INDUSTRY--EDUCATION RELATIONS

By

THOMAS EARL YAGER

Bachelor of Arts

Iowa State Teachers College

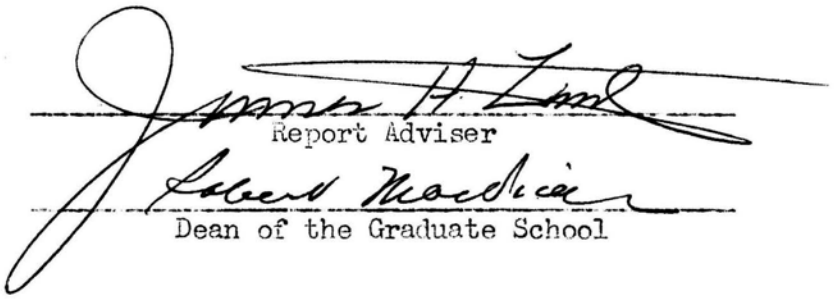
Cedar Falls, Iowa

1954

Submitted to the faculty of the Graduate School of
the Oklahoma Agricultural and Mechanical College
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
May, 1957

INDUSTRY--EDUCATION RELATIONS

Report Approved:



Report Adviser

Dean of the Graduate School

ACKNOWLEDGMENTS

The writer wishes to acknowledge indebtedness to the following individuals, industries, and societies for their valuable contribution of materials, information, and ideas: Dr. James H. Zant, Oklahoma A. and M. College; Dr. H. J. Ettlinger, University of Texas; Dr. Bruce E. Meserve, State Teachers College, Montclair, New Jersey; Mr. Paul Shackleton, National Committee for the Development of Scientists and Engineers; Dr. G. B. Hatch, Mid-Hudson Science Advisory Council, Fishkill, New York; American Chemical Society, Washington, D. C.; Manufacturing Chemists' Association, Washington, D. C.; National Council of Teachers of Mathematics, Washington, D. C.; National Science Teachers Association, Washington, D. C.; American Cyanamid Company, New York, New York; American Viscose Corporation, Philadelphia, Pennsylvania; Bell Telephone Laboratories, New York, New York; Burroughs Corporation, Detroit, Michigan; Caterpillar Tractor Company, Peoria, Illinois; E. I. Du Pont De Nemours and Company, Wilmington, Delaware; Ford Motor Company, Detroit, Michigan; General Electric Company, Schenectady, New York; General Foods Corporation, Hoboken, New Jersey; General Motors Corporation, Detroit, Michigan; Goodyear Tire and Rubber Company, Akron, Ohio; Eastman, Kodak Company, Rochester, New York; International Business Machines Corporation, New York, New York; Koppers Company, Pittsburgh, Pennsylvania; Lockheed Aircraft Corporation, Burbank, California; Monsanto Chemical Company, St. Louis, Missouri; National Broadcasting Company, New York, New York; New York Central System, New York, Ne

York; New York Life Insurance Company, New York, New York; Phillips Petroleum Company, Bartlesville, Oklahoma; Procter and Gamble Company, Cincinnati, Ohio; Radio Corporation of America, Camden, New Jersey; Shell Development Company, Emeryville, California; Sherwin-Williams Company, Cleveland, Ohio; The Texas Company, New York, New York; United States Steel Corporation, Pittsburgh, Pennsylvania; United States Rubber Company, New York, New York; Westinghouse Electric Corporation, East Pittsburgh, Pennsylvania; Antioch College, Yellow Springs, Ohio; Illinois Institute of Technology, Chicago, Illinois; New York University, New York, New York; Southern Methodist University, Dallas, Texas; Stetson University, Deland, Florida; Taft Junior College, Taft, California; University of California, Berkeley, California.

Without the splendid cooperation of the preceding individuals and groups this report could not have been written.

CHAPTER I

INTRODUCTION

The literature of today, popular as well as scientific and professional, bewails the manpower shortage in the United States. This is a shortage of highly trained scientists to run our highly mechanized world; a shortage of people trained in engineering and the sciences to take positions that ten years ago demanded no scientific training; a shortage of trained technicians to perform the "simple operations" of modern industry. And behind all this shortage is the shortage of qualified teachers of science and mathematics, who are needed to prepare future scientists, engineers, teachers, and other professional people.

It is almost impossible to read a newspaper or current events magazine without seeing some statistic pertaining to the increased need for people with at least some training or background in mathematics and science, and the consequences that will be suffered if we fail to recognize that need. And just how are the schools meeting this growing demand for the mathematically and scientifically trained? In the first place, the number of qualified teachers of science and mathematics in the United States has dropped 53% in the past five years, and during the same period the school enrollment has increased 16%. Also, the number of teachers being trained is not increasing, and not more than half of those prepared for teaching go into the profession. In too many instances this lack of "quantity" is also accompanied by a lack of "quality" of

of teaching.[1]

At the present, the apparent heart of our educational problem is financial in nature. Although money is definitely not the total cure for the problem, it is probably the most important factor. Funds are needed to increase teacher salaries, to build more school buildings, for more and better teaching aids and facilities. Money, time and effort must be spent to interest teachers, students, and the public in general in the aspects of the technical manpower problem and its solution.

How can we accomplish this? Perhaps at least part of the answer lies in "industry-education" relations. With this thought in mind, this report attempts to present general information regarding present activities in the field of "industry-education" relations, including a number of evaluations and suggestions for improvement.

The scope of industrial-educational relations is of such a nature that it is impossible to completely cover the subject in this study. This report, then, is an attempt to survey the field, singling out general trends and specific programs that appear to be of interest or value. A number of the topics covered, could in themselves be the basis for a complete report, but the main purpose of this study is to obtain a general view of industrial-educational relations rather than develop one particular facet of the field. Perhaps several significant points have been overlooked or neglected, and if so, an apology is offered in advance.

Undoubtedly, the main value of this report is to the author. Besides satisfying a personal interest and increasing his knowledge of a very important field, his work on the report has supplied a wealth of

---

[1]R. W. Wolfe, "The Technical Manpower Shortage," School Science and Mathematics, 57 (January, 1957), 64.

material that should prove quite valuable for teaching and guidance.

Since the problems with which "industry-education" relations are concerned is of great importance, this report should have some value to others, at least as a reference and bibliography. A number of the topics should also prove to be of general interest.

The preparation of this report in its present form would have been impossible without the cooperation of the individuals and industries acknowledged on page iii and iv. Forty-eight companies, ten colleges and universities, and five independent societies were contacted regarding various phases of industrial cooperation with education. In Appendix A are copies of the letter, report outline and outline supplement that were sent to the various industries. The outline and its supplement gives a preview of some of the topics included in the report and the light in which they are discussed. The report has been somewhat reorganized since the original printing of the outline however.

The author regrets that it was impossible to contact all the companies that support cooperative education programs. However, it is felt that a good cross section has been obtained.

Finally, the question might be asked "Why should there be any concern at all about cooperation between industry and education?" This question can perhaps best be answered by quoting Harvey R. Russell, Coordinator of Education Cooperation for the American Cyanamide Company.

> Industry and education are mutually interdependent. The schools rely on the community not only for support in terms of tax money, but also for support of curriculum, discipline, etc. Schools have become painfully aware of this dependence in recent years. Industry relies on the schools to provide basic knowledge, skills, and attitudes for future manpower, customers and stockholders. To its chargrin, industry has found recently that problems of education vitally affect its interests, particularly in the manpower area, and is making efforts to help. Every alert industrialist and educator is aware that the

> large growth of population in the country will require the best efforts of both industry and education to provide the needed goods, services, and training for the kind of life we all desire.[2]

This report is mainly concerned with the fields of mathematics and science. However, many of the statements, programs, and suggestions are applicable to education in general.

---

[2]Harvey R. Russell, "Chemists and Educators-A Partnership," Journal of Chemical Education, 33(November, 1956), 592.

