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TEXAS TECHNOLOGICAL COLLEGE

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DEPARTMENT OF PETROLEUM ENGINEERING

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BULLETIN

OF

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Petroleum Engineering

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Texas Technological College

Lubbock, Texas

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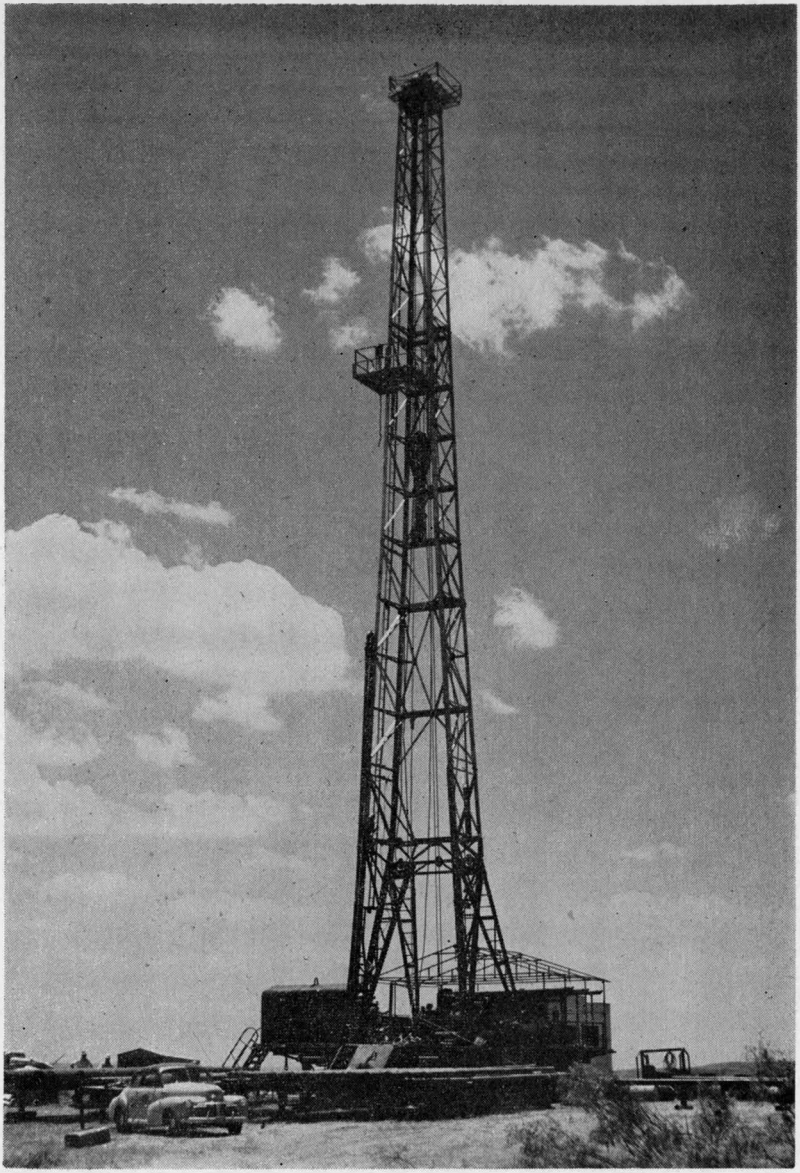

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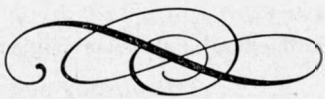

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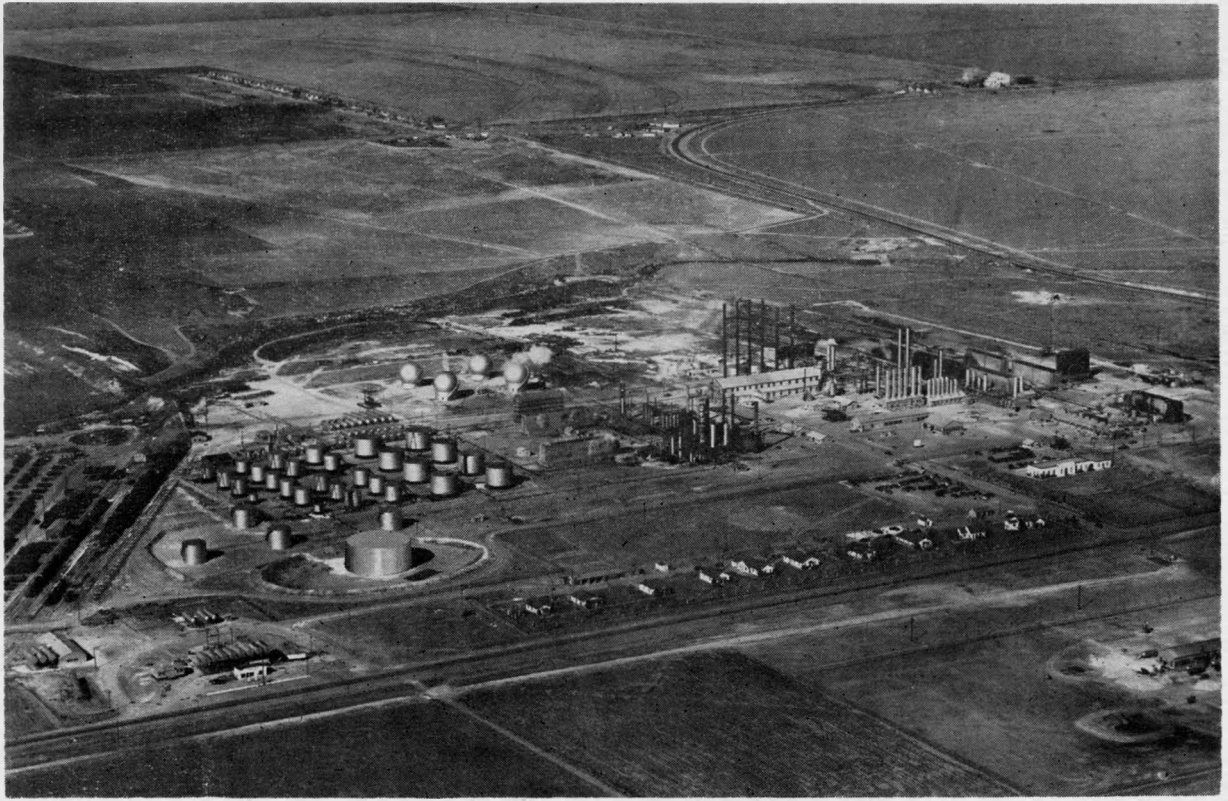


Petroleum on the Plains of West Texas

PETROLEUM INDUSTRY

An available energy source is *the basic essential* of an advanced civilization. All former civilizations were founded on a slave labor energy supply. Our present civilization has as its basis the natural resources of energy found in water power, coal, and oil. Of these, water power is minor. Coal and oil provide approximately equal quantities of energy in the United States today.

Since 1859 when Col. Edwin L. Drake brought in the first commercial oil well near Titusville, Pa., at a depth of 69 feet, petroleum has come to be one of the largest industries in our present world economy. In the United States today the industry annually supplies two and one-quarter billion barrels of its various products for the use of the country's 38,000,000 automobiles, 3,000,000 farm tractors, 9,000,000 oil burners and heaters, and 150,000 diesel power plants, as well as supplying military and naval requirements, commercial aviation needs, and the lubricants for industry. Within the United States alone there are 22 billion barrels of known underground reserve petroleum that has been definitely located by drilled wells—and untold billions of barrels of yet undiscovered oil.

The search for petroleum has led geophysicists, with their complex array of instruments, their radio communication and survey equipment, and their high explosives, from Point Barrow to the Straits of Magellan and from Norway to the Persian Gulf. The plains of Central Canada, the mountains of Wyoming, the western deserts, the swamps of Louisiana, the open waters of the Gulf of Mexico, the jungles of Venezuela, the mountains of Colombia, the wastelands of Tierra del Fuego, and the archipelagoes of the South Pacific are familiar grounds to these modern explorers.

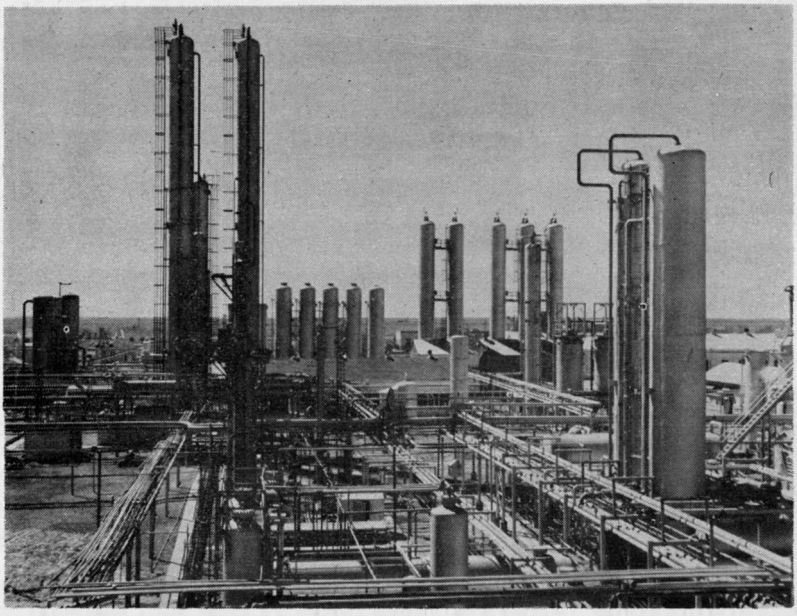
In the wake of exploration goes the powerful machinery of drilling and production. As these operations progress, roads are built, plants are erected, housing communities spring up and the vast wealth of oil is poured into the area, and a hitherto somnolent community will be transformed into a prosperous city of fine homes, good schools, shaded streets and wide avenues.

