do something about it, while the situation continues to grow worse until it is reaching a rather frightening state. This matter is of such importance that it seems that we should increase our scientific manpower even at the risk of depriving some of the other professions of skilled personnel.

COMPARISON OF SCIENTIFIC PERSONNEL IN RUSSIA AND THE UNITED STATES

The Russian technical schools and universities are turning out scientists and engineers who are well-trained and highly competent. It is very important that the United States at least equal Russia in training scientific personnel, but the United States is not keeping pace with Russia at the present time. The reasons for this will be brought out a

little later in this study. It is estimated that the quality of the scientific personnel of Russia is equal to that of the United States.[1] This might sound rather frightening, but it is not the most important. The thing which is most important at the present is the fact that Russia is training so many more scientist and engineers than the United States. It is more a challenge of quantity than it is of quality. At the present time the United States is not too far behind Russia in total number of scientist and engineers. The difference between the rates at which scientist and engineers are being trained at the present is what makes a very serious contrast.

Let us see how large this difference really is by looking at some comparisons. The United States needs from 45,000 to 50,000 new trained engineers every year, but is getting only about one-half that many. In the United States about 23,000 engineers were graduated in June, 1955, but about 53,000 engineers were graduated in Russia at the same period.[2]

In 1956, Russia graduated about 120,000 new scientists and engineers of all types as against about 70,000 for the United States. Between 1950 and 1960, Russia is expected to produce about 1,200,000 trained engineers and scientists, against 900,000 for the United States.[3] For the second

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[1]Max F. Baer, "Russia Outstripping U.S.A. In Sciences," Personnel and Guidance Journal, Vol. 34, January, 1956, pp. 256-257.

[2]Ibid.

[3]Ibid.

consecutive year, a decrease is expected in undergraduate engineering enrollments. As reported by the Educational Statistics Branch, there was a decrease of six per cent in 1958 as compared to a four and one-half per cent drop in 1957.[4] These are very convincing facts which show us that we can no longer loaf along and still retain industrial supremacy. It is high time that something should be done about the training of more and better scientific personnel.

IMPORTANCE OF SCIENTIFIC PERSONNEL

It is not the past that we should be so deeply concerned with, but it is our concern for the future that should make us think and act. If we could realize that the military and industrial power of our nation are the things which in turn may determine whether we shall remain a nation, then it would be far easier for us to see the importance that these occupations play in our modern life. Proctor Thomson summed up the importance of our scientific and technical knowledge this way:

> The community's stock of human assets is its most precious resource, and the fund of ideas in possession of scientists, technicians, philosophers, and men of letters is the most valuable portion of this stock of capital. If all the tangible instruments of production were destroyed, we could rebuild, but if our fund of ideas were to disappear, civilization would utterly vanish.[5]

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[4]Office of Education Studies and Surveys, "Engineering Enrollments and Degrees," Higher Education, Vol. 16, No. 4, December, 1959, p. 13.

[5]Proctor Thomson, "The Economics of Scientific and Technical Manpower," The Science Teacher, Vol. 22, September, 1955, p. 177.

The scientists, engineers, and technically trained people are the backbone of industries. Without the ingenuity of these people, industry would be at a standstill. First, the industry would not have been thought of, if it had not been for the work of some scientist who discovered a process of making the product that the industry produces. Next, it is the job of the engineers to make practical machines, for carrying out the process of making this product. Last, but not least, it is the technicians who operate the machines and keep them in proper working order. It is through the inventiveness and creativeness of these people that new and better products are being made.

