COOPERATIVE EDUCATION IN THE UNITED STATES

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Contents

COOPERATIVE EDUCATION FOR FEDERAL AGENCIES

VALUES INHERENT IN THE COOPERATIVE PLAN

TABLES

Foreword

THIS BULLETIN is essentially a revision of an earlier one—"A Survey of Cooperative Engineering Education," Bulletin 1949, No. 15, now out of print—by the same author, using some of the same content, but with new data and broadened coverage. It attempts to cover all cooperative education programs at the college and technical institute levels, rather than concentrating on engineering programs, as did the earlier bulletin.

An educational problem of long standing is that of trying to give to college students, especially in curriculums preparing for the professions, a knowledge of society and of social processes, which, as such persons are called to occupy positions of leadership, they may need to a greater degree than they need technical knowledge and skills. The continued growth of industry, both in size and complexity, increases the urgency of this problem.

The cooperative plan of education described in this bulletin may provide one workable solution to this problem in institutions whose location and clientele justify its adoption. The cooperative student, in addition to gaining throughly practical industrial training related to his technical studies, is also afforded many opportunities to study and practice human relations as they exist in industry.

This bulletin presents an organized outline of the basic philosophy and objectives of this relatively new system of education, its administrative and operating problems, and the values resulting from its operation. Included is a discussion of the utilization of the cooperative plan by Federal agencies, a development to which the author has actively contributed.

The author of this bulletin gathered material from numerous interviews with college, industrial, and governmental officials, from special memorandums and other unpublished materials, through visits to college campuses, and through correspondence with many interested people. The officers and members of the Division of Cooperative Engineering Education of the American Society for Engineering Education have been most helpful in furnishing information and advice. To all who contributed in any way the Office of Education expresses gratitude.

LLOYD E. BLAUCH, *Acting Head,*
Division of Higher Education.

Introduction

IN 1906 the University of Cincinnati inaugurated, under the inspiration and leadership of Prof. (later Dean) Herman Schneider, a new type of program for the education of engineers—the "cooperative plan," in which students alternate between class attendance and industrial or governmental employment under the supervision of the engineering college. Similar programs were soon established by other colleges and universities, and the plan has been adapted to education in other fields and at other educational levels, though it still finds its major application in the field of undergraduate engineering education.

During the academic year 1953–54 cooperative education programs were conducted in 35 colleges and 8 technical institutes. These programs included 33 different curriculums leading to baccalaureate degrees and 13 different nondegree courses. They enrolled 22,528 students, who were employed by 4,340 industrial firms and governmental agencies.

Much has been written about this type of program, as is indicated in the list of selected references. However, college and governmental officials have indicated the need for a booklet which would bring together the basic facts necessary for a general understanding of the program as a system of education, and sufficient detailed information to delineate the current programs of colleges and universities operating wholly or in part on this plan.

It is the purpose of this bulletin to provide such a booklet.

Nature and Scope of the Cooperative Plan of Education

THE COOPERATIVE PLAN of education was originally introduced at the University of Cincinnati by Dean (at that time Professor) Herman Schneider. It is frequently spoken of as the "Cincinnati plan," the "cooperative plan," or more popularly the "co-op plan." Students enrolled in this type of program are referred to as "co-operative students," "co-op students," or simply "co-ops."

DEFINITION OF COOPERATIVE PLAN

Basically the cooperative plan is defined as an integration of classroom work and practical industrial experience in an organized program under which students alternate periods of attendance at college with periods of employment in industry, business, or government. The employment constitutes a regular continuing and essential element in the educational process, and some minimum amount of employment and minimum standard of performance are included in the requirements for a degree. The plan requires that the student's employment be related to some phase of the branch or field of study in which he is engaged, and that it be diversified in order to afford a spread of experience. It requires further that his industrial work shall increase in difficulty and responsibility as he progresses through his college curriculum, and in general shall parallel as closely as possible his progress through the academic phases of his education.

OPERATION OF COOPERATIVE PLAN

The cooperative plan generally operates as follows: A full-time job is obtained in an industrial concern or governmental agency, preferably near the college concerned. This job is shared by two students, one of whom works on the job while his partner or "alternate" attends college. At the end of a certain period of time the two change places. Thus the job is kept continuously filled, and each student is enabled to spend approximately half of his time in college. The length of the period of alternation varies in different institutions, as do the total amount of work experience required and the point in the student's curriculum at which it starts.

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While the "two-man team" principle is generally observed in cooperative programs, it is not universally followed and is not a fundamental principle of the cooperative system. In some institutions the cooperative program is so arranged that all co-op students go to work at one time, and all return to college at one time. Certain advantages are claimed for this type of program, but the majority of institutions still use the "two-man team" arrangement. Even in the institutions which normally follow the practice of "pairing" students it is sometimes necessary or desirable in individual situations to provide only one co-op student for a given job, which can be handled in such a way as to permit him to return to college for the regular class periods. In the original group of co-op students at the University of Cincinnati one student was placed on this basis. The essential feature is not the "pairing" of students, but the alternation between periods of employment and periods of class attendance.

FIELDS OF STUDY AND EDUCATIONAL LEVELS

The cooperative plan was originally designed for the education of engineers, and it still finds its widest use in engineering colleges. The plan is probably more directly and easily applicable to engineering than to most other fields, although it is finding increasing favor in schools of business administration, and it has been extended in some institutions to curriculums in architecture, science, education, home economics, the arts and sciences, and other fields.

Although the majority of cooperative education programs lead to the bachelor's degree, there has also been a considerable development of the plan in technical institutes offering nondegree courses, especially in engineering and technical fields. Some of the nondegree programs are among the oldest and largest in the country. In these institutions the fundamental principles of the cooperative plan apply much as they do in the degree-granting institutions, although there is less opportunity for the extension of the plan into administrative and managerial positions. Information about cooperative education in technical institutes is included in appropriate sections of this bulletin.

The cooperative plan has also found limited application in junior colleges, but does not constitute an important part of the offerings of these institutions. It has seemed best to confine this study to the degree-granting institutions and the technical institutes.

At least two of the institutions conducting cooperative programs extended them to the level of the master's degree. In contrast with programs offered by most institutions, in which any interested employer offering jobs having educational value may cooperate, the cooperative training in these two institutions is limited to the em-

ployees of certain selected companies, which pay a fee to the college for the privilege of participating.

In general, it is more difficult to extend the cooperative program into the level of graduate study, at least on the "two-man team" basis, because of the highly specialized and individualized nature of the research projects pursued by most graduate students as a part of their programs. Some institutions have perfected arrangements whereby young engineers may do graduate study in the institution while employed either full time or part time, under the joint supervision of an older engineer in the cooperating company and a staff member of the institution. Such arrangements call for a high degree of cooperation between the institution and employers, but do not constitute programs of cooperative education as defined for the purposes of this bulletin.

Origin and Development of the Cooperative Plan

HERMAN SCHNEIDER, the originator of the cooperative plan of education, entered on his teaching career after several years of practical engineering experience following graduation from Lehigh University, and after having largely earned his own way throughout his life. He believed that programs for training engineers as conducted in the colleges of the period were inadequate. Principles, he thought, might be studied in the abstract, but their applications should be presented insofar as possible by means of concrete direct observation or experience if students were to be effective in rendering to industry the services for which they were being prepared.

EARLY CONCEPTS

From a study of case records of Lehigh graduates, Schneider found that most of those who had shown marked engineering ability soon after completing their college courses had either worked while attending college, worked during vacations, or stayed out of college a semester or a year in order to earn money to continue their education. This led him directly to the idea that the engineering student, instead of waiting until completion of his college course to enter industrial employment, might start such employment on a part-time basis while still in college and make the work a recognized part of his educational program. He visualized a new kind of institution which would offer a combined theoretical and practical training designed to give the student a foundation in the basic principles of science, the ability to use these principles in practice, an understanding of engineering in general as well as of one special department, a working knowledge of business forms and processes, and a knowledge of men as well as of matter.

PLANNING THE CINCINNATI PROGRAM

In 1903 Schneider joined the staff of the University of Cincinnati as assistant professor of civil engineering. He immediately began trying to interest industrial executives of the city and the officials of the university in his proposed plan of engineering training. The enrollment of the engineering school was then 97, as compared with 431

in liberal arts. Cincinnati at that time was rapidly developing as an industrial center, and the Cincinnati manufacturers, like industrial leaders in other parts of the country, recognized the lack of practical knowledge in the engineering graduates who came to them for employment. Many of them believed that it was time for the colleges to do something about this deficiency.

Professor Schneider proposed that industry itself should do something about it—or at least that industry should work with the college to provide a more practical method for training engineers. An expanding industry, he pointed out, would need a growing supply of engineers, supervisors, and administrators. He argued that the fundamental theory taught these men by the college would mean more to them if they could study the use of that theory in industrial practice, beginning with elementary processes and continuing to the most advanced applications. Thus industrial experience and book knowledge would help each other, and students would progress more rapidly in both work and study and would acquire a sound, realistic basis for an engineering career. He cited specific problems to individual manufacturers to suggest the possibilities of effective teamwork between college and the manufacturer.

Schneider got support for this view from an impressive number of manufacturers, and succeeded in "selling" his new idea to a friendly but skeptical faculty. By January 1906 the university's board of directors was ready to begin drafting plans for the new program.

The first students under the cooperative system, in September 1906, started work on the basis of a simple agreement by which they were admitted to the plants of the companies concerned for practical instruction and to the classes of the University of Cincinnati for theoretical instruction. The student agreed to abide by the rules of both the industry and the university, and the student's father agreed to be responsible for the faithful fulfillment of the agreement. Even this simplified agreement was soon dropped in favor of a more informal and more elastic understanding between the parties concerned.

THE PROGRAM DEVELOPS

The first group of co-ops contained 6 pairs of mechanical engineering students, 6 pairs of electrical engineers, and 3 chemical students, 1 chemical student having no alternate. These young men attended college every other week while their alternates were at work. (The job of the student who had no alternate remained vacant while he was in college.) Classwork was repeated by the instructors so that section 2 would receive the same assignments that had been given

during the previous week to section 1. Continuity and smooth alternation in the shop work were made possible by Dean Schneider's supervision, including Sunday conferences with students unable to see him at other times, and by evening or Sunday conferences between paired students who were to change places for the coming week. The shop work was arranged to provide a gradation from simple tasks to more complex ones involving greater responsibility, and for rotation of jobs to insure variety of experience.

In 1919 a cooperative curriculum in commerce was established at the University of Cincinnati, the first addition to the engineering curriculums which the university had been operating on the cooperative plan. The enrollment in the cooperative engineering curriculum had risen at that time to 780 students who were working in 135 different firms. In 1920 the regular 4-year curriculums in engineering were abandoned, and since that time the entire school of engineering has operated exclusively on the cooperative plan.

OTHER INSTITUTIONS ADOPT COOPERATIVE PROGRAMS

Table I on page 7 lists 35 institutions which during the academic year 1953–54 reported active co-op programs leading to degrees. Three of these were established by 1910 or earlier, 6 during the years 1911 to 1920, 6 in the period 1921 to 1930, 4 during 1931 to 1940, 10 in the years 1941 to 1950, and 6 since 1950. One of these discontinued operations for the period 1930 to 1952, and 6 discontinued during World War II.

Nineteen other institutions which established degree co-op programs at various times from 1919 to 1952 have subsequently discontinued them.

Table II on page 8 lists 8 institutions known to be conducting nondegree co-op programs during the academic year 1953–54. One of these programs was established in 1912, 3 others prior to 1935, and 4 since World War II.

Four other institutions which established nondegree co-op programs have subsequently discontinued them.

Thus a total of 66 institutions have established co-op programs since the inauguration of the original program in 1906. Of this number 54 were programs leading to degrees, and 12 were nondegree programs.

Forty-three programs were active during the academic year 1953–54, of which 35 lead to degrees and 8 do not.