CHAPTER II

INDUSTRY AND EDUCATIONAL AIDS

It is perhaps appropriate that this topic should be discussed first, for the role industry plays in supplying various teaching aids and materials is generally well known. In this section the topic of educational aids shall be expanded to cover the following points: (1) printed materials, visual aids, and the like, (2) industrial "information services," (3) use of speakers, (4) joint committee seminars of educators and scientists.

Printed materials, visual aids, etc. A wealth of this type of material is available from many industries. It has taken the form of booklets, charts, maps, photographs, films, filmstrips, kits, and models. A good part of the materials supplied can be of great advantage and quite valuable if used with discretion. However, it is usually a waste of time to use or distribute teaching aids or booklets without a definite well-planned purpose. Also, business sponsored teaching aids should supplement but not replace other educational experience.

Industry sponsored teaching materials can also have disadvantages when misguided efforts put excessive stress on company publicity or advertising or when material is unsuitable for the age level at which it is directed.

Every teacher should have some criterion for selection of teaching aids. The New York City Board of Superintendents adopted on May 20, 1952,

a list of "Guiding Principles for School Selection and Use of 'Non-Listed' Instructional Materials." Following is a summary of seven of the points contained therein. The industry-sponsored aid should:

(1) Make a significant contribution toward the attainment of educational objectives.

(2) Treat the subject competently and accurately.

(3) Be timely and suitable for the interest level and experience background of the pupils and at the same time be suited to the level of the pupils in language, diction and literacy qualifications.

(4) Possess a mechanical make-up and technical quality appropriate to the use intended.

(5) Harmonize with American democratic ideals and moral values.

(6) Keep the advertising content at a minimum.

(7) Be sponsored by an industry as a whole rather than an individual company intent upon the sale of its products.[1]

Another problem is securing the available aids that are desired. To compile a list of all the companies that distribute valuable teaching aids would be practically impossible. A few general suggestions will be attempted however.

One exceptional source of material is the National Science Teachers Association, 1201 Sixteenth St., N. W., Washington 6, D. C. The Business-Industry Section of the Association provides a clearinghouse for educational relations directors of 150 top companies to thrash out the problem of what sort of teaching aids are needed and wanted. The companies then

---

[1]Samuel Schenberg, "Criteria for Sponsored Teaching Aids in Science," The Science Teacher, 23 (October, 1956), 277.

turn out the materials which are distributed to N. S. T. A. members.

The official journal of the National Council of Teachers of Mathematics, The Mathematic Teacher, contains a monthly list of teaching aids in mathematics.

The American Chemical Society, 1155 Sixteenth St. N. W., Washington 6, D. C. and the Manufacturing Chemists Association, 1625 Eye Street, N. W., Washington, D. C. are valuable reference sources for educational aids in science.

The Ford Motor Co., Dearborn, Michigan; General Motors Corp., Detroit Michigan; Monsanto Chemical Co., St. Louis, Missouri; Westinghouse Electric Co., East Pittsburgh, Pennsylvania; General Electric Company, Schenectady, New York; and the American Petroleum Institute, New York, New York are just a few of the many good sources of useful teaching materials.

Industrial information service. This is a method by which scientists, engineers, mathematicians, businessmen, and others with particular knowledge or special skills can become sources of information for teachers and students. One example of such a method was the information personnel file established by the Western Connecticut Section of the American Chemical Society. A card file was set up containing the name, address, and field of specialty of volunteers from industry who were willing to be called by telephone for information concerning their field. As inquiries came from the schools, the name of a resource person in the field desired was taken from the file, and the questions were presented or relayed to the specialist by the program coordinator. Thus students and teachers were able to obtain current information which was difficult to obtain elsewhere.

---

[2]Harvey R. Russell, "Chemical Education Is Our Business Too!" Chemical and Engineering News, 31 (August 17, 1953), 3358.

Use of Speakers. Most industries are willing to provide speakers on popular scientific or mathematical subjects. Such a program is, of course, handled best on a local level. It is also desirable to include demonstrations in scientific talks. Using outside speakers can be a very effective teaching device if competent people are secured.

Some recent programs of "scientist-teacher swaps" can also be listed under the topic of "outside speakers."

Such a project took place in the Washington, D. C. area in March, 1956. Over 700 scientists, engineers, and other technical persons replaced over 350 science teachers to permit them to attend sessions of the National Science Teachers Association meeting in Washington. A post-project survey by supervisors, teachers, and scientists demonstrated the value of the effort.[3]

A somewhat similar project was held in the Pittsburgh area September 19, 1956. In a one-day program, 175 scientists from the industrial research laboratories of United States Steel Corporation, Aluminum Company of America, Gulf Oil Corporation, and Westinghouse Electric Corporation became science teachers in the schools of Pittsburgh and Allegheny County. Meanwhile the regular instructors visited the nearby Westinghouse research laboratories. The men from the "labs" planned their own class routines. Scientists, teachers, and students alike reported a very profitable day.[4]

Joint Committee Seminars of Education and Scientists. It is perhaps difficult to think of this point as a teaching aid, but perhaps an

---

[3]John K. Taylor, "The Washington Area Scientists-For-Teachers Program, Journal of Chemical Education, 33 (September, 1956), 461.

[4]"Scientists and Teachers Swap Jobs," United States Steel News, (January, 1957), 12.

example will be able to show the relationship.

In the Pearl River New York area there exists a committee of scientists from the Lederle Laboratories of American Cyanamid Company and of science faculty members from the Pearl River High School. The committee meets regularly to discuss problems in science teaching. The scientists are requested to keep their eyes open for various "gadgets" used in their work that involve simple science principles which might be of interest to the teachers and their students. The teachers are required to keep their eyes open to problems and questions which could perhaps be more completely answered by the scientists.[5] Committees and seminars of this nature can be a great aid to teaching quality.

---

[5]Harvey R. Russell, "Methods of Cooperation Between Industry and Education in Science Teaching," Science Education, 40 (April, 1956), 220.

CHAPTER III

INDUSTRY AND GUIDANCE

Every teacher, in fact, every person who associates with young people in any way, is a guidance counselor. However, it is not an easy task to do an adequate job in the field of guidance. Industry has obliged by making available many materials and individuals to assist in this task. Most teachers are familiar with the printed materials, visual aids, and demonstration materials made available by industry for guidance purposes. Most of the techniques and methods discussed in the previous section and those that will be discussed in Chapter IV can be actually considered guidance techniques. The problem of how to obtain and select the proper and most valuable aids and methods still exists however. All the qualifications and criteria listed for general educational aids can be applied to guidance materials.

In any type of guidance program, but particularly in one relating to science and mathematics, printed materials or visual aids alone are inadequate. It is insufficient to merely distribute booklets on careers. One step in the right direction is to conduct classroom discussions regarding career possibilities. Industry has done its part in furnishing guidance speakers.

Many industries and schools throughout the United States now cooperate in "career day" projects. The typical career day plan is to give the students of a certain school or certain area a chance to learn of

various professions and career opportunities from people who are actually in those fields. The key to a successful career day is efficient planning, cooperation, and competent speakers.

In all the methods discussed above the most important technique of vocational guidance has not been mentioned. This is the technique of personal consultation. Many industries have recognized this as one of the most effective and efficient educational procedures. It is undoubtedly the most time consuming, but is usually the most gratifying.

CHAPTER IV

INDUSTRY AND THE TEACHER

The various educational and guidance aids discussed in the preceding sections are, of course, a means by which industry assists teachers. In this section, however, we shall concern ourselves with some of the more direct methods of assistance (with particular reference for the fields of mathematics and science.)

It is perhaps trite to state that the shortage of teachers in the United States is a very important problem. Trite or not, the problem does exist. Industry has been helping solve the problem in three general ways: summer employment for teachers, advanced training programs for teachers, recognition awards for teachers. Each method merits at least brief discussion.