The gigantic pipe-line transportation industry, whose lines cover the country like a vast underground highway system, will extend to the new fields and carry the natural gas to distant cities to heat homes and to power factories, and will carry the crude oil to the refining centers or to the seaboard terminals to

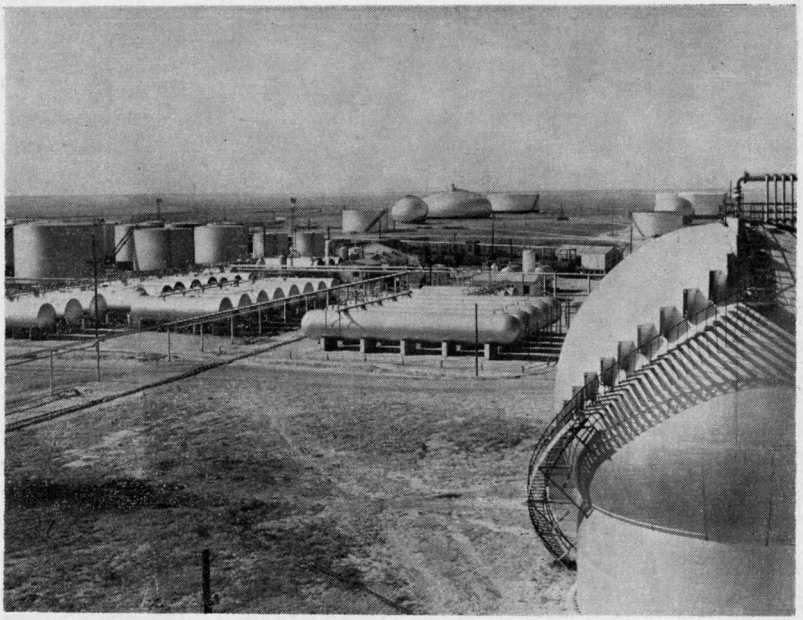
be pumped aboard the tankers whose vast fleets ply the seaways of the world.

The petroleum processing industry, with its natural gasoline plants, its propane and butane units, its refineries and its petrochemical plants, convert the petroleum hydrocarbons to an endless array of fuels, lubricants, gasolines, synthetic rubbers, alcohols, solvents, plastics, textiles, and other materials almost without end.

The steel mills, the vast equipment manufacturing industry, the motor manufacturers, and all of the collateral industries that supply materials and services to the petroleum industry share in the wealth recovered from the earth and converted to man's use by those men whose lives are devoted to petroleum.



The Conversion of Petroleum to Finished Products



The Products of Petroleum for the Use of Man

THE PETROLEUM ENGINEER

The works of the professional engineer confront us on every hand—automobiles, highway systems, airplanes, electric power distribution systems, communication systems, railways, refineries, agricultural mechanization, skyscrapers, air conditioning, pipe-line systems, oil fields, and other developments too numerous to mention. Each stands as a monument to the work of the professional engineer in converting the materials and the forces of nature to man's use.

The professional engineer not only designs and supervises the building of these things but constantly works toward the development of new materials, methods, efficiencies, and conveniences for the rest of mankind. He attacks these problems with vision and resourcefulness, executes his work with accuracy, integrity, courage, and judgment. Engineering is a profession commanding the same prestige and respect accorded the lawyer or the doctor—it is not a craft or a trade or an occupation. Engineering is a manipulation of *the forces and the materials of nature* for

the benefit of man, and it has as its basis the fundamental sciences of chemistry, physics, mathematics, mechanics, hydraulics, and all the similar basic sciences. And it is on a thorough knowledge of these fundamental sciences that the professional engineer developed his judgment, his resourcefulness, his vision, and his ingenuity that will be brought to bear upon the problems of engineering practice.

The field of petroleum engineering is as extensive as the petroleum industry, and its scope is too broad for one man to be proficient in all of its phases. The technology of petroleum can be divided into several classifications, but there is no sharp line defining them. The petroleum engineer is, therefore, most generally a specialist in one or two of these various branches, but his qualifications fit him to the work of a broad technology. He must have a broad basis of training in all of the fundamental sciences, and with such training he will be familiar with and capable of working in many branches of engineering. In addition to this broad and fundamental engineering training, he will have additional special training in petroleum technology. Thus he will be competent to supervise and direct all of the complex operations of the development and production of petroleum; or he will be qualified in the field of exploration methods to direct the complex procedures and methods employed in the search for petroleum deposits; or he will be trained and competent in the work of designing and manufacturing machinery and equipment for the petroleum industry; or he may have special training in the field of natural gas technology and find his work with the public utility corporations producing, transporting, distributing, and marketing this commodity. The petroleum engineer is first an engineer—in addition, he is a highly trained specialist in petroleum technology.

PETROLEUM TECHNOLOGY

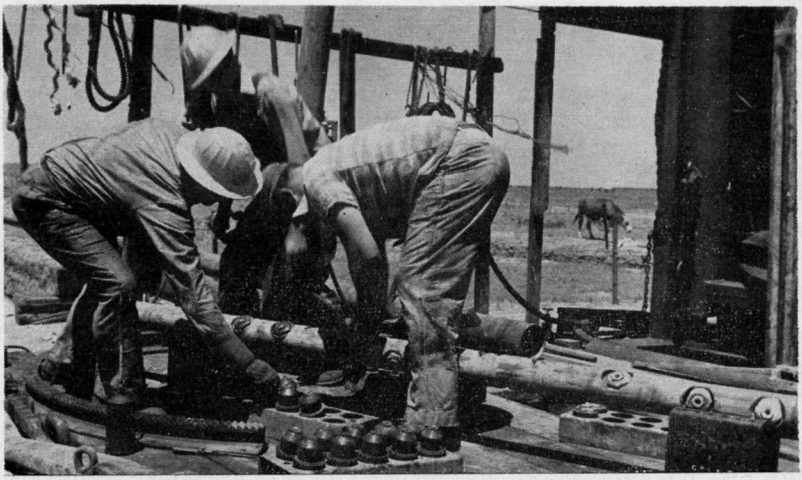
In the past 35 years petroleum has advanced from a position of insignificance as a basic energy source. Today in the United States petroleum furnishes almost as much power as is derived from the other major energy source, coal. The reason for this is solely economic. During this period the general commodity price index has steadily increased, but the cost of coal has advanced far more rapidly, while the cost of petroleum products has consistently lagged far behind the commodity index. In fact, it has advanced only slightly beyond the level of 25 years ago. During the same period the quality of petroleum products has improved many fold. The reason for this ever-increasing disparity in the costs of these two energy products is the difference in the vigor of the attack on the technology of the two industries. Petroleum technology in all of its branches has always been under the constant pressure of science and engineering, with the inevitable results that new and better methods and processes are being constantly developed and new and better products are being constantly produced.

The technology of petroleum is as vast and complex as is the industry and few men can hope to be proficient in all of its phases. However, the petroleum industry and its technology is normally divided into several fields, as follows:

GEOPHYSICAL EXPLORATION

This branch of petroleum technology has to do with all of those exploration methods that make use of the physical properties of the earth. These include reflection seismograph, refraction seismograph, magnetometer, gravity meters, air-borne gravity meters, and all similar geophysical methods. Tens of millions of dollars are expended annually by both the major oil companies and by independent geophysical companies in this work. In addition to the actual exploration work, these agencies also spend huge sums of money in their research and development laboratories for the development of new equipment and methods. These geophysical laboratories are among the finest equipped scientific and research laboratories to be found.

Geophysical exploration takes highly trained personnel with complex and highly specialized equipment to all parts of the world for both land and submarine exploration work. Geophysical exploration precedes almost all field drilling campaigns and is therefore the initial step in petroleum operations.