Table I.—Status of cooperative programs leading to degrees, 1953–54

Institution	Year program started	Curriculums offered		Cooperative students		Degrees to co-op students, 1953–54		Number of cooperating firms
		Engineering	Non-engineering	Engineering	Non-engineering	Engineering	Non-engineering	
1	2	3	4	5	6	7	8	9
Alabama Polytechnical Institute, Auburn	1937	9	2	300	80	30	5	105
Los Angeles State College, Los Angeles, Calif.	1950	4	5	80	300	0	42	236
University of California:								
Berkeley	1946	5	0	36	0	2	0	15
Los Angeles	1949	5	0	5	0	2	0	4
University of Denver, Denver, Colo.	1944	4	0	8	0	3	0	6
University of Delaware, Newark	1933	1	0	20	0	0	0	3
Stetson University, De Land, Fla.	1951	0	2	0	80	0	0	11
University of Florida, Gainesville	1936	5	0	3	0	0	0	0
Georgia Institute of Technology, Atlanta	1913	7	0	905	0	65	0	285
University of Georgia, Athens	1933	0	3	0	6	0	0	6
Bradley University, Peoria, Ill.	1949	2	0	6	0	2	0	1
Illinois Institute of Technology, Chicago	[1] 1938	4	0	90	0	0	0	28
Northwestern University, Evanston, Ill.	1939	6	0	813	0	101	0	155
Evansville College, Evansville, Ind.	1947	3	[2] 1	126	[2] 0	10	0	18
University of Louisville, Louisville, Ky.	[1] 1935	4	[2] 1	124	6	101	[2] 0	34
Massachusetts Institute of Technology, Cambridge	1919	2	0	98	0	46	0	8
Northeastern University, Boston, Mass.	[1] 1909	5	5	2,033	1,451	238	266	600
University of Detroit, Detroit, Mich.	1911	6	0	1,420	0	219	0	200
General Motors Institute, Detroit, Mich.	1924	2	1	1,673	175	154	28	[4] 161
University of Minnesota, Minneapolis	1909	3	0	97	0	17	0	15
Cornell University, Ithaca, N. Y.	1947	2	0	39	0	37	0	6
Rensselaer Polytechnical Institute, Troy, N. Y.	1945	3	0	46	0	20	0	5
University of Akron, Akron, Ohio	[1] 1914	3	0	240	0	39	0	23
Antioch College, Yellow Springs, Ohio	1921	5	0	70	230	22	120	230
University of Cincinnati, Cincinnati, Ohio	1909	6	6	1,271	1,746	217	208	600
Fenn College, Cleveland, Ohio	1923	6	6	482	417	143	120	313
Drexel Institute of Technology, Philadelphia, Pa.	1919	5	7	1,610	725	200	154	380
Lehigh University, Bethlehem, Pa.	1923	4	0	20	0	0	0	1
St. Joseph's College, Philadelphia, Pa.	1951	0	1	0	105	0	0	0
University of Pittsburgh, Pittsburgh, Pa.	[3] 1910	9	0	154	0	0	0	13
University of Tennessee, Knoxville	1920	5	1	121	27	16	3	43
University of Houston, Houston, Tex.	1948	10	0	285	0	34	0	41
Southern Methodist University, Dallas, Tex.	[1] 1925	4	0	285	0	71	0	48
Virginia Polytechnical Institute, Blacksburg	1923	7	0	218	0	0	0	51
Marquette University, Milwaukee, Wis.	[1] 1910	3	1	130	25	44	13	40
Total		148	51	13,161	5,945	1,813	1,047	3,826

[1] Program suspended during World War II.
[2] Program will start in fall of 1954—not included in totals.
[3] Program newly organized.
[4] Units of General Motors Co.
[5] Program suspended 1930 to 1933.

Table II.—Status of cooperative programs not leading to degrees, 1953–54

Institution	Year program started	Courses offered		Cooperative students		Certificates to co-op students, 1953–53		Number of cooperating firms
		Engineering	Nonengineering	Engineering	Nonengineering	Engineering	Nonengineering	
1	2	3	4	5	6	7	8	9
General Motors Institute, Flint, Mich	1924	0	1	0	435	0	179	[1] 365
Broome County Technical Institute, Binghamton, N. Y	1947	4	0	226	0	62	0	.....
Erie County Technical Institute, Buffalo, N. Y	1947	5	1	578	67	177	28	143
New York City Community College of Applied Arts and Sciences, Brooklyn, N. Y	1947	0	3	0	769	0	190	71
Rochester Institute of Technology, Rochester, N. Y	[2] 1912	3	2	525	191	58	40	59
Westchester Community College, White Plains, N. Y	1947	4	3	331	150	100	(3)	90
Ohio Mechanics Institute, Cincinnati, Ohio	[4] 1933	4	0	215	0	23	0	60
Wyomissing Polytechnic Institute, Wyomissing, Pa	1927	1	0	136	0	23	0	16
Total	.....	21	10	1,810	1,612	443	437	804

[1] General Motors dealerships.
[2] Program suspended 1918 to 1922.
[3] First certificates will be granted in 1954.
[4] Program suspended during World War II.

STATUS OF THE PROGRAM, 1953–54

Tables I and II set forth certain data concerning the cooperative programs which were in operation during the academic year 1953–54, Table I giving data for programs leading to degrees and table II containing similar data for programs which do not lead to degrees.

In column 2 of each table is noted the year in which the program was started in each institution, with footnotes indicating that some programs were suspended during certain periods since that date.

Columns 3 and 4 in each table set forth the number of different curriculums or courses offered in the various fields of engineering and in nonengineering fields by each institution. These are tabulated in detail in tables III and IV.

Thirty-two institutions offered engineering degree curriculums and 14 institutions offered nonengineering degree curriculums (see table I). Twenty institutions offered cooperative degree curriculums *only* in one or more subdivisions of the field of engineering, 3 institutions offered such curriculums *only* in nonengineering fields, and 11 institutions offered both engineering and nonengineering curriculums on the cooperative plan.

In table II it will be seen that 6 institutions offered nondegree engineering courses and that 5 institutions offered nonengineering nondegree courses. Three institutions offered cooperative nondegree

curriculums *only* in one or more subdivisions of the field of engineering, 2 institutions offered such curriculums *only* in nonengineering fields, and 3 institutions offered both engineering and nonengineering nondegree courses.

In columns 5 and 6 in both tables are listed the numbers of students enrolled in cooperative programs in the various institutions, subdivided into engineering and nonengineering. Enrollment in cooperative institutions, as presented in this study, represents the total number of students enrolled in cooperative programs, including those students who are still in the "residence term" of their respective institutions, which in most college programs is one full acadamic year or longer. The figures for the degree programs therefore do not represent the number of students who are assigned to cooperative jobs during the year. They do, however, represent the number of students who expected to complete their college education in this type of program.

Columns 7 and 8 in each table set forth the number of degrees or certificates issued to cooperative students during the academic year 1952–53, subdivided into engineering and nonengineering. The total number of engineering degrees granted to cooperative students constitutes 30 percent of the total undergraduate engineering degrees conferred by the institutions included in this table, while the nonengineering degrees constitute 3 percent of nonengineering degrees conferred by these institutions. Similar comparisons for the nondegree institutions are not available, but nearly all these institutions operate exclusively on the cooperative plan (see table VI).

Column 9 in each table sets forth the number of industrial concerns or governmental agencies which gave employment to cooperative students in each of the institutions during the academic year 1953–54. The general average for the entire group of degree-granting institutions is one firm for each 5.4 co-op students. Similar ratios were: For the year 1928–29 an average of one firm to each 6.2 cooperative students, for the year 1938–39 an average of one firm to each 5.2 cooperative students, and during the year 1948–49 an average of one firm to each 4.9 cooperative students.

Corresponding figures for the nondegree programs are: 1928–29, one employer to 3.2 co-op students; 1938–39, one to 4.6; 1948–49, one to 3.8; 1953–54, one to 4.3.

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Table III.—Undergraduate curriculums leading to degrees offered in cooperative education programs, 1983–84

Institution	1	Engineering																			Nonengineering														
		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
		Aeronautical	Agricultural	Architectural	Chemical	Civil (including structural)	Electrical	Engineering physics	General	Geological	Industrial	Mechanical	Metallurgical	Mining	Petroleum	Science and engineering	Textile	Applied arts	Architecture	Arts	Building construction	Business administration	Chemistry	Commerce	Design	Education	Home economics	Industrial management	Law (Pre-)	Pharmacy	Physical education	Physics	Retail management	Science	
Alabama Polytechnic Institute, Auburn																																			
Los Angeles State College, Los Angeles, Calif.																																			
University of California, Berkeley																																			
University of California, Los Angeles																																			
University of Denver, Denver, Colo																																			
University of Delaware, Newark																																			
University of Florida, Gainesville																																			
Boston University, Boston, Mass																																			
Georgia Institute of Technology, Atlanta																																			
University of Georgia, Athens																																			
Bradley University, Peoria, Ill																																			
Illinois Institute of Technology, Chicago																																			
Northwestern University, Evanston, Ill																																			
Evansville College, Evansville, Ind																																			
University of Louisville, Louisville, Ky																																			
Massachusetts Institute of Technology, Cambridge																																			
Northeastern University, Boston, Mass																																			
University of Detroit, Detroit, Mich																																			
General Motors Institute, Flint, Mich																																			
University of Minnesota, Minneapolis																																			
Cornell University, Ithaca, N. Y																																			
Rensselaer Polytechnic Institute, Troy																																			
University of Akron, Akron, Ohio																																			
Antioch College, Yellow Springs, Ohio																																			
University of Cincinnati, Cincinnati, Ohio																																			
Penn College, Cleveland, Ohio																																			
Drexel Institute of Technology, Philadelphia, Pa																																			

Lehigh University, Bethlehem, Pa.					X	X	X				X																						
St. Joseph's College, Philadelphia, Pa.																															X		
University of Pittsburgh, Pittsburgh, Pa.				X	X	X			X	X	X	X	X	X																			
University of Tennessee, Knoxville				X	X		X			X	X										X												
University of Houston, Houston, Tex.		X	X	X	X	X		X		X	X	X		X																			
Southern Methodist University, Dallas, Tex.					X	X				X	X																						
Virginia Polytechnic Institute, Blacksburg	X			X	X	X					X	X	X																				
Marquette University, Milwaukee, Wis.					X	X					X										X												
Number of institutions offering each curriculum	7	2	3	17	22	26	3	2	1	17	31	9	2	2	2	2	2	1	5	1	12	5	2	1	3	3	2	1	1	2	4	1	5

[1] Curriculum will be offered in fall of 1954.

Table IV.—Nondegree courses offered in cooperative programs, 1953–54

Institution	Engineering							Nonengineering					
	Automotive	Building construction	Chemical technology	Electrical technology	Industrial technology	Mechanical technology	Metallurgical technology	Business administration	Dental and medical technology	Executive assisting	Food service administration	Hotel technology	Retailing and merchandising
	2	3	4	5	6	7	8	9	10	11	12	13	14
General Motors Institute, Flint, Mich.													x
Broome County Technical Institute, Binghamton, N. Y.	x		x	x		x							
Erie County Technical Institute, Buffalo, N. Y.		x		x	x	x	x				x		
New York City Community College of Applied Arts and Sciences, Brooklyn, N. Y.										x		x	x
Rochester Institute of Technology, Rochester, N. Y.			x	x		x					x		x
Westchester Community College, White Plains, N. Y.		x	x	x		x		x	x		x		
Ohio Mechanics Institute, Cincinnati, Ohio		x	x	x		x							
Wyomissing Polytechnical Institute, Wyomissing, Pa.					x								
Number of institutions offering each course	1	3	4	5	3	5	1	1	1	1	3	1	3

Table III is a detailed tabulation showing for each institution the curriculums leading to degrees offered in cooperative education programs during 1953–54. Sixteen different engineering curriculums and 17 different nonengineering curriculums were offered in the 35 institutions which conducted cooperative programs leading to the baccalaureate degree. As might be expected from their close relationship to manufacturing processes, the fields of mechanical and electrical engineering led in the number of engineering curriculums offered on the cooperative basis, followed in order by civil, chemical, industrial, aeronautical, metallurgical, architectural, and engineering physics, and the remaining classifications with fewer than three curriculums each.

In the nonengineering fields the curriculum offered the most frequently is in business administration, although the combined fields of chemistry, physics, and science exceed it in number of offerings. These are followed in turn by curriculums in arts, education, and home economics, and the remaining classifications with fewer than three curriculums each.

A similar tabulation of cooperative courses which do not lead to degrees is shown in table IV. Electrical and mechanical technology are the most frequently offered courses, followed closely by chemical technology. Building construction is the only other course offered by as many as 3 institutions.

In the nonengineering field the only courses offered by as many as 3 institutions are in food service administration and retailing and management. The other courses are offered by only one institution each.