It is no secret that an improvement in teachers salaries will go a long way in increasing the supply of competent teachers. A number of industries have taken positive steps to improve the economic status of mathematics and science teachers. One of the most common means is to assist teachers in obtaining summer employment. Besides supplementing the income of the teacher, summer employment should give him a better understanding of industry's philosophy, methods, and needs, and increase his technical knowledge, thereby making him a more effective teacher. More specifically, summer employment, when handled properly, can give teachers "extra confidence" through associations with full-time scientists. The

actual experience of a job related to science and mathematics can have a great effect in upgrading the teachers training. And finally, summer jobs can do wonders for the counseling and guidance abilities of science teachers.

A study conducted by the American Chemical Society seems to indicate that teachers are of value to industry. Not only do teachers "pay their way" and perform valuable services through summer jobs, but they help repay industry through better teaching and counseling, improved community relations, and increased student interest in the sciences.[1]

Perhaps a few "summer job" programs should be noted. In the summer of 1956, the New York City Board of Education experimented with a program of placing thirty-three science teachers in technical jobs in private and government industry. It is reported that the program was very successful and is being continued.[2]

The Goodyear Tire and Rubber Company offered a total of sixteen work-experience awards and scholarships for the summer of 1956 to mathematics and science teachers of Summit County, Ohio.

The teachers selected for the work-experience awards were assigned to various departments of science, engineering and research for the company for the purpose of getting on-the-job experience in the sciences. The teachers were paid an amount equal to their weekly teaching salary for each of the ten weeks of the program. An evaluation of the program rated it as highly successful.

---

[1]John H. Woodburn, "Summer Jobs for Teachers," Chemical and Engineering News, 33 (February 14, 1955), 620-622.

[2]"Company Lab Gives Teenagers a Taste of Science," Business Week, (September 8, 1957), 128.

The teachers selected for the scholarship awards were permitted to attend any fully accredited college or university in the United States east of the Mississippi River. The courses selected had to be from the area of mathematics or science, and the participant had to carry a full schedule of summer college work. The teachers were paid for all tuition and lab fees, transportation to and from the college selected, plus an amount equal to the teacher's weekly salary multiplied by the number of weeks in attendance at summer school.

The Shell Development Company offers summer employment to a limited number of high school and junior college science teachers, giving them an opportunity to observe and participate in industrial research activity.

The American Cyanamid Company has employed three mathematics and five chemistry teachers on various projects related to the teachers' subject matter fields. The projects were so arranged that it was possible for each teacher to complete his assignment within the limited time without holding up other research.

The United States Steel Company provides summer employment for high school teachers and college and university faculty members, and conducts a summer program for engineering professors whereby they work on practical problems in the engineering field in industry.

Each summer, 20 to 30 college professors are invited to gain practical industrial experience in Westinghouse plants and headquarters departments. Selections are made by the deans from among the most promising young teachers on their staff. One of the main goals of the program is to strengthen college teaching.

In 1954-55 the Future Scientists of America Foundation of the National Science Teachers Association distributed 10,000 copies of "Let's Help Amer

Science Teachers Find Science-Related Jobs", a flier encouraging both teachers and employers to take the initiative in summer employment programs.

The National Association of Manufacturers and the Detroit Schoolmen's Club are representative examples of national and local groups that are helping push summer jobs for teachers. The American Chemical Society, through its local sections, has vigorously supported job programs. The results in some of the sections have been phenomenal.

At the present time, the Future Scientists of America Foundation of the National Science Teachers Association is conducting a study "concerning the summer employment of science teachers by industry." The study is headed by Mr. Edwin Cooper; Madison High School, Madison, New Jersey. It should be completed by May 1957 and will be widely publicized.

Although summer work programs for teachers are very valuable to the teacher from the standpoint of finances, training and experience, it should be mentioned that this is not a real cure to the economic problems of the teacher. A higher salary level is the only permanent answer.

Advanced Training Programs for Teachers. A number of industries provide fellowships and stipends for science and mathematics teachers permitting them to take part in summer study programs that include new teaching techniques as well as industry's adaptation of advances in science. Following are some examples of the institutes offered for 1957.

The Shell Merit Fellowship Plan will consist of specially designed programs for chemistry, mathematics and physics teachers at Cornell University and Stanford University. About 45 $500 fellowships plus tuition, book fees, board and lodging and travel allowances are provided at each school.

General Electric Company is sponsoring fellowships that include tuition, fee, board, room and transportation at the Case Institute of Technology, Syracuse University, and Union College.

The du Pont Company is providing various stipends and fellowships at Teachers College, Columbia University, Ohio State University, Harvard University, and Case Institute of Technology.[3]

The Westinghouse Educational Foundation supports two summer programs for high school teachers, one at the Massachusetts Institute of Technology and the other at Carnegie Institute of Technology.

It perhaps should be mentioned that a number of private foundations support teacher institute programs. Also during 1957, the National Science Foundation (a U. S. government supported agency) will support nearly 100 teacher programs for college as well as high school science and mathematics teachers.

In-service training programs for high school science teachers are another means of assisting education. In New York state, high school science teachers of the Niagara Frontier (including 30 different high schools) have been invited to participate in a series of refresher lectures, demonstrations, and discussions sponsored by local industry. The program consists of fifteen evening sessions per semester and is limited to 30 teachers each semester. Each teacher receives two units of credit from the New York State Education Department. The program has been received with enthusiasm and has proven to be quite valuable.[4]

---

[3] "Summer Institutes, Conferences and Fellowship Programs for Science Teachers," The Science Teacher, 24 (February, 1957), 20-21.

[4] R. J. Gladieux, "Industry Sponsored In Service Training Program for Teachers," Journal of Chemical Education, 33 (September, 1956), 460.

Recognition awards for teachers. Such awards can have particular value in that they can serve to improve the prestige of the teacher. Recognition of the important job teachers perform, and of good teaching has been seriously neglected. Besides not commanding the salary they deserve, in too many instances teachers do not command the respect they deserve. Perhaps if the respect and recognition increases, the salaries will also.

The Manufacturing Chemists Association is sponsoring a very interesting award program. In June of 1957 six awards of $1,000 each, accompanied by a medal and citation, will be made to college chemistry teachers. The purposes of this program are: "To honor all the men and women engaged in college science teaching; to call public attention to the importance of good science teaching; and to inspire the best qualified students to choose careers in science teaching."

Local sections of the American Chemical Society also sponsor various teacher award programs. Also, just recently the American Academy of Arts and Sciences, Boston, Massachusetts honored eight teachers from three New England states with awards for "outstanding teaching in science and mathematics in the secondary schools."[5]

In conclusion, perhaps a few general programs and studies relating to industry-teacher relationships should be discussed.

The National Council of Teachers of Mathematics has formed a "Committee on Coordination of Mathematics with Business and Industry. One problem being considered by this committee is "What can American men of business and industry do to help in carrying on an effective program in mathematics?" Some of the answers to this problem will, by necessity,

---

[5]National Science Teachers Association News Bulletin, Number 15, January 1957.

pertain to industry-teacher relationships.

The Manufacturing Chemists Association has launched a five year education program having as one of its objectives "to aid and encourage the education, recruiting and in-service training of science teachers and education administrators, seeking thereby not only to increase their numbers and effectiveness but also their prestige."

In 1955 the Carnegie Corporation granted funds for a Science Teaching Improvement Program to the American Association for the Advancement of Science. Among other projects, work is being done regarding the improvement of salaries and working conditions for teachers, and funds are being sought for a program of awards to "Master Teachers".[6]

A committee has been established by the National Science Teachers Association to develop plans for "On-The-Job-Research Grants for Science Teachers". The committee hopes to work out a plan that might make money available for this purpose. Research grants on a secondary level could, in the long run, be a great aid in interesting and keeping competent people in science teaching.

---

[6]I. E. Wallen, "The Science Teaching Improvement Program of the A. A. A. S.," The Science Teacher, 23 (December, 1956), 399-400.

CHAPTER V

INDUSTRY AND THE STUDENT

In this section we shall explore the problem of interesting students of ability in mathematics and science or the related technical and professional fields. Creating interest is not in itself sufficient, however. The student must be encouraged to pursue his or her interest, and must be given the opportunity to do so.

A few of the various methods by which industry and education are cooperating to meet the above problems are presented in the following paragraphs.

