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ENGINEERING EDUCATION AFTER THE WAR

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ENGINEERING EDUCATION AFTER THE WAR.

The period covered by this paper followed the demobilization of that experiment in education under war conditions known as the Students' Army Training Corps.

During the early part of 1917 many engineering students withdrew from the school of engineering to enter different branches of the Army and Navy of the United States, and others at this time, and even during the previous years from the outbreak of the World War in 1914, withdrew to enter the service of our allies or to become Red Cross drivers or workers. These withdrawals, followed by withdrawals due to the application of the Selective Service Draft Law, made it clear that steps must be taken to provide the Nation with men trained in engineering to fill the numerous places created by the war in the service of the United States and in the industries.

For the purpose of conserving the engineers in training, the Engineer Corps of the United States Army made provision to enlist engineering students of the proper age in a Reserve Officers' Corps and to assign them back to their colleges to complete their engineering work. This did not prove entirely satisfactory, and its inadequacy was soon manifest. To care for all branches of the service, and to train men as officers, the colleges and universities of the country were organized to receive and train members of the Students' Army Training Corps.

STUDENTS' ARMY TRAINING CORPS.

During the summer of 1918 it became evident that, with the application of the selective draft law, steps would have to be taken to preserve the educational institutions of the country and to supply the country with trained men. After a number of conferences between educators and Government officers, the War Department organized a Committee on Education and Special Training, consisting of Col. Robert I. Rees, General Staff Corps; Col. John H. Wigmore, Provost Marshal General's Office; Lieut. Col. Grenville Clark, Adjutant General's Office; and Maj. Wm. R. Orton, War Plans Division, with Ralph Barton Perry as executive secretary. In addition to this committee, an advisory board representing the educational interests was formed, composed of President James R. Angell, Samuel P. Capen, James W. Dietz, Hugh Frayne, Charles R. Mann, Raymond H. Pearson, and Herman Schneider. About the end of July, 1918, after plans were prepared for the use of the colleges, the Secretary of War appointed President R. C. Maclaurin, of the Massachusetts Institute of Technology, Director of College Training. The country was divided into 12 districts for this purpose, with a subdirector in each district. Practically all of the colleges of the United States entered into contracts with the Government to give instruction to men who were to be members of the Students' Army Training Corps. The various institutions made contracts for the subsistence, housing, and education of members of this corps, together with contracts for expenses connected with the construction of temporary buildings or making alterations in existing buildings belonging to the colleges, for the purpose of fitting them to the needs of the Government.

The Students' Army Training Corps was raised under authority of the act of Congress approved May 18, 1917, commonly known as the Selective Service Act, authorizing the President to increase temporarily the Military Establishment of the United States as amended by the act of August 31, 1918, and under General Order No. 79 of the War Department dated August 24, 1918, which was as follows:

Under the authority conferred by sections 1, 2, 8, and 9 of the act of Congress authorizing the President to increase temporarily the Military Establishment of the United States, approved May 18, 1917, the President directs that for the period of the existing

emergency there shall be maintained by voluntary induction and draft a Students' Army Training Corps. Units of this corps will be authorized by the Secretary of War at educational institutions that meet the requirements laid down in special regulations.

The object of establishing the Students' Army Training Corps was to utilize effectively the plant, equipment, and organization of the colleges for selecting and training officer candidates and technical experts for service in the existing emergency. For purposes of military organization the members of the corps formed single units, but for purposes of instruction the unit consisted of one or more sections, according to the type of educational training given.

The collegiate section (known as section A) was authorized in any civil educational institution which required for admission to its regular curricula graduation from a standard four-year secondary school or an equivalent, and provided a general or professional curriculum covering at least two years of not less than 32 weeks each and had a student attendance sufficient to maintain a collegiate section of a strength of at least 100 men. Collegiate sections of the Students' Army Training Corps were organized in colleges of arts and sciences, technology, engineering, mines, agriculture and forestry, business administration, industry and commerce, pharmacy, veterinary medicine, education, law, medicine, dentistry and in graduate schools, normal schools, junior colleges, and technical institutes.

The vocational section (known as section B) was authorized in institutions having adequate equipment.

A registrant of the Students' Army Training Corps became an enlisted man in the Army of the United States, or, on the establishment of naval units, in the Navy of the United States. This induction was voluntary, under the selective service regulations. Upon induction members of the Students' Army Training Corps were placed on active duty status, and the Committee on Education and Special Training entered into contracts with educational institutions for the quartering, subsistence, and instruction of such men. It was also understood that from time to time members of the corps might be assigned to training camps, training schools, depot brigades, or to do special technical work at collegiate institutions. It was also planned to give consideration to the preference of the registrants to the branch of service which they would ultimately enter.

The administration of the corps was carried on by the War Department through its Committee on Education and Special Training of the Training and Instruction Branch, War Plans Division, General Staff, assisted by the Advisory Educational Board, together with educational directors, district educational directors, and special advisers. The War Department provided an officer of the Army at each college to serve as commanding officer, and the commanding officer and other officers assigned to duty with different units were directed to observe the general usages of the various institutions affecting the duties and obligations of the members of the faculty or other academic instructors. They were not permitted to undertake any instructional or administrative duties in the institution other than those connected with the military work of the corps. The military officers were assigned to the duty of enforcing military discipline, but no authority was given them to direct or interfere with purely educational matters.

The original plan of training consisted of 11 hours of military studies, including drill, theoretical and military instruction, and physical training, and 42 hours per week for allied subjects. These 42 hours included lectures, recitations, laboratory instruction, and necessary preparation therefor. After two terms of work the arrangement provided for 6 hours of military training and 47 hours of study of the allied subjects. It will be seen later that suggested courses for technical schools were submitted by the committee from which the actual courses given at an institution were planned and submitted for approval to the regional director.

The Committee on Education and Special Training issued from time to time circulars regarding the treatment of the various subjects in accordance with the aims of the War Department.

The allied subjects mentioned above included the following: English, French, German, mathematics, physics, chemistry, biology, psychology, geology, geography, topography and map drawing, meteorology, astronomy, hygiene, sanitation, descriptive geometry, mechanical and free-hand drawing, surveying, economics, accounting, history, international law, military law and government. In the case of the technical and professional schools, provisions were made for approving a general program containing subjects other than those included in the above list, and also permission could be granted any institution for the recognition as an allied subject one subject outside the foregoing list provided it occupied not more than three hours per week in lectures and recitations combined.

A special course in war issues was demanded in all programs of study for section A. This was to cover three classroom hours per week for two terms. This course was intended to give students a clear understanding of the causes of the war and the various steps previous to the beginning of hostilities.

In section B the required hours were as follows: Military subjects, including drill and physical training, 15½ hours; vocational subjects, 33 hours; war issues, 1 hour.

The general scheme for work in section A covered a period of eight terms of 12 weeks each, with a vacation period of one week at the end of each term. In this way the academic or technical work would be done in a period of two years, and it was hoped that the men thus trained would be prepared for technical work or for officer material.

The proposed schedules of studies for the four engineering courses as proposed by the Committee on Educational and Special Training are given herewith:

CIVIL ENGINEERING.

FIRST TERM.	Hours per week.
Mathematics	12
Chemistry	12
Drawing and descriptive geometry or surveying	9
War issues and English composition	9
Military training	11
Total	53

SECOND TERM.	
Mathematics	12
Chemistry	12
Drawing and descriptive geometry or surveying	9
War issues and English composition	9
Military training	11
Total	53

THIRD TERM.	
Mathematics	12
Physics	14
Mechanics and mechanism	15
Drawing and descriptive geometry or surveying	6
Military training	6
Total	53

FOURTH TERM.	
Mathematics	9
Physics	14
Mechanics	15
Surveying or drawing	9
Military training	6
Total	53

FIFTH TERM.	
Theory of structures	6
Materials	10
Railroad engineering (including drafting and field work)	15
Highway engineering	6
Map reading and topographical drawing	2
Geology	8
Military training	6
Total	53

SIXTH TERM.	
Theory of structures	9
Bridge design	4
Railroad engineering (including drafting)	9
Hydraulics	13
Electrical engineering	12
Military training	6
Total	53

SEVENTH TERM.	
Theory of structures	12
Bridge design	10
Railroad engineering	4
Heat engineering	12
Hydraulic and sanitary engineering	9
Military training	6
Total	53

EIGHTH TERM.	
Theory of structures	12
Hydraulic and sanitary engineering and design	16
Heat engineering	9
Railroad design	3
Sanitary science and public health	1
Business law and accounting	6
Military training	6
Total	53

Courses divided between surveying and drawing were to be given in accordance with the season of year in which they came and the number registered. The total time allotment to surveying was to be equivalent to 12 hours per week for one term.

MECHANICAL ENGINEERING.

FIRST TERM	Hours per week.
Mathematics	12
Drawing and descriptive geometry	9
Chemistry	12
War issues and English composition	9
Military training	11
Total	53

SECOND TERM.	
Mechanism	9
Mathematics	12
Chemistry	12
War issues and English composition	9
Military training	11
Total	53

THIRD TERM.	
Mechanism and mechanical engineering drawing	10
Mathematics	12
Physics	14
Shopwork	4
Surveying, map reading, and topographical drawing	7
Military training	6
Total	53

FOURTH TERM.	
Applied mechanics	12
Mathematics	12
Mechanical engineering drawing	5
Physics and physical laboratory	14
Shopwork	4
Military training	6
Total	53

FIFTH TERM.	
Heat engineering and engineering laboratory	15
Electrical engineering	10
Applied mechanics	12
Machine drawing	6
Shopwork	4
Military training	6
Total	53

SIXTH TERM.	
Heat engineering and engineering laboratory	15
Hydraulics	11
Applied mechanics	10
Electrical engineering laboratory	7
Shopwork	4
Military training	6
Total	53

SEVENTH TERM.	
Materials of engineering and testing materials laboratory	12
Mechanism of machines	5
Machine design	10
Applied mechanics	10
Surveying or refrigeration	2
Shopwork	4
Engineering laboratory	4
Military training	6
Total	53

EIGHTH TERM.	
Power plant design	5
Industrial plants (including heating and ventilation)	16
Mechanics of engineering	7
Engineering laboratory	10
Gas motors	5
Shopwork	4
Military training	6
Total	53

In place of gas motors, 60 hours (total) of laboratory and lecture work may be assigned to heat treatment.

