IN THIS ISSUE — "Alumni and the Petroleum Industry"

ALUMNI REVIEW

CALIFORNIA INSTITUTE OF TECHNOLOGY

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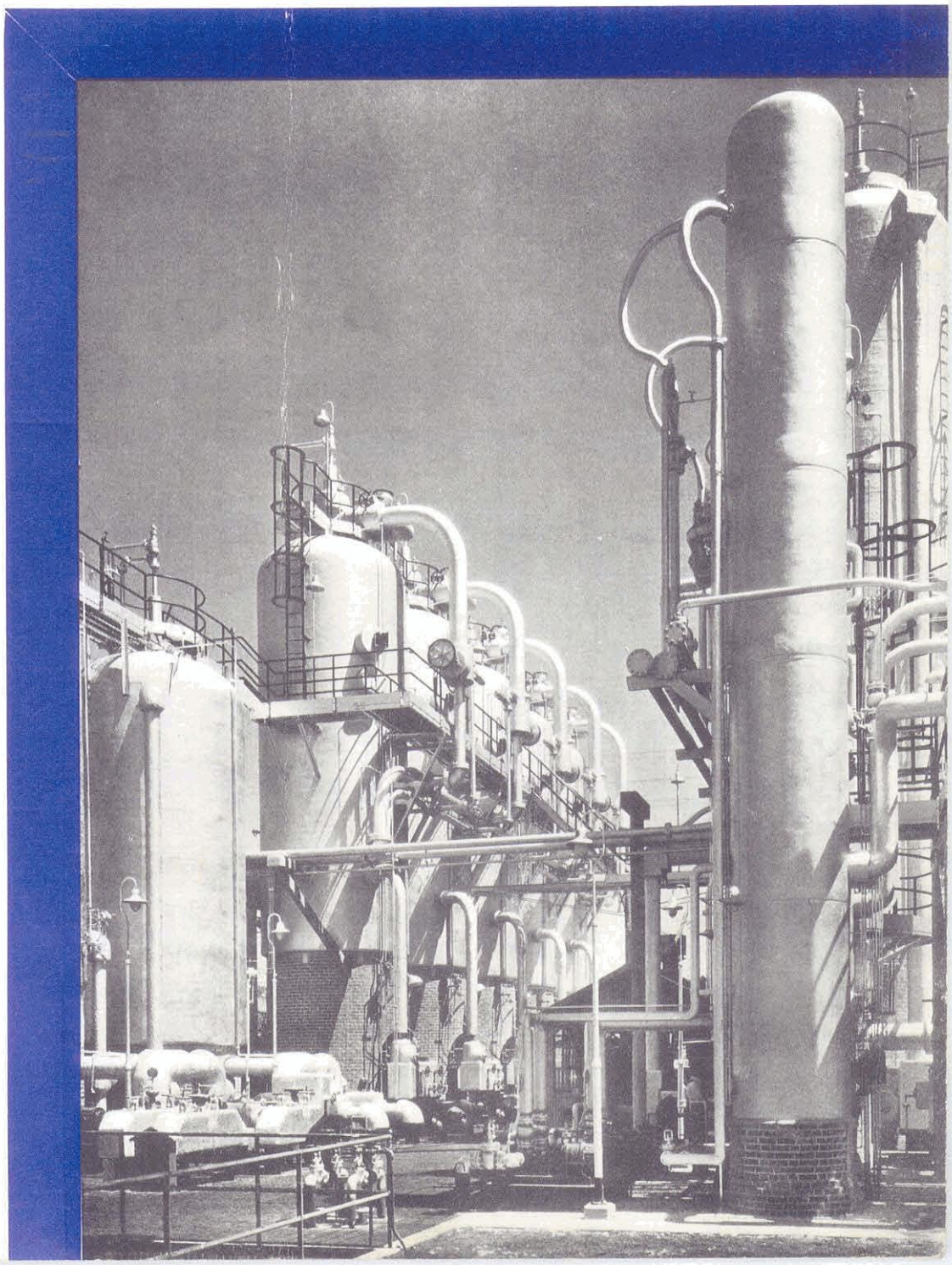