Today, a nation's military strength is not measured by manpower alone. The nation with the most powerful bomb, the fastest airplane, and the most accurate guided missile is feared more than a nation with a large standing army. A nation's military and economic power is measured largely by that nation's industries. In today's society, the scientists and engineers are the heart of a nation's military strength. Scientists and engineers play such important parts in military defense as; developing new fuels, making better metals, developing better and more powerful weapons, and trying to find ways of combating the effects of modern warfare. Some examples of these effects are fall-out of atomic and hydrogen bombs and biological warefare. If a nation cannot keep up in the latest atomic weapons, guided missiles, jet-planes, and space exploration, then that nation does not

have a strong military defense. These are developed by the combined efforts of well-trained scientists and engineers. In a report based upon interviews with officials of about 200 large companies, which employ well over half of the nation's industrial research scientists and engineers, at least half reported that they were unable to meet their needs, and one out of three reported major or substantial needs of such personnel.[6] Every aircraft company in the survey reported a shortage of research and development personnel.

A short time ago, the Department of Labor issued a list of over 80 critical jobs that were essential to the economic well-being and common defense of the country; jobs in which there is a shortage of workers and few qualified people in sight to fill them.[7]

REASON FOR SHORTAGE OF SCIENTIFIC PERSONNEL

Now, let us see why there is such a shortage of scientifically trained personnel. It seems that a field so challenging and exciting would have many applicants. What, then, are the reasons for the shortage of these

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[6] U. S. Department of Health, Education, and Welfare, "Scientific Manpower Shortage in Industry," Higher Education, Vol. 12, No. 3, November, 1955, p. 34.

[7] H. H. London, "Our Manpower Problem," American School Board Journal, Vol. 138, May, 1959, p. 27.

people? Look around you and think of the many products that you see which are the results of the efforts of scientists and engineers. Think of the products that require the work of many technically trained people. Think of the work that must have gone into developing, testing, and producing that product. Some examples of these products are; television, black and white or colored; wonder drugs that have lengthened the life of good health which we enjoy; miracle fibres that threaten to make obsolete nature's wool and cotton; air-conditioning; airplanes; radar; guided missiles; and space satellites. Each of these fields requires many thousand of engineers, scientists, and highly skilled craftsmen. All of these have largely been developed within recent years; therefore, there has been a great increase in the number of scientifically trained personnel which are needed to staff these new and rapidly growing industries.

Twenty years ago, only one scientific or technical worker was employed for every 100 people in the labor force; today there is one for every 32 workers.[8] By 1970, the number of engineers at work in this country may be nearly twice as great as the estimated 800,000 employed in 1957.

America is confronted with a manpower problem that is growing more serious each year. The problem arises out of three major factors; (1) change in the composition of our

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[8]Newell Brown, "The Manpower Outlook for the 1960's," Higher Education, Vol. XVI, No. 4, December, 1959, p. 4.

population, (2) technological changes going on in nearly every phase of our economy, and (3) the lack of any national man-power management program. In 1950, according to the census reports, 8.4 per cent of our labor force was professional and technical. The U. S. Department of Labor estimates that in 1960 over 37 per cent of the labor force will be professional and technical.[9]

Only about 16% or 66,000 of the high school graduates entering college plan to enter the fields of scientists and engineers. About one-half of those will either fail or change to easier courses.[10]

The course of study required for engineers and scientists is not easy for most students and requires considerable interest, effort, and ambition on the part of the student. These are some of the reasons for the shortage of scientific personnel, but the most important reason is that of emphasis in the secondary schools. Probably the reason that it is the most important is because it is something that we can correct with a certain amount of effort and time. The reasons for the lack of emphasis on the scientific fields in the secondary schools are discussed in the next chapter.

Scientific progress has been made at a very rapid rate and is almost sure to be even faster and more astonishing in the future. How long this fantastic progress will last,

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[9]H. H. London, "Our Manpower Problem," American School Board Journal, Vol. 138, May, 1959, p. 27.