ELECTRICAL ENGINEERING.

FIRST TERM.	Hours per week.
Mathematics	12
Drawing and descriptive geometry	9
Chemistry	12
War issues and English composition	9
Military training	11
Total	53

SECOND TERM.	
Mathematics	12
Chemistry	12
Drawing and descriptive geometry	9
War issues and English composition	9
Military training	11
Total	53

THIRD TERM.	Hours per week.
Mathematics	12
Physics	14
Mechanics and applied mechanics	12
Mechanical engineering drawing	9
Military training	6
Total	53

FOURTH TERM.	
Mathematics	12
Physics	14
Elements of electrical engineering	2
Applied mechanics	12
Surveying, map reading, and topographical drawing	7
Military training	6
Total	53

FIFTH TERM.	Hours per week.
Elements of electrical engineering and direct-current machinery	15
Electrical engineering laboratory	8
Heat engineering	9
Materials of engineering	6
Shopwork	9
Military training	6
Total	53

SIXTH TERM.	
Variable and alternating currents	12
Electrical engineering laboratory	12
Heat engineering	9
Mechanical engineering laboratory	8
Structures or machine design	6
Military training	6
Total	53

SEVENTH TERM.	Hours per week.
Alternating current machinery	15
Electrical engineering laboratory	8
Hydraulics	9
Electrical transmission (power and telephone)	15
Military training	6
Total	53

EIGHTH TERM.	
Alternating current machinery	8
Electrical engineering laboratory	6
Power stations (steam and hydraulic)	13
Motor applications, lighting and storage batteries	16
Business law and accounting	4
Military training	6
Total	53

CHEMICAL ENGINEERING.

FIRST TERM.	Hours per week.
Inorganic chemistry	21
Mathematics	12
War issues and English composition	9
Military training	11
Total	53

SECOND TERM.	
Inorganic chemistry and qualitative analysis	21
Mathematics	12
War issues and English composition	9
Military training	11
Total	53

THIRD TERM.	
Qualitative analysis	12
Quantitative analysis	2
Mathematics	12
Physics	14
General engineering drawing	7
Military training	6
Total	53

FOURTH TERM.	
Quantitative analysis	14
Elements of organic chemistry	6
Physics	12
Theoretical and applied mechanics	7
General engineering drawing	8
Military training	6
Total	53

FIFTH TERM.	Hours per week.
Quantitative analysis	15
Physical chemistry	17
Theoretical and applied mechanics	15
Military training	6
Total	53

SIXTH TERM.	
Physical chemistry	17
Organic chemistry	18
Elements of electrical engineering	12
Military training	6
Total	53

SEVENTH TERM.	
Organic chemistry	16
Chemical technology	8
Proximate technical analysis	8
Elements of thermodynamics and heat engineering	15
Military training	6
Total	53

EIGHTH TERM.	
Chemical technology	24
Chemical warfare	1
Engineering materials	12
Mechanical engineering laboratory	10
Military training	6
Total	53

To show how closely the schedule suggested by the Committee on Education and Special Training was carried out in one instance, the schedules given below were submitted by the Rensselaer Polytechnic Institute and approved by the regional director, President Charles Alexander Richmond, of Union College, Schenectady, N. Y.

The numbers given after courses represent clock hours in the following order: Recitation, preparation, lecture, laboratory, followed by total number of hours.

RENSSELAER POLYTECHNIC INSTITUTE.

CIVIL ENGINEERING.[1]

FIRST TERM.	Hours per week.
Algebra 4-8-0-0	12
Chemistry 2-4-2-4	12
Drawing 1-2-0-6	9
War issues 3-6-0-0	9
Military training	11
Total	53

SECOND TERM.	
Trigonometry and analytics 4-8-0-0	12
Chemistry 0-0-0-12	12
Descriptive geometry 2-4-0-3	9
War issues 3-6-0-0	9
Military training	11
Total	53

THIRD TERM.	
Analytics and calculus 4-8-0-0	12
Physics 2-4-4-4	14
Mechanism 3-6-0-0	9
Surveying 1-2-0-3	6
Descriptive geometry 1-2-0-3	6
Military training	6
Total	53

FOURTH TERM.	
Calculus 4-8-0-0	12
Physics 2-4-4-4	14
Mechanics 2-4-0-0	6
Railroad engineering 2-4-0-0	6
Surveying 1-2-0-6	9
Military training	6
Total	53

FIFTH TERM.	
Theoretical mechanics 2-4-0-0	6
Applied mechanics 4-8-0-0	12
Materials laboratory 0-0-0-4	4
Railroad engineering 0-0-0-9	9
Highways 2-4-0-0	6
Map reading and top drawing 0-0-0-2	2
Geology 2-4-2-0	8
Military training	6
Total	53

SIXTH TERM.	
Structures and bridge design 4-8-1-0	13
Railroad engineering 2-4-0-0	6
Geodesy 1-2-0-1	4
Hydraulics 4-8-0-0	12
Electrical engineering 2-4-2-4	12
Military training	6
Total	53

SEVENTH TERM.	
Bridge design 4-8-0-0	12
Reinforced concrete 3-6-1-0	10
Steam engines 3-6-0-0	9
Power plants 0-0-0-3	3
Business law and accounting 1-2-1-0	4
Hydraulic and sanitary engineering 3-6-0-0	9
Military training	6
Total	53

EIGHTH TERM	
Bridge design 0-0-0-12	12
Hydraulic and sanitary engineering design 2-4-0-4	10
Thermodynamics 2-4-0-0	6
Mechanical laboratory 0-0-0-2	2
Railroad engineering 0-0-0-9	9
Machine design 0-0-0-2	2
Sanitary science and public health 1-2-1-0	4
Astronomy 0-0-0-2	2
Military training	6
Total	53

MECHANICAL ENGINEERING.[1]

FIRST TERM.	Hours per week.
Algebra 4-8-0-0	12
Chemistry 2-4-2-4	12
Drawing 1-2-0-6	9
War issues 3-6-0-0	9
Military training	11
Total	53

SECOND TERM.	
Trigonometry and analytics 4-8-0-0	12
Steam engineering 3-6-0-0	9
Mechanism 1-2-0-0	3
Descriptive geometry 2-4-0-3	9
War issues 3-6-0-0	9
Military training	11
Total	53

THIRD TERM.	Hours per week.
Analytics and calculus 4-8-0-0	12
Physics 2-4-4-4	14
Mechanism 3-6-0-0	9
Chemistry 0-0-0-12	12
Military training	6
Total	53

FOURTH TERM.	
Calculus 4-8-0-0	12
Physics 2-4-4-4	14
Mechanics 2-4-0-0	6
Surveying 1-2-0-4	7
Shop 0-0-0-8	8
Military training	6
Total	53

[1] The numbers given after the courses represent the clock hours in the following order: Recitation, preparation, lecture, laboratory, followed by total number of hours.

FIFTH TERM.	Hours per week.
Theoretical mechanics 2-4-0-0	6
Applied mechanics 4-8-0-0	12
Thermodynamics 3-6-0-0	9
Electrical engineering 3-6-1-0	10
Boilers 2-4-0 0	6
Shop 0-0 0 4	4
Military training	6
Total	53

SIXTH TERM.	
Structures 3-6 0-0	9
Hydraulics 4-8-0 0	12
Heat engines 3-6 0 0	9
Naval architecture 0 0-0-2	2
Mechanical laboratory 0 0 0 4	4
Electrical laboratory 0-0-0-7	7
Shop 0 0 0 4	4
Military training	6
Total	53

SEVENTH TERM.	
Metallurgy 3-6-0 0	9
Materials laboratory 0 0 0-3	3
Graphics of machinery 1-2-0-2	5
Machine design 2-4-0-4	10
Steam engine design 3-6-0-0	9
Refrigeration 1-2-0-0	3
Business law and accounting 1-2-1-0	4
Mechanical laboratory 0-0-0 4	4
Military training	6
Total	53

EIGHTH TERM.	
Power plants 1-2-0-2	5
Industrial plants 3-6-0 0	9
Marine engineering 1-2 0-0	3
Heating and ventilation 2-4-0-0	6
Automobile design 0-0-0 4	4
Gas engine 2-4-0-0	6
Hydraulic turbines 1-2-0-0	3
Shop 0-0-0-5	5
Mechanical laboratory 0 0 0-3	3
Military training	6
Total	53

ELECTRICAL ENGINEERING.[1]

FIRST TERM.	Hours per week.
Algebra 4-8-0-0	12
Chemistry 2-4-2-4	12
Drawing 1-2-0-6	9
War issues 3-6-0 0	9
Military training	11
Total	53

SECOND TERM.	
Trigonometry and analytics 4-8-0-0	12
Steam engineering 3-6-0-0	9
Mechanism 1-2-0-0	3
Descriptive geometry 2-4-0-3	9
War issues 3-6-0-0	9
Military training	11
Total	53

THIRD TERM.	
Analytics and calculus 4-8-0-0	12
Physics 2-4-4-4	14
Mechanism 3-6-0-0	9
Chemistry 0-0-0-12	12
Military training	6
Total	53