Philosophy and Objectives of Cooperative Education

IN THE EARLY DAYS of the cooperative program, Dean Schneider visited the students at their work, talked with their employers, inspected the educational material connected with the work of each student, noted his progress, and offered suggestions which might help him to get more out of his experiences. Later he assigned these duties to "coordinators," whose duties and qualifications will be discussed in detail on pages 32 and 33.

EARLY EXPERIENCES

The co-op student's direct contact with machinery had an educational value which Dean Schneider considered important. A student could learn *about* a piece of equipment from a textbook. He could inspect it and observe its operation in a school shop. But the tool that he operated in an industrial plant was not an isolated piece of shop equipment or a working model. It was a unit of manufacturing equipment, and its operation was a phase of production. The machine in industrial use suggested to an inquiring mind many technical and economic questions, which the student brought back to college as a part of his "work report."

The work reports were discussed in classes conducted by the coordinator, whose special task was to aid the students in getting the maximum educational value from their industrial experiences. Other students picked up ideas during this discussion and asked questions of their own drawn from other and perhaps different industrial experiences. Complete answers to some of the questions might have to await the student's further observation in industry or his study of advanced courses in college. However, the questions served to arouse the student's curiosity, to direct his thinking along profitable lines, and to definitely motivate his later study.

There were also human interest aspects to the co-op's outside contacts which could not be reduced so readily to questions and answers, but which had no less appeal to his curiosity than the more strictly technical problems. To meet and work with men under

varied and unpredictable conditions, to get along with them, learn from them, to respect them, and to command their respect, these were more than incidental phases of the co-op training, even though they may have been considered byproducts of his practical work.

The faculty found that to conduct this kind of program was not easy. Members of the teaching staff needed to get together to keep up with new developments in the cooperative program and to compare notes on the class work done by the alternating groups of students. Faculty meetings were held regularly and frequently. The necessity for maintaining balance and sequence for the two sections of students emphasized the importance of keeping prerequisites and advanced subjects in order. Attention was also paid to the avoidance of duplications and omissions, to the elimination of purely descriptive material, and to a concentration upon fundamental subjects. The faculty thus conducted a sort of continuous self-survey, in which the dean took an extremely active part, being particularly interested in specific problems of instruction and in general teaching effectiveness.

"ATTAINABLE OBJECTIVES" OUTLINED

About 1912 Dean Schneider and his colleagues attempted to appraise the results obtained from the "outside" work of the cooperative students. Assuming that the operation of the scheme was moderately efficient, the dean and his colleagues outlined a number of advantages (17)[1] which they thought might be classed as "attainable objectives." These are briefly outlined in succeeding paragraphs.

Advantages to the Student

The student's industrial experiences help him to participate intelligently in the shaping of his education in many ways, such as:

(*a*) The practical test of his inclinations and adaptability help him to decide on a suitable type of work.

(*b*) He is stimulated to make original investigations and to learn the practical applications of the theories he is studying in college.

(*c*) His first-hand contacts with other employees and with problems of labor management increase his understanding of the human factors in industry.

(*d*) Industrial discipline helps him to form good work habits and to acquire a feeling of self-reliance and a sense of responsibility.

(*e*) He has an opportunity for partial or perhaps total self-support, and can command a better salary upon graduation than can the "regular" student.

[1] The numbers in parentheses refer to articles, books, or papers listed in the selected references.

Advantages to the Cooperating Firm

The cooperating firm benefits in several ways, among which are the following:

(*a*) Carefully selected employees are trained in company organization and procedures while securing a technical education, without the expense to the firm of maintaining a training school.

(*b*) Experience shows that many of these employees remain with the employing firm after graduation, and that they are qualified to fill important key positions.

(*c*) The exchange of ideas among students, coordinators, and supervisors leads naturally to the university becoming interested in the problems of industry, and ultimately to its becoming a center for basic research in these problems.

Advantages to the College

In addition to the larger service which the cooperative school renders to its students and the employing industries, there are advantages within the school itself, among which the following are outstanding:

(*a*) The double test of academic fitness and industrial suitability speeds up the process of elimination of unqualified students.

(*b*) The industrial contacts of the students permit the elimination of much descriptive technical matter from courses, allowing correspondingly greater emphasis to be placed on fundamental principles.

(*c*) The availability of industrial equipment enables the university to reduce its expenditures for school shops and illustrative models.

(*d*) The alternating periods of shop and college permit a fuller use of the university plant, since many more students can be accommodated when only part of them are in college at one time.

(*e*) Through its intimate relationship with industry the university finds not only a humanising influence, but also a perpetual stimulus to research in the basic principles of science.

"THE COOPERATIVE SYSTEM—A MANIFESTO"

The basic principles of the cooperative system of education as formulated by Dean Schneider and his colleagues still prevail. Modifications in details of administering the program have been made through the years, and the basic principles have been elaborated, but essentially they have not been changed.

In 1946 the Division of Cooperative Engineering Education of the American Society for Engineering Education (at that time the Society for the Promotion of Engineering Education) adopted as the official statement of policy for the division and for the cooperative institutions holding membership in the society, a report entitled "The Cooperative System—A Manifesto" (1).

The manifesto sets forth the belief that "the cooperative college is not distinct from others as far as its ultimate purposes are concerned.

Both cooperative and noncooperative colleges seek identical ultimate educational aims." It declares that the cooperative colleges of engineering accept and fully subscribe to the aims set forth in the report of the A. S. E. E. Committee on Aims and Scope of Engineering Curricula (11) in 1940, and repeated by the Society's Committee on Engineering Education After the War, in 1944 (12). These reports, both of which were officially adopted by the society, listed the basic scientific-technical and humanistic-social aims of engineering education.

The manifesto then discusses at some length five additional auxiliary purposes "which are peculiar, or at least especially appropriate to the cooperative institutions, and which serve as means to the ultimate ends of engineering education. * * * These do not and could not possibly include all the particular aims of all the cooperative colleges. * * * [but] only those which are common to the cooperative schools and upon which they can and do agree."

1. To impart first hand an actual knowledge of and experience with the execution in industry of engineering designs, projects and developments.
2. To impart understanding of and familiarity with the problems and viewpoints of working men and women.
3. To assist students, by direct and personal experience in industry, to test their aptitude for engineering careers.
4. To enable engineering students to adjust themselves to engineering employments by gradual and easy transition from academic pursuits and mode of life to the requirements and conditions of industry.
5. To train and otherwise prepare students especially and directly for the administrative and operating functions which, to a greater or less degree, enter into most engineering careers.

The S. P. E. E. Report of the Investigation of Engineering Education (29, 30) pointed out some of the deficiencies "necessarily inherent in engineering training because materials, forces, dimensions and quantitative methods are the objective of engineering work." The report continued:

> These deficiencies cannot be corrected in college; they can possibly be corrected by daily work and contact with men, machines and structures.
>
> The cooperative plan obviously does not provide complete executive training, but it does afford an opportunity for intimate work with men and with equipment, the kind of opportunity which the average continuous engineering student cannot easily obtain until after graduation and which he probably will not obtain at all because after graduation the attraction of office work will be too compelling. * * * The attributes of the cooperative plan in developing particular personal traits and points of view, together with the orientation to industrial organization which it affords, would seem to indicate that it is particularly advantageous as a means of developing personnel for the administrative and operating side of industry. This, indeed, seems to be the peculiar merit of the system which is indicated most clearly.

Administrative and Operating Requirements

CERTAIN MINIMUM CONDITIONS of operation and administration must be fulfilled by the cooperative college if the objectives of the co-op plan are to be fully realized.

SUPPORT OF INSTITUTIONAL ADMINISTRATION

It is essential to the success of a cooperative program that the administrative and teaching staffs of the institution endorse and support the plan and those responsible for its administration. The operation of the plan affects not merely the academic departments, but the personnel offices, the business offices, the extracurricular undertakings, the registrar or recorder, and even the athletic offices. Hence, nothing less than the authority and the influence of the highest officers of the institution will fully sustain the plan.

The support of the highest officers is especially important if the institution operates only part of its program cooperatively, in which case the cooperative plan must be closely integrated with the basic curriculums and program of the institution, and should not be considered as being on a different level from the school's full time program. This integration must be recognized and endorsed by all concerned, faculty, students, and employers.

Some institutions have found it useful to organize a cooperative work committee consisting of representatives of the administration, the degree-granting departments, and the coordination department to serve in an advisory capacity to the coordinators in establishing policies, in evaluating cooperative jobs for their educational value, in selecting students for their respective jobs, and in evaluating student experiences.

EMPHASIS ON EDUCATIONAL VALUES

Everyone connected with the co-op program, faculty members, students, and employers alike, must be thoroughly familiar with the basic concepts and objectives of the cooperative system and constantly on the alert to seek their attainment. The most important of

these concepts is that educational and training values must be the paramount considerations in the placement of students. Earnings, convenience of location or transportation, working conditions, and personal preferences of the student must yield to educational advantages if these advantages cannot otherwise be achieved.

Each job much yield educational values, must fit the student's field of study, vocational aims, capacities, interests, and personality, and must supplement and vitalize his theoretical instruction. There must also be a proper sequence of jobs, designed to constitute a steady progression from subordinate tasks, directly in contact with labor and raw materials of production, into positions of responsibility in management, design, accounting, or some other phase of industry, in which a complicated process is seen as a whole.

Care should be taken not to deny consideration of industrial assignments merely because they seem to duplicate experience which the student can acquire on the campus. An assignment to an industrial laboratory may have no more educative value than the student could gain equally well on the campus. Even if it does not, a factory assignment may do more to fulfill the larger purpose of the cooperative plan. He may learn as much science and technique as on the campus, and at the same time learn something about organization, operations, human relations, and responsibilities which characterize the successful industry, and which are difficult to portray properly on the campus.

Above all, the student must be inspired to make the most of his work experiences, to gain not only technical knowledge, but also social and economic knowledge which will tend to make him a more valuable and more capable citizen than he would be without it.

RESPONSIBILITIES OF EMPLOYERS

It is essential that the executives and supervisory personnel of cooperating firms understand and endorse the basic objectives of the cooperative system as an *educational program*. On the one hand, there must be no exploitation of the student by the employer, who must not sacrifice educational purposes of cooperative employment to his immediate employment needs. On the other hand, the student must meet all employment requirements and should not be in any way privileged, nor should he expect to be.

Obviously, the employer must derive some advantages from participation in the plan; but he should look to the long-term rather than the immediate benefits. Rather than regarding the program merely as a means of establishing a rich source of future technical personnel, the industrialist might well take the broader view that all industry, including his own, will be improved if the general usefulness of graduate engineers can be increased.

SUPERVISION OF EMPLOYMENT

One of the most important tasks of those in charge of cooperative programs is the establishment and maintenance of adequate controls to insure that the responsibilities of the employer are recognized and accepted as administrative policies and that these policies are properly implemented by the operating personnel to whom the co-op student is immediately responsible. This requires that the employment experiences of co-op students be as closely supervised as their academic work. The college must maintain a well-organized service to counsel these students concerning their employment relations as well as their academic progress and difficulties. This service should be competent, sympathetic, and convenient to the students. It should include:

1. Frequent check, preferably personal, with each student's employer and, if necessary, with the student's immediate supervisor.
2. Regular conference with the student concerning progress, employment conditions, and character of his duties.
3. Thorough employment reports and records, including name of employer, type of work, caliber of performance, hours completed, wages earned, difficulties experienced and solved, and other significant data.

Adjustment must be made for cycles of industrial booms and depressions—always a major problem in the administration of a cooperative plan. The following have been suggested by coordinators as useful adjustment devices:

1. Rendering to the employer such effective service that he will wish to maintain student employment at full strength during dull periods.
2. Limiting co-op enrollments during periods of peak production, to avoid the dismissal from jobs of many students with the first slight business depression.
3. Placing as many students as possible in long-established and stable types of industry in which employment fluctuation is not severe.
4. Reducing the employment hours of all students rather than laying off a few while the remainder continue fully employed.
5. Spreading employment at all times over as many employers as possible, consistent with efficient supervision by college officials.
6. Inducing employers during dull periods to undertake special, long-term development projects in which students can be advantageously engaged.
7. Allowing limited cooperative work credit (nonacademic) for diligent and intelligent efforts on the part of the unemployed student to find work on his own initiative.
8. Searching aggressively for employment openings.

