Cooperative Work-Study Programs

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Scientific progress of the Soviet Union as evidenced by their recent satellite launchings has given impetus to a wave of publicity informing the American people that we are being far out-distanced in the race for technical supremacy. Almost daily we read or hear from spokesmen saying that unless immediate action is taken to increase production of scientists and engineers, we stand to lose this race hands down, along with its serious defense implications.

Whatever your reaction to this latest outburst, there can be little doubt that Russia has made tremendous advances in science and has, once and for all, eliminated the commonly-held opinion that it is a backward agrarian nation incapable of competing with our industrial leadership.

The fact that colleges, universities, and technical institutions in Russia are turning out a greater number of scientists and engineers than the United States appears to be indisputable. We must not, however, become confused into thinking only in terms of taking action to out-produce the Soviet Union in this scientific talent contest. What must be done, agree more level-headed spokesmen, is to muster our resources to assure adequate numbers of such specialists who are properly trained and effectively utilized. In so many words, "Of what value is a four-platoon football team if they lose to the school with only a handful of reserves?"

This is not to imply that we have at the present time, a sufficient number of scientists and engineers. We cannot disregard the fact that Russia apparently has pulled ahead in certain areas. But the crux of the problem is that it must be tackled from a *total* point of view: all three—quantity, quality, and utilization—must be adequately provided.

Nationwide attention is currently being focused on a problem that White Sands Proving Ground has faced for the past ten years. This vital defense in-

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stallation, located in South-Central New Mexico, is charged with the responsibility for developing and testing guided missiles and rockets of the Army, Navy and Air Force. This truly integrated testing range covers an area of approximately 2½ million acres employing over seven thousand military and civilian workers.

Providing a scientific and technical staff adequate to execute the responsibilities of the Proving Ground is a major task of the Civilian Personnel Office. While all parts of the country are experiencing difficulties in scientist and engineer recruiting, the Proving Ground must accomplish its mission in a geographic area that produces the smallest percentage in the country of such personnel. This, and the fact that Government Service cannot compete with industrial salaries, presents a difficult problem.

In 1952, the Army at White Sands Proving Ground, recognized that this problem would be continuous and embarked upon a cooperative work-study program with the New Mexico College of Agriculture and Mechanic Arts in nearby Las Cruces. The plan was designed to recruit into Federal Service, undergraduate students in engineering, physics, and mathematics and has now completed its fifth year. Cooperative education, a system of academic study interwoven with related work experience, is, of course, not a new concept. A number of colleges and universities throughout this country have established work experience as a mandatory requirement under their degree plans, we are also familiar with the requirement of most teaching curricula which require actual teaching experience. But while this philosophy of education can be found in this country in engineering and science, it is more of an exception rather than a general practice. On the other hand, it is interesting to note that work experience (called industrial practice) is required of all engineering students in the Soviet Union.[1]

Cooperative plans of education such as we have in this country vary but among the most popular we find the following:

1. The undergraduate student attends college full time during the regular school year and works at an installation or company during the summer months.

2. The student may attend class for half a day and work the other half. This is normally on a year-round basis and the morning and afternoon groups exchange places at the company or installation.

3. The year may be divided into two equal six-months periods with one group of students attending college full time while the other group is working full time. The two groups exchange places twice a year at the start of the semester or summer session.

Prior to July, 1952, when the cooperative system was being studied for possible adoption at the Proving Ground, these three plans were carefully considered. The first plan with the student attending school during the regular semester would be the easiest to place

1. *Soviet Professional Manpower,* National Science Foundation, Washington, D.C., 1955.

into effect since it would involve no action by the participating college who would consider the student as only having summer employment. The disadvantage of the plan was that our installation would have the benefit of the student's productive ability for only three months of the year and in most cases, the trainee would have little opportunity to do more than observe engineering and scientific work. This uneconomical factor, together with a steadily increasing shortage of personnel that normally carry out sub-professional work, such as Engineering Aides, Draftsmen, Physical Science Aides, etc., resulted in rejecting this plan.

The second plan, wherein students would work half a day, was eliminated for a very practical reason—the location of White Sands Proving Ground. Since the student would have to spend approximately two hours traveling to and from work, this was considered highly impractical.

The cooperative plan as it was finally placed into effect provided for two groups of students working or studying on a six-month basis. This not only overcame the objections of the other two programs but had the advantage of increasing the student's earnings during his undergraduate period.