FOURTH TERM.	
Calculus 4-8-0-0	12
Physics 2-4-4-4	14
Elements of electrical engineering 0-0-2-0	2
Mechanics 2-4-0-0	6
Shop 0-0-0-6	6
Surveying 1-2-0-4	7
Military training	6
Total	53

FIFTH TERM.	Hours per week.
Theoretical mechanics 2-4-0-0	6
Applied mechanics 4-8-0-0	12
Elements of electrical engineering and direct current machinery 5-10-0 0	15
Electrical engineering laboratory 0-0-0-8	8
Thermodynamics 2-4-0-0	6
Military training	6
Total	53

SIXTH TERM.	
Variable and alternating current 4-8-0-0	12
Electrical engineering laboratory 0-0-0-12	12
Hydraulics 4-8-0-0	12
Mechanical laboratory 0-0-0-5	5
Machine design 1-2-0-3	6
Military training	6
Total	53

SEVENTH TERM.	
Alternating current machinery 2-6-4-3	15
Electrical engineering laboratory 0-0-0-8	8
Electrical transmission 5-10-0-0	15
Business law and accounting 1-2-1-0	4
Boilers 1-2-0-2	5
Military training	6
Total	53

EIGHTH TERM.	
Alternating current machinery, 2-4-2-0	8
Electrical engineering laboratory, 0-0-0-6	6
Power plants, mechanical, 1-2-0-2	5
Power plants, electrical, 1-2-0-2	5
Hydraulic turbines 1-2-0-0	3
Motor application, lighting and storage batteries 3-6-3-3	15
Heat engines 1-2-0-2	5
Military training	6
Total	53

[1] The numbers given after the courses represent the clock hours in the following order: Recitation, preparation, lecture, laboratory, total.

CHEMICAL ENGINEERING.[1]

FIRST TERM.	Hours per week.
Algebra 4-3-0-0	12
Chemistry 2-4-2-4	12
Drawing 1-2-0-6	9
War issues 3-6-0-0	9
Military training	11
Total	53

SECOND TERM.	
Trigonometry and analytics 4-8-0-0	12
Chemistry 2-4-0-0	6
Chemistry 0-0-0-12	12
Mechanical drawing, 0-0-0-3	3
War issues 3-6-0-0	9
Military training	11
Total	53

THIRD TERM.	
Analytics and calculus 4-8-0-0	12
Physics 2-4-4-4	14
Chemistry, quantitative 3-6-0-0	9
Chemistry, qualitative 0-0-0-12	12
Military training	6
Total	53

FOURTH TERM.	
Calculus 4-8-0-0	12
Physics 2-4-4-4	14
Chemistry 2-4-0-9	15
Mechanics 2-4-0-0	6
Military training	6
Total	53

FIFTH TERM.	
Theoretical mechanics 2-4-0-0	6
Applied mechanics 4-8-0-0	12
Electrical engineering 2-4-2-0	10
Chemistry, organic 3-6-0-10	19
Military training	6
Total	53

SIXTH TERM.	
Structures 1-2-0-0	3
Electrical engineering laboratory 0-0-0-7	7
Hydraulics 4-8-0-0	12
Machine design 1-2-0-3	6
Physical chemistry 3-6-0-8	17
Gas analysis 0-0-0-2	2
Military training	6
Total	53

SEVENTH TERM.	
Metallurgy 3-6-0-0	9
Business law and accounting 1-2-1-0	4
Materials laboratory 0-0-0-3	3
Steam engines 2-4-0-0	6
Water analysis 0-0-0-10	10
Electro-chemistry 1-2-1-4	8
Physical chemistry 1-2-0-0	3
Mechanical laboratory 0-0-0-4	4
Military training	6
Total	53

EIGHTH TERM.	
Sewage 1-2-1-0	4
Power plants 1-2-0-2	5
Thermodynamics 2-4-0-0	6
Surveying and topography 1-2-0-4	7
Mechanism 2-4-0-0	6
Food analysis 1-2-0-4	7
Industrial chemistry 2-4-0-2	8
Sanitary science and public health 1-2-1-0	4
Military training	6
Total	53

To care for men who had been at the Rensselaer Polytechnic Institute for one or two years, the following schedules were arranged.

Work was to be done as of third term for men who had been at the institute one year of two terms and who were taking the third term at this time. Numbers after courses have the same meaning as given on complete schedules, viz, clock hours devoted to recitations, preparation, lecture, laboratory, followed by total.

CIVIL ENGINEERS.	Hours per week.
Calculus, 4-8-0-0	12
Physics, 2-4-2-2	10
Mechanism, 5-10-0-0	15
Highways, 2-4-0-0	6
Surveying, 1-2-0-1	4
Military training	6
Total	53

MECHANICAL AND ELECTRICAL ENGINEERS.	Hours per week.
Calculus, 4-8-0-0	12
Physics, 2-4-0-2	8
Mechanism, 5-10-0-0	15
Chemical laboratory, 0-0-0-9	9
Topographical drawing,[2] 0-0-0-3	3
Military training	6
Total	53

[1] The numbers given after the courses represent the clock hours in the following order: Recitation, preparation, lecture, laboratory, followed by total.

[2] Shop taken in past summer.

CHEMICAL ENGINEERS.

	Hours per week.
Calculus, 4-8-0-0	12
Physics, 2-4-0-2	8
Chemistry, 3-6-0-12	21
Mechanics, 2-4-0-0	6
Military training	6
Total	53

War issues for this class were to be given in the fifth and sixth terms.

The work to be done was considered as of the fifth term for men who had been at the institute for two years, or four terms, and who were taking the fifth term at this time.

CIVIL ENGINEERS.

	Hours per week.
Physics, 2-4-0-4	10
Mechanics, 5-10-0-0	15
Highways, 1-2-1-0	4
Topographical drawing, 0-0-0-1	1
Mineralogy and geology, 2-4-2-0	8
Railroad engineering, 3-6-0-0	9
Military training	6
Total	53

MECHANICAL ENGINEERING.

Thermodynamics, 3-6-0-0	9
Boilers, 2-4-0-1	7
Electrical engineering, 3-6-1-0	10
Mechanics, 5-10-0-0	15
Mechanical laboratory, 0-0-0-6	6
Military training	6
Total	53

ELECTRICAL ENGINEERS.

	Hours per week.
Elements of electrical engineering and direct current 5-10-0-0	15
Electrical engineering laboratory, 0-[illegible]-0-8	8
Thermodynamics, 3-6-[illegible]-0	9
Mechanics, 5-10-0-0	15
Military training	6
Total	53

CHEMICAL ENGINEERS.

Mechanics, 5-10-0-0	15
Electrical engineering, 3-6-1-0	10
Chemistry, organic, 3-6-0-10	19
Electrical engineering laboratory, 0-0-0-3	3
Military training	6
Total	53

The work done by men who had been at the institute for three and one-half years, since the first term of the senior year had been given during the spring and summer of 1918 and were therefore taking the eighth term at the institute, was arranged to complete the regular institute course during the term which ended January 9, 1919, at which time a proposed commencement would take place. The work during the summer included the subjects of the regular course to such an extent that the number of hours per week required for students on the Students' Army Training Corps basis ran from 27½ to 47½ hours per week. This included study periods. The courses given were the theoretical subjects of the senior year of the institute curriculum.

The committee schedules were issued in many cases after the regular time of opening for the technical institutions, and from the middle of September to the 1st of October students were being inducted into the corps.

On October 1, 1918, the United States Army training detachments which were established at educational institutions by the Committee on Education and Special Training were merged with the Students' Army Training Corps, as this date was set for the formal mobilization of this corps. At this time, at more than 400 colleges and universities throughout the United States, over 150,000 young men became members of the Army or Navy of the United States.

On September 17, 1918, orders were issued to the mobilization officers at various recruiting stations permitting students subject to draft to enroll as members of the naval section of the Students' Army Training Corps at institutions at which naval units were established. At various institutions throughout the country a limited number of men were allowed to enter the naval units.

Following the signing of the armistice, orders were issued to demobilize the Students' Army Training Corps, and this began about the first of December, demobilization being completed about December 21.

This experiment covered a period of 12 weeks and completed the first term of the Student's Army Training Corps. It was necessary for each school to keep records of the scholastic work of the students on the percentage basis of 100. The committee requested monthly records of grades to be sent to them for the purpose of furnishing necessary information regarding various members of the corps. The military records were kept by the personnel officer. The work of each term of 12 weeks was to have been followed by a furlough of one week, and from the records made by members of the corps their continuation was to have been determined.

The work of the Students' Army Training Corps was in general far from satisfactory to the college administrators, largely because the relations between the military commanders and the educational authorities were not fully adjusted. The demand for men to be used for military duty and for kitchen police prevented many students from properly pursuing their studies, and in many cases the time taken for drill and guard duty prevented students from obtaining proper educational training. The period covered by this experience, however, was the period of an entirely new experiment, and the unforeseen difficulties had not been overcome by the time the experiment was concluded. It was the belief of many that, had the Students' Army Training Corps been continued for a longer period, these difficulties could have been rectified and the training made successful.

From a study of the courses listed above, it will be evident that with proper administration the four courses in engineering would have given training sufficient to produce able engineers, considering that this training was planned for intensive study during a critical period of the life of the nation.

LATER DEVELOPMENTS IN ENGINEERING EDUCATION.

The period covered by the years 1919 and 1920 is marked by few changes in the curricula of the engineering schools; some of these changes have been in progress for five or six years, some have been brought about by new demands, and some by new laws. Very few schools report changes due to war experiences or to the Mann report, mentioned in the Biennial Survey of Education, 1916–1918, U. S. Bureau of Education, Vol. I, page 100.