Granted the cooperation of the employer and the endorsement and support of the college administration, employment programs can be arranged so that each student will obtain the maximum benefit possible with respect to his individual objectives.

Patterns of Organization and Administration

IT HAS BEEN one of the cardinal principles in the development of American education that each institution shall organize its work in the light of its own peculiar circumstances of location, support, and clientele. In conformity with this tradition, the cooperative programs in the various institutions, while exhibiting the same basic philosophy, objectives, and operating requirements, have developed with many differences in details of organization and administration.

An attempt will be made to present the essential elements in the various types of programs now in effect, and to synthesize them into a representative pattern of the organizational and administrative plans now in use for the conduct of cooperative educational programs. Complete details regarding individual programs may be found in catalogs and descriptive booklets which are published by the cooperative colleges.

ADMINISTRATIVE PATTERNS

Table V outlines the administrative patterns of the 35 institutions which in 1953–54 granted degrees for the completion of cooperative programs. Table VI gives similar information for the 8 institutions which conducted cooperative courses not leading to degrees. The two tables will be discussed together.

In both tables the notation (Co-op) after the name of an institution indicates that its instruction is offered exclusively on the cooperative plan. The notation (Both) means that both the cooperative and the regular plans are used.

Table V shows that 9 degree-granting institutions operate exclusively on the cooperative plan, while 26 institutions conduct the cooperative plan and the regular plan side by side. In a few of these institutions there is a small difference between the academic work required of cooperative students and that required of regular students, the difference consisting of excusing the cooperative student from a small amount of laboratory work which the regular students are required to do.

Table V.—Administrative patterns in cooperative education—programs leading to baccalaureate degrees

Institution, operation, student assignment	Operating schedule	Number of weeks assigned						
		1st year	2d year	3d year	4th year	5th year	6th year	Total
1	2	3	4	5	6	7	8	9
Alabama Polytechnic Institute (both):								
School [1]	Quarter	24	24	24	24	24	24	144
Work periods	do	24	24	24	24	24	24	144
Los Angeles State College (both):								
School [1]	Semester	36	36	36	36			144
Work periods	Part-time work	(2)	(2)	(2)	(2)			(2)
University of California, Berkeley (both):								
School [1]	6- and 16-week terms	32	22	22	22	32		130
Work periods	12 weeks	0	26	26	26	0		78
University of California, Los Angeles (both):								
School [1]	Semester	48	30	30	30			138
Work periods	do	0	18	18	18			5
University of Denver (both):								
School [1]	Quarter	32	32	32	32	32		122
Work periods	do	0	0	26	26	26		78
University of Delaware (both):								
School [1]	12- and 16¼-week terms	32	28½	32½	30			128
Work periods	14 and 20 weeks	14	18	20	0			52
University of Florida (both):								
School [1]	Semester	24	(3)	(3)	(3)	(3)		128
Work periods	do	0						(3)
Stetson University (both):								
School [1]	8- and 18-week terms	26	18	26	18	26	18	122
Work periods	8 and 18 weeks	18	26	18	26	18		106
Georgia Institute of Technology (both):								
School [1]	Quarter	22	22	22	22	44		122
Work periods	do	27	27	27	27	0		108
University of Georgia (both):								
School [1]	do	24	24	24	24	24	24	144
Work periods	11 to 12 weeks	24	24	24	24	24	24	144
Bradley University (both):								
School [1]	Semester	36	36	0	36	36		144
Work periods	12 weeks	0	12	48	12	0		72
Illinois Institute of Technology (both):								
School [1]	8- and 17-week terms	25	17	26	17	25	17	126
Work periods	8 and 17 weeks	17	25	17	25	17		101
Northwestern University (co-op):								
School [1]	Quarter	26	26	22	22	22		122
Work periods	do	0	13	26	26	13		78

Evansville College (both):									
School [1]	do	48	24	24	24	24			144
Work periods	do	0	24	24	24	24			96
University of Louisville (co-op):									
School [1]	do	33	33	22	22	44			154
Work periods	do	0	0	28	28	0			56
Massachusetts Institute of Technology [4] (both):									
School [1]	Semester	34	34	24 or 17	17 or 24	24 or 17			153
Work periods	17 weeks	0	0	17 or 34	34 or 17	17 or 34			68
Northeastern University (both):									
School [1]	5- and 10-week terms	30	25	25	25	25			120
Work periods	10 and 15 weeks	0	26	26	26	26			104
University of Detroit (co-op):									
School [1]	Quarter	39	39	26	26	26			156
Work periods	do	0	0	26	26	13			65
General Motors Institute (co-op):									
School [1]	4- and 8-week terms	24	24	24	24	8			104
Work periods	4 and 8 weeks	24	24	24	24	44			140
University of Minnesota (both):									
School [1]	Quarter	33	33	22	22	22			132
Work periods	11 weeks	0	0	22	22	22			66
Cornell University (both):									
School [1]	Semester	33	33	20	16	48			160
Work periods	14 to 19 weeks	0	0	19	31	0			50
Rensselaer Polytechnic Institute (both):									
School [1]	Semester	34 or 48	34	17 or 34	34				136
Work periods	14 to 18 weeks	0	17 or 0	32 or 0	0 or 13			45 to	49
University of Akron (co-op):									
School [1]	Half semester	34	42	24	16	25			141
Work periods	10 weeks	0	0	21	31	10			61
Antioch College (co-op):									
School [1]	8- and 12-week terms	20	20	20	20	20			100
Work periods	8, 12, and 17 weeks	26	26	26	26	26			130
University of Cincinnati (co-op):									
School [1]	7- and 14-week terms	35	21	21	21	25			123
Work periods	8 and 10 weeks	10	25	25	25	8			93
Penn College (co-op):									
School [1]	Quarter	33	22	22	22	33			132
Work periods	13 weeks	13	26	26	26	13			104
Drexel Institute of Technology (both):									
School [1]	Quarter	36	24	24	24	24			132
Work periods	do	0	24	24	24	12			84
Lehigh University (both):									
School [1]	12- and 15-week terms	30	30	27	30				117
Work periods	12 weeks	0	12	12	12				36
St. Joseph's College (both):									
School [1]	12- and 16-week terms	32	32	28	28				120
Work periods	12 and 16 weeks	0	0	16	28				44
University of Pittsburgh (both):									
School [1]	Semester	(3)	(3)	(3)	(3)	(3)	(3)		140
Work periods	12 and 16 weeks								Varies

See footnotes at end of table.

Institution, operation, student assignment	Operating schedule	Number of weeks assigned						
		1st year	2d year	3d year	4th year	5th year	6th year	Total
1	2	3	4	5	6	7	8	9
University of Tennessee (both):								
School [1]	Quarter	36	24	24	24	36		144
Work periods	do	12	24	24	24	0		84
University of Houston (both):								
School [1]	Semester	(3)	(3)	(3)	(3)	(3)		144
Work periods	Semester, day, half day							36 to 72
Southern Methodist University (co-op):								
School [1]	8-week terms	42	24	24	24	16		130
Work periods	8 weeks	0	26	26	26	16		94
Virginia Polytechnic Institute (both):								
School [1]	Quarter	22	22	22	24 or 22	24 or 45		157
Work periods	13 weeks	26	26	26	18 or 20	0		90 or 104
Marquette University (both):								
School [1]	Quarter	22	22	22	22	22		132
Work periods	do	0	0	26	26	13		65

[1] Including examinations.
[2] Varies. Maximum of 2 units academic credit per semester granted for industrial work.
[3] Starting time of co-op program is optional.
[4] Data covers EE curriculum. ME requires 1 industrial period of 5 to 6 months plus regular ME curriculum.
[5] For engineering students. For nonengineering subtract 11 weeks.
[6] Simultaneous part-time work and part-time study for 6 to 7 years.

Table VI.—Administrative patterns in cooperative education programs not leading to degrees

Institution, operation, student assignment	Operating schedule	Number of weeks assigned				
		1st year	2d year	3d year	4th year	Total
1	2	3	4	5	6	7
General Motors Institute (co-op):						
School [1]	4- and 8-week terms	24	24	.....	.....	48
Work periods	4 and 8 weeks	24	24	.....	.....	48
Broome County Technical Institute (both):						
School [1]	Quarter	36	36	.....	.....	72
Work periods	do	14	14	.....	.....	28
Erie County Technical Institute (co-op):						
School [1]	do	39	39	.....	.....	78
Work periods	do	13	13	.....	.....	26
New York City Community College (co-op):						
School [1]	do	34	34	.....	.....	68
Work periods	10 weeks	10	10	.....	.....	20
Rochester Institute of Technology (co-op):						
School [1]	Quarter	36	24	24	.....	84
Work periods	do	12	24	24	.....	60
Westchester Community College (co-op):						
School [1]	Semester	36	36	.....	.....	72
Work periods	do	0	15	.....	.....	15
Ohio Mechanics Institute (co-op):						
School [1]	4- and 8-week terms	21	21	.....	.....	42
Work periods	4 and 8 weeks	26	21	.....	.....	47
Wyomissing Polytechnic Institute (co-op):						
School [1]	8- and 4-week terms	22	22	11	0	55
Work periods	8 and 4 weeks	30	30	41	52	153

[1] Including examinations.

Table VI shows that among the non-degree-granting institutions 7 are organized exclusively on the cooperative plan, while one maintains both cooperative and regular courses.

The original cooperative program established by Dean Schneider provided weekly alternation between academic and work periods throughout the 6 years required for graduation. There has been a general tendency through the years to increase the length of the periods of alternation, until at the present time the majority of cooperative institutions operate on a period of alternation of approximately 3 months.

The seasonal needs of the industries being served may influence the operating schedule of the institution. It is generally found advisable to provide a reasonably constant supply of co-op students throughout the year rather than to concentrate them in the summer when they will be in direct competition with the students in non-cooperative institutions.

Column 2 in tables V and VI indicates the variations in the operating schedules of cooperative institutions, as to both the academic and industrial phases of the program.

ACADEMIC CALENDAR

Among the 9 degree-granting institutions which offer curriculums exclusively on the cooperative plan, none operate on the semester

plan, 4 on the quarter plan, and 5 on some other basis. Of the 26 institutions which conduct both co-op and regular engineering curriculums, 9 operate on the semester plan, 10 on the quarter plan, and 7 on some other plan. Among the non-degree-granting institutions, 1 operates on the semester plan, 4 on the quarter plan, and 3 on some other plan.

LENGTH OF WORK PERIODS

If the institution is not operating exclusively on the co-op plan, the periods of co-op alternation are generally fitted into the regular academic schedule in the interests of simplicity of administration and minimum costs.

There is a wide variation in the length of work periods, shown in column 2 of tables V and VI, from a half day to a semester. It should be noted that in addition to the periods of alternation as shown in the table many institutions will, upon request of the employer, make provisions for "double periods" for individual students, allowing them to retain a job in industry for twice the stated period.

The distances between the institution and cooperating industries may affect the desirable periods of alternation. In general a longer work period will increase the distance co-op students can advantageously travel to jobs. Too long a period may adversely affect the student's academic work.

Institutions choosing the shorter periods of alternation generally do so with a view to minimizing the effects of discontinuity of instruction. They feel that the student is better able to take up classwork at the point where he left off at the end of a previous college period if his period in industry is relatively short.

The longer period is frequently chosen to permit co-op students to complete certain subjects or major divisions of subjects during a single period in college, and to allow them greater opportunity to participate in campus activities. The longer period also has advantages to industry, since it requires less frequent changes in personnel, and thereby reduces training expense and overhead costs.

The advantage of the quarter plan for the cooperative institution is obvious, since it permits splitting the calendar year into four equal or nearly equal periods plus a short vacation period, and permits the institution to have only about half of its upperclass students in classes at any one time. It also results in the two members of a team having the same length of industrial period, and thereby provides greater uniformity of working conditions in industry.

A good case can be made for a schedule based on three terms during the year, which permits synchronization with a semester plan of

operation in case the institution is not operating exclusively on the cooperative plan. For example, at Cornell University the regular engineering curriculums leading to bachelor's degrees consist of 5 years or 10 semesters. The co-op students follow the same curriculums as the regular students, and in addition complete three industrial periods of approximately 4 months each following the completion of their second academic year, utilizing the periods which for the regular students are set aside for vacations. An ingenious plan of scheduling (30) enables the institution to offer during these periods only the subjects regularly scheduled in semesters 5 and 8. The co-op students attend the same classes as regular students during semesters 6, 7, 9, and 10.