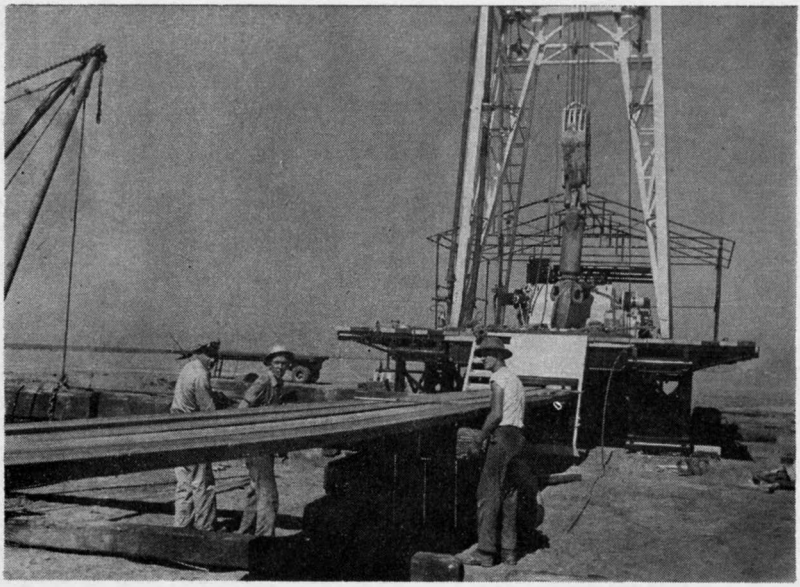
Loading a Casing Perforating Gun

DRILLING AND PRODUCTION

This branch of petroleum engineering has to do with all operations beginning with the staking of the well location and ending with the delivery of the crude oil to the common carrier pipelines. It involves all phases of the drilling operations, formation testing, treating methods, well completion methods, reservoir behavior and operation, gas lift, pumping methods, oil treating and lease storage. It also includes the proper selection, installation, and operation of the equipment and materials. This is one of the most important branches of petroleum engineering in that it has directly to do with the economical recovery of petroleum. It includes all of the manifold and complex operations encountered in a producing oil field.

NATURAL GAS

This phase of petroleum engineering has to do with the drilling and completion of the gas wells; the operation of natural gas reservoirs; the gathering of gas produced from oil wells; the treating of natural gas; the extraction of natural gasoline, butane and propane; the measurement, compression, and transportation of natural gas through the large transmission lines; distribution, pressure control and marketing to domestic and industrial consumers. Although natural gas is a petroleum product, it is usually handled by public utility companies rather than by oil companies. Due to its cleanliness and ease of handling, natural gas has come



Rigging Up

to be the preferred fuel in most applications and this factor is making the natural gas industry the fastest growing subdivision of the whole petroleum industry. Use of natural gas as a raw material for the petro-chemical industry is another potent factor in its current rapid growth. Today the field of natural gas engineering offers some of the finest opportunities to men well trained in this branch of petroleum technology.

PIPE-LINE AND TRANSPORTATION

This field of petroleum engineering has to do with all phases of the transportation and storage of crude oil and natural gas, from the producing lease to the refinery or to the natural gas consumer. It involves the design, construction, and operation of the huge transmission lines that interlace the country like a vast underground highway system. The engines, pumps, and compressors that move these products are among the largest internal combustion power installations in the country. This field of petroleum technology also includes the storage of crude oil, finished products, and natural gas; in a vast variety of pressure storage vessels, underground storage vessels, and even geological structure storage of natural gas. Also included in this category

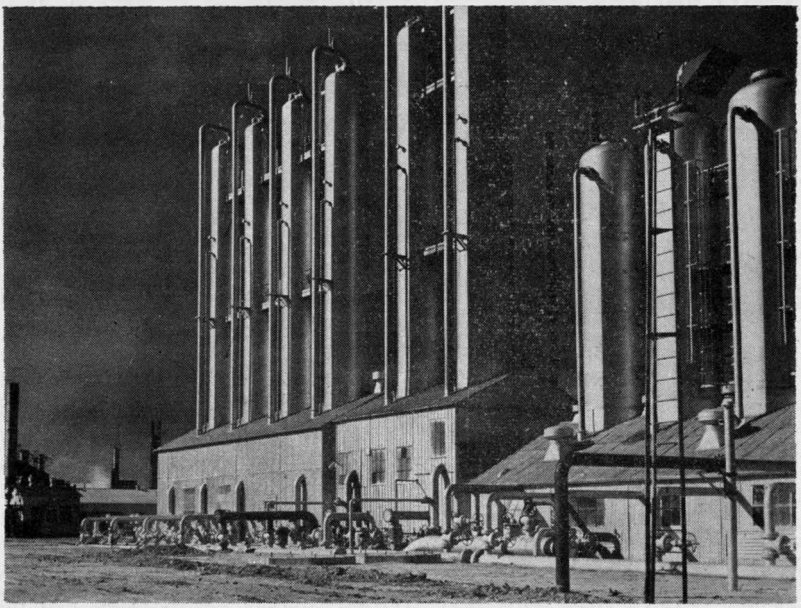
Laying a Pre-Coated Products Line

Field Loading Rack

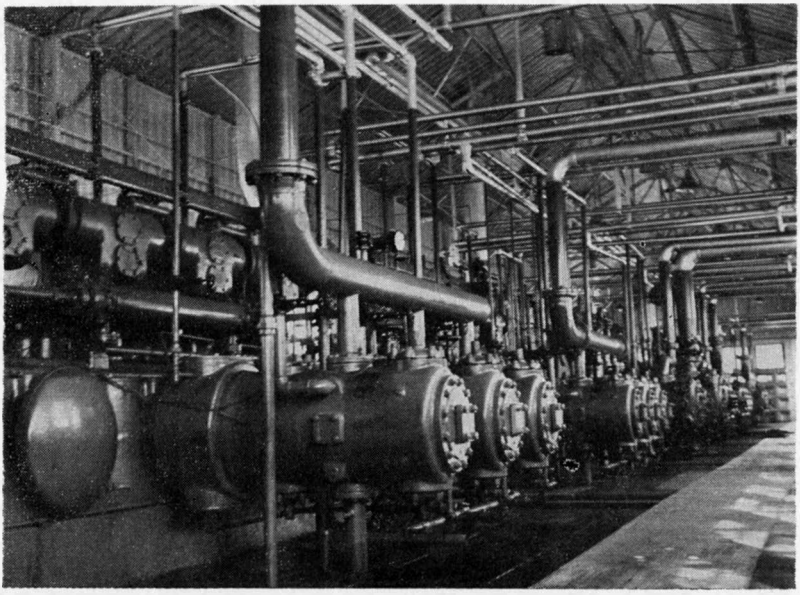
is the operation of tanker fleets transporting both crude oil and finished products and the recently inaugurated practice of transporting liquefied petroleum gases in tankers carrying pressure storage vessels.

REFINING AND PETRO-CHEMICAL CONVERSION INDUSTRY

This branch of the industry has to do with all of the complex phases of converting hydrocarbon raw materials to finished products. These include not only gasoline and motor fuels but an almost endless array of synthetic products, including rubbers, solvents, alcohols, plastics, and kindred materials. The petroleum conversion industry employs not only men trained in petroleum technology, but chemical engineers as well. This division of the petroleum industry represents the final stages of petroleum technology, because its products are of a finished nature and their further handling is in the field of distribution and marketing.



Natural Gas Processing



Typical Gas Pipe-Line Compressor Station

OIL SHALES AND SYNTHETIC FUELS

This is the newest branch of petroleum technology and it has not yet emerged from the experimental and development stage. It has to do with the production of finished petroleum-like products from the vast reserves of oil shales in the Rocky Mountain area, the production of liquid fuels from natural gas, and the production of petroleum-like products from coal. The attack on these problems represents one of the largest research and development projects being undertaken by the petroleum industry. The progress that is being made indicates that these methods will be reduced to commercial practice within the next few years, and that they will add immeasurably to our available reserves for liquid fuels. This work is being carried on by private industry and by the United States Bureau of Mines, and all phases of the problem are being vigorously developed. Although this field does not yet represent a major division of petroleum technology, nor does it employ men especially trained in its techniques, it nevertheless will come to be a distinct division of the industry and will in the future employ men who have trained themselves in those special fields.

THE PETROLEUM INDUSTRY AND TEXAS TECHNOLOGICAL COLLEGE

When Texas Technological College first opened its doors a quarter of a century ago, West Texas was largely a domain of cotton, grain and livestock. Today vast petroleum deposits have been discovered underlying these same fields and ranches until the college is almost completely encircled by oil fields. These discoveries have placed a new responsibility upon the college. Industry demands that trained personnel be provided to take charge of its operations; youth demands that opportunities be made available so that it may secure the training necessary for the fulfillment of these needs.

The college has accepted these challenges and, in order to make sure that it will meet its obligations, it has invited the co-operation and counsel of industry in establishing its petroleum engineering program. The oil industry has responded generously and wholeheartedly. It has set up a permanent Petroleum Committee whose purpose it is to provide continuous aid and counsel to the Department of Petroleum Engineering.

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Freeport Sulphur Company
New Orleans 5, La.