Secondary School—Industry Cooperation

Leaders of industry and education have come to realize that science interest programs must be initiated in the public schools if the technical manpower shortage is to be met.

What has been done to "perk up" mathematics and science? The various teaching aids and guidance materials distributed by industry (that have been discussed previously) is one method that has been used. Touring science shows have been and are being sent out by such companies as General Electric, Bell Telephone, General Motors, Standard Oil and others. These have been very carefully developed. In general, the experiments and demonstrations are reduced to the simplest principles, and the theatrical bag of tricks is employed to make the points clear and vivid.

Another method used to steer the better students into science and mathematics is that of scholarships and awards. Many industries sponsor scholarship programs for the purpose of spotting and assisting young people who are particularly talented in engineering and science. One example is the ten George Westinghouse Scholarships, carrying a stipend of $3,170, that are awarded annually as a result of nation-wide competition

The General Motors Corporation gives a total of four hundred scholarships to promising high school seniors. These awards are not confined to the fields of mathematics and science.

Various other types of awards can be used to create interest. Section of the American Chemical Society have sponsored competitive examinations in chemistry as a means of stimulating interest and encouraging study of the subject. A great deal of publicity is given the contests, and various prizes such as medals, etc., are presented to the winners. American Cyanamid Company from time to time contributes prizes and gifts to stimulate science on a local level.

Several United States Rubber Company plants have initiated scholarship awards for local high school students. A typical example of the program is one in which the sponsoring plant presents an award of $200 and a gold cup to the outstanding member of the senior class (chosen by the faculty and students on the basis of scholarship, leadership, etc.) Awards of this type could be used to stimulate science interest and publicize and "glorify" good scholarship.

A nation wide program is the Science Achievement Awards For Students conducted by the Future Scientists of America Foundation of the National Science Teachers Association and sponsored by the American Society for Metals. One hundred and forty awards totalling $10,000 are given

at various grade levels (ranging from 7th to 12th grade) for projects in any field of mathematics or science.

Science Clubs of America (a branch of Science Service, 1719 N. Street Northwest, Washington 6, D. C.) sponsor two annual national events to promote science. (Science Service is a non-profit corporation with trustees nominated by the National Academy of Sciences, the National Research Council, the American Association for the Advancement of Science, the E. W. Scripps Estate, and the Journalistic Profession.) One event is the National Science Fair (started in 1950) which is affiliated with more than 70 regional fairs throughout the United States. On both the regional and national level, various honors and awards are given to students showing the best science exhibits.

Besides furnishing awards, many industries cooperate with the science fair program by furnishing materials and individual assistance services to aid students in science projects. The American Cyanamid Company lists this activity as an important part of their educational program.

The second event handled by S. C. A. is the National Science Talent Search held for seniors in high school who want to compete for $11,000 in Westinghouse Science Scholarships. Annually 300 are honored.

A number of other programs are also worth mentioning. For instance, last September, Victor Chemical Works of Chicago announced a nationwide contest for new ideas on what industry can do to induce high school graduates to become scientists and engineers. The results should be quite valuable.

Some companies, such as American Polymer Corporation in Peabody, Mass., use summer employment as bait to get students in the laboratory. The company gives apprenticeship training and constructive work at the

same time.

Scientific employment plucks this field from the realm of the artificial and gives the student meaningful experience. An important problem is how to provide adequate supervision to prevent undue exploitation of youth.

In January, 1956, Sunray Mid-Continent Oil Company's D-X subsidiary in Tulsa, Oklahoma set up a some-what new plan of attack when it formed a Science-for-Youth Club for its employees' children, and opened its labs to seventh through twelfth-graders. The students are given a wide range of freedom, and encouraged to develop their own pet projects. The program is supervised by a D-X research director and a Tulsa mathematics teacher. They hope to eventually expand the program to open it beyond employees' children.[1]

The Manufacturing Chemists Association is launching a five-year, $1,000,000 program (mentioned previously) of educational assistance that will have as one of its objectives, "to inspire students especially talented in science and mathematics with the desire to follow science as a career, either in industry, government or education."

Perhaps plant tours should be mentioned as another means of interesting and assisting students in science. Most industries are more than willing to cooperate. Plant visits can be extremely valuable tools of education when adequately prepared for. This requires planning and preparation by both school and industry and should involve a great deal of cooperation between both groups. A good example of the type of preparation needed can be obtained by quoting H. R. Russell, Coordinator of Education

[1]"Company Lab Gives Teenagers a Taste of Science," Business Week, (September 8, 1957), 128-132.

Cooperation for the American Cyanamid Company.

> The technique which seems to work best in our experience is to request the teacher to come alone to tour the plant. A conference is then arranged in which we discuss the question of which portion of the tour is most useful for students. Sad experience has taught us that no one gets very much value out of a random tour through the building. The entire class frequently gets a preview of the trip through pictures, slides, and descriptions by the teacher after his visit. Thus the class as a whole can do some meaningful preparation and planning for the trip.[2]

From Pennsylvania comes another somewhat unique program. For the past few years the Gilmer Plant of the United States Rubber Company has provided high school students with a workshop in the free enterprise system by sponsoring a Junior Achievement Company. Under the Junior Achievement program, a group of teenagers organize a company, raise capitol by selling stock, manufacture a product, and then market it. The company stays in business just one year and at the end of that time it is liquidated and the stockholders' money is refunded along with a share of the profit if any. This program has proved to very effective and valuable educationally. Such a program could undoubtedly be expanded to include more applications of mathematics and science and thus be a very valuable tool for creating interest in those fields.

One final example should perhaps be mentioned. In 1953, Florida State University initiated a summer "Science Camp". Student participation was emphasized in an effort to give students exciting science experiences. Results of the camps have been very gratifying.[3]

---

[2]Harvey R. Russell, "Methods of Cooperation Between Industry and Education in Science Teaching," Science Education, 40, 220-224.

[3]"Science Camp to Foster Science Careers," Chemical and Engineering News, 34 (August 3, 1953), 3304.

College--Industry Cooperation

Perhaps a qualification of the heading for this section should be made. To completely summarize all the facets of college--industry cooperation would be a very lengthy task. There is a great deal of cooperation between institutions of higher learning and industry regarding research projects, and many industries make financial grants to colleges for scholarships, department support, or general support of the institution. To give one example, the Shell Oil Companies Foundation announced in 1956 that $450,000 were being provided by educational programs during that year. Of that amount, research grants to colleges totaled $150,000. This is just one example of a course being followed by a number of large industries. If one wishes to pursue this point further, a large amount of facts and statistics regarding educational aid from industry can be obtained from the Council for Financial Aid to Education, 6 East 45th Street, New York 17, New York. All of these programs of financial aid are of benefit to the student, either directly or indirectly.

Financial aid to colleges, its administration, purposes and effects, is not going to be treated in detail, however. This section of the report will be mainly concerned with cooperative programs sponsored jointly by colleges and industry that are of value to both groups. Two general types of cooperative programs will be investigated: (1) work-study programs; (2) management and advanced professional training programs.

In general, a work-study program is a plan of education that is mainly designed to do three things: (1) To enable employers to fill jobs with competent men and women, (2) to give college students practical work experience as part of their regular education and thus integrate

theory and practice while still in a student status, (3) to enable students to earn a portion of college tuition and miscellaneous expense.

There are many benefits of a work-study program. Employers benefit in many ways. (a) They have found that the students employed give valuable service for wages received, (b) The plan provides a flow of trial personnel possible recruits for permanent jobs. (c) The plan can be used by employers as an "educational assembly-line" to produce young people that will be valuable to their organization. (d) Many employers realize that they have a stake in education--that the future of their professions, even of the nation, depends upon the education that young people get. The work-study program thus gives employers a chance to help improve education.

The advantages of work experiences programs to the student's career are obvious. He can try out his interests and abilities. He obtains valuable experience that aids in making textbook theories come to life. Bringing his experience back into his classrooms keeps his teachers on their toes and up-to-date in their own fields, thus making the student's classroom instruction more valuable. It also should give the student respect for the human element in practical affairs. Many more advantages for both employers and students could be listed.