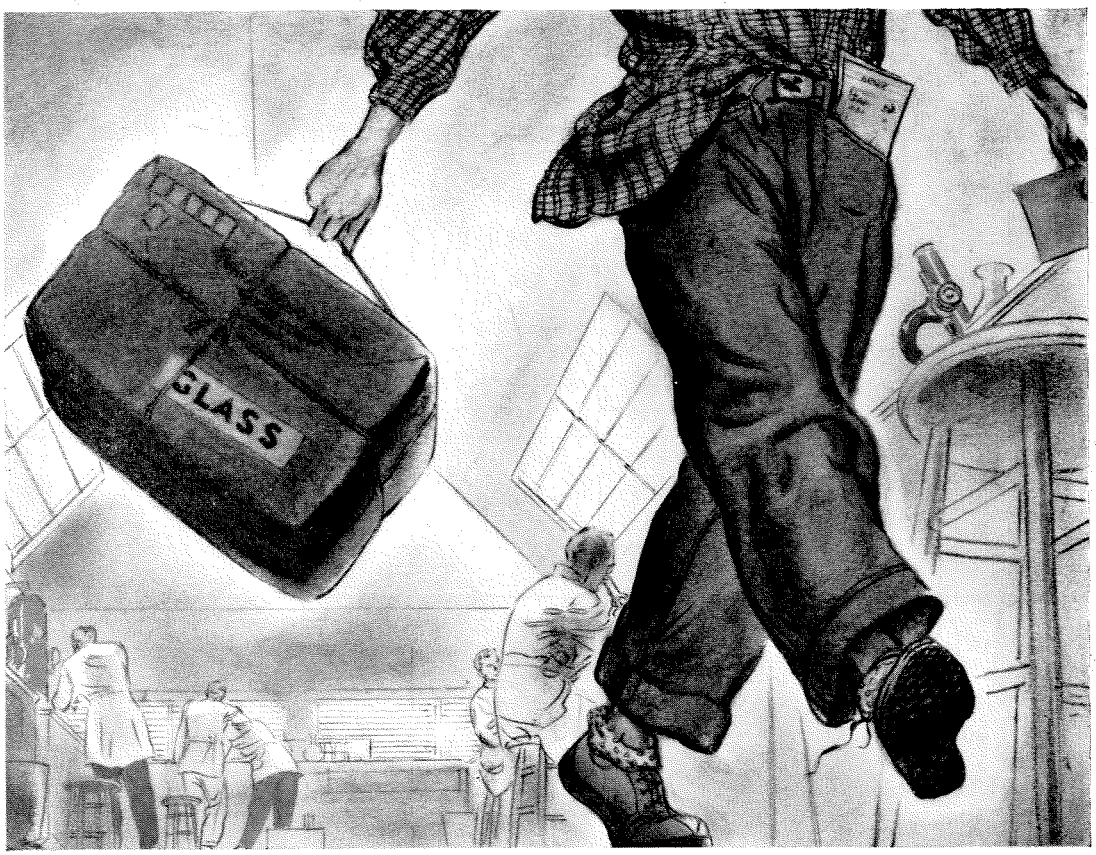

A $1,000,000 package insured for $50.00

IT WAS EARLY *in the spring of 1933. Chemists in one of the nation's largest paint and lacquer companies were worried. Their new automobile finish required a light aromatic solvent . . . obtained as a by-product in the production of steel. But a shortage had developed. Almost overnight, the price of solvents had jumped ski-high. With contracts to supply lacquer for two-thirds of the automobile industry, the situation was serious.*

It was no concern of the mail boy, however. He was whistling his own arrangement of "Stormy Weather" when he sauntered in and dumped a battered package in their midst. Insured for $50, it bore the return address of Union Oil Company of California, 2800 miles away in Los Angeles. They opened it.

Inside was a sample of an aromatic solvent ***made from petroleum.*** *After six years of independent research, Union Oil engineers had finally achieved* ***the first large-scale, commercial production of TOLUOL concentrate ever made from petroleum.*** *Furthermore, they could supply it at a price well within the range required.*

By June, the first shipment of Union Aromatic Solvents was delivered. Since then, this new petroleum product has saved the lacquer industry, and American automobile owners, millions of dollars.