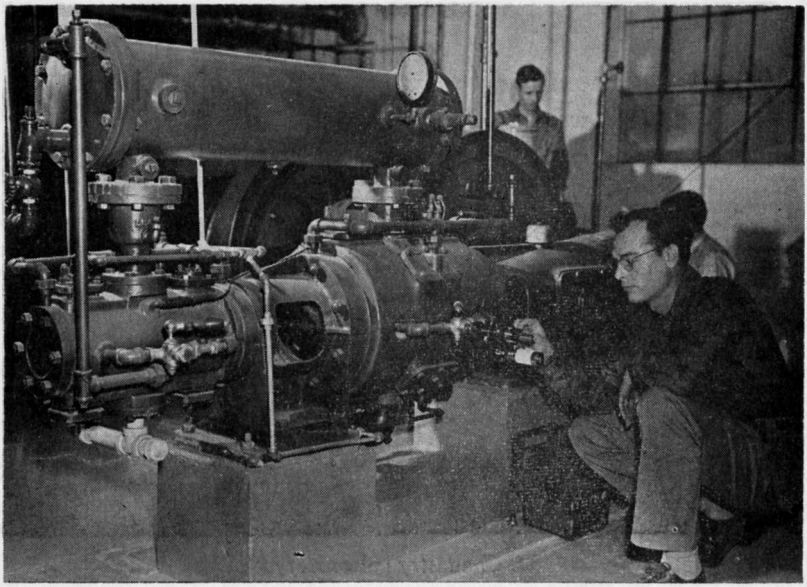
The Petroleum Division of the American Institute of Mining and Metallurgical Engineers, with national division offices in Dallas, Tex., and the Permian Basin section of the society at Midland, Tex., are both most active in their support of the Department of Petroleum Engineering. This affords the undergraduate petroleum engineer contact with the men in the petroleum industry, as well as providing a ready means of gaining an acquaintance with the professional practices of the industry that will facilitate his entrance into the field of engineering.

ENGINEERING AT TEXAS TECH

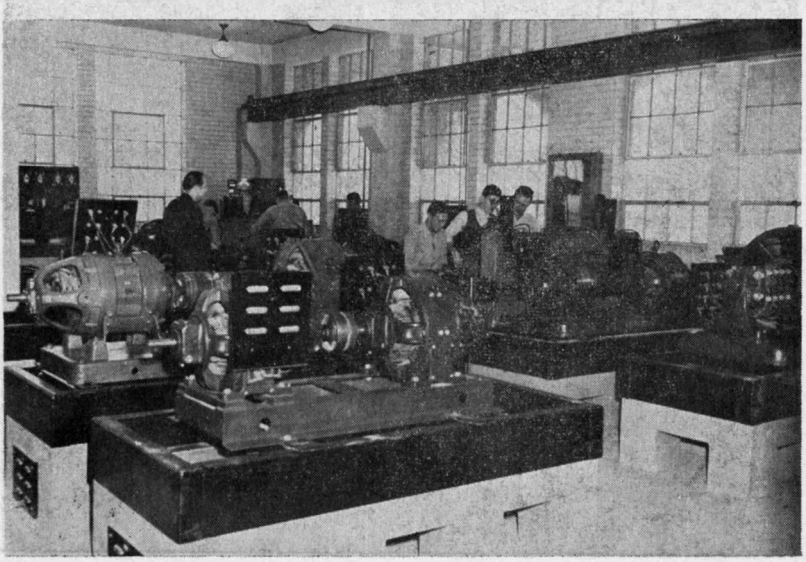
Excellence of the work in engineering at Texas Technological College is best evidenced by the fact that students from practically every country in the world have come here for their engineering training. Engineering was one of the primary objectives at the time the college was founded, and today the Division of Engineering ranks with the best in the nation.

The division is subdivided into the eight departments of Architectural, Chemical, Civil, Electrical, Industrial, Mechanical, Petroleum, and Textile Engineering. Every undergraduate petroleum engineer has a part of his work in each of these departments, with the exception of Architectural and Textile Engineering. In this respect almost every department in the Division of Engineering is a working part of every other department. Every undergraduate engineer has the opportunity to do a part of his work under the competent direction of the broadly experienced engineers who make up the staff of these various departments, and he has the opportunity to work in the excellently equipped laboratories in these departments. It is this breadth of undergraduate training that prepares the student for his place in the engineering profession.

The undergraduate engineer is under the direction of the Dean of Engineering in all matters pertaining to his relations with the college, and is under the direction of the head of his department in all matters pertaining to the work of his curriculum.

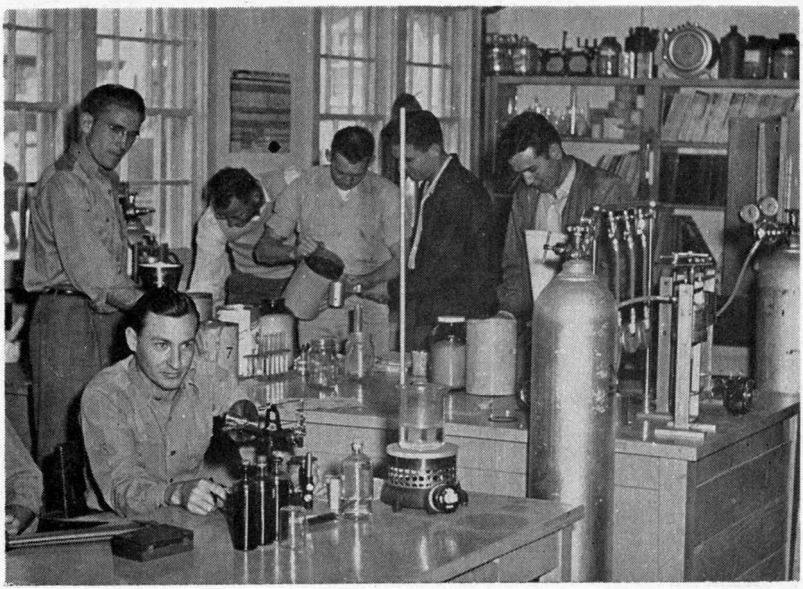


A Corner of the Mechanical Engineering Lab



A Part of the Electrical Engineering Lab

A Chemistry Laboratory



A Part of the Petroleum Lab

DEPARTMENT OF PETROLEUM ENGINEERING

The Department of Petroleum Engineering is the youngest and most rapidly growing department in the Division of Engineering. Its student enrollment is second among the eight departments of the division. Its faculty is made of men with broad experience in the petroleum industry who are primarily interested in utilizing their engineering training and experience in the education of young men for positions of responsibility in the profession of petroleum engineering.

FETROLEUM COMMITTEE

The Department of Petroleum Engineering is uniquely fortunate in having the cooperation and counsel of the Petroleum Advisory Committee of the petroleum industry. Through contact with this committee the policies of the department and the courses of the curriculum are kept in close adjustment to the advancing and changing requirements of the industry. That committee is also actively instrumental in assisting the department in obtaining more and more industrial and laboratory equipment for use in the petroleum laboratories and lecture courses.

INSPECTION TRIPS

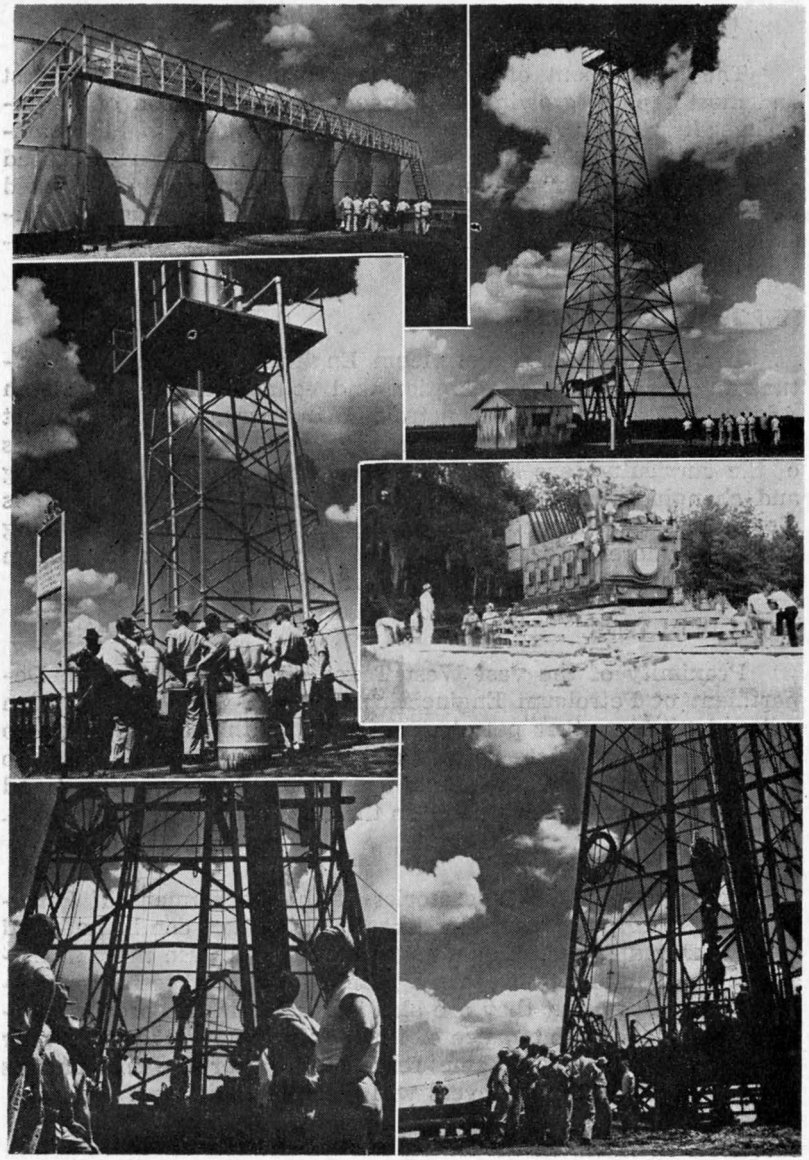
Proximity of the vast West Texas oil fields places the Department of Petroleum Engineering at Texas Tech in a position enjoyed by few other petroleum schools, in that it is possible to take the undergraduate petroleum engineers on frequent trips to these fields to observe the actual operations of the equipment and methods that have been studied in the classrooms and laboratories.