The work-study programs of Antioch College, Yellow Springs, Ohio, Southern Methodist University, Dallas, Texas, Illinois Institute of Technology, Chicago, Illinois, and Taft Junior College, Taft, California were examined in detail. Some of the features of these programs will be pointed out to demonstrate the general operation of work experience plans.

Antioch College has been using such a plan since 1921. The organization of the plan is such that two students cooperate to hold each job assignment. One studies while the other works. Four times a year they

trade places. They divide vacation periods also. In general, five years is required to complete an undergraduate program.

The first jobs are usually elementary ones so that the students can learn basic skills, try different kinds of work, or see where they fit in or what they do best. As the students gain experience, the jobs become more specialized. Jobs are selected so that they will have educational value for the students in their fields of interest. Approximately 500 employers in over thirty states use Antioch students in work-study jobs. The plan seems to work equally well in all fields, from the sciences to the theater.

The class work coordinated with the work-experience combines text book theory (related to the students' on the job training and professional interest) with general education. The student is thus given a broad educational background.

The Engineering School of Southern Methodist University operates a program which is somewhat similar in organization to the Antioch plan. The freshman year, consisting of two semesters and a six-week summer term, is spent entirely in school. At the start of the sophomore year the class is divided into two groups. One group goes to school while the other gains work experience in industry. Every eight weeks until graduation the groups alternate.

The average expenses for tuition and fees for the five year period required for a degree is $2,345.50. Average earnings for the period is $6,470.00. Thus approximately $4,100 is available for other living expenses.

The engineering co-op plan at the Illinois Institute of Technology is again somewhat similar to the programs already discussed. In addition,

they have encouraged industry to aid in a search for young people who would profit by such a program. A number of industries help defray the initial tuition fees and expenses for co-op students, besides providing them with work experience opportunities.

A system of work experience programs has been organized in a number of California high schools and junior colleges. Taft Junior College is one example of that program. At Taft a very interesting plan of work-experience has been developed on a junior college level. More information on the California program can be obtained by writing the California State Department of Education, Sacramento, and asking for the Report of the Study of Work Experience Programs in California High Schools and Junior Colleges.

Perhaps more cooperation between industry and colleges in establishing work-study programs could help solve the problem of a shortage of technically trained people in the sciences.

A large number of industries cooperate with colleges and universities in programs of advanced training for their executive and technical personnel. Such programs tend to aid the universities and colleges financially, and help these institutions to realize the problems and needs of industry. Industry, in turn, is assisted by the advanced training and experience gained by its employees and executives.

A few specific examples will be mentioned to give a general idea of the type of thing that is being done and can be done.

The Institute of Industrial Relations at the University of California at Berkeley is one example of industry--education cooperation. Conferences, training programs, and monthly discussion meetings are held regarding topics pertaining to industrial relations and the sciences.

New York University conducts a similar program.

An interesting program initiated by industry is the Westinghouse Graduate Study Program. This program encourages qualified employees to work toward advanced degrees in engineering, the physical sciences, or business administration. The program is affiliated with nineteen universities.

Another plan of interest is the Fitchburg State Teachers College Industrial Education Program. The College, in collaborating with representatives of local industry, has established a curriculum in Industrial Education. The courses in the curriculum were prepared primarily as a part-time education service for apprentices and other workers engaged for apprenticeship in an organized training program, or for people seeking to qualify as technicians. Many of the single courses, however, are of general educational value. All the courses carry college credit and can be counted toward a degree.

An attempt has been made to present a few typical examples of cooperation between industry and institutions of higher learning and to suggest some of the possible advantages of such programs. If handled correctly, such plans can be of great value to both education and industry.

In Appendix B is a list of colleges and universities that sponsor various types of co-op programs. The author is indebted to Antioch College, Yellow Springs, Ohio for the material in Appendix B.

Television and the School

In discussing the relationship between industry and the educational training of American youth, the important role of television should not

be omitted. Television, the television industry, and industry in general working through this medium, can have a great and far-reaching effect on many of the educational problems mentioned previously in this report.

At the present time, televised closed circuit teaching has been admitted experimentally into the regular curriculums of at least a dozen school systems and 18 colleges and universities. Televised instruction is also broadcast over a good many educational and commercial television stations for the use of individuals and school groups. Private foundations, like the Fund for Advancement of Education established by the Ford Foundation, have invested large sums of money (more than $2.5 million by the Fund) in educational TV experiments. Other groups, such as the Radio-Electronics-Television Manufacturers Association, have provided equipment needed for educational television experiments.[4]

In December 1956, the National Broadcasting Company announced a plan to "furnish specialized educational programs to all of the nation's non-commercial educational stations." The plan calls for a 26-week project in 1957 consisting of three half hour presentations each week, with instruction in mathematics, the humanities and government.

The recent discussions regarding a shortage of science and math teachers has lead to a number of TV teaching experiments pertaining to these fields.

Although most people seem to agree that television and the TV industry can be of value to education, there is wide disagreement regarding the actual role it should play. Rather than discuss the various ideas related to this question, it will merely be stated here that there

---

[4]"Teaching with TV," Life, (February 25, 1957), 130-132.

are good arguments both for and against televised instruction. Although television can be a great aid to students and teachers and can perhaps be a partial cure to the teaching shortage, it cannot in itself overcome the need for competent, well trained people in the teaching profession.

The scope and nature of this report is such that the complete story of television-industry-education-relations and its aspects cannot be fully discussed. For those who wish to pursue this topic further, a bibliography, prepared by the National Broadcasting Company, is presented in Appendix C.

CHAPTER VI

INDUSTRY AND EDUCATIONAL PUBLICITY

Thus far, various methods of educational cooperation that are being used or can be used by industry have been discussed. These methods, no matter how valuable or how widely practiced, (and the author feels that the various programs mentioned are valuable) cannot completely meet the education problems that face the United States. In other words, common sense tells us that industry cannot completely support or manage the public schools of the United States. In fact, there would be particular objection if industry would attempt to control or manage the schools.

There is perhaps one method by which all industry and business can actively help combat education problems. This method is educational publicity; educational publicity on a national and, more effectively, local level.

What type of program is implied by educational publicity? A program of active support by local industries of school and teaching improvement campaigns. This support can take the form of public service advertisements in newspapers and on radio and television. It can take the form of school support pamphlets and notices distributed throughout the industrial plants. The support can take the form of industrial cooperation in forming and assisting community school-improvement committees having as their objective better schools and better teachers. Industry can assist in local studies involving school needs and means of supplying those needs

Too many people have only a passive interest in American education. This is perhaps partially due to a lack of knowledge of the value of education to both the individual and general public. The facts concerning the values of education and the problems involved in keeping that education on the highest possible level must be impressed upon the American public. The teachers and administrators must do a better job of public relations. Industry can do a great service by cooperating with informative campaigns of this nature.

Undoubtedly, many industries do actively promote local school publicity. Isolated examples are, of course, difficult to find. A trend in this direction is indicated in a statement from an American Chemical Society bulletin. The statement recommends a campaign to educate the public to the need for a higher salary level and greater prestige for all teachers.

Some industries have supported educational publicity on a national level. For example, just recently the Brog-Warner Corporation devoted a portion of an advertisement to the fact that the teacher shortage for 1957 is equal to the total population of Lincoln, Nebraska. The advertisement went on to say that practical information on this problem could be obtained from Better Schools, 9 E. 40th Street, New York, N. Y. Other industrial and business concerns have sponsored similar public service advertisements.

A number of industries contacted stated that company officials of local branches took an active part in school improvement programs through individual community service. Some companies encouraged their local plants and dealers to participate in pre-school publicity. One such program is carried on by the United States Rubber Company. The Public

Relations Department publishes and distributes pamphlets and other materials that (1) encourage local plants and distributors to support and assist the schools and (2) outline methods for such a task.

Many of the problems of the public schools could be met if more people would take an active interest in those schools. Perhaps industry can do a great service by helping create and maintain that interest.