The war experiences of the schools of engineering are so recent, and in many cases were so unsatisfactory, that it is difficult to obtain any constructive suggestions from these experiences. Of the replies received from those in charge of engineering schools, only one states that the war experience gave suggestive matter. This suggestion was the value of supervised study. The author of this reply believes that great value can be derived and should be accomplished by supervised study. To the writer of this report the plan of supervised study was welcomed as a method of increasing the study time of the students, but when this was instituted it was found that with those unaccustomed to study in large rooms with a number of persons present the method produced poor results. The psychological effect of restricted activity and uniform study time of definite duration was bad. The results of this method were not good, and there was much complaint from the students.

The methods used for the Students' Army Training Corps were revolutionary in that old values were absolutely abandoned for the time being, and many thought that the engineering curricula might be changed at the conclusion of the war. This did not occur, for the unhappy experiences of the Students' Army Training Corps days made all anxious to return to prewar conditions. This experience was unfortunate in that it was of such short duration that there was nothing in the three months of operation to correct the evils which had developed, and, as said before, many believe that had the Students' Army Training Corps been continued for a year with war incentives for work, a different result could have been expected.

The experiment did prove the value of an incentive for work, an impelling motive, and in this post-war period courses for orientation of the young engineer have been

introduced, and "motivation" is a new term, which indicates the influence of such courses on the work of the engineering student. The war experience has also shown to many that courses of study may be changed without great difficulty, and it may be with advantage.

The various replies that have been received regarding the effect of the Mann report have indicated in most cases that the report has had little influence. A few have used the reports as a basis for changes in the curriculum, and others have made changes which are recommended in the report, but the consideration of these antedated the report, and were due to the developments of educational methods or the demands of the times. Many of these changes have been advocated and discussed at the meetings of the Society for the Promotion of Engineering Education. In many institutions the report has received careful study by faculty and officers.

To help the Nation at the critical period of the war, many institutions graduated the classes in engineering at an early day by utilizing Saturdays for class work, and in this way men were graduated in February and May, 1918, in place of June, 1918.

In some institutions, before the establishment of or plans for the Students' Army Training Corps were made, instruction was given during the summer of 1918, and thus they were enabled to graduate the class of 1919 in December, 1918. The armistice of November, 1918, made any further speeding up of work unnecessary; and after the graduation in December, 1918, or January, 1919, and the demobilization of the Students' Army Training Corps, work was resumed on almost normal schedules. The changes brought about by the Students' Army Training Corps work of the first term made the studies in January of such a nature that the regular schedule could be resumed at the beginning of the second term in February, 1919.

The period 1918–1920 marks a new era of increased enrollment in the engineering schools. The enrollment of September, 1918, in the Students' Army Training Corps, was large. This was due to many causes. In the first place the Government agreed to send eligible young men to college and to pay their expenses, including tuition, board, room rent, and clothing, as well as to give them the pay of regular soldiers. Besides this, the Selective Draft Law made it impossible for one of draft age to get an education in any other manner, and many men wanted to serve their country in this way. It is possible, too, that some who were eligible took advantage of the Students' Army Training Corps to avoid active fighting service.

On the demobilization of the Students' Army Training Corps a number of men left, but after the demobilization of the Army many other men returned for the second term in the spring of 1919, so that the second term enrollment amounted to 75 per cent of the enrollment of the first term.

In the fall of 1919 the enrollment of most engineering schools was even larger than that during the Students' Army Training Corps period, and this large enrollment was continued or exceeded in the fall of 1920, and that of 1920 by the still larger enrollment of 1921.

The large enrollments during these years have been due to the return of many who had interrupted their studies early in the war to unite with arms of our own service or those of our allies; to the return of those who were drafted; to the fact that the war interrupted the education of many who would have entered the engineering schools during the period of the war, and finally to the fact that many students or parents had been placed in such a financial condition, because of the high wages paid to artisans, that certain young men were able to pay the cost of higher education. In addition, the value of college education was demonstrated by the success of the college trained men during the war in the service and the industries.

The showing made by men trained in engineering during this critical period indicated to many the value of such education, and it is believed that this large enrollment will be maintained unless business depression continues for a long time. The demand for men trained in engineering for executive positions in the industries also indicates that this enrollment will continue.

There are several tendencies of this period which are indicated by a study of the college catalogues and of the replies to inquiries. These tendencies, although more evident at this time, have been gradually developing, and in some cases they have been evident for years.

There is some indication that more special courses are desired, such as compressed-air engineering, industrial engineering, heating and ventilating engineering; but there is a strong current of feeling that we should develop men fundamentally and broadly and leave the specialties to be acquired after graduation. Thus at the State University of Iowa the course of the first three years in engineering is common to all engineers, and only two-thirds of the work of the various branches of engineering in the senior year is different. Others report two years in common, and many report one year in common.

There is a tendency to introduce engineering courses of a general nature in the freshman year for the purpose of orientation, although this has been the avowed practice of many for years. A number of institutions have introduced these courses, and in some cases the course takes the form of a series of lectures by heads of the various engineering departments given to all students, while in others special courses are given in each of the departments of engineering. These institutions feel the necessity of giving the student a motive for work by arousing interest in the activities of the engineer, the study of which must of necessity come after the preparatory years in fundamental subjects.

In many engineering schools the subjects of citizenship, economics, sociology, bookkeeping, shop management, business administration, finance, and law are being added to the curriculum by the exclusion of certain engineering subjects. The engineer is now playing more of a part in administration and the management of plants. For this reason these courses are required. The courses omitted are those of a special nature, which may therefore be properly taken up by the graduate in connection with his technical work. The sciences dealing with the fundamentals of human relationships are as necessary as the fundamentals of engineering in the world in which the engineer must work to-day.

In addition to adding these subjects in a greater or lesser degree, some institutions have offered courses in administrative engineering, as at Sheffield Scientific School of Yale University; in administrative science, as at the University of Kansas; and in an administrative option, differing in the last two years from a technical option, as at Union College in civil engineering; and others have offered courses in commercial mechanical engineering or commercial electrical engineering, as at the State College of Washington.

The courses in industrial engineering established at certain engineering schools are being continued, while at Columbia and at the University of New Hampshire industrial engineering has just been established. At some institutions special intensive summer courses in the industries are given to engineers who are engaged in industrial engineering.

Certain schools of engineering, such as that of the University of Pennsylvania, are giving special spring courses in highway engineering to train graduate engineers in road building and economics. The great wave of service by the engineer is entering our schools in their desire to render service to the graduate needing further training after entering practice.

The success obtained from certain problem courses during the intensive Army training period, and the belief of some educators even before the war, have united to cause the introduction of courses in engineering by which the teaching is done through problems. At Lafayette College freshmen during their first term are given problems connecting mathematics and engineering. At other institutions this kind of work is applied to the subjects of the later years, and as a result of five years of

investigation the engineering school of Tufts College has made a departure from the usual curricula of engineering schools, the aim of which is:

(1) To present a survey or perspective of a chosen field of engineering previous to a detailed study of fundamentals. (2) To coordinate theory and practice by using projects of a distinctively engineering character involving theory. (3) To reduce the number of subjects studied at one time, while intensifying the work in these subjects. (4) To rate the student by observation on his character as well as by the quality and quantity of the prescribed task.

To accomplish these ends, there is given in the freshman year the so-called main introductory course in connection with mathematics, English, and drawing. The main course consists in the study of four projects for the civil engineers and four projects in common for the mechanical engineers and electrical engineers.

During the first year of this new method the projects for the civil engineers were:

First. The study of a wooden garage.
Second. The study of a steel garage.
Third. The study of a small highway bridge.
Fourth. The layout and survey of an underground tunnel.

The projects for the mechanical and electrical engineers were:

First. The measurement of power developed and delivered by a steam engine.
Second. The dismantling, reassembling, and operation of various types of automobiles.
Third. The distribution of potential along lighting circuits.
Fourth. The study of the operation of batteries.

The projects use three laboratory periods and three recitation periods a week for the whole freshman year, and in this time laboratory work, drawing, surveying, graphics, handbooks, sketching, elementary mechanics, kinematics, steam engineering, and electrical instruments were used as needed, and where possible the work was coordinated with textbook assignments.

This introductory course increased the interest shown by the student and made him more observant. It reacted on the student in helping him in the English work of the freshman year in giving him material on which he could write.

In the upper class the endeavor is to cut down the number of required subjects to five. This was done by combining certain related courses into one course. The outline of the course for each term in each year is given below:

FIRST YEAR.

	Hours per week.
Main introductory course	12
Mathematics	9
Graphics	7
English	6
Total	34

SECOND YEAR.

Department courses	12
Two supplemental courses	14
Mathematics and mechanics	6
Electives	4
Total	36

THIRD YEAR.

	Hours per week.
Departmental courses	18
Applied mechanics	6
Physics	6
Elective	6
Total	36

FOURTH YEAR.

Engineering economics and business law	6
Departmental courses and electives	30
Total	36

In the application of the problem method some institutions feel that their lack of success has been due to the lack of maturity of the students. There can be little doubt that the problem method may excite interest and aid in the later theoretical study, but it may also be said that previous theoretical study will lead to greater facility in the solution of problems.

In languages there is a tendency to extend the work in English and reduce or eliminate foreign languages. Training in public speaking and debate are required by some.

The lack in English is felt for the same reason that we feel the lack of training in the subjects dealing with human relations. As the engineer has to deal with men to a greater degree, he must know how to transmit his thoughts in words as well as by drawings.

There is a slight indication that more physical exercise is to be demanded in our schools. This probably is an indirect result of war experience, when it was found that so many of our men were not physically fitted for effective service.