FETROLEUM LABORATORIES

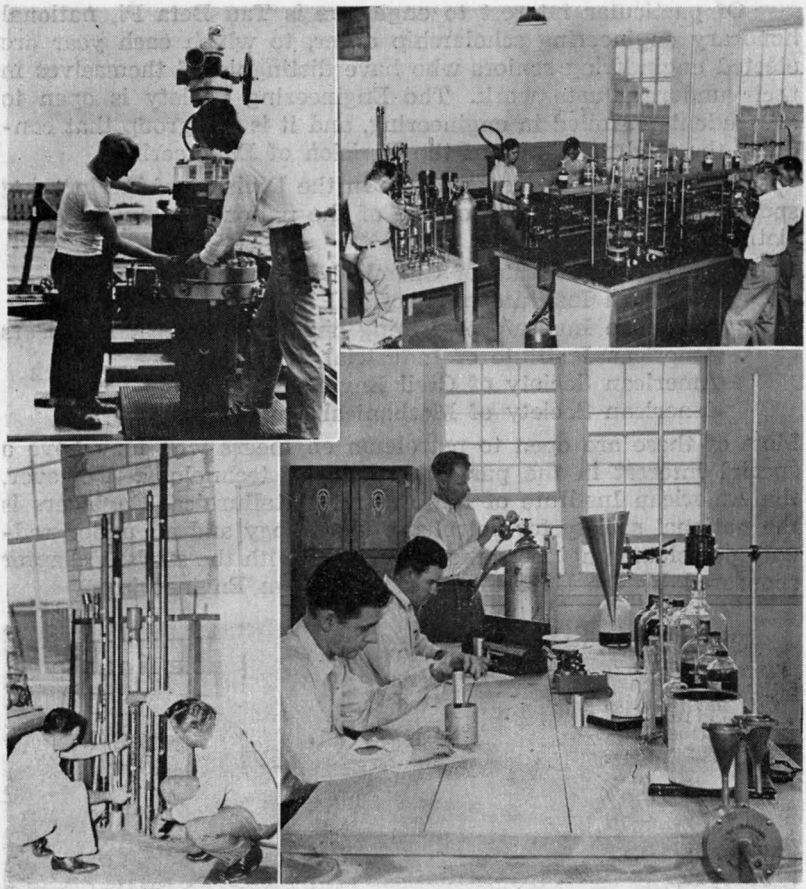
Equipment in the laboratories of the Department of Petroleum Engineering as Texas Tech is the finest that can be had, and the undergraduate petroleum engineers not only use these instruments and equipment in learning the methods and tests of petroleum technology, but they are also instructed in the proper operation, care, and maintenance of fine equipment, so that they may intelligently use and assume responsibility for the instruments and equipment that employers will place in their care.

STUDENT ACTIVITIES

The college encourages student activities that offer opportunities for development and self-advancement. As a result, there



Petroleum Engineering Students Inspect Installation in the Oil Fields Surrounding Texas Tech



Petroleum Laboratories

are campus organizations that offer activities of significance to almost every type of student interest, and each student should affiliate with such groups as best supplement his own special interests.

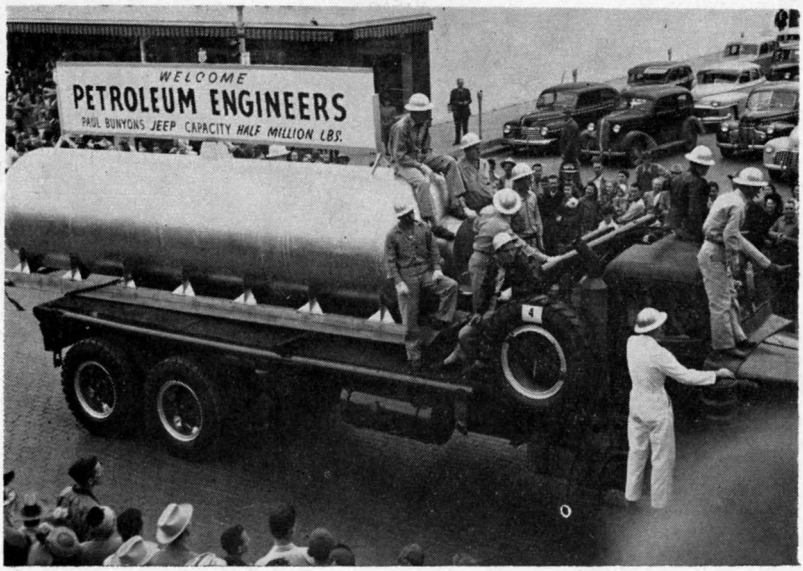
There are local chapters of many of the national honorary societies to which the student who has shown outstanding interest and work may be elected. Some of these are for mathematics, photography, band, geology, etc.

Of particular interest to engineers is Tau Beta Pi, national honorary engineering scholarship order, to which each year are elected engineering seniors who have distinguished themselves in their undergraduate work. The Engineering Society is open to all students enrolled in engineering, and it is the group that conducts the student affairs of the Division of Engineering.

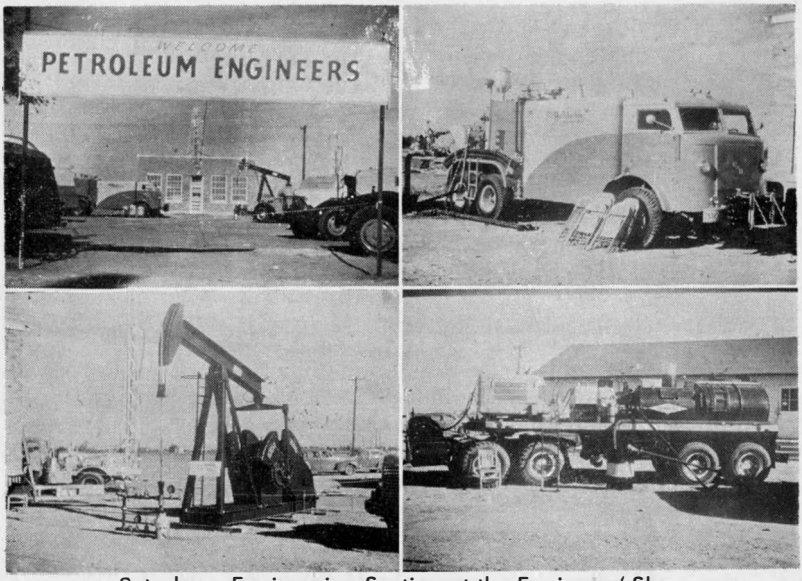
In addition, most departments in the Division of Engineering sponsor a student chapter of one of the national engineering societies. These include:

American Institute of Chemical Engineers
American Institute of Electrical Engineers
American Institute of Mining and Metallurgical Engineers
American Institute of Industrial Engineers
American Society of Civil Engineering
American Society of Mechanical Engineers

Most of these are open to petroleum engineers who may have a special interest in the particular field of technology. However, the American Institute of Mining and Metallurgical Engineers is the national society for petroleum technology and all undergraduate petroleum engineers should affiliate with the student chapter sponsored by the Department of Petroleum Engineering.



Petroleum Engineering Float—Homecoming Parade



Petroleum Engineering Section at the Engineers' Show

The Student Chapter of A.I.M.E. is the group that manages all student affairs of the petroleum engineers, and the Texas Tech chapter is one of the largest and most active in the country.

It puts on the annual Fall Petroleum Engineering Freshman Open House. This introduces the freshmen to the department, to the upperclass petroleum engineers, and to the A.I.M.E. The petroleum engineering float in the Homecoming parade is another project of the A.I.M.E. which affords opportunity for the petroleum engineers to demonstrate their skill and ingenuity in a competitive undertaking.

The A.I.M.E. also sponsors the annual Petroleum Engineering Field Trip, which is a three- or four-day inspection tour to some outstanding operation or installation in the petroleum industry. On those years that the International Petroleum Exposition is held, it is the subject of the annual field trip.