LENGTH OF CURRICULUMS

Columns 3 to 8 in table V and columns 3 to 6 in table VI indicate for each institution the number of years required for completion of its cooperative program, and the actual number of weeks of academic and industrial work during each calendar year. In column 9 in table V and column 7 in table VI is shown the total number of weeks of school, including examinations, and the total length of work periods, required for the completion of cooperative programs in each institution.

In 6 of the 35 degree-granting institutions the cooperative curriculum can be completed in 4 years. In 24 of the institutions 5 years are required to complete a cooperative curriculum, and 5 institutions require more than 5 years. In the non-degree-granting institutions the time required is 2 years in 6 institutions, 3 years in 1 institution, and 4 years in 1 institution.

EXTENT OF COOPERATIVE WORK

The majority of degree-granting cooperative institutions require students to complete the freshman year in the classroom before entering on cooperative employment. This has many advantages, both to the institution and to the student. It permits a general grounding in business and industrial problems as well as in first aid, industrial safety, hygiene, health, etc. It serves as an additional screening beyond the entrance requirements of the institution and enables the officials of the institution to have much greater confidence in the student's ability than they have at the time of his admission. They are naturally anxious not to recommend a student for employment unless they feel reasonably sure that he is able and willing to "make good on the job." Opportunity is given for the student and his teachers and coordinators to discover his interests, abilities, and general qualifications, and coordinators are almost unanimous in feeling

that they can make placements with much greater satisfaction to all concerned after this preliminary period of classroom attendance.

Several institutions delay the beginning of cooperative work until the student has completed two full academic years of study. This provides still greater selectivity and gives the college authorities even more assurance that they can make intelligent placement of their co-op students.

In some institutions admission to the cooperative program is open only to students who have attained a certain specified grade average or class rank during the first year, or the first 2 years, of college.

Several institutions require students to devote a larger proportion of their times to class attendance during the senior year than in earlier years. A few schedule no industrial work in the senior year.

Variations in the amount and distribution of cooperative work required in different institutions are set forth in columns 3 to 9 in table V and in columns 3 to 7 in table VI.

COORDINATION

By far the most important elements in the organization and administration of the cooperative educational plan are the functions performed by the persons called coordinators. These persons, who are members of the school staff, serve as a combination of placement bureau, job supervisors, student counselors, labor mediators, scheduling officers, curriculum builders, and teachers. The success or failure of the cooperative plan depends largely upon their intelligence, initiative, industry, and ability to inspire students. In the larger institutions, especially those which operate entirely on the cooperative plan, will be found not merely one coordinator, but a staff of coordinators, and perhaps even a dean of cooperative education.

EARLY PROGRAMS OF COORDINATION

Dean Schneider, in his earliest speaking and writing about the cooperative system, even before its inauguration at the University of Cincinnati, spoke of the traveling coordinator. This person, he anticipated, would question the students at their work to see if they were duly observing details, would point out applications of theory already learned or later to be studied, and would collect shop problems for the use of classroom instructors.

During the early days of the program, coordination was carried on personally by Dean Schneider, but as the number of students grew, he relinquished some of this work and soon engaged a full-time coordinator, Prof. C. C. Myers.

Max B. Robinson, dean of personnel services at Fenn College, was one of the original co-ops at Cincinnati, and later served as a "cub" coordinator under Professor Myers. Dean Robinson has said (20):

> In those days, it became regular practice to visit students on jobs at frequent intervals and the coordinator was as familiar with the superintendent, foreman or straw boss as is the present-day coordinator with the chief engineer and personnel or training director. Taking 10 or 15 minutes of the student's time on the job to stimulate observation or explain difficulties was not objectionable because it aimed at developing a better man for company responsibility later on.

Professor Myers took many notes and developed hundreds of "shop problems" illustrating practical applications of mathematics, descriptive geometry, engineering drawing, physics, chemistry, mechanics, strength of materials, hydraulics, economics, labor relations, and general management. These in turn were assigned either to students for solution in coordination class work or to instructors of the various courses for such use as they saw fit.

PROGRAMS OF COORDINATION

With the increased complexity of modern industry and the great variety of work done by cooperative students, it would be almost impossible for any one coordinator to be a specialist in all the types of work in which his students are engaged. In addition, in many plants visits to students on-the-job would be forbidden by the management, and even if permitted might make the student unpleasantly conspicuous in the eyes of his co-workers. The following devices, however, are in use in cooperative schools today and have been found to be practicable and effective in helping the student to get the greatest educational value from his industrial experience.

Orientation class.—A course designed to provide general orientation to industrial employment has proved helpful in preventing embarrassing errors by students. Such a course is usually conducted for one or more terms or semesters of the freshman year, prior to the start of industrial employment. It generally includes instruction in first aid, safety, industrial hygiene, and other industrial problems and practices, an understanding of which will help the students to perform more smoothly on the job and to gain values which otherwise they might miss.

Coordination class.—After students have started their co-op employment, an occasional meeting of a "coordination class" gives opportunity for the interchange of practical experience, and for preparation and stimulation for the next period of employment. Oral or written work reports by members of the class aid in the identification of values received from work experience and present

problems for discussion and attempted solution by the group. Oral reports by students have proved particularly interesting and effective, especially if written outlines are submitted to the instructor in advance so that he may be ready with questions and related material.

Work syllabus.—A "work syllabus" is an outline of the types of experience the student is expected to gain on a particular job, generally formulated as a series of questions. The student is expected to obtain the answers through direct observation, suggested text material, company catalogs and advertisements, and other sources. The answers to these questions might well be checked by the professor whose field and background are related most closely to the work of the student.

Work reports.—The basic principle of cooperative education is that a combination of academic study and practical experience will produce a better graduate than either one can do alone. It is easy to assume that the student will gain the full educational benefits of his practical experiences if he is merely placed on worthwhile jobs. The benefit he derives, however, will depend to a large degree on the extent of his motivation for exploring the values in his working environment, for evaluating for himself his job experience, and for providing the necessary synthesis of classroom theory and industrial practice.

The student's "work report" is probably the most logical basis for this motivation. Coordinators generally agree that some formal work report, either oral or written, should be required from every student for every cooperative work period, in such form that its preparation will consume an appreciable amount of the student's time and necessitate some careful work. The specifications for the report usually make it necessary for the student to begin organizing his report early in his work period, to analyze his job, to cultivate the habit of close observation, to extend personal contacts, and generally to increase his usefulness and the value of his experience.

Job supervisors who understand the true purpose of the "work report" often cooperate with the student and frequently ask to see the finished report, which generally indicates interest in the student's development much more than it indicates any fear that confidential or embarrassing information may be disclosed.

It is frequently recommended that the reports from any one student should be varied in type, but that all of them should conform to acceptable standards of composition. Some schools require submission of written reports to the department of English for grading from the standpoint of organization and composition. Some utilize oral reports as exercises in public speaking, in which the student is coached on methods of delivery as well as being graded on the organization and technical correctness of his report.

Such reports as have been briefly described above constitute a dynamic part of the process of education and provide information and stimulation to the student himself, his fellow students, his teachers, employers, and coordinators, especially if teachers are encouraged to use the reports in classes, personnel conferences, and in relations with employers and with other students.

Employer evaluation of student.—Another device which has been found practicable and effective in helping the co-op student realize the fullest educational benefit from his industrial experiences is the evaluation of the student by his employer, which is required in one form or another by most cooperative colleges. Such evaluations, carefully made out by conscientious work supervisors, can be of tremendous value to students and counselors. Some institutions have regular report forms which they request the employer to use. Others simply ask for informal statements from the student's immediate supervisor. Still others combine the two methods.

The form of the employer's report is much less important than the methods used to interpret to the student his performance and progress. The greatest value of the report lies in the encouragement of work supervisors to deal directly with students in giving them judgments of their work and suggestions for improvement. Such appraisal of the student's cooperative work is so valuable to the student and to the college that the coordinator can well afford to devote considerable time and energy to personal discussions of students and their work with work supervisors.

Placement of students in co-op employment.—Coordinators generally agree that it is desirable for a student, particularly in the early part of his course, to secure a variety of jobs to aid him in determining his fitness and liking for some particular kind of work, or as one coordinator has phrased it, "to find out some of the things he doesn't want to do." Many of the more capable and farseeing students, however, realize that their education will not cease with graduation and are anxious to secure employment with companies which have well-organized and efficient training programs. From this viewpoint they are anxious to get started as early in their careers as possible with a good company, and to stay with it.

It is important that for each co-op student a properly graded sequence of jobs be arranged which will parallel his theoretical instruction and constitute a steady progression from subordinate tasks into positions of technical or administrative responsibility. Such sequences are indicated on pages 33 to 35.

One criticism that has been leveled against the cooperative system is that the student loses the experience of finding his own job, since the coordinator places him with a firm. While it is true that in most

cases the coordinator does place the co-op student, the employer is usually chosen on the basis of the expressed desires of the student himself, either for a particular employer or for work in a particular industrial or governmental area. In other words, the placement is generally a cooperative effort of the student and the coordinator to find the work for which the student will be best suited, and in which he will be happiest. Furthermore, the usual practice in co-op colleges is to require the student to report to the employer for an interview in which he must "sell himself" just as any other applicant for work must. The employer is at liberty to reject the student and to ask for another candidate. However, because of the screening done by the coordinator, and the advice and counsel he gives the co-op student, the co-op represents a better-than-average risk for his employer.

THE COORDINATOR

The college official responsible for the cooperative relations of the institution and of the students is usually called the "coordinator." He ordinarily has the status of a director or department head, reporting to the dean, but exercising wide discretion in carrying out his duties. In many of the larger institutions there is a staff of coordinators, who may form a "department of coordination." Except in the institutions which have only a few co-op students, the coordinators will have no other duties.

QUALIFICATIONS OF A COORDINATOR

The "Manifesto," (1) lists the following qualifications, "in addition to those which are taken for granted in any college official," which the successful coordinator of an engineering program should possess:

(1) Engineering education or wide engineering or industrial experience.
(2) Sympathetic attitude toward students and young people.
(3) Information and experience concerning personnel procedures and techniques.
(4) Vocational information in the fields of engineering and industry.
(5) Willingness promptly to solve problems as they arise, without regard to personal convenience, office hours, work routine, etc.
(6) Ability to solve problems completely without compromise of principle, indecision, evasion, or timidity.
(7) Fairness, tact, and skill in dealing with students, employers, and faculty.
(8) Buoyant, optimistic, and confident attitude in the face of difficulty and disappointment.
(9) More than usual resourcefulness in appraising a complex situation and in revising plans and procedures accordingly.
(10) Ability to adhere to standards and principles under widely changing and complex situations.
(11) Large capacity for friendship.

WORKLOAD OF A COORDINATOR

A study of the work of coordinators in 17 colleges (5) revealed that the number of students placed by one coordinator in one placement period varied from a low of 8 in one institution to a high of 250 in another, the average being 59, and the modal figure 50. Among the institutions which place 100 or more students in each period, the average was 83 students per coordinator, although the modal figure was again 50. Nearly all the respondents believed that no coordinator should be responsible for more than 100 students, indicating a desire to furnish individual attention to each student and each cooperating company.

This study showed that 4 institutions assign the function of admissions officer to their coordinators, and that 7 put graduate placement in his office. Of the 17 colleges, 10 required some form of teaching duties of their coordinators, while 7 did not. The majority of the colleges expected their coordinators to assist the public relations office of the institution, chiefly by making addresses to high schools, service organizations, trade associations, and the like.

Ten colleges reported that their coordinators visit each of their students on the job each term; six reported such visits being made every other term, while one reported visits only in case of trouble on the job. However, on trips of more than one day away from the campus, in the interest of economy, it seemed to be the general practice for *one* coordinator to make all company and cooperative placements in an area, regardless of usual coordinator, student, or company assignment.

CO-OP JOB SEQUENCES AND STUDENT EARNINGS

A small number of the larger cooperative institutions were asked what kinds of jobs their cooperative students hold in each year of each curriculum, and the kinds of industries in which these students work. A combination of the lists prepared by the coordinators in two large institutions in metropolitan centers is presented below, in the belief that it gives a reasonably representative, although not all-inclusive, picture of the kinds and sequences of jobs held by co-op students.