During the last 5 or 10 years there has been a tendency to divide the year so as to form quarterly periods, using the summer quarter for the removal of conditions and for the graduate or undergraduate work of public school teachers. This meant that the regular courses were given in three quarters. The reports from some institutions indicate that a return will be made to the customary two-semester plan, although at the Southern California Institute of Technology the two-semester work has been changed to three terms.

The design courses, which are an important part of some curricula, have been dropped from the curriculum of the University of Oklahoma.

One of the recent changes in engineering education has been the extension of the school of engineering at Princeton University in 1921 to include undergraduate courses in civil engineering, electrical engineering, mechanical engineering, chemical engineering, and mining engineering, as well as a graduate year for the first four of these courses.

The plan has been under consideration for a number of years, and the desire has been to utilize the facilities of the university for the general education of engineers with broad vision and to give the necessary technical work to prepare the graduate for the profession. The aim has been to limit the technical work to the fundamentals of engineering, covering sufficient preparation to make the graduate of the four-year course able to enter engineering as an assistant, leaving to a graduate year the many special courses now included in the four-year engineering courses.

The preliminary schedule of studies for these courses shows the following average figures:

	Per cent.
Science	23
Mathematics	11
English and foreign language	15
Sociology, economics, history, and electives	18
Engineering	33
Total	100

The graduate year leading to an engineering degree is to consist of engineering, economics, and research. The four-year course will lead to a bachelor's degree.

The cooperative system of engineering education used for a number of years at various institutions has been introduced into the electrical engineering department of the Massachusetts Institute of Technology. In this newest cooperative plan of study the aim has been to give all practical training in one manufacturing institution, the General Electric Co., at Lynn, Mass.

The first two years of the course are similar to the first two years of the regular four-year course, and then during the summer of the second year the entire cooperative class is sent to the General Electric Co., at Lynn, Mass., to begin their practical training. At the end of this summer period of 13 weeks the class is divided into halves, and one half continues at the works for 13 weeks while the other half returns to the institute for 11 weeks of instruction to be followed by a 2 weeks' vacation to complete the 13 weeks' period. The halves now change places, one section returning to the institute for its 11 weeks of instruction and 2 weeks of vacation and the other going to the shops for 13 weeks of practical work. This is continued until the expira-

tion of two and one-half years, the student having had work in the factory for 18 months and 5 terms of 11 weeks' actual instruction at the institute. The whole class spends the last period at the institute. Interpreting this into standard college years of about 33 weeks, the student has completed four college years at the institute and one and one-half actual years in practical work and some theory at the shop. At the end of this period the successful student receives the degree of B. S. as of the previous year and the degree of M. S.

The work in the shop is so arranged that the student works 48 hours per week in shop or office, 4 hours in lectures or recitations, and 6 hours in study and preparation. Of the 4 hours mentioned, 1 hour is devoted to a lecture by one of the shop superintendents and 3 hours are given to recitations in electricity and English. This requires 58 hours per week and gives the student three week-day evenings, Saturday afternoon, and all of Sunday as free time, and permits him to do all required work by 9.30 on the other three evenings.

The period of 11 weeks at the institute is such that the institute courses can be given without any disarrangement of other work, as the periods correspond with institute terms. The theoretic studies include advanced subjects, and in the last year are included research and creative design at the institute and experience in the research laboratories and in the engineering and manufacturing offices at the factory.

The shopwork is under the direction of representatives of the cooperating company and the institute, and the recitations in theoretical work during the shop period are held by members of the institute faculty.

The principal differences between this cooperative course and those previously given are stated by Prof. W. H. Timbie as follows:

First. Length of periods for shop and college. This has been thought advisable to permit the student to become familiar with men, methods, materials, and spirit of the department in which the period is spent, although in some cases the student may be placed in several departments during one period. The length of period also reduces the number of changes to 12.

Second. The recognition by the cooperating company that for three years the student is in its plant for the purpose of being educated and trained as a high-grade electrical engineer. There is no attempt to make student labor of value to the company per se, but the work is so arranged that the student may learn manufacturing methods and the best relations of labor, machinery, and materials for proper production. Shifts are made as soon as knowledge of the detail of a department is attained by a student.

Third. A continuity of studies of theoretical and humanistic subjects. This work is carried on at the institute and at Lynn.

Fourth. Required collateral reading. This is done at the Thompson Club, at which the students live together while at Lynn. Here books from the institute library and Lynn Public Library are found. The books permit reading outside the prescribed courses.

Fifth. Intense spirit of loyalty inculcated in members of this course to one another, to the institute, and to the cooperating company.

Sixth. The continuation of the work for three years in one company. Of course the magnitude of the plant of the General Electrical Co. at Lynn makes this cooperative course of great value in that the student will be brought in contact with most manufacturing and business methods in connection with the production of electrical apparatus. The practical training deemed necessary can be obtained with one company.

Seventh. The unusual amount of theoretical work, so that the master's degree can be given at the end of five years.

This cooperative work, as that conducted by Cincinnati, Pittsburgh, Akron, and Massachusetts, is applied to a very limited degree in other institutions. Thus

Yale requires a limited amount of summer work, and electrical engineers at Rensselaer may substitute eight weeks of work in an approved plant for the second shop period of four weeks at the institute. Johns Hopkins requires six months of industrial work. At Antioch College summer work as well as term work in the industries is encouraged for the purpose of self-support as well as to train the student in practical details of the profession for which he is preparing. The University of Maine is planning to require work in industrial plants during two summers.

One other trend remains to be mentioned. In a number of institutions, civics, citizenship, or United States history has been added to the engineering curriculum. The war probably demonstrated the advisability of such training; and, moreover, there is a desire in all educational institutions to prepare men to take an interest and an active part in civic affairs as well as to fit them for specific work.

The Smith-Hughes Act, approved by the President February 22, 1917, appropriates funds amounting in 1926 to a yearly sum of $6,000,000 for the purpose of cooperating with the States in providing instruction in agricultural, trade, home economics, and industrial subjects, and in preparing teachers of vocational branches of study on condition that the States appropriate equal sums. The act divides one half of the fund among the States in proportion to the ratio of their rural inhabitants to the total rural inhabitants of the United States for the salaries of agricultural teachers, supervisors, or directors, and the other half in proportion to the ratio of their urban inhabitants to those of the United States for the salaries of teachers, supervisors, and directors of trade, home economics, and industrial subjects. Another appropriation amounting to $1,000,000 annually is divided in proportion to the total population of the States for the purpose of preparing teachers.

In carrying out this act a number of the State schools of engineering are offering courses of vocational training. Some of these courses are given in the engineering schools; others are given in the department of home economics, agriculture, or education. The work has been so recent that many institutions have not arranged these courses completely. The following quotations will give some idea of the present condition of the courses in engineering organized to meet the requirements of the Smith-Hughes Act:

WEST VIRGINIA UNIVERSITY, MORGANTOWN, W. VA.

Undergraduate curriculum in industrial education, leading to the degree of bachelor of science.—The object of this course is to prepare young men and women to teach vocational subjects and to supervise vocational work in connection with the administration of the Smith-Hughes Act. This is a new course, and the exact requirements have not been definitely fixed. A total of 128 semester hours will be required for graduation, which must include 10 hours in English, 10 hours in mathematics, a thorough knowledge of one or more trades, 4 hours in mechanical drawing, and 10 hours of vocational industrial education.

UNIVERSITY OF WISCONSIN, MADISON, WIS.

Smith-Hughes courses for those who desire to teach trades and industry or the related subjects as prescribed by State and Federal laws.—The department of manual arts will administer courses in accordance with State and National prescription in the training of teachers of trade and industry. At different times in the past the department has been instrumental in organizing special groups of mechanics in order to assist them, by means of short courses, to prepare for teaching in Wisconsin continuation schools or other vocational or trade schools. Under the new organization the department will, if possible, organize similar classes to be given instruction in accordance with the provisions of the Smith-Hughes law and those for the Wisconsin State Board of Vocational Education.

For several years the University of Wisconsin, through the agency of the department of manual arts acting for and with the extension division of the university, has conducted evening courses of study in Milwaukee, Wis., for tradesmen preparing to teach industrial subjects. The department is prepared to continue this work, to modify it

to conform to Smith-Hughes requirements, and to assist in the organization and conduct of similar instructional work in other Wisconsin centers. In doing this it will not seek to set up an independent organization, but will endeavor to cooperate in any way possible with local agencies, the Wisconsin State Board of Vocational Education, and the Federal Board of Vocational Education.

A registrant for courses given under the heading of "Vocational courses for teachers of trade and industry" shall be admitted as a special student. Upon the completion of any unit of work or prescribed special course, he shall receive a certificate specifying his accomplishment.

UNIVERSITY OF TEXAS, COLLEGE STATION, TEX.

Course in industrial education.—The course in industrial education has for its main purpose the preparation of teachers of related subjects as prescribed for industrial education under the Smith-Hughes Act. Graduates of this course will be prepared not only to teach related subjects but to teach the regular shopwork ordinarily given in the high schools of the State, to teach shopwork under the Smith-Hughes Act in schools of cities having a population of less than 25,000, and to direct or supervise industrial education in large city school systems. The course requires contact with a wide range of trades through its shopwork and a liberal education in science, mathematics, history, English, etc. Thorough preparation in the art of teaching and supervising is afforded. The wide range of electives permits the student to specialize in some trade, or to do more extensive work in a wide field.

The State plans for requirements of teachers of related subjects in classes using Federal funds under the provisions of the Smith-Hughes Act which specify that the teacher must have had at least 880 hours of experience in at least two trades. This is to insure adequate contact with shops operated on a commercial basis. Students in this course are expected to get this experience through summer work following the sophomore year and the junior year. The department of vocational teaching will assist in arranging for this work.

BUSINESS ADMINISTRATION.