Since 1934 some ten million automobiles have been finished with lacquer made with these Union Aromatic Solvents. Today, Union Oil Company is the largest single supplier of aromatic solvents in the petroleum industry.

That such a position could have been achieved by an independent, regional company—big in its own territory, but small by comparison with the industry's giants—may seem remarkable. But to Union Oil men pioneering has always been a tradition.

They made the first successful experiments with an oil-burning locomotive in the U. S. They developed Dieso-Life—an oil that set a new standard for Diesel lubrication. They invented a revolutionary cable lubricant that penetrated to the *inside* and worked out. They produced Triton—the first 100% pure paraffin-base oil from western crudes.

In its 50 years of pioneering, Union Oil Company has grown to be the largest independent oil company in the West. It is big enough to have adequate facilities, but not so big it has become complacent; old enough to have a background of experience, but not too old for new ideas.

Have you a problem we can tackle?

UNION OIL COMPANY
of California

ALUMNI REVIEW

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CALIFORNIA INSTITUTE
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PASADENA, CALIF.

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DECEMBER, 1940

CALENDAR OF EVENTS

JAN. 10 — ANNUAL FOOTBALL BANQUET at Pasadena Athletic Club, with squad members of 10 and 20 years ago as honored guests and Professor Sorensen as toastmaster. Make reservations through Athletic Office. Dinner at 6:30 p.m.

FEB. 15 — ANNUAL ALUMNI DANCE at the Los Angeles Biltmore Hotel. Bigger and better than ever before. Don't buy your wife a Valentine, take her to the Alumni Dance!

APR. 5-6 — SEMINAR WEEKEND at the Institute. Over 500 Alumni attended these sessions last year, some of them travelling many miles to hear the speeches and discussions.

THE PROGRESS OF PETROLEUM

By V. A. KALICHEVSKY, '24
Director of Research, Socony-Vacuum Oil Company

Petroleum, this "flowing gold" of the world, has little in common with the beautiful, sparkling metal which fascinates mankind. For centuries little appreciation has been shown to the black, evil-smelling liquid emerging from the ground, and much time was needed before its value had been realized by man. Even up to now few people have a true picture of the part which petroleum plays in our everyday life although without undue exaggeration, the present period of our civilization may be referred to as The Petroleum Age. Without petroleum we would be unable to develop the wonderful machinery which is now at our disposal, we would have no suitable fuels or lubricants to keep our engines running, and we would not be in a position to manufacture cheaply a large variety of materials indispensable to our comfort. Fortunately for our generation the supply of oil is still plentiful and we have no reason to worry that it will be exhausted in the near future. On the contrary, due to the unceasing efforts of various research organizations generously supported by the large oil companies we may expect that the utilization of petroleum in the future will be even more complete than it is at the present time.

The beginning of the petroleum industry can be traced back scarcely further than a century. For many decades petroleum refining was confined to distillation of crude oil in various fractions supplemented by purification with chemicals. These fractions are known to the general public under the names of gasoline, kerosene, lubricating oils and asphalt, and up to the present time have constituted the major products of the petroleum industry. Little was known, however, about the desirable properties of these products and they were accepted by the consumer without undue complaints on their performance. With the general progress in industrial development and a better understanding of petroleum properties the refiner was in a position to improve the quality of his products and to satisfy the growing demand of the market for petroleum materials.