[10]Max F. Baer, Personnel and Guidance Journal, pp. 256-257.

we do not know, but we do know that we cannot stop now. We as a nation must retain our leadership in the realm of scientific progress in order that we can remain a nation. As one writer summarized it: "There's no place to hide".[11] We cannot build a wall around our nation and expect to remain a leader in scientific progress for very long. We must trade with other nations in order to get some of our essential products needed in scientific works. If we are going to live in a jet-propelled, air-conditioned, space age, then we must train a sufficient supply of scientists and engineers in order that we may be among the leaders in the number of scientific and technically trained personnel. How these needed personnel may be trained brings about many perplexing problems and one of these, the need for emphasis upon scientific education in the secondary schools, discussed in the following chapter.

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[11] Sam Adams, "The Forward Look in Science Teaching," Clearing House, Vol. 30, No. 7, February, 1956, p. 391.

CHAPTER III

THE SHORTAGE OF TRAINED SCIENCE TEACHERS

The responsibilities of supplying the needed number of scientists and engineers falls back upon the schools and universities. The science teachers are being called upon from many quarters to give both public advice and private counsel without reference to the price system. The teachers are being called upon to increase the number of qualified persons entering the fields of pure and applied science. It has been discovered that there were few to call upon; therefore, the number of scientific personnel has not increased very much. Many school superintendents, wishing to increase the curriculum in science and mathematics have found that well-qualified science and mathematics teachers are very hard to find.

The total shortage of teachers in the fall of 1959 was estimated to be 135,000 with the most critical shortage in the mathematics and science.[1] This teacher shortage is not present in Russian schools. One of the main reasons for this is the pay received by a professor. In the Soviet

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[1]Ray C. Maul, "Changing Aspects of Teacher Supply and Demand", American School Board Journal, Vol. 138, May, 1959, p. 25.

Union, the average professor gets far more pay than the industrial managers and about eight times the pay of a laborer.[2] In America the average pay of all our professors is less than twice as much as a laborer. In Russia, a distinguished teacher and investigator will get as much as four or five thousand dollars a month plus a car and driver and a summer home in the country.

The teacher shortage problem will be very difficult to correct in the near future because of increased enrollment in high schools and colleges. The increase in enrollment as the secondary level from 1958 to 1965 is estimated at 47.0 per cent.[3] College enrollments are expected to increase by 40.9 per cent over their 1958 level by 1965.

We have dealt with the importance of trained scientists and engineers and have seen the part which they play in our world today. We have also noticed the acute shortage of scientific personnel. Now let us see from where these needed scientists and engineers will come. The largest obligation falls upon the secondary schools. It is here that a firm background in mathematics and the sciences should be obtained by those expecting to enter the scientific field. At the present time, it is in the secondary school where the sciences need more emphasis. This lack of emphasis is probably due

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[2]Deane W. White, "Higher Education--A Challenge from the Soviet Union," The Educational Record, Vol. 40, April, 1959, p. 96.

[3]National Education Association, Research Division, "Growth in School Enrollments," Vol. 36, December, 1958, p. 125.

to the limited number of qualified teachers and to the large number of teachers in science who are not qualified.

COMPARISON OF SCIENCES OFFERED IN THE HIGH SCHOOLS OF THE U. S. AND RUSSIA

This is what Aleksei I. Markushevich, chairman of the team of Soviet educators touring American schools, had to say about American and Soviet science and mathematics curriculum.[4] In the United States, chemistry is usually taught in the eleventh grade, for one year; but in the Soviet Union it begins in the seventh grade and continues for four years. In the United States, physics is taught only in the eleventh or twelfth grade; but in the Soviet Union it begins in the sixth grade and continues for five years. As for mathematics, all secondary school graduates complete a full course, including plane and solid geometry, more algebra than the Algebra I and II given here, and trigonometry.

It should be mentioned that in the Soviet Union, secondary education begins with the fifth grade and ends with the tenth, but Soviet children go to school six days a week.

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[4] Through Soviet Eyes, School Life, Vol. 41, No. 4, January-February, 1959, pp. 9-10.