A course in business engineering has been offered at the Iowa State College. In this course subjects of various courses in the engineering school have been united with administrative courses for application to business. The college makes the following statement:

Large corporations, contracting firms, municipalities, and all employers of technically trained college men are showing an increasing tendency to transfer such men as have made successes in strictly engineering lines into positions of magnitude and trust requiring knowledge of economic relations and business principles. It is true that the engineering graduate has the ambition to own and manage a business. Many men with the training secured in our engineering schools, combined with the principles of economics and rules of business which they have had to acquire slowly, are meeting with the greatest success in positions which rquire the highest type of business training and qualifications and a minimum of engineering experience.

From such employers of technically trained men and from engineering graduates now in business for themselves has arisen a demand that the engineering schools offer studies in the fundamental principles of business, supplemented with advanced work along lines closely allied with engineering industries. The engineering schools of the country have felt this demand, and many are meeting it in various ways. The problem might be solved most easily by increasing our engineering courses from four to five years, by requiring certain studies related to business during the last two years, and by giving opportunity for free electives. Under present conditions it seems desirable that the studies relating to the fundamentals of business be offered in the regular four-year course.

The intimate relation which must exist between engineering and business is not a new idea at this college. The engineering courses have been requiring or offering as electives many studies bearing direcly or indirectly on business relations. The number of such studies and the quality of the work offered are continually being increased and improved. It is believed that there should be no weakening of the essentially technical and engineering side of the four-year courses. It is probable that the marked success with which many men with engineering training are filling business positions is due to personality and opportunity combined with habits of logical and independent thinking acquired in large part while completing an engineering college course and supplemented by later experience.

The subjects of this course include the following:

Architectural engineering: Elements of contracting.

Civil engineering: Estimating and cost keeping, engineering reports, professional practice, railway operation and administration.

Economic science: Money and banking, public finance, American labor, distribution of wealth, economics for engineers, accounting, business law, rural sociology.

Engineering: Specifications and contracts, history of engineering.

English: Main elements of composition, exposition, narration and description, argumentation.

History: Industrial history of the United States; history of labor in the United States; financial history of the United States; history of foreign relations of the United States; American Government, municipal government.

Agricultural journalism: Beginning technical journalism; feature writing for technical journals.

Mathematics: Statistical method of interpreting experimental data.

Mechanical engineering: Power plant engineering, industrial engineering, industrial organization, scientific management.

Mining engineering: Mining engineering, mine administration, and mining law.

Public speaking: Extempore speech, debating, advanced public speaking.

JUNIOR COLLEGE.

During the last few years the development of the junior college in connection with the high schools of a number of cities, the division of the work at the university into an upper and lower division and also to give engineering in two years to graduates of colleges of arts and sciences, has caused some engineering schools to rearrange their curricula so that with a little extra work men with preparation can graduate with two years of engineering work. The junior college and its many advantages have been discussed in the Report of the United States Commissioner of Education for the year 1920. The division of university work into upper and lower divisions has been practiced for many years as at Chicago, it being recognized by others that the work of the first two years of most colleges and schools is a continuation of high-school work, and as such it is distinct from the work of the two latter years. The recognition of this has made possible the acceptance of work done in postgraduate high-school courses or junior colleges.

RÉSUMÉ.

To give in a brief form the progress of engineering education during 1918-1921, it may be stated that during this period there has been manifest a greater desire to stress fundamental studies to the exclusion or removal of certain applied studies, an elimination of modern language by some and an increase of English, an increase in the study of economics, history, civics, and business methods, an inclusion in the early years of motivating courses, a wider use of the problem method of teaching, and finally a desire to decrease the number of courses by the grouping together of short courses.

DATA FROM REPLIES.

The following digest of replies gives the data for the foregoing report.

Antioch College, Yellow Springs, Ohio.—The reorganization program for the college includes cooperative work in all branches of study. The trustees of Antioch College have determined to reorganize along the following lines:

1. Student self-support by a division of time between college study and remunerative work, the college program being arranged accordingly.

2. A combination of practical experience with academic study, preferably in the calling for which the student is preparing himself.

3. Allowance of credit for actual accomplishment and not for "clock hours" spent in any given subject. (It is estimated that the average student will require 6 years to complete a course of study requiring full time for 4 years.)

4. The college will offer liberal arts courses and a limited number of technical courses. In the belief that the best results can be secured by a comparatively small faculty of high-grade men and women, the number of regular liberal arts courses will be limited to about 80, which is less than half the number usually offered in small colleges.

5. Except for students who show marked ability in any department, liberal arts courses will deal only with the fundamentals of their subjects. For students who do show such ability, autonomous courses will be provided. That is, for advanced work, well-considered courses will be offered, with library and laboratory facilities, and with occasional access to the heads of departments or other competent authorities for advice. Thereupon the student will carry the advanced work in the manner of a seminar.

6. There must be coordination between different courses, so that the college will be a synthetic unit and not an aggregation of unrelated departments each bidding for the students' time and interest.

7. A limited number of technical courses will be offered. A technical course must include the fundamentals of a liberal arts education, as it is the aim to make citizens as well as technicians. These courses will aim to develop general competency rather than highly specialized technique, and to prepare men and women for callings for which adequate preparation is not now being given in colleges and universities. They will aim to make men directors of industry rather than employees working under detailed directions.

8. The college will aim to eliminate the traditional cleavage between cultural standards and practical standards and to make practical life for its students a medium of expression for such cultural standards and ideals.

9. Physical fitness is a primary condition to happiness and success. Students will be required to care for their physical condition in order to remain in the institution.

10. The final measure of accomplishment will be the success attained in turning out students whose preparation has laid the basis for productive service and whose primary aim is service to their communities and to their times. No paper program will accomplish this result, but only the spirit with which the college may be imbued. The chief hope of the trustees is to secure a faculty and a student body that will make this result possible.

California Institute of Technology, Pasadena, Calif.—The institute has changed from a two-term to a three-term year. Modern language has been eliminated, being replaced by English, history, current topics, and geology. A new course, physics and engineering, has been introduced.

Carnegie Institute of Technology, Pittsburgh, Pa.—No important changes. Discussing return to two semesters from four quarters.

Case School of Applied Science, Cleveland, Ohio.—The present day requests for engineers indicate the importance of students using summers for work in industrial plants so as to better understand labor and industrial problems. This work is not required at present, but the requirement is being considered. The experience of the school indicates that preparatory work is not being done as well as it was before the war. A tendency to student organization is more manifest than formerly.

College of the City of New York, New York, N. Y.—The school of technology was recently organized. Although contemplated for some time, the war accelerated the inauguration of this new school. The chemical engineering course is such that B. S. is given at the end of four years and Ch. E. at the end of the fifth year.

The freshman year contains public speaking, analytic geometry, calculus, English, a foreign language, chemistry, descriptive geometry, mechanical drawing, American Government, citizenship, physical training, and military training.

For sophomore year: Prose and poetry, declamation, English, history, physics, qualitative analysis, geology, evolution of industry, causes and cures of diseases, defense of health, and military training.

For junior year: Debate, physical laboratory, organic chemistry, philosophy, machine design, qualitative analysis, electrochemistry.

For senior and post senior years the subjects are technical with the exception of courses in debate, business organization, and commerce.

The courses in mechanical engineering, electrical engineering, and civil engineering are the same as the above for the first two years and differ in the technical subjects of the last years. There are small differences in the first two years, but these differences are due to sequence. In all four courses there is training given in history, philosophy, civics, hygiene, and business. Economics is included in certain courses.

The announcement of the school contains the following quotations:

These technical courses as established cover a period of five years. During the first two years the work required consists almost entirely of necessary prescribed collegiate science subjects, the better to prepare and develop the mind of the young student for what is to follow. The third and fourth year subjects taken up are to a very great extent strictly in engineering, but so arranged that the student is upon completion of the fourth year eligible for the degree of bachelor of science.

Then, after an additional or fifth year of purely advanced technical engineering subjects, he receives the degree of chemical, civil, electrical, or mechanical engineer.

In each instance the ground covered by the course has been carefully studied and thought out by a corps of well-equipped technical and practical instructors, each one thoroughly conversant with his particular branch. The purpose is to make the course fundamental rather than intensive along any particular line.

The collegiate work is largely cultural in character, in order to secure in the education of the engineer a much broader range than if confined only to the engineering field.

Upon completion of the entire course the graduate is thereby better equipped to go into the business world and meet the problems of life; he is better fitted to take his place as an executive with big financial, operating, and construction interests.

Owing to the great development in the industrial world and the rapid advancement of this country as a financial and commercial power, the field of the engineer is much larger than heretofore. There has always been a dearth of men fitted to fill the higher positions; there is at present and will be for a generation to come a considerable demand for trained men in all grades. There is hardly a line of endeavor which does not require the advice, cooperation, and assistance of the engineer.

Many of the engineering subjects are given in the evening session for the benefit of those who are employed during the day. These evening courses are identical with the day work in so far as the scope and thoroughness are concerned. They are meant to meet the needs of those who are engaged during the day but wish to secure a technical education and better their condition.

Columbia University, New York, N. Y.—In 1919-20 numerous readjustments took place to accomplish four objects:

1. A better selection of subjects to study.
2. The avoidance of nearly similar courses given similarly for different groups of students.
3. Reduction in number of different subjects of study pursued at the same time.
4. A reasonable total weekly requirement of class, laboratory, and study hours.

The university offers a new course in industrial engineering. This is largely a course in mechanical engineering until at the later end of the course the subjects of organization, management, and business methods are given.

The courses in engineering at Columbia require three years of college work for entrance, and three years are required for completion of the courses.