CONSUMPTION OF PRODUCTS

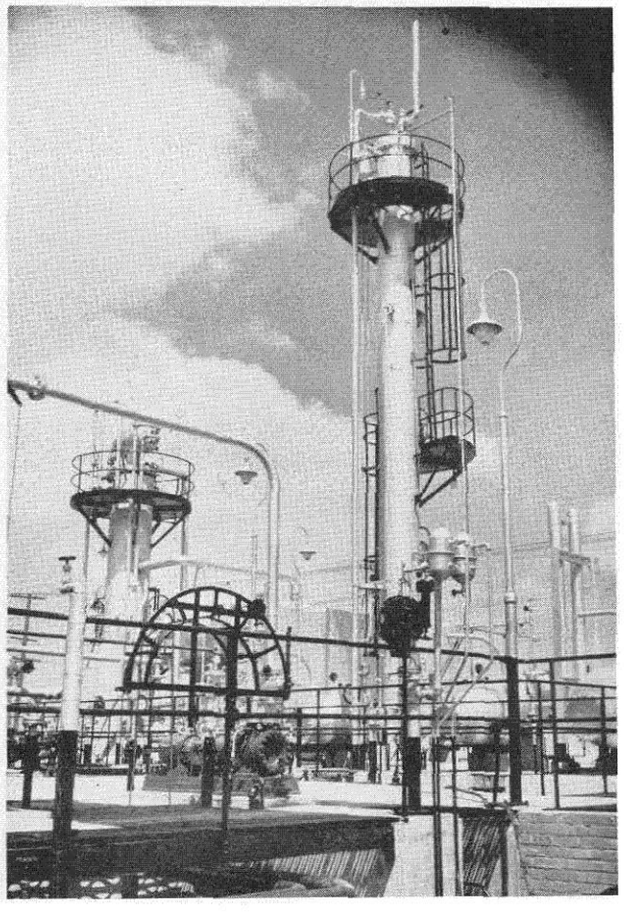
On a volumetric basis the demand for the individual petroleum products is not equal. This may be visualized from the following data showing relative consumption of gasoline and other materials:

Gasoline (Cracked and Straight Run)	1000 bbls.
Kerosene	104 bbls.
Lubricants	45 bbls.
Asphalt and Road Oils	57 bbls.
Fuel and Gas Oils	851 bbls.
Wax	2.4 bbls.
Miscellaneous	139 bbls.
Loss	51 bbls.

The above shows that gasoline is consumed in quantities considerably greater than those which are available in the crude oil. In order to meet the demand and to utilize all the crude obtained from the field the refiner was obliged to develop cracking processes which are capable of converting heavy petroleum fractions into the light ones by application of heat and usually pressure. The gasoline fractions obtained by these liquid-phase or vapor-phase themal cracking processes differ in many respects from the gasoline fractions obtained by straight distillation of the crude. These cracking processes may be, therefore, regarded as the first attempts to synthesize certain materials not found in the crude oil. For many years the cracked gasolines were regarded as inferior to the straight-run products because of their instability and tendency to form gum deposits in service. However, with the advance of high compression engines the true value of cracked gasolines has been gradually realized because of their relative freedom from the tendency to knock in the motor. Simultaneously considerable progress has been made in improving the stability of such gasolines by proper refining, and at the present time the product formerly looked upon with suspicion has become one of the highly desirable gasoline constituents.

In preparing gasoline from the heavy petroleum fractions the refiner was confronted by the problem of improving both the yield and quality of the product. Cracked gasoline is deficient in hydrogen as compared to the straight-run gasoline. The crude oil as a whole likewise contains less hydrogen than its gasoline fractions. This indicated that the problem could be solved by supplying hydrogen during the cracking operations from an outside source. Such considerations led to the development of hydrogenation processes which are capable of converting all the heavy oil fractions into gasoline irrespective of their hydrogen content. Large commercial plants of this type have been constructed, particularly in Europe, where the crude oil supply is scarce and where gasoline had to be produced from materials having exceptionally low hydrogen content such as coal. However, in this country the vast resources of petroleum

ALKYLATION PLANT IN A CALIFORNIA REFIN



and the cheapness of crude oil prevented an extensive development of the hydrogenation processes except for the manufacture of some special products.

Although the relative proportion of hydrogen in the gasoline fraction is greater than in the crude oil itself, the possibility existed of enriching the hydrogen content of cracked gasoline at the expense of the remaining portions of the crude, and thus producing a gasoline which would combine all the desirable properties of cracked and straight-run products. As a result of these considerations the catalytic cracking processes, as represented by the Houdry process, were developed. In the Houdry process the catalyst directs splitting of heavy petroleum hydrocarbons and recombination of the resulting fragments of molecules into materials boiling within the gasoline range and possessing exceptional anti-detonating quality and stability. Although the yield of these catalytic gasolines per barrel of crude oil is less than that obtained by hydrogenation, the expense of supplying hydrogen from an outside source is avoided and the process received a quick recognition on the part of petroleum refiners. As a result a large number of catalytic cracking plants came into existence in this country and abroad supplying the aviation and automobile industry with a premium product but without an increase in cost to the consumer.