REASONS FOR A LIMITED CURRICULUM OF SCIENCES

What are the reasons for the limited number taking science and mathematics courses in the United States? One reason is that many high school students tend to take the road of least resistance. They steer away from higher mathematics and the more advanced sciences. This is often due to lack of guidance or to teachers who are not well qualified to teach these subjects and are not interested in the subjects themselves. A teacher of this type can do more harm than good by killing the interest of the students. As one author put it, "If our teachers themselves do not know science and mathematics very well, they are not going to be flaming evangelists".[5] A teacher must be sold on the subject that he or she is teaching in order to be an effective teacher.

The shortage of trained science teachers is another reason for the limited courses being offered in these fields. Because of this shortage, many teachers teaching mathematics are teaching out of their field. One large city in the fall of 1957 reported that twenty-five per cent of its mathematics teachers were teaching out of their field.[6]

We can now see how the situation stands. The industries, needing scientific personnel, depend upon the schools to

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[5]Myrl H. Ahrendt, "Mathematics," NEA Journal, Vol. 47, No. 2, Feb. 1958, p. 87.

[6]Ibid.

supply them. The schools, needing teachers in order to supply the necessary training, depend upon the colleges and universities for their teachers. The teachers are taking better paying jobs in industries. The industries are cutting their own throats by hiring a large amount of science and mathematics teachers. This will reduce the number of students being trained in mathematics and science. All in all, it is a rather complex cycle and to find out where to start correcting it is not easy. One of the first steps seems to be that of supplying enough well-trained teachers. This plan is in operation now, but it will take time to see its effect upon the scientific personnel shortage.

One suggestion, which came from Brigadier General David Sarnoff, board chairman of the Radio Corporation of America, suggested that industries should release to schools qualified teachers in their ranks to supply the present emergency shortage of science teachers, particularly in high-schools, and give them at least a year's pay.[7] General Sarnoff also suggested using retired scientists and engineers in the military reserve for teachers of mathematics and science. It is generally agreed that there will not be enough science teachers trained until the salary is raised enough to compete with industries. The method of doing this is one which may cause considerable conflict. If the science teacher's salaries are increased, then the other teachers will not be receiving

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[7] David Sarnoff, "Industry Should Supply Science Teachers," Science News Letter, Vol. 69, No. 9, March 3, 1956, p. 69.

equal pay for equal work. This situation will be solved only through many sacrifices made by many people. It is clear that the high-school is the place that great emphasis should be placed upon the scientific courses and where a good background should be obtained in the sciences. Therefore, it is necessary that the high-schools be staffed with competent teachers in these fields. From where these teachers will come and how they will be encouraged to teach remain to be seen.

TEXTBOOKS, ONE WAY TO INCREASE SCIENTIFIC MANPOWER

The Science Manpower Project was conceived in recognition of the fact that in the early fifties the flow of prospective scientific personnel through the schools and colleges had not been adequate to meet the needs of industry, government, the defense program, education, and other elements in the national economy.

In planning the operation of the Science Manpower Project it was proposed to attack the general problem along two lines; (a) to effect improvement in the science program of the schools, and thus increase the flow of students with science aptitudes from secondary schools to colleges, and (b) to effect improvement in the teacher-training program designed to produce a larger and more effective corps of science teachers.

One of the efforts of the Science Manpower Project has been to develop an articulated sequence of science books

with modernized content for elementary grade through high school. Status of the course-of-study program as reported by Science Education[8] on May 1, 1959, was as follows: Modern High School Physics (David Vitrogan), published and distributed. Modern High School Chemistry (Edward F. Pierce), undergoing final review. Modern High School Biology (Dorothy F. Stone), undergoing final review. Modern General Science (Abraham Fischler), ready for final review in the near future. Modern Elementary Science (Willard J. Jacobson, Harold Tannenbaum, and others), in preparation.

As they become available, monographs which present these courses of study may be obtained by purchase from the Bureau of Publications, Teachers College, Columbia University, New York 27, New York.