The petroleum section of the annual Tech Engineers' Show has for the last several years been the climax of activities of undergraduate petroleum engineers. At that time students go out into industry and arrange for the various companies to bring equipment for the show. Departmental laboratories and other facilities are put on exhibit, and a two-day Petroleum Exhibition is conducted by the students. Hundreds of thousands of dollars

worth of equipment and exhibits are shown to the public and to high school students attending the regional interscholastic league meet that is held at Texas Tech at the same time.

Student members of A.I.M.E. also frequently attend meetings of senior sections of A.I.M.E. held in West Texas, as well as the division meetings that may be held within traveling distance of the college. These afford student members opportunity to become acquainted with the men in the industry and with the professional practice of petroleum engineering.

PETROLEUM ENGINEERING COURSES OF STUDY

The Department of Petroleum Engineering at Texas Technological College offers work in two options, and a five-year curriculum in combination with Department of Mechanical Engineering leading to Bachelor of Science Degrees in both Petroleum and Mechanical Engineering.

PRODUCTION OPTION

The curriculum in this option offers work in the fundamental fields of science and engineering that will give the graduate broad basic engineering training essential to the professional engineer. In addition he will get specialized training in the technology of petroleum development and production which will fit him for the broad field of practice that he will encounter in drilling, development, production, operating, and secondary recovery methods practiced in the petroleum industry.

NATURAL GAS OPTION

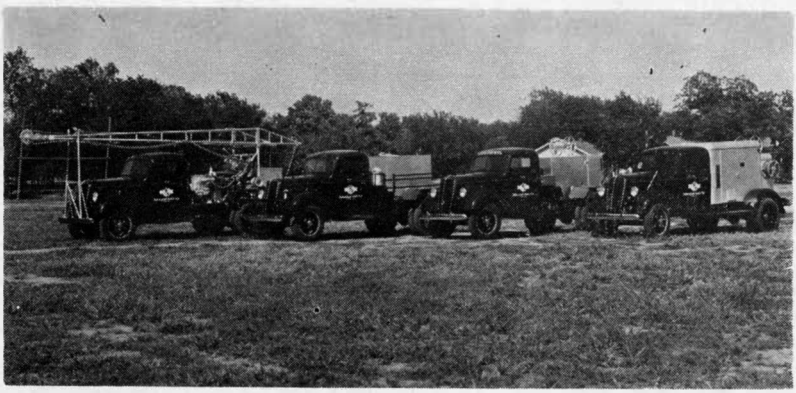
The curriculum in Natural Gas Engineering provides the student electing this option the broad foundation of the basic fields of science and engineering, as well as specialized work in the field of natural gas technology that will fit him for the professional practice of engineering in this division of the petroleum industry. The field of natural gas engineering offers to the well-trained graduate some of the finest opportunities to be found today in the industry.

FIFTH YEAR MECHANICAL ENGINEERING DEGREE

Those students in either of the above options who so elect may make certain minor course substitutions in their junior and

senior years and at the completion of the prescribed work receive the Bachelor of Science Degree in Petroleum Engineering in their respective option. Then, upon the completion of a fifth year of work under the direction of the Department of Mechanical Engineering, they will be awarded the Bachelor of Science Degree in Mechanical Engineering.

These two fields will provide the professional engineer with a particularly powerful qualification in certain branches of the petroleum industry where the technology falls in both classifications—as in the drilling industry, the equipment industry, and similar fields. For further information on this combination course, refer to the Annual Catalog of the college.



Typical Equipment for Reflection Seismograph Exploration Work

BACHELOR OF SCIENCE IN PETROLEUM ENGINEERING

PRODUCTION OPTION

Freshman Year

First Semester	Credit	Second Semester	Credit
E.Dr. 131—Engr. Drawing	3	E.Dr. 121—Engr. Drawing	2
Math. 121—Algebra	2	Math. 122—Algebra	2
Math. 131—Trig.	3	Math. 132—Anal.	3
Eng. 131—Comp.	3	Eng. 132—Comp.	3
Chem. 131—Gen. Chem.	3	Chem. 132—Gen. Chem.	3
E.Or. 111—Orient.	1	Govt. 230—Amer. Govt.	3
P.E. or Band	1	P.E. or Band	1
or M.S.	2	or M.S.	2
	16 or 17		17 or 18

Sophomore Year

First Semester	Credit	Second Semester	Credit
Chem. 235—Hydrocarbons	3	Chem. 246—Analytical	4
Math. 251—Calc.	5	Math. 233—Calc. Applic.	3
Phys. 235—Engr. Phys.	3	Phys. 236—Engr. Phys.	3
Phys. 215—Phys. Meas.	1	Phys. 216—Phys. Meas.	1
Geol. 131—Gen.	3	Geol. 132—Gen.	3
M.E. 221—Engr. Prob.	2	C.E. 331—Statics	3
Eco. 235—Prin.	3	Eng. 233—Tech. Writing	3
P.E., M.S., or Band	1	P.E., M.S., or Band	1
	21		21

Junior Year

First Semester	Credit	Second Semester	Credit
Pet.E. 331—Dev. Meth.	3	Pet.E. 333—Prod. Meth.	3
Geol. 433—Struct.	3	Geol. 434—Petrol.	3
Math. 432—Diff. Equat.	3	Eco. 326—Petrol.	2
C.E. 332—Kinematics & Kinetics	3	C.E. 333—Strength of Mater.	3
C.E. 231—Plane Surveying	3	C.E. 310—Testing Lab.	1
M.E. 338—Thermo.	3	M.E. 339—Thermo.	3
M.E. 317—Heat Lab.	1	M.E. 318—Heat Lab.	1
	19	Chem. 346—Physical	4
			20

Senior Year

First Semester	Credit	Second Semester	Credit
Pet.E. 410—Seminar	1	Pet.E. 411—Seminar	1
Pet.E. 433—Advan. Prod. Engr.	3	Pet.E. 436—Reservoir Engr.	3
C.E. 334—Surveying	3	Pet.E. 412—Prod. Lab.	1
E.E. 438—Elem. of. E.E.	3	Fin. 3310—Oil & Gas Law	3
E.E. 412—E. E. Lab.	1	E.E. 439—Elem. of. E.E.	3
M.E. 423—Int. Comb. Engines	2	E.E. 413—E. E. Lab.	1
Geol. 4312—Sedimentation	3	M.E. 424—Int. Comb. Engines	2
C.E. 339—Fluid Mech.	3	Geol. 4313—Sedimentation	3
C.E. 312—Fluid Mech. Lab.	1	Acct. 231—Acct. for Engrs.	3
	20		20

Advanced Military Science may be substituted for Accounting 231 and English 233 in accordance with catalog regulations.

BACHELOR OF SCIENCE IN PETROLEUM ENGINEERING

NATURAL GAS OPTION

Freshman Year

First Semester	Credit	Second Semester	Credit
E.Dr. 131—Engr. Drawing	3	E.Dr. 121—Engr. Drawing	2
Math. 121—Algebra	2	Math. 122—Algebra	2
Math. 131—Trig.	3	Math. 132—Anal.	3
Eng. 131—Comp.	3	Eng. 132—Comp.	3
Chem. 131—Gen. Chem.	3	Chem. 132—Gen. Chem.	3
E.Or. 111—Orient.	1	Govt. 230—Amer. Govt.	3
P.E. or Band	1	P.E. or Band	1
or M.S.	2	or M.S.	2
	16 or 17		17 or 1

Sophomore Year

First Semester	Credit	Second Semester	Credit
Chem. 245—Hydrocarbons	3	Chem. 246—Analytical	4
Math. 251—Calc.	5	Math. 233—Calc. Applic.	3
Phys. 235—Engr. Phys.	3	Phys. 236—Engr. Phys.	3
Phys. 215—Phys. Meas.	1	Phys. 216—Phys. Meas.	1
Geol. 131—Gen.	3	Geol. 132—Gen.	3
M.E. 221—Engr. Prob.	2	C.E. 331—Statics	3
Eco. 235—Prin.	3	Eng. 233—Tech. Writing	3
P.E., M.S., or Band	1	P.E., M.S., or Band	1
	21		21

Junior Year

First Semester	Credit	Second Semester	Credit
Pet.E. 331—Dev. Meth.	3	Pet.E. 333—Prod. Meth.	3
Geol. 433—Struct.	3	Geol. 434—Petrol.	3
Math. 432—Diff. Equat.	3	Eco. 326—Petrol.	2
C.E. 332—Kinematics & Kinetics	3	C.E. 333—Strength of Mater.	3
C.E. 231—Plane Surveying	3	C.E. 310—Testing Lab.	1
M.E. 338—Thermo.	3	M.E. 339—Thermo.	3
M.E. 317—Heat Lab.	1	M.E. 318—Heat Lab.	1
		Chem. 346—Physical	4
	19		20

Senior Year

First Semester	Credit	Second Semester	Credit
Pet.E. 434—Nat. Gas Engr.	3	Pet.E. 435—Nat. Gas & Gasoline	3
Pet.E. 410—Seminar	1	Pet.E. 413—Nat. Gas Lab.	1
C.E. 334—Surveying	3	Pet.E. 411—Seminar	1
E.E. 438—Elem. of. E.E.	3	*Fin. 3310—Oil & Gas Law	3
E.E. 412—E. E. Lab.	1	E.E. 413—E. E. Lab.	1
M.E. 423—Int. Comb. Engines	2	E E. 439—Elem. of. E.E.	3
Geol. 4312—Sedimentation	3	M.E. 424—Int. Comb. Engines	2
C.E. 339—Fluid Mech.	3	Geol. 4313—Sedimentation	3
C.E. 312—Fluid Mech. Lab.	1	Acct. 231—Acct. for Engrs.	3
	20		20

Advanced Military Science may be substituted for Accounting 231 and English 233 in accordance with catalog regulations.