SYNTHESIS FROM REFINERY GASES

The attention of the refiner was next attracted by the possibility of synthesizing additional quantities of gasoline from the refinery gases which contain large proportions of reactive hydrocarbons. As a result of these researches a number of thermal and catalytic polymerization and alkylation processes have been developed which are capable of converting gaseous hydrocarbons into liquid gasoline fractions of high anti-detonating characteristics. This placed into the hands of refiners an additional possibility of obtaining high grade products and of utilizing the crude oil to its best possible advantage.

However, the rapid strides of the aviation industry did not permit the refiner to rest on his laurels. The aviation gasoline as now used in the most modern airplane engines must possess exceptionally high anti-detonating properties and oxidation stability. Such products can be obtained only by preparing relatively pure petroleum hydrocarbons in large quantities and blending them in proper proportions in order to meet the required specifications for finished materials. The problem has been solved by the commercial development of selective catalytic and thermal polymerization and alkylation processes which are capable of synthesizing practically pure hydrocarbons of the desired type such as iso-octane (2,2,4-trimethyl pentane) and neohexane (2,2-dimethyl butane). In these processes the raw materials fed to the units are carefully selected among certain gaseous petroleum hydrocarbons in order to minimize the possibility of undesirable side reactions. Subsidiary processes for increasing the supply of raw materials for such plants have been also developed or are in the state of development, thus insuring a plentiful supply of high grade aviation gasolines in this country in the case of national emergency.

SOURCE OF PURE CHEMICALS

The above brief outline of the miraculous progress of gasoline manufacturing in the course of the last few years shows a distinct tendency on the part of the refiners to synthesize their products from more or less pure hydrocarbons rather than be satisfied with the naturally available materials. Crude oil is thus rapidly becoming a source of chemicals which are artificially produced in the course of refining and then blended to the desired product specifications. Petroleum refining is approaching the status of a true chemical industry and it might be expected that in the not too far distant future crude oil will be regarded mainly as a source of carbon and hydrogen and not as a naturally occuring material the properties of which are beyond our control.

While the previously described processes refer to the manufacture of high grade hydrocarbon materials forming the body of commercial gasolines, other methods were developed which permit correction of certain undesirable properties of other hydrocarbon materials without impairing their good characteristics. This is accomplished by the use of additives or substances which, when added in very small quantities, have a remarkable effect on certain characteristics of gasoline or other petroleum products. The use of such additives is now quite universal, as for instance the use of tetraethyl lead to improve the anti-knock characteristics of the basic gasoline fraction. Stability of gasoline with respect to color or gum formation is also often insured by the use of corresponding protective agents and inhibitors. New additives of such types are continually appearing on the market and are utilized to the best possible advantage by the petroleum refiners in their attempts to satisfy the customers with high grade, low cost products.

COMPLEX LUBE OIL FRACTIONS

Up to the present time the complex nature of the crude oil fractions employed in the manufacture of lubricating oils foiled the attempts of research chemists to penetrate into their structure and to evolve methods for synthesizing the desirable hydrocarbons in a way similar to that employed in the manufacture of high grade gasolines. However, some progress in this direction has been made through the synthesis of lubricating oil fractions from hydrocarbon gases by employing aluminum chloride or other catalysts. Both methods of attack are similar in the respect that the crude oil is first converted into simple hydrocarbon molecules which are then reunited to form the desired products. Nevertheless these methods of manufacturing lubricating oils are now only in their infancy.

Although the methods of synthesizing lubricating oils cannot yet be considered commercial, tremendous progress has been made towards isolation of certain groups of compounds which are best suitable for preparation of finished lubricating oil. This has been made possible by the development of the so-called solvent refining processes which permit separation of the desirable constituents present in the charge stock by methods of preferential solubility in certain solvents. Methods of this type have been already in use for a number of years in manufacturing high grade kerosenes from inferior crudes. The lubricating oil fractions obtained by solvent refining are thus freed from asphalt, wax and the unstable hydrocarbon compounds, retaining only the stable, high viscosity index hydrocarbons, i.e. hydrocarbons which show the least change in viscosity with temperature. This latter property is important for lubricating oils intended for use in engines, such as automobile motors, which are frequently heated from the cold. In manu-