CHAPTER VII

WHAT DOES INDUSTRY EXPECT OF THE HIGH SCHOOL OR COLLEGE GRADUATE?

A great deal has been said about ways in which industry can assist American education. If industry is to aid the schools, it has a right to expect a return on its investment. What type of return should it expect? Certainly not a monetary one, but instead one measured in terms of increased school quality. In other words, industry should be able to expect the schools to do the best possible job in educating American youth. This job cannot be done unless the educational ideas of industry, business, and education are coordinated. With this thought in mind, the question "What does industry expect of the high school or college graduate?" was asked in the letter and outline sent to 48 different industries, (see outline, Appendix A).

What then, does industry apparently expect of the young people of the country? What type of preparation does it hope the schools will give? The replies to the outline question indicated general agreement by industry on several points.

One main idea was that high school and college graduates should be well-trained in basic academic concepts and skills. The need for a strong background in English, mathematics and science was stressed, and proficiency in reading, speaking, writing, spelling, arithmetic, and reasoning were given considerable importance. The tendency was to

attribute less importance to "how-to-do-it" courses and "facts" courses, and emphasize the need for fundamentals, basic concepts and development of good mental habits. This idea is exemplified in a recent letter to the author, by F. D. Leamer, personnel director for Bell Laboratories.

> If we were to be critical of high school and college science programs, it would be to point out an overemphasis of the superficialities at the expense of the fundamentals. Students emerge from these programs with a welter of scientific knowledge but often with little understanding of what science really is or of its discipline, meaning, and methods. We consider the mental attributes of curiosity, unconventionality, imagination and ability to think and reason to be equally as important and useful as mere knowledge.

The employers also expressed the idea that the schools should help develop such personal traits as responsibility, initiative, social maturity promptness, dependability, honesty, industry, and the ability to get along with others.

Perhaps the desires of industry can best be summarized by two quotations.

The first is by C. R. Austin, President of the Jones and Laughlin Steel Corporation.

> We are looking to higher education to furnish good teaching of basic fundamentals of the sciences, the so-called humanities, and the arts. We are vitally concerned with obtaining graduates who have developed a respect for God, a respect for the fundamental moral law and a respect for our nation.[1]

The second quotation is from a speech by Kenneth A. Meade, Educational Relations Director for the General Motors Corporation.

> We believe the essential components of a successful career can be reduced to just three requirements on the part of the young graduate:
>
> 1. Native abilities such as health, energy, imagination, intelligence, initiative and comparable characteristics.
> 2. Ability to use the known laws of the arts and sciences--as

---

[1]C. L. Austin, "What Industry Expects From Higher Education," Association of American Colleges Bulletin, 34 (December, 1953), 549.

the schools have taught him to do in his formal education.

3. An understanding and ability to apply the "unwritten laws" by which his own efforts are integrated into the field of industrial endeavor.[2]

[2]Kenneth A. Meade, "The Type of College Graduate Desired by a Manufacturing Industry," School Science and Mathematics, 53 (June, 1953), 486-487.

CHAPTER VIII

CONCLUSION--A NEED FOR COORDINATION

A number of ways have been discussed in which industry can help and is helping the teacher, the student, and school systems in general. The value of "education assistance" programs to industry has been noted. Increased cooperative work and planning between industry and education, and increased industrial support of educational publicity on a local level have been suggested as methods of improvement. We've noted that many industries support "education cooperation" programs of various types, and are spending large sums of money on such programs. Perhaps the various programs, methods, and ideas of educational relations could be expanded and utilized by more industries, but that question is beyond the scope of this report.

There is, however, a general conclusion that should be examined. The nature of this conclusion can be expressed with two words--organized cooperation. Perhaps the greatest progress in industry--education relations can be realized through <u>organized cooperation</u> between <u>all</u> the industries of a geographical area and the schools located therein.

The need for more collective action on industry-wide or governmental levels has apparently been recognized. F. D. Leamer, personnel director for Bell Telephone Laboratories reports that Bell officials are serving on committees concerned with the above problems on city, state, and national levels.

As more industrial and governmental groups concern themselves with the problems of education, there is a greater need for proper coordination. This idea is well expressed by Walter J. Murphy, Editorial Director of the American Chemical Society journals.

> There is dire need now for better coordination among all the groups directly interested in educational matters. We begin to sense a feeling of frustration on the part of teachers and school administrators. In the main, these people welcome help--but they should not be overwhelmed by needless duplication of effort. Somehow a workable formula of better coordination and cooperation must be found. If it is not forthcoming in the near future, much of the potential good to be gained from the present intensive interest of many groups will be lost. Such cooperation and coordination can best be done, we believe, at the grass-roots level. Never-the-less, there is also urgent need for thoughtful consideration of major objectives by those groups which by their very nature, must operate on a national basis.[1]

Organization of education cooperation programs is undoubtedly easier and most effective on a local basis. One example of local "coordination" is the Mid-Hudson Science Advisory Council of New York state. The Council came into existence in 1955 to unify the efforts of a number of organizations so that the schools would not be subjected to contacts from a series of parallel activities by different organizations. The Council includes the following local chapter organizations and groups: American Chemical Society, American Society of Mechanical Engineers, American Institute of Electrical Engineers, Institute of Radio Engineers, Rensselaer Polytechnic Institute Alumni, Texaco Research Club, Poughkeepsie and Kingston Chamber of Commerce.

Services are supplied to 28 schools in the area. These services include a well organized "speakers bureau" covering a wide range of topics and purposes, the loan of laboratory equipment, summer employment for

---

[1]Walter J. Murphy, "Assistances in Solving the Educational Problem," Chemical and Engineering News, 34 (December 3, 1956), 1,953.

teachers in science-related fields, well organized plant tours, and a means of keeping the schools and teachers "in touch" with industry and business in the area.

In the Washington, D. C. area the Joint Board of Science Education has been formed as a coordinating agency. Its purpose is to consolidate the educational activities of the some 50 societies affiliated with the Washington Academy of Sciences and the D. C. Council of Engineering and Architectural Societies. A school contact committee has been established with a representative appointed for each of the 125 secondary schools in the area. This person becomes personally known to the science teachers and the principal in the school he represents and aids them in securing technical information, speakers, technical programs, and in other related services. The Board has demonstrated that it can promote better understanding and cooperation between the scientific community and the school systems in the solution of problems in science education of concern to both groups.[2]

There are a number of good examples of cooperation on the state level. The Oklahoma Frontiers of Science Foundation is one example of the progress possible through proper coordination of the efforts of businessmen, government officials, and educators.

Although cooperation between industry and the schools is certainly not a "cure-all" for the educational problems of the United States, it can be the basis for many advantages and improvements. Such cooperation cannot be one sided, however. All the methods and ideas mentioned in this report are dependent on <u>both</u> industry and the schools. A valuable

---

[2]John K. Taylor, "The Washington Area Scientists-For-Teachers Program" <u>Journal of Chemical Education</u>, 33 (September, 1956), 461.

program can only result from sincere and concentrated effort by both groups.

BIBLIOGRAPHY

Austin, C. L. "What Industry Expects From Higher Education." Association Of American Colleges Bulletin, 34 (December, 1953), 548-553.

Basilius, Harold A. College Graduates In Industry. (2nd edition), Detroit Michigan: Wayne State University Press, 1957.

Business Week. "Company Lab Gives Teenagers a Taste of Science." (September 8, 1957), 128-132.

Chemical and Engineering News. "Science Camp to Foster Science Careers." 31 (August 3, 1953), 3,304.

Gladieux, R. J. "Industry Sponsored In Service Training Program for Teachers." Journal of Chemical Education, 33 (September, 1956), 460-461.

Higher Education. "Financial Aid to Education Survey." 13 (October, 1956), 28.

Life. "Teaching With TV." (February 25, 1957), 123-132.

Meade, Kenneth A. "The Type of College Graduate Desired by a Manufacturing Industry." School Science and Mathematics, 53 (June, 1953), 486-487.