DESCRIPTION OF COURSES

ACCOUNTING

231. Industrial Accounting for Engineers.
Intended for engineers interested in the processes and executive uses of industrial accounting. Offers a foundation in basic accounting principles, a treatment of the essentials of cost accounting theory and practice, and training in managerial aspects of accounting.

FINANCE

3310. Oil and Gas Law.
General contracts, oil and gas leases and their interpretation, titles, royalty, proration and conservation of oil and gas, regulations governing drilling operations. Government lands. cases on oil and gas.

CHEMISTRY

131-2. General Chemistry.
Meets twice each week in recitation, once each week in laboratory, and once each week in lecture and requires three hours per week in preparation. Prerequisite to all other courses in chemistry. Metals and non-metals and the underlying principles of chemistry. Together with Chem. 220, this course satisfies pre-medical requirements for general chemistry.

235. Hydrocarbon Chemistry.
Prerequisite: Chem. 131-2 and sophomore standing in petroleum engineering. The study of hydrocarbons, with particular reference to petroleum, natural gas, and synthetic fuels.

246. Analytical Chemistry.
Prerequisite: Chem. 131-2 and sophomore standing in petroleum engineering. Theory and methods of analysis of fuels, gases, petroleum products, water and emulsions.

346. Physical Chemistry.
Prerequisite: Chem. 235, 246, 5 semester hours in calculus, sophomore physics. and junior standing in petroleum engineering. A survey of the modern concept of solids, liquids, and gases, and the laws regarding their physical and chemical behavior. Physicochemical measurements.

CIVIL ENGINEERING

231. Plane Surveying.
Prerequisite: Math. 131. The use and adjustment of surveying instruments; plane surveys with transit and tape; profiles and cross sections; computations from field notes; the mathematics of curves as applied to railroads and highways, with field practice; earthworks, mass diagrams.

310. Testing Laboratory.
Prerequisite: Registration in C.E. 333. Standard tests and reports on steel, iron, and wood specimens; the physical properties of cement and concrete.

312. Fluid Mechanics Laboratory.
Prerequisite: Registration in C.E. 339.

331. Applied Mechanics-Statics.
Prerequisite: Math. 251. Resultants of coplanar and non-coplanar force systems; equilibrium of force systems, friction, centroids, moments of inertia. Slide rule is required.

332. Applied Mechanics-Kinematics and Kinetics.
Prerequisite: C.E. 331. Motion of the particle and of rigid bodies; kinetics of translation, rotation, and plane motion; work, energy; impulse, momentum.

333. Applied Mechanics-Strength of Materials.
Prerequisite: C.E. 331. Stresses and strains in elastic bodies subjected to tension, compression, and shear; bending and torsion; deflection of homogeneous beams; column theory, combined stresses.

334. Surveying.
Prerequisite: C.E. 231. Topographic mapping, stadia, and plane table; astronomical determination of azimuth, latitude, time; elements of photogrammetry, plane coordinates.

339. Fluid Mechanics.
Prerequisite: Registration in C.E. 332. Dynamics of viscous and non-viscous fluids impulse and momentum, pipe flow, fluid resistance.

ECONOMICS

235. Principles of Economics.
Prerequisite: 30 semester hours. The same general subject matter as 231-2 condensed into one semester.

326. Petroleum Economics.
Prerequisite: Eco. 235. Theory and problems particularly applicable to the economics of the petroleum industry.

ELECTRICAL ENGINEERING

412-3. Electrical Engineering Laboratory.
Prerequisite: Registration in E.E. 426-7 or 438-9. For civil, chemical, industrial mechanical, and textile engineering students.

438-9. Elements of Electrical Engineering.
Prerequisite: Phys. 235. Math. 251. Recitations and problems dealing with the principles of direct and alternating current circuits and machinery. For industrial and mechanical engineering students.

ENGLISH

131-2. English Composition.
Essentials of correctness and effectiveness in general writing. Text studies, lectures, readings, themes, tests, and conferences.

233. Technical Writing.
Essentials of correctness and effectiveness in technical writing. Regular themes, reports, and a long term report. Some reading in standard English and American literature. Required of sophomore engineering students, except those in the Department of Architecture. Design and Commercial Art Options.

GEOLOGY

131-2. General Geology.
Physical and historical geology. Present day geologic processes followed by applications of these principles to the interpretation of the geologic record. A foundation course for further work in geology. May also serve for cultural purposes.

433. Structural Geology.
Prerequisite: Geol. 333-4, 335-6. Deformation and structure of rocks with special emphasis on the relation of these to economic problems.

434. Geology of Oil and Gas.
Prerequisite: Geol. 433. Problems of the origin and accumulation of oil deposits, assembling and interpretation of data bearing on problems peculiar to certain fields. For students expecting to engage in the exploration and development of oil fields.

4312-13. Sedimentation for Petroleum Engineers.
Prerequisite: Senior standing in petroleum engineering. Study of sedimentation as applied to problems of petroleum engineering.

GOVERNMENT

230. American Government, Organization.
A study of the constitutions and organization of the governments of the United States, the states in general, and Texas in particular. Required of students whose departments require only 3 hours of government. Credit will not be given for both Govt. 230 and 131.

ENGINEERING DRAWING

121. Engineering Drawing.

(Formerly 133). Prerequisite: E. Dr. 131, or equivalent. Intersections, developments, dimensioning, slant lettering, oblique drawings, elementary working drawings.

131. Engineering Drawing.

(Formerly 132). The essentials of drafting including freehand sketching, use of instruments, vertical lettering, engineering geometry, orthographic projection, sections, isometric drawings. In lecture, problems are given in solid geometry.

MATHEMATICS

121-2. Algebra.

Prerequisite: Two units of high school algebra. Review of high school algebra, quadratic equations; variation; progressions; binomial theorem; graphs; inequalities; complex numbers; theory of equations; exponential equations; determinants. Prerequisite for Math. 122, Math. 131 or concurrent registration in Math. 131.

131. Trigonometry.

Prerequisite: One unit of high school algebra, one unit of plane geometry, and Math. 121 or 130, or concurrent registration in Math. 121. Trigonometric functions; identities; radians; trigonometric equations; logarithms; solutions of triangles.

132. Analytic Geometry.

Prerequisite: Math. 121 or 130, and 131. The straight line and conic sections, transformation of coordinates; polar coordinates; parametric equations; introduction to solid analytic geometry.

233. Calculus Applications.

Prerequisite: Math. 232 or 251. Volumes; centroids; moments of inertia; pressure; work; partial differentiation; series; multiple integrals; indeterminate forms; hyperbolic functions.

251. Calculus.

Prerequisite: Math. 122 and 132. Differentiation; maxima and minima; rates; curvature; formal integration; areas.

332. Differential Equations.

Prerequisite: Math. 232 or Math. 251. Solutions of differential equations, with geometric and physical applications.

MECHANICAL ENGINEERING

221. Engineering Problems.

Prerequisite: Registration in Math. 251. Study and practice of slide rule operations. Application of dimensional analysis, mechanics, pressure measurement, and perfect gas laws to elementary engineering problems. Curve drawing and presentation of engineering computations.

317-8. Heat Engineering Laboratory.

Prerequisite: Registration in M.E. 334-5. Mechanical measurements, heat transmissions, and heat transfer equipment. Tests of power plant equipment, internal combustion engines, pumps, blowers, and air equipment. For chemical, electrical, and textile engineering students.

338-9. Thermodynamics.

Prerequisite: Phys. 236, Math. 251, M.E. 221. Thermodynamic principles governing transformation of heat energy into power energy or work. Study of perfect and imperfect vapor and gas cycles. Transmission of heat under various conditions. Similar to M.E. 330-1, except that more emphasis is placed upon imperfect gases and less upon vapors. For petroleum engineering students.

PETROLEUM ENGINEERING

331. Petroleum Development Methods.

Prerequisite: Math. 233, junior standing in petroleum engineering. Exploration methods; standard and rotary drilling methods; cementing and well completion methods; well surveying; drilling hazards, directional drilling; field trips.

333. Petroleum Production Methods.

Prerequisite: Pet. E. 331 and junior standing in petroleum engineering. Flowing wells; gas-lift methods and equipment; gas wells; pumping methods and problems; water emulsion problems; gathering and storage systems; field trips; laboratory.