Cornell University, Ithaca, N. Y.—The experiences of the war have been to accent the practical side of vocational training and to reduce to a minimum the training necessary to produce men of specific types. Although a number of special courses in military engineering were requested, the engineering school has only introduced courses in ordnance engineering and signal engineering. The general tendency has been to give broad training to the engineers rather than more special engineering work relating to the particular branch giving its name to the department.

Economics, English, and other general subjects are being added to the engineering courses. All engineering instruction has been combined into one college which will now be known as the college of engineering and will consist of three divisions offering the degrees of civil engineer, mechanical engineer, and electrical engineer. The curriculum will be the same for all students during the freshman year. The civil engineering students will have a slightly different course during the sophomore year from those in the two other departments. At the end of the second year all three departments will be under different schedules.

University of Dayton, Dayton, Ohio.—The curriculum provides for ethics, psychology, and logic to succeed or to be taken conjointly with economics.

University of Florida, Gainesville, Fla.—All courses are the same for one year and for mechanical engineers and electrical engineers for two years. Selects best men for admission, as capacity is limited. Advocates higher standards rather than expansion.

State University of Iowa, Iowa City, Iowa.—Civil, electrical, and mechanical engineers have three years in common, and in senior year one-third of their work is common. The chemical engineering course has been extended to five years. The Students' Army Training Corps made clear the value of supervised study.

Johns Hopkins University, Baltimore, Md.—The following changes have been made:

1. Transference of applied mechanics from third year to second year.

2. Introduction of course in general engineering for freshmen. Course is given by various faculties in turn.

3. The increase of the requirement of three months in industrial work to six months.

University of Kansas, Lawrence, Kans.—Changes made during the years 1918–1920 have been as follows: Establishment of a complete schedule in engineering and administrative science; a course in elementary economics for all students; elimination of shopwork for civil engineers, and the introduction of elementary geology into the freshman year; the permission of substitution of other work for modern languages; the omission of modern languages for students of the Reserve Officers Training Corps; the introduction of an option for civil engineers and the introduction of a four-year course in architecture.

The university is considering the provision for freshman students who enter with one year of training in algebra and geometry and a further reduction of the modern-language requirement.

Lafayette College, Easton, Pa.—The college has made a complete revision of the curricula in civil, electrical, mechanical, and chemical engineering, for the following purposes:

1. To give the freshmen some real engineering problems in their first term, to establish some connection in their minds between their mathematics and actual engineering. These courses were taught by the heads of the engineering departments.

2. To reduce the number of credit hours per week, each credit representing three hours of the student's time, to 17 or 16 if possible.

3. To provide electives for engineering students in the so-called cultural subjects. The greatest number of such credits was required in the civil engineering course, i. e., 18 credits.

4. To reduce the number of subjects studied in any given term to 5 or 6, or less if possible.

5. To introduce the laboratory method of instruction, i. e., problem work in class, so that assistance and corrections may be made immediately by an instructor. These laboratory periods were made three hours in length and introduced into courses in mathematics, mechanics, and materials. These are distinct from experimental laboratory periods.

6. To relieve the pressure on the curriculum by eliminating courses on the applications of engineering and putting more time on fundamentals. For example, such

courses as telephone engineering, aeronautics, advanced structural design, etc., were either omitted or made elective by groups.

These changes, which have been in operation for two years, are now being revised in the light of this experience. Certain courses will be shortened, while others will be extended. There is a tendency to combine a number of shorter courses into one larger course. No modern language is required for engineering students with the exception of those taking chemical engineering.

The electives available for engineering students are American history, government, sociology, labor problems, ethics, applied psychology, and similar subjects.

Lehigh University, Bethlehem, Pa.—Scholastic changes of minor character such as might normally be made have been made during the period. These have not been caused by experience during the war.

In February, 1919, a unit of the Reserve Army Training Corps was established, with voluntary enrollment. The work in military science and tactics was made obligatory on all students entering the university.

Leland Stanford Junior University, Stanford University, Calif.—The mechanical engineering department gives, during the four years of undergraduate curriculum, a course which is intended to represent common training for five years of work in both mechanical and electrical engineering. Students at the end of four years receive the degree of A. B. in mechanical engineering, following which, after a year of further work along either mechanical or electrical engineering lines, they receive the degree of engineer in mechanical or electrical engineering.

Changes during 1918–1920 have been due to the fact that the first two years of undergraduate work at Stanford constituted a so-called lower division, and it has been necessary to readjust certain courses to care for this type of organization. The rearrangement has the effect of providing a more regular and definite manner for certain general courses, including modern languages, history, literature, and biological science. The university work is arranged so that after four years the student receives the degree of A. B. and the fifth year leads to the degree of engineer.

Courses are given in civil engineering, mining engineering, mechanical engineering, and chemical engineering. Electrical engineering is given as graduate work.

University of Maine, Orono, Me.—The faculty is considering requiring work in industrial plants during two summer vacations.

Michigan Agricultural College, Lansing, Mich.—New courses introduced with common freshman year for all, 20 per cent differentiation in sophomore year, and slightly more in junior and senior years; 60 per cent of work of all four courses is the same. Former courses were common for two years, with 72 per cent of the entire work of the four courses the same. An optional group of economics, English, French, and Spanish for three hours for senior year is now part of the four courses.

New Hampshire College, Durham, N. H.—The college gave courses in engineering and construction. The courses in mechanical and electrical construction have been abolished, and an industrial course given, so that the engineering division offers courses in mechanical, electrical, and chemical engineering, architectural construction, and a four-year industrial course. This latter course requires one year of mathematics and a wide range of electives during the last two years, enabling a student to fit himself to enter the industrial or manufacturing field, to become a sales engineer, or to prepare himself to teach under the Smith-Hughes Act.

New Mexico State School of Mines, Socorro, N. Mex.—Desire to eliminate some theoretical work and to substitute practical subjects therefor.

Norwich University, Northfield, Vt.—The amount of modern languages has been decreased from two years to one year, while the amount of English has been increased from one year to two years. The work in physical laboratory has been doubled, and the time devoted to theoretical mechanics has been decreased. A course in elements of

mechanism has been added, as well as a short course in business organization and finance.

In the senior year a course has been added in engineering abstracts.

University of Oklahoma, Norman, Okla.—A course has been introduced in second-term freshman year in applied engineering. Economics has been extended to include elementary accounting, cost accounting, business organization, management, and business law. Experience during the war has led to elimination of design work for undergraduates.

Pennsylvania College, Gettysburg, Pa.—Changes of a minor nature have been made. War experiences were not long enough to suggest any changes. The problem method as used at Camp Humphreys has been applied with only moderate success, owing to the younger age of the students at the college compared with those in the Army. There was a lack of effort on the part of most of the students. To obtain moderate success a large number of instructors would be necessary.

Rensselaer Polytechnic Institute, Troy, N. Y.—Extension of English to a course in second term senior year, including report writing, correspondence, and technical papers; minor readjustments of courses to care for larger enrollment with present laboratory equipment. Changes have made the load upon laboratories more uniform, permitting the same effective work to be done with a larger number of students.

Rhode Island State College, Kingston, R. I.—Changes of minor importance have been made, resulting from an effort to produce harmony in various phases of the work of the institution. Certain modern language has been omitted from the sophomore year for additional work in chemistry by the chemical engineers.

Certain condensation of courses in electrical engineering have been made to introduce mechanisms and making the mechanical and electrical engineering courses the same to the beginning of the junior year.

Rutgers College, New Brunswick, N. J.—No particular changes have been made in the course of instruction. Certain changes will probably be made on the appointment of a new dean.

University of Santa Clara, Santa Clara, Calif.—A simplification of courses as much as possible, avoiding all specialization in a four-year course, emphasizing English, and more thorough grounding in fundamentals.

Sheffield Scientific School of Yale University, New Haven, Conn.—The courses in Sheffield scientific school of Yale University have been changed to four-year courses, with the degree of B. S., in place of the three-year course leading to the degree of Ph. B. The various engineering courses have been made to include general subject of history and English of about 13 per cent; science subjects of chemistry, physics and mathematics of 31 per cent; engineering, including drawing, laboratory work, as well as theory, 46 per cent; administrative subjects, including economics, accounting, and management, 8 per cent; electives in engineering and administrative work, 2 per cent. Although the figures above are for the mechanical engineering course, the civil and electrical engineering courses correspond with this quite closely. The school has established a course in administrative engineering, with 13 per cent of the work in general subjects, 24 per cent in science, 28 per cent in engineering, 21 per cent in administration work, and 14 per cent in electives.

South Dakota State School of Mines, Rapid City, S. Dak.—The school has been enlarged to graduate civil engineers and electrical engineers, in addition to those courses which have been given for years in mining engineering and metallurgical engineering. The first engineering degrees are given at the end of a four-year course, and advanced degrees are given not earlier than two years after graduation in practice or after one year of graduate study. Some of the courses have been rearranged to give courses in business management.

University of South Dakota, Vermilion, S. Dak.—Course in engineering technology for all freshmen. The work is given by C. E. department for first term, M. E. depart-

ment second term, and E. E. department third term. Three terms are to be changed to two semesters.

Stevens Institute of Technology, Hoboken, N. J.—No changes to report.

Union College, Schenectady, N. Y.—The course in civil engineering has been revised by giving two options, one known as the technical option, the other as the administrative option. These options are the same for the first two years, which include, with the scientific and engineering subjects, foreign language, English, American history, and public speaking. In the junior and senior years the administrative option contains the subjects of psychology and European history in place of reinforced concrete construction. Both options contain business administration, including economics, accounting, business law, finance, banking, and contracts and specifications.

The administrative option contains important subjects in civil, mechanical, and electrical engineering, and has an unusually large percentage of business administration and cultural subjects; 26 per cent of the course is devoted to science, 39 per cent to engineering, 10 per cent to business administration, and 25 per cent to cultural subjects.