A student selected to enter the White Sands Proving Ground program from high school can complete the requirements for his degree in a minimum of five years. This includes five six-month work periods during which he is required to take evening courses. A typical program would look like this:

	Aug. - Jan. WORK PERIOD Reg. 40-hr. Wk. Hourly Pay	Evening Credit Hours	Feb. - July FULL-TIME STUDY 18-Wk. Reg. Sem. Credit Hours	6-Wk. Summer Session Credit Hours
FIRST YEAR				
High School Graduate				
Enters Program in July	$1.42	3	18	6
SECOND YEAR	$1.42	3	19	6
THIRD YEAR	$1.53	3	19	7
FOURTH YEAR	$1.64	3	19	7
FIFTH YEAR	$1.76	3	19	7
TOTAL		15	94	33

142 Credit Hours required for the B.S. degree in Engineering.

Students are also selected to enter the program in February, thereby enabling the installation to have positions occupied year-round. Since a salary is received only during the work periods, money must be set aside then to cover the college costs.

1957 ended the first cycle of the five-year program and the Proving Ground is carefully analyzing the results obtained. Objectives are being reaffirmed and action taken to strengthen program administration in selection, academic standards, counseling, work assignments, and records and reports.

The primary objective of the cooperative program—to develop a source of scientists and engineers—has not changed.

Experience, however, has revealed a number of by-products important to the installation, the college, the student, and the country as a whole.

Cooperative education very definitely induces many high school graduates to enter college and in our case, engineering and science, who otherwise would not have done so. This becomes quite important when we read that the National Science Foundation reports that of every twenty members in the top one-fifth of a high school age group (the higher intelligence group) over fifty per cent fail to enter college. By providing a student with the assurance of an income six months out of each year we greatly reduce the financial reasons for not going to college.

We have also found that many high school graduates end their formalized education with high school because of a lack of incentive or desire to go on. This in itself, is a discouraging waste of talent. We also know that many students who enter college withdraw because they lack the stimulation so necessary to complete the difficult scientific or engineering curriculum. "Why beat your brains out when you can make more money selling insurance" is stated by far too many sophomores.

A planned program of work assignments geared to the student's academic progress and major field of study plays an important part in stimulating interest throughout the undergraduate period. By actually applying his theoretical knowledge, the student soon recognizes the value of achieving his goal. The opportunity of being able to work in the field of guided missiles and rockets becomes not only a major inducement to the high school graduate, but also reduces the college withdrawals. (It should be realized that the cooperative plan of education occasionally contributes to a student's withdrawing from science or engineering. During the work periods a student may decide that he has neither the interest nor aptitude for such a profession. Can we question the value of such a discovery before he completes his college work?)

Management officials at White Sands Proving Ground have many times expressed their belief in the value of this program. While they have not yet benefited in terms of having large numbers of graduate cooperative students to fill professional vacancies, they do believe that this large group of energetic, in-

telligent workers has assumed many of the less demanding duties and responsibilities previously carried out by professional engineers and scientists.

Mr. M. E. Harris, Civilian Personnel Officer, has expressed it this way, "Let's not, for one minute, think that these students are receiving a college education at the taxpayers' expense. They work, and by and large, the assignments they carry out would cost the Army more money if they were replaced with full-time regular employees or if the duties were left with our professional people."

In terms of administration and operation of the cooperative plan, our experiences have emphasized a need for certain basic requirements. During the work periods, the cooperative student must be effectively utilized. If he feels that he is not being employed at a level consistent with his past work experience and academic progress, he will tend to become discouraged and withdraw from the program. With the exception of those who are absolutely dependent upon the income received, the student will not extend the time required to obtain his degree unless he believes that the work experience is of value. In those instances where the student does remain because of money, we do not feel that we can expect him to return as a professional employee if he has been dissatisfied with previous assignments.

A successful cooperative program must have high standards of selection and academic progress. New students must be carefully screened to assure that previous high school and college work indicates the abilities necessary for successful completion of the accelerated engineering or scientific curriculum. During the cooperative period we have found that students who fail to carry a normal course load or fail to maintain passing grades, fall behind and eventually decide to attend school upon a full-time basis or withdraw completely.

The supervisor to whom the student has been assigned during the work periods must recognize that the individual is primarily a student and he must be willing to provide counsel and advice, and closely monitor the student's academic work to assure that he is progressing satisfactorily. A high level of work performance is of little value if the student fails during the study periods.

The major advantage of cooperative education, whether it be in a vital defense installation such as White Sands Proving Ground or in a private company, is the merging of academic theory with practical experience. As Thomas Carlyle once so aptly stated, "Knowledge conquered by labor becomes a possession . . . facts thus acquired become invested in the mind in a way that mere imparted information can never produce."

Under the leadership of Major General W. E. Laidlaw, Commanding General of White Sands Proving Ground, and President Roger E. Corbett of the New Mexico College of Agriculture and Mechanic Arts, this cooperative work-study program employing approximately 250 students has become a positive step towards supplying increased numbers of well-trained engineers and scientists. Training Directors throughout the country, in both industry and Government, might well investigate the possibilities of this type of program.