410-11. Seminar.

Prerequisite: Senior standing in petroleum engineering. Discussion of current petroleum problems; reports, lectures by men from industry.

412. Production Laboratory.

Prerequisite: Pet. E. 433. Theory and application of tests of petroleum, petroleum products, materials of the petroleum industry; advanced gas-lift problems; and other production techniques.

413. Natural Gas Laboratory.

Prerequisite: Registration in Pet. E. 435. Natural gas analysis and testing; measurement and calibration of flow metering devices, regulation and control devices; gas phase relationships, and natural gasoline techniques.

433. Advanced Production Engineering.

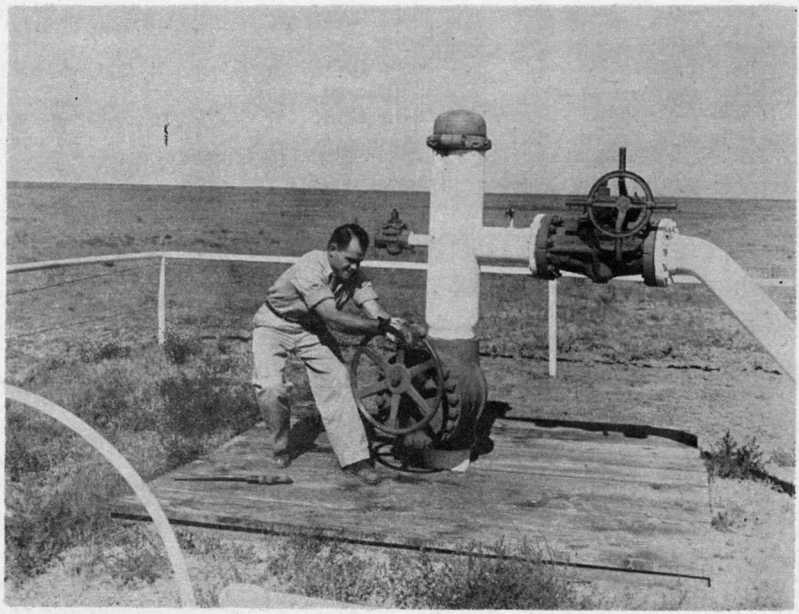
Prerequisite: Pet. 333. Continuation of Pet. E. 333 covering advanced oil production methods and problems; well logging methods; secondary recovery problems; pipe line transportation systems; power sources and transmissions; equipment specification.

434. Natural Gas Engineering.

Prerequisite: M.E. 339, M.E. 318. Study of the methods of production, treating, compression, distribution, measurement, analysis and utilization of natural gas, and the thermodynamic principles related thereto.

435. Natural Gas and Gasoline.

Prerequisite: Petr. Engr. 434. Study of distillate wells and distillate reservoir behavior. Extraction methods and techniques of natural gasoline production. Liquified petroleum gases.



A Gas Well Head

436. Reservoir Engineering.

Prerequisite: C.E. 339, Pet. E. 433. Study of the fundamental forces in reservoirs and the evidence of these forces as expressed in mathematics relationships; behavior of reservoir fluids; flow of fluids in reservoirs; productivity indices, prediction of the reservoir behavior; laboratory analysis of reservoir fluids; solubility, shrinkage, viscosity; sample and pressure methods; displacement experiments, capillary pressures and advanced core analysis.

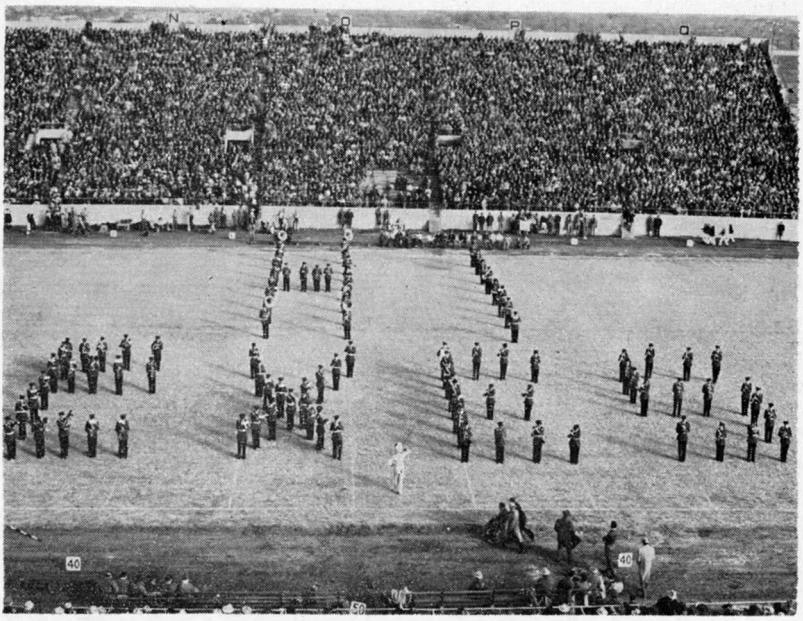
PHYSICS

215-6. Physical Measurements.

Must be taken parallel with Phys. 235-6

235-6. Engineering Physics.

Prerequisite: One year of high school or college physics; parallel enrollment in calculus. See Phys. 215-6.



Homecoming Band Formation

ADMISSION

Admission by High School Certificate. The first requirement for admission into Texas Technological College is graduation from an accredited high school with a minimum of 15 units of work. No credit may be obtained without graduation. The following units are the uniform requirements for admission to any division of the college.

1.	English	3
2.	Mathematics *Algebra, Geometry, Trigonometry*	2
3.	Two units each from any two of the following groups: *Laboratory Sciences* *Social Sciences* *Foreign Languages* *Vocational Home Economics, or Vocational Agriculture*	4
4.	Electives	6
	Total	15

Admission to the Division of Engineering with Condition. The study of engineering requires a thorough background of high school preparation in mathematics and physics. A prospective engineering student is strongly urged, therefore, to present three units of mathematics, not including general mathematics or arithmetic. Likewise he should present at least two units in science, one of which should be physics. The student lacking one unit in algebra, geometry, or physics is strongly urged to attend summer school to remove this deficiency rather than waiting for the fall semester. However, opportunity will be offered for the removal of such deficiencies in the first semester of the long session, but this may delay the student's ultimate graduation, as conditions must be removed during the first semester. The student deficient in high school physics may remove this condition by satisfactory completion of freshman college physics (Physics 131-2).

Admission from Other Colleges or Universities. The student who has attended another recognized college or university may be admitted on presentation of an official transcript showing a grade point average of not less than 1.00 (C average) in (1) all courses for which he has been enrolled, or (2) the last two full semesters or their equivalent.

EXPENSES

All registration expenses must be paid in full at the time of registration. Room and board may be paid by partial payments made from the first to the fifth of each month.

To enable the student to approximate his expense at the time of entering college, the following estimates are offered:

FALL SEMESTER

Registration Fee	$ 25.00
Health and Activity Fee	15.00
Property Deposit	7.00
Books and Incidentals (approximate average)	33.00
First payment of room and board in the college dormitory	38.00
TOTAL (estimated)	$118.00

SPRING SEMESTER

Registration Fee	$ 25.00
Health and Activity Fee	15.00
Property Deposit (new student)	7.00
Books and Incidentals (approximate average)	20.00
First payment of room and board in the college dormitory	60.00
TOTAL (estimated)	$127.00

The cost of books and supplies will vary with the different curricula of the college from a minimum of $29 to a maximum of $36. Engineering students are required to purchase their own drawing equipment, slide rule, etc., which, plus books, cost approximately $65 per year, or an average of $32.50 per semester.

Estimate of Annual Cost. An estimate of the annual expense by semesters for one long session is as follows:

Registration Fee	$ 25.00	$ 25.00
Health and Activity Fees	15.00	15.00
Property Deposit	7.00	
Books and Incidentals	33.00	20.00
Room and Board in College Dormitory	260.00	232.00
TOTAL (estimated)	$340.00	$292.00

Registration Fee for Out-of-State Students. Each non-resident student is required to pay a non-resident registration fee of $150 per semester or $300 for the nine-month session. For the non-resident student enrolled in the long session for less than 12 semester hours, the registration fee is $12.50 per semester hour for which the student is enrolled.

Charges for Room and Board in College Dormitories. All prices indicated below are subject to change without notice prior to registration date and with 10 days notice thereafter. It is hoped that the following prices will provide for dormitory service during the 1949-50 year.

Charges for room and board and supervision in college dormitories will be $492 per nine-month period for the regular double rooms occupied by two students. The payments will be as follows:

September	$38.00	February	$60.00
October	60.00	March	60.00
November	60.00	April	60.00
December	42.00	May	52.00
January	60.00		

FURTHER INFORMATION

For more detailed information pertaining to the college and its program of work, those interested are invited to see the Annual Catalog or write to the Registrar, Texas Technological College, Lubbock, Texas.

Dorm Boys Take Time Out