Washington University, St. Louis, Mo.—A readjustment has been made in all curricula.

State College of Washington, Pullman, Wash.—Changes have been made to include course in commerce and also to give distinct courses in management engineering, commercial mechanical engineering, and commercial electrical engineering. The courses in civil engineering, mechanical engineering, and electrical engineering have been continued; and in these, special courses in engineering economics have been substituted for special courses in the various curricula. The new courses have been introduced in response to the general trend of public opinion.

Worcester Polytechnic Institute, Worcester, Mass.—Nothing to report. The institute gives great importance to industrial management.

DATA FROM CATALOGUES.

In addition to the institutions sending letters, certain institutions sent catalogues. From the catalogues received in response to the communication from the Commissioner of Education the following has been obtained:

University of Akron, Akron, Ohio.—Five-year cooperative course, patterned after the Cincinnati plan, organized in 1914. Changes made at end of periods of two weeks. Year is composed of 11 months. Holidays of one week at Christmas, one week at Easter, and two weeks at end of summer. Degrees of C. E., M. E., E. E., and B. S. in Manufacturing Production. English and modern languages begin in the third year. Modern languages are continued for three years and English for two years. Economics is given for one year.

Alabama Polytechnic Institute, Auburn, Ala.—Common freshman year. English, three years, with English or economics for fourth year; no modern language; history, two years.

University of Alabama, University, Ala.—English, one year; no modern language; economics in one year.

University of Arizona, Tucson, Ariz.—Two years of English; one year modern language.

University of Arkansas, Fayetteville, Ark.—Two years the same for all engineers. English, one year; economics, one-third year.

Brooklyn Polytechnic Institute, Brooklyn, N. Y.—English, two years; modern language, two years; history, one year; economics, one-half to one and one-half years. Five years required for chemical engineers.

Brown University, Providence, R. I.—One course only in engineering. English, two years; economics, one year; engineering electives and approved electives.

University of California, Berkeley, Calif.—No English or foreign language required if preparation is sufficient. Electives.

Catholic University of America, Washington, D. C.—English, two years; modern language, philosophy, and economics, each one year.

University of Cincinnati, Cincinnati, Ohio.—Four-year theoretical courses and five-year cooperative courses, with alternation between shop and university every two weeks. The latter course has years of 11 months. The first two years of all courses are about the same. English every term. Modern language required for two years in chemical engineering and one year for others. Certain courses require economics, management, and history.

Clarkson School of Technology, Potsdam, N. Y.—Three terms to one year. Five terms common to all courses. English, one year; economics, one year; modern language, one year.

University of Colorado, Boulder, Colo.—English one and one-third years; no modern language.

Colorado Agricultural College, Fort Collins, Colo.—English, one year; no modern language.

Dartmouth College, Hanover, N. H.—Two-year course in Thayer School of Civil Engineering after three years of college work. Suggested preparation: One year each in sociology, political science, psychology, civics, and one and one-half years in English and modern language, and two years in economics.

Des Moines College, Des Moines, Iowa.—English, public speaking, each one year. Electives from modern languages, English, commercial law, bookkeeping, business efficiency, accounting, and social sciences.

University of Florida, Gainesville, Fla.—One year in common. English, two years; economics, one-half year; law, one-half year; sociology, one-half year.

George Washington University, Washington, D. C.—One year in common for C. E., M. E., E. E. English one year and modern language one year.

University of Georgia, Athens, Ga.—History and English, one year; modern language, two years.

Georgia School of Technology, Atlanta, Ga.—One year common to all. English, two and one-half years; modern language, two years; economics, one-half year.

Harvard University, Cambridge, Mass.—English one year, or may be credited from preparatory work. Two modern languages which may be offered for admission. Accounting and business administration one year. An elective is allowed in each of the first three years.

Howard University, Washington, D. C.—English, one year; modern language, two-thirds year; law and economics, one year.

University of Idaho, Moscow, Idaho.—One year common; English, two years; modern language one year for chemical engineers, contracts and specification for other engineers.

University of Illinois, Urbana, Ill.—One year English, one year modern language, three to four terms of nontechnical electives.

Iowa State College, Ames, Iowa.—English, one and two-thirds years, no modern language; one quarter of specifications and contracts, one quarter of history of engineering, one quarter of engineering economics, one quarter of accounting. A course in business engineering is made up of subjects from the various courses at the college for application in business.

Kansas State Agricultural College, Manhattan, Kans.—English, two years; economics, one year; business law, one semester; history, one semester; no modern language.

Lehigh University, Bethlehem, Pa.—English, one and one-half years; modern language, one or two years; economics, accounting, law, finance, contracts, each one-half year.

Lowell Textile School, Lowell, Mass.—English, one year; modern language, two years; economics, one year; business administration, one year.

University of Louisiana, Baton Rouge, La.—English, two years. No modern language.

University of Maryland, College Park, Md.—English, three years; modern language, two years; history, one year; economics and law, one year.

University of Michigan, Ann Arbor, Mich.—English, one year; modern language and cultural subject, three years; law, one term, options two years.

Michigan College of Mines, Houghton, Mich.—English, one and one-half years.

University of Minnesota, Minneapolis, Minn.—One year common. English, one year; electives in economics, government, finance, law, accounting.

University of Missouri, Columbia, Mo.—One year common. Citizenship, one year; economics, one term; English, one term; no modern language.

University of Montana, Bozeman, Mont.—English, two years; economics, one year; specifications and contracts, one-third year. No modern language.

University of Nebraska, Lincoln, Nebr.—One year common. English, one year; modern language, one year for civil engineers. A six-year combined academic-engineering course is offered.

University of Nevada, Reno, Nev.—English, one year; four terms of electives. No language.

New Mexico School of Mines, Socorro, N. Mex.—Two years in common. English, two years; modern language, two years.

New York University, New York, N. Y.—English, two years; modern language, two years; economics and industrial history, one year. A course is offered in business and engineering.

North Carolina State College, West Raleigh, N. C.—One year in common. English, three years, one year modern language. English, economics, industrial engineering, or modern language, one year.

University of North Carolina, Chapel Hill, N. C.—English, one year; modern language, two-thirds year; law, one-third year.

North Dakota Agricultural College, Fargo, N. Dak.—English, one and one-third years; history, one-third year; social science, one-third year.

University of North Dakota, University, N. Dak.—One year in common. English, one and one-half years; modern language, an elective. Economics, one term for certain courses.

Northeastern College, Boston, Mass.—English, one year; no modern language.

Norwich University, Northfield, Vt.—English, two years; modern language, one year; law, one year; economics, one year.

New Mexico College of Agriculture and Mechanic Arts, State College, N. Mex.—English, one and two-third years; modern language, one year; economics, sociology, and business law, one year.

Ohio State University, Columbus, Ohio. One year in common. Modern language one year; English, one year.

Ohio Northern University, Ada, Ohio.—English, option; languages, option.

Oklahoma Agricultural and Mechanical College, Stillwater, Okla.—One year common. English, one and one-half years; modern language, one year for chemical engineers, electives equivalent to four years; economics, one and one-half years.

Oregon Agricultural College, Corvallis, Oreg.—English, one year; public speaking, one-third year; economics, one year.

Pennsylvania State College, State College, Pa.—One year common. English, two years; modern language, two years; economics, one year; law, one-half year; history, one-half year; political science, one-half year.

University of Pennsylvania, Philadelphia, Pa.—English, two years; modern language two years; law, one year; economics, one-half year for mechanical engineers and electrical engineers.

University of Pittsburgh, Pittsburgh, Pa.—Work in four terms of three months each in some engineering industry in the Pittsburgh district is required of every student before graduation. This work is supervised. One year in common. English, one and one-half years; modern language, two years; economics, one and one-half years; philosophy and psychology, one year.

Polytechnic Institute of Brooklyn, Brooklyn, N. Y.—English, two years; modern language, two years; history, one year; economics, one-half to one and one-half years. Five years required for chemical engineers.

Princeton University, Princeton, N. J.—English, two years; modern language, two years; economics, two years; business methods, one term; electives two years.

Purdue University, Lafayette, Ind.—English, one and one-half or two and one-half years; modern language, two or three years; economics, one-half year; history, one-half year; law, one-half year.

Rose Polytechnic Institute, Terre Haute, Ind.—English, one and one-half years; modern language, two years; economics, one-half year.

University of South Carolina, Columbia, S. C.—English, one year; modern language, one year.

University of Southern California, Los Angeles, Calif.—English, one year; law, one-half year; electives, three years.

University of Tennessee, Knoxville, Tenn.—Two years in common. English, two years; modern language, two years; law, one-half year.

Agricultural and Mechanical College of Texas, College Station, Tex.—One year in common. English, four years; history, one-half year; economics, one-half year.

Tulane University of Louisiana, New Orleans, La.—English, one or two years.

University of Utah, Salt Lake City, Utah.—Two years in common. English, one-third year. Economics, one-third year, business methods.

Valparaiso University, Valparaiso, Ind.—English, one year.

Vanderbilt University, Nashville, Tenn.—One year in common. English, one year.

Villanova College, Villanova, Pa.—English, two years; modern language, two years; law, one-half year.

Virginia Polytechnic Institute, Blacksburg, Va.—English, three years; modern language, three years; economics, one year.

State College of Washington, Pullman, Wash.—English, one and one-half years; economics and law, one year. Courses in commercial mechanical engineering and commercial electrical engineering, giving economics, business administration, finances, investments, and contracts.

Washington and Lee University, Lexington, Va.—English, one year; modern language, two years.

West Virginia University, Morgantown, W. Va.—English, one year; law, one-half year.

University of Wisconsin, Madison, Wis.—English, one year; law, one-half year.

University of Wyoming, Laramie, Wyo.—One year in common. English, one year; electives, three years.