Murphy, Walter J. "Assistance in Solving the Educational Problem." Chemical and Engineering News, 34 (December 3, 1956), 953.

Russell, Harvey R. "Chemists and Educators--A Partnership." Journal of Chemical Education, 33 (November, 1956), 592.

_____. "Chemical Education Is Our Business Too!" Chemical and Engineering News, 31 (August 17, 1953), 3358-3363.

_____. "Methods of Cooperation Between Industry and Education in Science Teaching." Science Education, 40 (April, 1956), 220-224.

Schenberg, Samuel. "Criteria for Sponsored Teaching Aids in Science." The Science Teacher, 23 (October, 1956), 277-278.

Taylor, John K. "The Washington Area Scientists-For-Teachers Program." Journal of Chemical Education, 33 (September, 1956), 461.

The Science Teacher. "Summer Institutes, Conferences, and Fellowship Programs for Science Teachers." 24, (February, 1957), 20-21.

United States Steel News. "Scientists and Teachers Swap Jobs." (January, 1957), 12.

Wallen, I. E. "The Science Teaching Improvement Program of the A. A. A. S The Science Teacher, 23 (December, 1956), 399-400.

Wolfe, R. W. "The Technical Manpower Shortage." School Science and Mathematics, 57 (January, 1957), 63-69.

Woodburn, John H. "Summer Jobs for Teachers." Chemical and Engineering News, 33 (February 14, 1955), 620-622.

APPENDIX A

Dear Sir:

I am attending the National Science Foundation's program for science and mathematics teachers at Oklahoma A. and M. College. I hold a B. A. degree from Iowa State Teachers College, and hope to obtain a M. S. degree in science at the end of this school year. My major fields are mathematics, chemistry and science education. I have two years teaching experience in advanced high school mathematics, chemistry, and physics. American education is of great interest to me.

In recent months a great deal has been said about the need for and advantage of technically trained people (particularly those with training in mathematics and science) in business and industry. This problem in turn has been related to the shortage of competent teachers particularly in mathematics and science. A good deal of publicity has been presented relating to the shortage of teachers in all fields, the lack of adequate teaching facilities, and the need for a strong educational system throughout the United States.

Perhaps part of the solution to these educational problems lies in industrial--educational relations. With this thought in mind, permit me to list the two-fold purpose of this letter: (1) To attempt to discover what is being done by industry in the "field" of educational relations and the ideas possessed by industry along such lines; (2) To find what "industrial-educational" career opportunities exist.

In regard to the first point, I plan (as part of my work under the National Science Foundation program) to report on industrial--educational relations. Enclosed is an outline of the various points I hope to briefly discuss in the report. This outline is accompanied by a supplement, explaining and qualifying the topics listed. Any information, materials, references, comments, or ideas that you might be able to send to me relating to any of the points in the outline would be greatly appreciated.

In particular, I am especially interested in obtaining assistance regarding the following categories: (1) What is the nature and extent of educational relations carried on by your company? (I'm particularly interested in what is being done, how it is handled, the purposes involved, and plans or ideas for the future.) (2) What does industry expect of the high school and college graduate? I feel that this point is particularly important, for it can (a) aid in making teachers more aware of what the public expects of our schools, (b) assist teachers in making their teaching more meaningful and practical, (c) be of great value in guidance work and (d) make students aware of what will be expected of them in our economic society. Comments and ideas of personnel directors and other company officials are especially desired and will be sincerely appreciated.

INDUSTRY--EDUCATION RELATIONS

Thomas Yager

I. Industry and the training and guidance of teachers and students in mathematics and science. (All the categories of section I will be considered in reference to the following three questions: What is being done? What values and goals are involved? What changes would be practical and valuable?)

   A. Industry and educational materials

   B. Industry and guidance
      1. Printed literature regarding careers
      2. Career Days in schools

   C. Industry and teacher training
      1. Summer industrial teacher training programs
      2. Industry sponsored scholarships for teachers and prospective teachers

   D. Industry and student training
      1. Secondary school--industry cooperation
      2. Industrial field trips
      3. College--industrial cooperation regarding technical and professional training

   E. Industry and the teacher's salary problem
      1. Out-right salary grants
      2. Industrial summer work programs for teachers

   F. Industry and educational publicity

II. What does industry expect of the high school graduate?

III. Miscellaneous problems

   A. The age of automation and its related effect on industry and education

   B. The trade school (both public and private) and its relation to industry and public education

OUTLINE SUPPLEMENT

The purpose of this supplement is to explain and qualify the various points of the outline.

I. Industry and the training and guidance of teachers and students in mathematics and science

A. Industry and educational materials
The purpose of this section is to (1) survey the various types of educational materials that are being supplied or could be supplied by industry; (2) learn something about how much materials are prepared, their values, the finances involved, etc; (3) list some criterion for the selection and use of such materials for classroom work; and (4) list some general references and sources for exceptional educational materials. This section is not intended to be a catalog of all the industry-sponsored educational materials available.

B. Industry and guidance

1. Printed literature regarding careers
The same qualifications as listed for IA above are intended here.

2. Career days in schools
There are many examples of cooperation of industry, business various professions, and colleges with high schools in sponsoring projects often termed as "career days". The idea involved is to present to the students information about various career opportunities. This report shall merely attempt to highlight a few of the points that might make or break a career day project.

C. Industry and teacher training

1. Summer industrial teacher training programs
A number of industrial concerns have sponsored summer instructional programs for teachers. Most reports regarding such programs have been favorable. An attempt shall be made to survey briefly some of the types of programs being offered and present some ideas relating to the value of such programs. The suggestion that a regular master's degree for science and mathematics teachers under a program sponsored jointly by graduate schools and industry (and mixing practical aspects with the academic) might prove worth investigating under this point.

2. Industry sponsored scholarships for teachers and prospective teachers
The three questions listed under I of the regular outline will be the main things considered here.

D. Industry and student training
This section is related to the problem of getting the students that have interest and ability in mathematics and science into those fields.

1. Secondary school--industry cooperation
A topic worth considering here pertains to the role industry can play in getting and keeping brilliant young people interested in science projects, scientific job opportunities, etc.

2. Industrial field trips
These can be very valuable or a complete waste of time and effort depending upon how they are handled. An attempt shall be made to obtain some considerations (from the standpoint of industry and that of the schools) that should go into the planning and carrying out of an industrial field trip.

3. College--industrial cooperation regarding technical and professional training
A report on the cooperative "work-study" programs of various colleges will be made and the advantages of such programs will be discussed.

E. Industry and the teacher salary problem
Our schools and the quality of individuals "produced" by them depend a great deal upon the quality and quantity of the teachers who man those schools. It is well known that one of the biggest problems in securing and retaining competent, well qualified people in the teaching professions is that of salaries Although the monetary problem is not the only one that must be met to provide an adequate army of teachers for the United States, it is at present the most important and the one that must be met first. In the outline two ways are listed by which industry has been helping combat the teacher salary problem. Should industry do more, or is it already doing more than it should?

F. Industry and educational publicity

1. What is industry doing "publicity-wise" (both locally and nationally) to support American schools?

2. Can more be done?

II. What does industry expect of the high school and college graduate? Since this topic was discussed in the letter, further comment here will be omitted.

III. Miscellaneous problems

The two problems listed under III of the outline are ones that are definitely of concern to both industry and education. Although this report is not intended to fully cover the two topics listed, it is hoped that enough can be presented to point out the great need for a competent educational system that must be capable of co-operation and coordination, not only with industry, but with all phases of our ever-changing American society.