Chemical Engineers

Sophomore	Production operations, physical and chemical analytical testing.
Prejunior or middler	Sampling, physical and chemical laboratory control, testing, erecting and maintaining control and production equipment, drafting.
Junior—senior	Production control, process supervision, library research, development, research, pilot plant operator.

Civil Engineers

Sophomores	Chainman, rodman, draftsman, computer, inspector.
Prejunior or middler	Instrumentman, draftsman, computer, inspector.
Junior	Chief of party, instrumentman, inspector, elementary design and estimating.
Senior	Detailer, designer, estimator, inspector, field engineer.

Electrical Engineers

Sophomore	Shop operations, electrical repair and construction, assembling, installing, drafting, testing, maintenance.
Prejunior or middler	Inspecting, testing, development laboratory, production, test, maintenance and repair, drafting, estimating, design.
Junior	Diagramming, computing, standardising, estimating, testing and development laboratory, assistant field engineer.
Senior	Detailing, sales quoting and correspondence, development, application, production, design engineering.

Industrial Engineers

Sophomore	Production operations, drafting, assembly.
Prejunior or middler	Inspecting, maintenance, drafting, layout.
Junior	Stock control, cost study, quality testing.
Senior	Time and motion and methods study, estimating, product engineering.

Mechanical Engineers

Sophomore	Machine tools and/or foundry operations, drafting, installing, assembling, maintenance.
Prejunior or middler	Inspecting, plant maintenance operations, layout, drafting, research assistant.
Junior	Laboratory and production testing, detailing, stock control, calculations.
Senior	Planning, estimating, standards setting, design, production engineering, testing, development and research.

Metallurgical Engineers

Sophomore	Inspection, drafting, research assistant.
Prejunior or middler	Research assistant, production control assistant, assistant in development division.
Junior	Inspection, development and research.
Senior	None yet assigned, metallurgical program only 3 years old.

Commerce and Engineering

Sophomore	Drafting, production assistant, cost accounting trainee.
Prejunior or middler	Production assistant, cost accounting, time and motion studies, wage analyses.

Junior	Cost accounting, quality control, testing and inspecting.
Senior	Cost accounting, sales, administration, methods engineering.

One of the coordinators furnished similar lists of typical jobs for cooperative students in the fields of business administration, retail management, and home economics. These lists exhibit a similar diversity of experience and a similar progression from simpler to more complex jobs, with accompanying increases in responsibility and authority.

In the cooperative engineering courses which do not lead to degrees, a combination of job lists prepared by coordinators of two large institutions indicate that the following types of cooperative jobs are being filled by their students:

CHEMICAL: Laboratory assistant, apprentice technician, clerk, tester, laboratory technician, assistant metallurgist.

ELECTRICAL: Tester's helper, repairman's helper, apprentice draftsman, production work, machine tool operator, clerk, assemblyman.

INDUSTRIAL: Machine tool operator, clerk, assembler, instrumentman.

MECHANICAL: Clerk, tracer, assistant inspector, machine tool operator, laboratory assistant, time study assistant, sheet metal worker, assembler.

As to the industries served, one coordinator reported that most of the industries employing his students are in the medium to large category, but that about 40 percent of his students are working in industries employing fewer than 100 people. Two other coordinators gave lists of typical industries served, which almost constitute a cross section of American industry, Government, and education. In the manufacturing field the smaller companies predominate.

Another coordinator replied "with some 450 firms and every type of firm you can imagine, I frankly do not know what to indicate as a 'typical' job. * * * Since our students are located on jobs throughout the eastern half of the United States, there is no 'average' or 'typical' industry served, no typical job, and the salaries vary greatly in different localities, [and in some cases] even in the same locality."

It is difficult to quote rates of pay which would have any real significance, since the types of jobs upon which co-op students are employed have such a wide variation. The co-op schools in general make no attempt to establish definite rate scales or to control rates—other than to make every effort to insure that co-op students are paid the rate prevailing in the locality for the class of work on which they are employed.

ORGANIZED COOPERATIVE TRAINING PROGRAMS

Some industrial companies and governmental agencies which employ co-op students have developed well-organized and integrated

programs covering several years' work. These programs are designed to give experience in such a variety of jobs of increasing responsibility as will make the students effective and valuable employees upon graduation. Three such programs are outlined in succeeding paragraphs.

For a number of years a midwest machine manufacturing company has offered comprehensive training programs for cooperative students in mechanical, electrical, chemical, and metallurgical engineering, and in business administration. These programs, under the director of training, are designed to train young men "to enter the field of sales, engineering, service, estimating, advertising, manufacturing, and other allied departments." Definite schedules are worked out for each student to give him experience in the various departments of the company. At the end of each assignment the student is required to pass a comprehensive written examination before advancement to the next department. The student is eligible for merit raises each 6 months, and he is scheduled to attend shop classes each week on company time. The senior theses are often selected and completed in conjunction with company officials. Upon the successful completion of the training program the student receives a certificate and is eligible for graduate employment with the company.

A large manufacturer of electrical and electronic equipment started a co-op engineering program in 1921 with 1 college, and in 1954 was employing co-op students from 9 colleges situated in 6 States. A committee of key research and engineering personnel interviews each student, reviews his qualifications and objectives, and maps out an overall program for him to follow until graduation, including diversified assignments in its research and engineering divisions which enable students to gain experience in research, design, development, and production of a variety of products for the home, for industry, and for the Armed Forces. The committee evaluates periodic reports from the student and his supervisors.

Students are enabled to work in some of the best-equipped laboratories in the industry, have access to a complete technical library, and are supervised by experienced engineers and scientists. They may be rewarded for patent disclosures, and may participate in an achievement award program and in profit-sharing and retirement plans and in recreational and professional activities.

The Tennessee Valley Authority has used the cooperative plan for some years and has developed a comprehensive program for administering it. In each department which employs cooperative students and at each location where students are employed advisers are named whose backgrounds correspond to the professional fields in which students are enrolled. Advisers assist the students in relating their

work experience to their academic programs, assign professional reading and determine the subject of a "work report" by each student covering each work period, and review the reports and discuss them with the students. An individual program is prepared for each student, using regularly classified TVA positions of several levels and of varying nature and difficulty of work assignments. After graduation TVA "makes every effort to place the graduate in a regular position, in accordance with personnel policies."

INDUSTRIAL SCHOLARSHIPS

In one institution operating under the cooperative plan there has been developed, in cooperation with several corporations served by the institution, a system of industrial scholarships. A number of annual scholarships are in effect, representing corporations which have been long-time employers of cooperative students and graduates.

Each scholarship carries a stipend for the freshman year, which is expected to cover tuition, books, and living expenses for the first year. If his scholastic record for his freshman year is satisfactory the scholar will be employed on the usual cooperative basis by the corporation. One corporation offers stipends sufficient to cover tuition for the remaining years of the 5-year curriculum, subject of course to satisfactory scholastic and industrial records.

Some of the corporations stipulate that holders of the scholarships shall be chosen from sons of employees or from returned veterans who are former employees of the corporation. In every case the applicants for scholarships are further screened with respect to high-school records, high-school activities, several special examinations, and interviews with company and college officials.

The establishment of these scholarships is a clear indication that the corporations concerned believe that the cooperative plan has considerable value in training persons for their staffs. The idea may hold possibilities for other institutions and the companies with which they have cooperative arrangements.

TRAVEL OF CO-OP STUDENTS TO JOBS

While the great majority of cooperative students are employed within commuting distance of the college in which they are registered, the cooperative institutions have long since ceased to be purely local institutions, and some cooperative students travel considerable distances to their cooperative jobs. The University of Cincinnati reports that their students "are located on jobs throughout the eastern half of the United States." Northeastern University in Boston reports that their operations cover "all of New England, New York, New Jersey, Pennsylvania, and Washington, D. C. One student is cur-

rently employed in Michigan. Another will go to Texas during his next work term. These two are exceptional instances." Drexel Institute of Technology in Philadelphia reports the average travel of cooperative students as 40 miles and the maximum travel as 900 miles. These instances are probably typical of the longer established cooperative programs.

In the nondegree programs the travel of the students is less extensive than in the degree programs. One coordinator reports that nearly all his students are employed in the city in which the institution is located, or within easy commuting distance. Another reports that approximately one-third of his students work outside of the city, their average travel being 150 miles, and their maximum about 600 miles.

COSTS OF COOPERATIVE PLAN OF EDUCATION

No comprehensive and reliable data are available which would enable a valid comparison to be made between unit costs under the cooperative and regular plans.

The proper coordination of the cooperative plan, which has been pointed out as the most important part of the plan, and which calls for a high degree of individual attention to students, is admittedly expensive. One institution enrolling 3,000 cooperative students reports a budget for the coordination department of $91,000 per year, which does not include additional costs to the academic departments and the university as a whole. Another institution enrolling 1,900 cooperative students reports 14 full-time coordinators and 6 full-time secretaries whose entire time is devoted to making and maintaining contacts with cooperating firms.

On the other side of the picture, since only part of the upper class students are in class at any one time, the requirements for space, equipment, and staff in upper class engineering courses are considerably less under the cooperative plan than under the regular plan.

The cooperative plan, with its multiple shiftings of the students from work to classes and vice versa, involves additional administrative expense and indirect costs to the college and to the cooperating industries. One of the replies to an opinion poll conducted by the American Society for Engineering Education in 1946 read in part:

> Cooperative plan is good. Industrial concern participating in such a plan with a college or university should receive some remuneration for training the student during his working period. This cost should be included in the tuition fee.

On the other hand, at least three institutions which are currently operating cooperative engineering programs, two of which extend to the level of the master's degree, require a payment from the cooperating company as a basis for operating the program.

ACADEMIC CREDIT FOR INDUSTRIAL WORK

The question is frequently raised as to the possibility and desirability of granting a certain amount of academic credit for the industrial experience of co-op students. The Engineers' Council for Professional Development does not approve such credit, but expects the cooperative engineering colleges to require the same weight of credit hours in their curriculums as do the conventional, noncooperative institutions.

Among the cooperative institutions opinion is divided on this point. All agree that the industrial experiences of the co-op student are of great value to him as a future engineer. Many think, however, that they should not be substituted for academic experiences, but should be added to them. Others believe that the many months of carefully supervised employment included in a well-designed and administered co-op program have educational value which should be recognized by being assigned academic credit.

With the wide variety of jobs held by co-op students, and the differences in working conditions and in amount and nature of supervision by the colleges, a fair evaluation of employment experience in terms of academic credit would be extremely difficult.

If the cooperative colleges wish credit for the industrial experience of co-op students to be recognized by accrediting agencies, it will probably be necessary for them to agree upon and submit an acceptable norm of comparison to the Engineers' Council for Professional Development before the Council will alter its existing position. Presumably other accrediting agencies will be guided to a large extent by the attitude of the Engineers' Council for Professional Development.

Cooperative Education for Federal Agencies

IN PREPARATION for the 1948 annual meeting of the Division of Cooperative Engineering Education of the American Society for Engineering Education, the members were asked to express their preferences among a list of possible topics for consideration at the meeting. The topic which led all others in general interest was "The Furtherance of Cooperative Relations with Government Departments." The author of this bulletin presented before the Division a paper (4) on this subject, based on correspondence with and visits to cooperative colleges and upon interviews with Government officials.

STUDY OF EXISTING PROGRAMS IN FEDERAL AGENCIES

These investigations had disclosed that a number of institutions had previously placed co-op students with Federal agencies, but usually on a "temporary" basis (not culminating in permanent appointments), an arrangement which has not proved attractive to competent students. College officials believed that better results might be obtained both for the Government agencies with their needs for better trained personnel and for the students themselves, if it were possible to give the students regular appointments and ratings under United States Civil Service.

A lack of understanding of the possibilities open to Federal agencies under existing civil-service procedures was found among both college officials and governmental personnel. Considerable interest was evident in the cooperative system, but there was a rather widespread belief that civil-service regulations, personnel ceilings, and budgetary uncertainties make it extremely difficult to set up a cooperative program with a Federal agency. It was evident from investigations conducted in Washington, however, that civil-service procedures give ample opportunity for the establishment of such programs.

THE WRIGHT FIELD PROGRAM

The paper outlined in considerable detail the program described by the Cincinnati Regional Office of the Civil Service Commission in Announcement No. 6–19 dated June 17, 1946. This announced an examination to fill positions as engineer, trainee, for "a combination of alternating periods of (*a*) on-the-job training at Wright Field, Dayton, Ohio, and (*b*) scholastic training in engineering at a university designated by the Air Materiel Command."