SOME EXISTING PROGRAMS FOR IMPROVEMENT OF SCIENCE EDUCATION

The following are some of the programs now in effect in improving science education. This particular list was taken from School Science and Mathematics.[9]

The Fellowship Programs. There are now seven different fellowship programs. They are, the Predoctoral, Postdoctoral, Senior Postdoctoral, Science Faculty Fellowship, Summer

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[8]Frederick L. Fitzpatrick, "The Science Manpower Project," Science Education, Vol. 43, No. 2, March 1959, pp. 121-125.

[9]Walter J. Preston, "New National Programs in Science Education," School Science and Mathematics, Vol. LIX, No. 4, April, 1959, pp. 257-265.

fellowships for secondary school science and mathematics teachers, Summer study program for graduate teaching assistants, and Cooperative Graduate fellowship.

The Institute Programs. The primary purpose of these programs is to improve subject matter knowledge of teachers of science. The institutes are held on college and university campuses in all parts of the country and offer courses in science and mathematics especially prepared to meet the needs of high school and college teachers.

Summer Institutes for High School Teachers of Science and Mathematics. In 1959, there were about 320 of these institutes for high school teachers.

Academic Year Institutes. Since the beginning of the academic year in 1956-57, the National Science Foundation has administered a program of specially designed year-long courses of study at selected universities for high school science and mathematics teachers. Thirty-two institutes were conducted in 1959-60.

In-Service Institutes for High School Teachers. These institutes are especially designed to meet needs of high school science and mathematics teachers for supplemental instructions in the subject matter of science through courses offered on Saturdays or during after-school hours. Eighty-five of these institutes were supported in 1958-59 with a considerable expansion expected in 1959-60.

Summer Institutes for Elementary School Teachers and Supervisors. About ten of these institutes were supported

in the summer of 1959 on an experimental basis.

Summer Conferences for College Teachers. About twenty of these conferences were supported in 1959 for a period of two weeks. These are for college teachers of science and mathematics.

Special Projects in Science Education. This is support for research studies of new ideas for the improvement of science instruction and more effective methods of increasing understanding of science by young people.

Visiting Scientists (Secondary Schools). Outstanding scientists and engineers are enabled to visit secondary schools to make personal contacts with students and teachers. These visits stimulate an interest in science on the part of the students, and at the same time offer support, prestige, and professional advice to the teacher.

Traveling Science Library Program. Carefully selected books on science and mathematics are make available to high schools. A total of 1,350 schools used this library program in 1958-59.

Traveling Science Demonstration Lecture Program. This program provides for special science lecture-demonstrations in physics, chemistry, biology, and mathematics. About 140 traveling teachers were trained for the 1959-60 school year.

Science Clubs and Student Science Projects. This program supports extracurricular science projects under the guidance of national youth organizations.

Summer Training Program for Secondary School Students. This program includes short summer institutes conducted by universities and colleges to supplement the regular secondary school science programs.

State Academies of Science. State academies of science and similiar non-profit scientific societies will be supported by the Foundation in carrying out specific projects to improve the status of science and science education.

Career Information. This program will support the development and dissemination of facts about careers in science and engineering to high school students, guidance counselors, and science teachers.

College Programs and Teacher Improvement Programs. These programs are designed to further the scientific education of superior college students of the sciences, mathematics, and engineering, and to improve the scientific background of science teachers.

Visiting Scientists (Colleges). This is a program which enables distinguished scientists and engineers to visit small colleges and universities for a period of several days to give lectures and to conduct classes and seminars. This program is administered through grants to the appropriate professional scientific societies in mathematics, chemistry, physics, biology, and astronomy.

Undergraduate Science Training Programs. These programs are designed to provide promising undergraduates in mathematics, science, and engineering with enriched opportunities

for accelerated scientific study, through (1) laboratory training programs, and (2) undergraduate science institutes.