APPENDIX B

LIST OF COLLEGES AND UNIVERSITIES WITH

CO-OP (WORK-STUDY) PROGRAMS

Alabama

Alabama Polytechnic Institute	Auburn
Alabama, University of	Tuscaloosa
Tuskegee Institute	Tuskegee

Arkansas

Harding College	Searcy
John Brown University	Siloam Springs

California

California, University of	Berkeley
California, University of	Davis
California, University of	Los Angeles
Golden Gate College	San Francisco
Los Angeles City College	Los Angeles
Los Angeles State College of Applied Arts and Sciences	Los Angeles
Orange Coast College	Costa Mesta
Sacramento State College	Sacramento
St. Mary's College	St. Mary's College
San Francisco, City College of	San Francisco
Taft Junior College	Taft

Colorado

Denver, University of	Denver
Fort Lewis A. and M. College	Hesperus

Connecticut

Bridgeport, University of	Bridgeport
Mitchell College	New London

Delaware	
Wesley Junior College	Dover
District of Columbia	
American University	Washington
Wilson, James Ormond, Teachers College	Washington
Florida	
Stetson University	Deland
Georgia	
Emory University	Atlanta
Georgia Institute of Technology	Atlanta
Idaho	
Idaho State College	Pocatello
Illinois	
Blackburn College	Carlinville
Bradley University	Peoria
Illinois Institute of Technology	Chicago
Northwestern Technological Institute	Evanston
Iowa	
Buena Vista College	Storm Lake
Kansas	
Bethel College	North Newton
Coffeyville College of Arts, Science and Vocations	Coffeyville
El Dorado Junior College	El Dorado
Kentucky	
Berea College	Berea
Louisville, University of	Louisville
Maryland	
Baltimore Junior College	Baltimore

Massachusetts

Atlantic Union College	South Lancaster
Massachusetts Institute of Technology	Cambridge
Massachusetts State Teachers College	Fitchburg
Northeastern University	Boston

Michigan

Central Michigan College of Education	Mount Pleasant
Detroit, University of	Detroit
Flint Junior College	Flint
General Motors Institute	Flint
Jackson Junior College	Jackson
Michigan State College	East Lansing
Northern Michigan College of Education	Marquette
Port Huron Junior College	Port Huron

Minnesota

Minnesota, University of	Minneapolis

Missouri

Park College	Parkville

New Jersey

Fairleigh Dickinson College	Rutherford

New Mexico

Eastern New Mexico University	Portales
New Mexico, University of	Albuquerque

New York

Cornell University	Ithaca
Keuka College	Keuka Park
Long Island University	Brooklyn
New York University	New York
Rensselaer Polytechnic Institute	Troy
Rochester Institute of Technology	Rochester
Sarah Lawrence College	Bronxville
State University Agricultural and Technical Institute	Alfred
State University Institute of Applied Arts and Sciences	Binghamton
Walter Harvey Junior College	New York

Ohio	
Akron, University of	Akron
Antioch College	Yellow Springs
Cincinnati, University of	Cincinnati
Fenn College	Cleveland
Mount Union College	Alliance
Ohio Mechanics Institute	Cincinnati
Western Reserve University	Cleveland
Wilmington College	Wilmington
Oregon	
Southern Oregon College of Education	Ashland
Pennsylvania	
Drexel Institute of Technology	Philadelphia
Pennsylvania College for Women	Pittsburgh
Pittsburgh, University of	Pittsburgh
St. Joseph's College	Philadelphia
South Dakota	
Dakota Wesleyan University	Mitchell
Tennessee	
Chattanooga, University of	Chattanooga
Southern Missionary College	Collegedale
Tennessee, University of	Knoxville
Texas	
North Texas State College	Denton
Southern Methodist University	Dallas
Vermont	
Goddard College	Plainfield
West Virginia	
Marshall College	Huntington
West Virginia State College	Institute
Wisconsin	
Marquette University	Milwaukee
Milwaukee School of Engineering	Milwaukee

APPENDIX C

RADIO AND TELEVISION EDUCATIONAL ASPECTS

Bibliography

American Council on Education — Television in Education. (American Council on Education, Wash., D. C. 1952)

Battin, T. C. — Television and Youth (Nat'l Assoc. for Radio and TV Broadcasters, Wash., D. C., 1954)

Bauchard, Phillipe — The Child Audience--A report on Press, Film, and Radio for children. (Unesco, Paris, 1953)

Braun, E. C. and Stanley, F. J. — Let's Broadcast (North Western Press, Minneapolis, Minn., 1948)

Broderick, G. G. — Educational Television--Local Program Survey 1952-53 (Nat'l. Assoc. of Radio and TV Broadcasters, 1953)

Callahan, J. W. — Radio Workshop for Children (McGraw-Hill, N. Y., 1948)

Callahan, J. W. — Television in School, College and Community (McGraw-Hill, N. Y., 1953)

Cuthber, Margaret and Others — Adventure in Radio (Howell-Soskin, N. Y., 194[illegible]

Cooley, Hazel — Vision in Television (Channel Press, N. Y., 1952)

Dunham, Franklin — Television in Our Schools Revised (Govt. Prtg. Off. Wash., D. C., 1953)

International Assn. for Childhood Education — Children and TV (The Assn., 1200 15th St., N. W. Wash. 5, D. C., 1954)

Joint Committee on Educational Television — TV Channels for Education. (The Committee, Wash., D. C., 1951)

Joint Committee of The U. S. Office of Education and The Radio-TV Manufacturers Assoc.	Teaching With Radio, Audio, Recording and TV Equipment (RTMA, Wash., D. C., 1953)
Levenson, Wm. B. and Stasheff, Edward	Teaching Through Radio and Television (Rinehart, N. Y., 1952)
Library Public Relations Council and American Library Assoc.	The Use of Television by the Public Library. (American Library Assoc., Chicago, Ill., 1949
Mabley, Jack	What Educational Television Offers You (Public Affairs Pamphlets, N. Y., 1954)
Miller, Justin	Textbooks and TV (Nat. Assoc. of Radio and Television Broadcasting, Wash., D. C., 1951)
National Assoc. For Better Radio and Television	Annual Report--Children's Radio and TV (NAFBRT 882 Victoria Ave., Los Angeles 5, Calif.) (Annual)
Newsom, C. V.	A Television Policy for Education (American Council on Education, Wash., D. C., 1952)
Nunmaker, F. G.	The Library Broadcasts (H. W. Wilson Co., N. Y., 1948)
Olson, O. J., ed.,	Education on the Air. Yearbook of the Inst. for Education by Radio and Television (Ohio State Univ. Columbus, Ohio) (Annual)
Quinn, Ruth and McNay, A. J.	Classroom Radio Production (C. G. VerHalen Pub Co., Hollywood, Calif., 1948)
Rock, R. T. Jr. Duva, J. S. and Murray, J. E.	Training by Television, 2 vols. (U. S. Navy Special Devices Center, 1951)
Shayon, R. I.	Television and Our Children (Longman, Green, N. Y., 1951)
Sterner, A. P.	Radio, Motion Picture and Reading Interests (Columbia University Press, N. Y., 1947)
Summann, C. A.	Television and Education in the U. S. (Columbia Univ. Press, N. Y., 1952)
Tucker, D. E.	Radio for Children (Station KOAC, Korvalles, Oregon, 1953)
Waller, Judith C.	Radio, The Fifth Estate 2nd ed. (Houghton Mifflin Co., Boston, 1950)

Wollerford, George — A survey of Educational Radio Stations (Natio Ass'n. Educational Broadcasters, Wash., D. C. 1948)

Willey, Roy and Young H. A. — Radio in Elementary Education (D. C. Heath, Boston, 1948)

VITA

Thomas Earl Yager

Candidate for the Degree of

Master of Science

Report: INDUSTRY--EDUCATION RELATIONS

Major Field: Natural Science

Biographical:

Personal Data: Born in Burlington, Iowa, July 17, 1932, the son of Earl M. and Barbara E. Yager.

Education: Attended grade school and junior high school in Burlington, Iowa; graduated from Burlington, Iowa High School in 1950; received the Associate of Arts degree from Burlington Junior College in June, 1952; received the Bachelor of Arts degree from Iowa State Teachers College, with a major in mathematics, in June, 1954; completed requirements for the Master of Science Degree with a major in natural science at Oklahoma A. and M. College in May, 1957.

Professional experience: Taught chemistry, physics and advanced mathematics in the Tama, Iowa High School from September, 1954 to June, 1956.