Organization.—This program was organized by the Air Materiel Command in cooperation with the Civil Service Commission regional office because of the war-incurred shortage of young graduate engineers. The Air Materiel Command officials believed that the cooperative program offered an excellent means of developing a future source of supply of young engineers who would be familiar with the purposes and procedures of the Engineering Division before they were assigned as professional personnel. They believed it would also be a satisfactory way of accomplishing necessary subprofessional work.

Approval by Civil Service Commission.—This program had been called to the attention of other civil-service regions by the Executive Director and Chief Examiner of the Commission in Commission Letter No. 46–504. The letter outlined the chief characteristics of the program and included the following statement:

> This language was carefully drawn to establish a plan that would meet all requirements, legal and otherwise, for an examination to fill positions involving such cooperative training arrangements
>
> Other regions are encouraged to work out similar plans wherever desirable and practicable between Federal establishments and colleges and universities in their regions. In this connection, however, arrangements should be worked out so that all colleges and universities in the area of competition which find it feasible to cooperate on an alternate work-study basis are given an opportunity.

Similar examinations were announced in 1947 and 1948, and an examination containing similar provisions for a combination of on-the-job training and scholastic training was announced by the Philadelphia Civil Service regional office on April 27, 1948 (Announcement No. 3–14).

Outstanding features.—The following are the outstanding features of the Wright Field program.

1. For this particular type of trainee program, which makes attendance at college a part of the job, the Civil Service Commission has found it possible to include definite educational requirements for qualifying for the examination. For many types of jobs this is not possible under section 5 of the Veterans' Preference Act of 1944.

2. The educational requirement and the stipulation of a certain specified grade in the written examination insure that successful applicants will meet the admission requirements of the cooperating institutions. This provision eliminates the difficulty which might otherwise arise in securing persons acceptable both to the agency and to the college or university.
3. The institutions which trainees are to attend are to be selected by the employing agency, not by the Civil Service Commission. This makes the assignment to the college or university part of the job as set up by the employing agency, and gets away from the objection that the register is not open to all. As this examination is set up, any citizen of the United States can qualify who can pass the examination and who is willing to accept employment under the terms specified.
4. Appointments are on a probationary basis, the probationary period being 1 year, consisting of 9 months of school and 3 months of work. This is essentially the same probationary period required in most cooperative colleges.
5. Trainees who satisfy the probationary period become regular civil-service employees with civil-service status and retirement rights, etc. Upon graduation from college or completion of the trainee program they can be immediately appointed to P–1 positions without further examination, whereas students employed on a temporary basis must compete after graduation with all other candidates for the P–1 rating and must take the regular P–1 examination at that time, with the attendant delay which frequently accompanies civil-service procedures. Furthermore, students receive no retirement or seniority benefits while serving on temporary appointments.

The paper listed some of the benefits which could accrue to colleges, students, and Federal agencies from the establishment of cooperative programs with Federal agencies, and some of the difficulties which Federal departments might experience in establishing such programs.

CONFERENCE OF REPRESENTATIVES OF COLLEGES AND FEDERAL AGENCIES

The discussion which followed the paper resulted in the appointment of a committee of the division to work in liaison with governmental departments toward a better understanding and a furtherance of cooperative relationships. A formal meeting of the full committee was held in October 1948, at which there were in attendance in addition to the members of the committee 71 governmental officials representing 15 different agencies (3).

Following brief talks by representatives of the Civil Service Commission and of the Potomac River Naval Command about examination procedures, representatives of the United States Bureau of Reclamation and of Wright Field spoke of their experiences in employing and placing cooperative students in their agencies.

Several members of the committee then spoke on the philosophy and mechanics of typical cooperative programs and the values which might accrue to Federal agencies by using such a program.

After a general discussion of the talks mentioned above, a group of Federal officials, in a round table symposium, developed a list of factors the governmental representatives believed should be considered by the college representatives in developing their report. The college representatives then met separately and drew up a report which was submitted in draft form to the entire conference at its closing session.

REPORT OF COLLEGE REPRESENTATIVES

The report of the committee of college representatives (2) was divided into five main parts and an appendix. It is briefly summarized below.

1. Introduction

Part 1, the introduction, briefly reviewed the history and the objectives of the co-op program, referring readers to the "Manifesto," (1) and listing the essential purposes and aims peculiar to cooperative education in addition to the scientific-technological and humanistic-social aims of engineering education in general.

2. College Functions

Part 2 outlined the following functions which should be performed by a cooperative college:

(a) *Program planning.*—The college coordinator must work with the Federal agency in planning and agreeing upon a mutually acceptable training program.

(b) *Selection of students.*—The coordinator knows his students and is in a strategic position to promote interest among them in securing Federal employment, provided he has accurate information.

(c) *Available information on students.*—The coordinator will make available personal information about students, such as scholastic records, special test results, student activities, etc.

(d) *Pairing of students.*—Pairing of students is generally desirable and recommended, but is not a requirement for a cooperative program. Coordinators can provide pairs of suitably matched applicants, if desired.

(e) *Student progress followup.*—Cooperative schools follow the progress of students at work through visits to employers, and through supervisor's ratings and work reports from students. Many schools also give oppertunity for students to discuss their experiences and for analyses of problems they have encountered. It is the responsibility of the coordinator to see that restricted or confidential information is not divulged in any of these procedures.

(f) *Alternating periods.*—The length of the cooperative work period must conform to the schedule already in use at the participating schools. These periods range from 2 to 6 months.

3. Federal Agency Functions

This part of the report discussed the following main topics:

(a) *Program planning.*—The objective of producing competent men trained in the functions of a participating agency requires a logically planned sequential training program. The training of a student should not be subordinated to the immediate convenience of the employing agency. It is recognized, however, that specific work assignments will of necessity be affected by the current workload on the agency.

(b) *Agency-college liaison.*—It is desirable that there be *one* representative in each participating agency to act as liaison officer between the colleges and the agency. This official and college coordinators should agree upon procedures for: job analysis, selection of personnel, evaluation of student progress.

(c) *On-the-job training.*—Training programs should provide for rotation of the student on various jobs in which he should be treated as a normal employee and should be encouraged to avail himself of appropriate educational facilities existing in the agency.

4. Implementation of Proposed Programs

(a) *General recommendations.*—The committee recommended (1) that Federal agencies examine their needs with a view to determining the optimum period and frequency of work-study alternation and incorporate their findings in their official trainee-position requirements. In many cases Federal agencies, interested in cooperative training, might make a *joint* investigation of the possibility of securing approval for the inclusion in certain descriptions of trainee-positions a requirement that the incumbent be a cooperative student who is available for alternating periods of college classroom instruction and on-the-job training. The Wright Field program was cited as a precedent for the suggested procedures; (2) that agencies indicate the dates on which they will need trainees in the various trainee positions; (3) that the colleges advise their students to indicate in their applications the dates on which they will be available for placement and the agency with which they desire employment; (4) that appointments of student trainees under the provisions of schedule A should be avoided, and all appointments confined to persons selected through the regular competitive civil-service procedure.

The committee believed that procedures for national recruitment and for regional recruitment need not differ essentially from each other, and that under the suggested procedures Federal agencies can find ways and means of accomplishing the desired results within the framework of Civil Service Commission procedures.

(b) *Special problems.*—The committee considered some of the special problems which had been mentioned in the discussions of the conference.

(1) *Transportation.*—In general the student pays his own transportation expenses, even when sent a considerable distance from the college he is attending.

(2) *Length of periods.*—The most common periods in the colleges are from 2 to 3 months at a time, but most colleges make provisions for doubling up these periods for any one student, so that the period on the job at one time could be as long as 4 to 6 months.

(3) *Timing of examinations.*—The committee recommended a minimum of two examinations a year, spaced 6 months apart, with the interval between announcement and final establishment of a list of eligibles as short as possible. They also suggested that the Civil Service Commission give thought to holding continuous unassembled examinations, since it was their belief that only a small fraction of existing needs can be filled by assembled examinations.

(4) *When to start the cooperative program.*—The committee believed that the co-op program should begin as early as the conditions of the job will permit. Many Federal agencies consider that they need more advanced students. The committee suggested that such agencies attempt to establish more elementary jobs from which students may be promoted as they progress through college. The disadvantage in deferring the cooperative relationship is that it will restrict the number of cooperative students available to the agency, since many of them will be hired by other employers in the early years.

(5) *Security and safety.*—Cooperative students during their periods of on-the-job training are subject to the same regulations and privileges as other employees, including safety and security regulations.

(6) *Unsatisfactory students.*—A cardinal precept of the cooperative system is that no student is to remain on any job where he is performing unsatisfactorily. The coordinator will remove any student who is not rendering satisfactory service.

5. Summation

In summing up its report the committee expressed the belief that there are many opportunities for the development of cooperative programs with various Federal agencies, to the mutual benefit of the Government and the colleges. Many Government representatives have expressed a definite and immediate need for training on a subprofessional level to create a source of professional personnel. The cooperative plan offers one excellent long-range means through which this objective may be accomplished. Agencies interested in establishing cooperative programs were asked to inform the chairman of the committee, who will direct the inquiry to appropriate colleges. The coordinators of these colleges will then make contact with the agency officials for the purpose of developing mutually satisfactory programs.

DEVELOPMENTS SINCE THE CONFERENCE

On November 30, 1948, the Civil Service Commission announced an examination for student aid (trainee) in the fields of engineering, chemistry, mathematics, metallurgy, physics, meteorology, and geology, to fill departmental and field positions in a number of Federal agencies at grades SP–4 and SP–5 (Announcement No. 139). The examination offered to sophomores and juniors the opportunity to participate in special training programs in Federal agencies, and to become acquainted with the work of these agencies.

This was the first announcement of a United States Civil Service examination on a national basis which specifically mentioned colleges operating on the cooperative plan. The announcement states "Appointments to the positions will be probational but are usually for employment during school vacation periods, or for the periods of employment of students in cooperative courses." Furthermore, applicants for the examination are required to submit, along with other information, "The expected dates of availability for on-the-job training in a Federal agency (i. e., the dates of summer vacation period for students enrolled in a standard 4-year curriculum leading to a bachelor's degree, or the dates of availability for on-the-job training of cooperative students)."

Joseph Hilsenrath, at that time scientific educational adviser, National Bureau of Standards, who served as chairman of the college-government conference in the fall of 1948, under date of July 18, 1949, outlined developments in his agency since the announcement of this examination. The first lists of eligibles were mailed to the National Bureau of Standards in May 1949. Of 132 persons certified at the SP–5 level, 2 were from cooperative plan colleges. Of 63 eligibles for grade SP–4 about half were enrolled in cooperative colleges.

The examination was repeated in the fall of 1949, and in January 1950 Mr. Hilsenrath reported that 75 pairs of co-op students were currently placed in 19 Federal agencies, and that these and 2 additional agencies were anticipating increasing this number.

Since 1948 many announcements of examinations covering positions open to undergraduate college students have specifically mentioned in one way or another the co-op system. This means that the Civil Service Commission has fully recognized the co-op system of education, and that the way is clear for Federal agencies to employ co-op students if they wish to do so.

In the fall of 1953, 21 cooperative colleges reported their total enrollment of co-op students, and the numbers placed with Federal agencies and with local governmental units (State, county, or city), for the academic years 1948–49 and 1952–53. For 1948–49, the 21

schools had a total enrollment of 13,131 co-op students, of whom 208, or 1.3 percent, were placed with Federal agencies and 357, or 2.2 percent, with local governmental units. For the school year 1952–53 the same institutions enrolled 12,259 co-op students, of whom 362, or 3 percent, were employed by Federal agencies, while 306, or 2.5 percent, were employed by local governmental units.

These reports show that while the total co-op enrollment of the 21 schools was decreasing by 6 percent, the number of co-ops employed by Federal agencies increased 74 percent, and those employed by local governmental units decreased 14 percent. The number of schools which had students placed with Federal agencies increased from 9 in 1948 to 14 in 1952, and those with students in local governmental units increased from 10 schools in 1948 to 12 schools in 1952. Furthermore, while some individual institutions had fewer students working for governmental units in 1952 than in 1948, not a single institution had completely discontinued the placement of students with governmental agencies.