Research Participation Program for Teacher Training. Through participation in laboratory research programs of colleges and universities during the summer, secondary school science teachers and science teachers in small colleges will have an opportunity in this program to increase their professional background and thus to improve their classroom teaching.

Supplementary Training Programs for Science Teachers. This program offers a wide variety of opportunities for the improvement of the subject matter qualification of high school and college teachers. These include: (1) short conferences and symposia in specialized aspects of science and new developments in scientific knowledge; (2) work conferences to study improvements in science curricula, in teaching procedures, and in the dissemination of scientific knowledge; and (3) group study programs designed to provide instruction in the sciences for teachers unable to participate in institutes or conferences because of factors such as geographical isolation.

International Science Education Programs. Conferences, curricular studies, and teacher training programs will be undertaken in cooperation with other interested nations. Support will also be given to American scientists and educators participating in exchange missions primarily concerned with the comparative study of science education systems.

Course Content Improvement Studies. Progress in the sciences has been so rapid in recent years that courses in science and mathematics now offered in most secondary schools no longer reflect either the current state of knowledge or the attitudes of mind which characterize modern scientific study. The seriousness of the situation has led a number of eminent scientists to make a thorough and critical re-examination of science programs in the public schools. The National Science Foundation has provided support for major studies of science curricula in the secondary schools in which the knowledge, judgement and experience of distinguished scientists and competent teachers have been welded together to produce new and imaginative approaches to science instruction.

Supplementary Teaching Aids. It is the purpose of this program to assist in the development of instructional equipment and other devices that will help teachers to maintain the highest possible levels of quality in their science courses.

CHAPTER IV

SUMMARY

As science and technology increase in importance in our everyday life, it is certain that the number of scientists and technologists must also increase. It is a fact that there is a great shortage of trained scientists and science teachers in the United States. Industries wanting to expand cannot do so until more scientists and technically trained people are available.

It is a known fact that our world is becoming more scientific; therefore, our education should also become more scientific. The obligation is very heavy upon the schools and colleges to adequately prepare students in mathematics and the sciences. The training given to prospective scientists is of greatest importance. This is the responsibility of our school system. It is necessary that a student have not only a good background in English, social studies, and humanities, but he must also have a sound mathematical preparation and a basic understanding of the sciences in order that he will be prepared to begin study as a scientist or engineer.

Never has the opportunity been greater for students entering the scientific field. There are great opportunities

awaiting in almost every scientific field for those students that are capable and willing to work. We are not turning out the number of scientists and engineers we need. The amount of scientific ability devoted to the teaching of more scientists and engineers is getting rather critical. The field of science teaching is one that offers opportunities and is almost sure to be more attractive in the future. If special inducements are not offered to qualified science teachers, then the supply cannot be expected to meet the demand.

The shortage of trained teachers is of greatest importance. The teachers of the sciences help to defend our country and create new products for better living. A teacher is of utmost importance in interesting and training the students in science. A teacher who is not trained in the sciences and is not interested in these subjects, but must teach them due to the shortage of teachers, can kill the interest of the students and do more harm than good.

One writer described today's science situation as a three way challenge. "It is a challenge to the entire nation to realize that its future progress, safety, and perhaps even its existence depends upon its ability to train more men and women in science. There is a challenge to science teachers to make every effort to attract the ablest and best students to careers in science. Last, there is a challenge to the youth to take a career in the scientific field".[1]

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[1]Arthur Roe, "Today's Challenge in Science,", High School Journal, February, 1956, Vol. 39, No. 5, pp. 258-60.

RECOMMENDATIONS

The writer recommends that further study be made of the possible ways of attracting and training more and better science teachers. Also, an evaluation should be made of the training programs now being practiced. The writer also recommends that each science teacher rededicate himself or herself to his or her profession. The writer recommends that each teacher devote his full effort to developing talent and creating interest in science in order that he may do his share in overcoming the shortage in scientific personnel.

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