Values Inherent in the Cooperative Plan

THE VALUES which can result from a well-organized and efficiently administered co-op program may be summarized under the categories of values for the student, for the institution, and for industry and governmental agencies.

VALUES FOR THE STUDENT

VOCATIONAL GUIDANCE

Many students are attracted to a particular profession by popular misconception concerning the profession, rather than by actual knowledge of it. Some of these, even though they are able to complete a college course in preparation for their chosen profession, may be lacking in some of the qualities other than scholastic, which are necessary for success in the profession. In spite of the efforts of teachers and guidance counselors the educational process frequently fails to give students a realistic conception of the working conditions they will face in their chosen careers. Much of the accepted guidance material leaves many students with vague and inaccurate occupational ideas.

Cooperative work experience is one technique which can provide the practical realistic guidance which young people often need. The cooperative system helps to discover their own weaknesses, to analyze their fitness for practical work in the field they have tentatively chosen, and to learn whether this field actually does have the attraction for them which they thought it would. They can then either correct their faults, proceed on their course with more confidence and greater effectiveness, or change their course.

SPECIAL EDUCATIONAL VALUES FOR THE ENGINEER

One of the most pressing problems in the field of engineering education arises from the rapid and tremendous expansion of scientific and technical knowledge, and the resulting increase in specialization in each of the divisions of the field. These changes tend to lead to an increasingly crowded curriculum which, while it gives a good foundation for technical work, is apt to be deficient as a preparation for general citizenship.

However, there is a growing tendency in industry and government

to place engineers in administrative and managerial positions. In these posts they are in a position to give leadership in social and public affairs as well as in technical matters.

A properly organized and efficiently administered cooperative program may provide one workable solution to this problem; namely, the integration of off-campus work experiences and academic instruction into a program designed to gain the fullest educational benefit from both. The cooperative student gains opportunity for studying human relations, and his industrial experiences constitute a realistic laboratory for community living and for active citizenship.

The co-op student has opportunity early in his career to learn something of the practical applications of engineering principles to industrial and governmental methods and techniques—in short, to learn the "engineering know-how." This knowledge helps him to comprehend the basic principles taught in his college courses. Thus his theoretical courses and practical experience reinforce each other.

Much of the course work in an engineering curriculum is conducted with the objective of obtaining technical results, and too often little or no regard is paid to cost. The cooperative engineering student in his industrial periods has an opportunity to observe the great importance of time, money, and materials, and of their efficient and economic use, which is one of the basic principles of industry.

The cooperative system offers an unusual opportunity to acquaint students with the importance of the social and economic implications of the engineer's work. It aids them in learning to organize and apply their knowledge and skill so as to contribute to the welfare of humanity.

STUDENT GROWTH AND DEVELOPMENT

It is the consensus of coordinators that co-op students tend to mature early and quickly as a result of their employment contacts and of the duties and responsibilities they assume, which might not fall to the lot of a regular college graduate until he had completed a considerable period of industrial experience.

The cooperative student learns early that self-discipline is a necessity in industrial and professional positions. He also acquires the important mental attitude of being a "member of the team" an attitude which is of great value in industrial work.

Most successful college graduates eventually assume administrative and executive responsibilities, requiring an understanding of the human factors in the industrial professional world. The co-op student learns early to get along with people of all types, and his contacts in industry tend to develop his personality and tact, which helps to qualify him for later positions of leadership.

The cooperative student learns to adapt himself to conditions he will have to meet as a citizen after graduation. The following is

quoted from an appraisal of the cooperative plan written by a senior in a cooperative college:

> The necessity of having to adapt oneself to different environments certainly has its advantages. I have found that facing a strange city independently has encouraged and accelerated my maturity. Assuming full responsibility for myself, in all respects, could not but help give me a broader, soberer outlook on life. I found that living in a new community required assumption of the role of a citizen if the work period was to be an enjoyable one. * * * I learned to find associations and outlets for active community life, with the result that I now find it relatively easy to enter a new city and feel reasonably at home within a month or two. Above all else, the cooperative plan has given me an acquaintance with life as it really exists for the majority of people. * * * Seeing society as it actually is, and being a part of it, has provided an opportunity to evaluate the knowledge received in the classroom and to promote a practical synthesis.

FINANCIAL AID

Although student earings are considered incidental in the philosophy of cooperative education, they do enable many students to obtain an education which would otherwise be denied them because of its cost. It is easy for a student to over-emphasize this value, and the attendant value of establishing connections which will be useful in securing employment after graduation.

Care is needed on the part of the administrators of cooperative programs lest these incidental values obscure the main educational objectives. One coordinator has suggested that this danger can be minimized by competitive selection of students for the co-op plan, including scrutiny of individual motives, by avoidance of assigning students to jobs near their homes, and by uniform pay rates commensurate with co-op objectives.

VALUES FOR THE INSTITUTION

INDUSTRIAL AND GOVERNMENTAL CONTACTS

The cooperative institution benefits through enriched industrial and governmental contacts, which integrate it more closely with its community and facilitate the flow of up-to-date information and equipment from industry and Government agencies.

USE OF EMPLOYER'S EQUIPMENT

The availability for student use of the complete and modern production and research equipment of industrial corporations and governmental agencies affords the co-op student better opportunities to become acquainted with such equipment and its use than most regular institutions can give him. It also saves the co-op institution much expense in its equipment for shop courses and demonstration models.

POSSIBLE MODIFICATION OF ACADEMIC COURSES

The industrial experiences gained by co-op students eliminate the necessity of including certain types of descriptive technical matter in academic courses. This allows opportunity for increased emphasis on fundamental principles and may result in lower costs of instruction.

MORE EFFICIENT USE OF INSTITUTIONAL FACILITIES

An institution operating on the cooperative plan can accommodate a larger number of students with a given amount of classroom space and laboratory facilities than a regular college can, since in general only a part of the student body is in class at any one time. The tuition from the additional students provides revenue which may be used for improving the plant, for higher salaries for staff members, for increased activity in unsponsored research, or all three.

BENEFITS TO TEACHERS

Teachers in cooperative institutions benefit from all the values mentioned above, especially by keeping informed concerning current industrial equipment, practices, and problems. The teachers of cooperative students who have just returned from work in industrial or governmental offices and plants cannot continue to teach techniques which industries have discarded, but must keep their teaching up to date and to the point.

VALUES FOR THE EMPLOYER

Values for the employer of co-op students may be listed under three categories as immediate, longer term, and ultimate.

IMMEDIATE BENEFITS

Morale is improved by the continuous infusion of "new blood" into the organization, by the addition of ambitious young employees who are known to be working their way up through the ranks. Many of these people remain with the employer and rise to key positions.

LONGER TERM BENEFITS

The employer benefits not merely from the immediate work of the co-op employee, but even more importantly from a most favorable opportunity for recruiting pretested graduates of high promise. The co-op student becomes familiar with the organization's personnel and operations and is specifically trained for that particular organization at a lower training cost than would otherwise be possible. He is able to take his place immediately as a productive "member of the team."

ULTIMATE BENEFITS

The employer who participates in a co-op program will find his organization receiving additional benefits from his contacts with the college, benefits which he probably would not realize otherwise. His continual exchange of ideas with students and coordinators leads to a better understanding by students and faculty of his problems as an employer, and acts as a spur for the college to become a center for basic research in these problems.

Most employers who have had experience with cooperative students appreciate these values. They are willing to provide carefully planned sequences of jobs to give students the kind of training which will lead to their realization, even though this may result in the students producing somewhat less than employees who are trained continuously on a single job.

While there is no obligation, real or implied, between students and employers for employment after graduation, the records of cooperative schools show that the majority of co-op students continue to work after graduation in the same company or agency with which they worked as co-op students.

EXPANDING OPPORTUNITIES FOR GRADUATES

The coordinator is in an excellent position, through his widespread contacts with industry, to find new opportunities for his graduates and to arouse the interest of industrial concerns which have not used college graduates in the advantages of employing some of this type of personnel, to their own benefit and to the general benefit of the country. Donald C. Hunt, coordinator at the University of Detroit, has pointed out a number of instances of this sort of development (13) which have helped the industrial firms concerned, the universities and their students, and society in general.

OPINIONS OF EMPLOYERS

In the spring of 1946 a committee of the American Society for Engineering Education conducted a survey of a large number of industries which employ engineers, as a preliminary to the preparation of a report on the demands for and supply of engineering graduates. One part of the survey made by this committee consisted of an opinion poll in which industrial executives were asked their subjective opinions on a number of questions, one of which was, "What do you think of the cooperatively trained engineers?"

The majority of opinions expressed by the industrialists in reply

to this question were favorable to the co-op system. The following list shows the distribution of opinions expressed:

Opinion expressed	Percent
We consider co-op trained students to be very satisfactory	28
We regard the co-op system favorably	28
We have had no experience with co-op graduates but approve the general idea of the system	25
We have observed no significant difference between co-op and regular graduates	10
We think co-op graduates are inferior to regular graduates	5
We are opposed to the interruptions in study	3
The co-op theory is good but its application is impractical	1

The following statements by employers of co-op students are quoted from a pamphlet "Cooperative Education and Other Work-Study Plans" (15) published by the National Association of Manufacturers in 1946:

> The cooperative plan helps to discover and develop a reservoir of competent, alert, industrious, and intelligently maturing men who better understand the basic principles of both the social and natural sciences. It helps to satisfy wants in various fields of work where apprenticeship occupations are lacking, and it makes people aware of the many existing wants so that they can better undertake to satisfy them properly.
>
> Our company has been extremely interested in cooperative students and in the whole plan of education from the very beginning. We can say unqualifiedly that we have had a very splendid success with the men we have trained who have stayed with us. Actually, a large part of our sales, shop, production, and other top-grade men came through this course.
>
> Many of our young junior executives in the field of production and engineering are former cooperative students.

Perhaps one of the most significant and practical endorsements of the value of cooperative programs to employers is found in the establishment and support of the industrial scholarships described on page 37.

Summary and Conclusions

THE COOPERATIVE PLAN has had a healthy growth since its inception in 1906. In that year 1 institution enrolled 27 co-op students in 3 engineering curriculums. In the academic year 1953–54 degree programs of this type were conducted by 32 colleges and universities which offered 16 different engineering curriculums to their 13,161 co-op engineering students. These students constituted 30 percent of the engineering students in the 32 institutions, and 7¼ percent of all students in the United States enrolled in engineering curriculums leading to baccalaureate degrees.

The cooperative principle has been successfully extended to non-engineering fields, but to a lesser extent than in engineering. The first such curriculum offered was one in commerce in 1919. During the academic year 1953–54, 17 different nonengineering curriculums enrolling 5,945 co-op students were offered in 14 colleges and universities, 11 of which also offered engineering curriculums. It is the consensus of the coordinators in these institutions that, while it is somewhat more difficult to administer a nonengineering program than one in engineering, the resultant values are similar to those accruing from engineering programs.

The plan has also been found useful in technical institutes, which conduct non-degree courses preparing students for the more technical phases of engineering and other professions. The first offering by this type of institution was a course in mechanical trades, established in 1909 at the Illinois Institute of Technology. During the academic year 1953–54 nondegree co-op programs were conducted in 8 institutions, which offered 7 different engineering courses to 1,810 students and 6 different nonengineering courses to 1,612 students.

The cooperative institutions do not contend that their plan should be adopted by all schools, or even by all colleges of engineering, or that it will fit all industries. Indeed, it is generally agreed that no institution should even experiment with the system unless it is located in an urban or industrial community, or unless abundant opportunity for cooperative employment is otherwise available. Experience has shown that, under present employment conditions and policies, firms

having thousands of employees are able to absorb only a few dozen co-op student workers. This is borne out in the figures showing average numbers of co-op students per firm served, which are contained on pages 7 to 9.

When local conditions are propitious, the cooperative system affords a workable method of combining practical industrial experience with theoretical instruction in such a way that each reinforces the other. If the program is organized and administered with proper attention to educational values, with adequate supervision of students' employment as well as of their academic work, and with the wholehearted cooperation of the employers and the institution, it can result in important values to the student, to the institution, and to the employers served.

Selected References

ALL THE INSTITUTIONS listed in this bulletin publish catalogs and descriptive literature giving detailed information about their cooperative educational programs.

Herewith is presented a selected list of recent papers and books bearing in whole or in part on various phases of the cooperative educational system.

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