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MAGNETIC TESTING OF STEEL IN THE PETROLEUM INDUSTRY

By EMMETT M. IRWIN, '24
Chief Engineer, Magnetest Corporation

Old methods of drilling and producing oil wells by rule of thumb, brute force, and a great expenditure of money, have given way to scientific methods. This has been brought about both by economic pressure and by recent developments of a scientific nature. Such scientific developments as geophysical exploration, bore hole inclination recorders, and mud analyzers are now well-known in the drilling field. Top and bottom hole dynagraphs and depthographs are scientific aids to the production department.

Recently a new scientific development of considerable importance has been made available to the oil industry. This is a magnetic method of measuring fatigue in steel. It is of particular importance to the oil industry, as alternating stresses are applied to steel goods in both the drilling and producing departments, which causes the development of fatigue and subsequent failure of the steel. In the drilling department fatigue is largely responsible for the failure of drill pipe which is used in drilling wells. This failure of the drill pipe often occurs in uncased holes where it is very difficult, expensive, and sometimes impossible to fish out the broken pipe. In the production department sucker rods used in pumping wells are subjected to alternating stresses which cause ultimate failure. The use of magnetic testing permits the development and extent of fatigue in the steel goods to be measured and permits the fatigued steel to be removed from service before failure occurs. By this method it is possible to remove badly fatigued material from heavy service before failure occurs and place such material in lighter service where it may be used for a long time without failure.

This magnetic testing has been commercially developed by the Magnetest Corporation of Long Beach, California. It is now commercially available for the testing of sucker rods and developments are now being made so that it will be available for testing drill pipe and other steel goods at a later date.

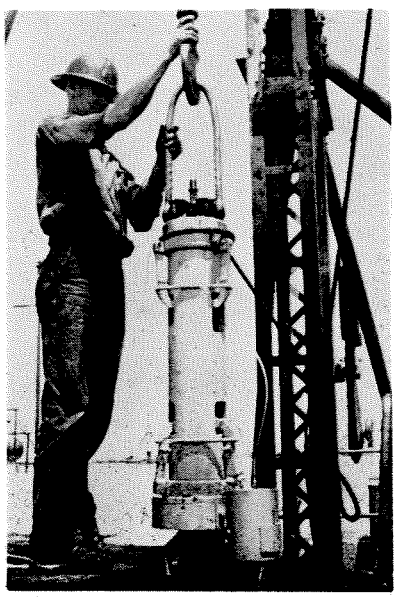


Fig. 2 — EQUIPMENT AT WELL HEAD

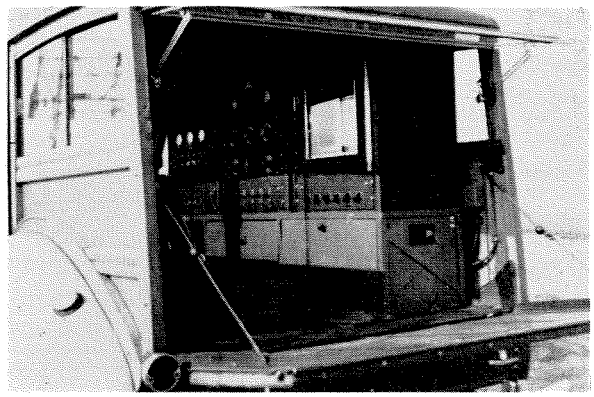


Fig. 1 — TESTING TRUCK

MAGNETIC FLUX ANALYSIS

The method used in testing for fatigue in steel makes use of the change in the magnetic properties due to the development of fatigue. The steel to be tested in magnetized with an alternating current. The magnetic flux thus produced induces a voltage in a pick-up coil. Variations in the induced voltage in this pick-up coil are indicative of variations in the magnetic properties. Since the voltage variations are small, resort is had to a bridge method and sensitive instruments to measure the change. This small voltage change is amplified and recorded on a chart so that a record may be obtained of the condition of the material.

The testing equipment is made up in a portable form so that testing may be carried on at the well. The photograph in Figure 1 shows the appearance of the interior of the testing truck, with the testing and recording equipment. The photograph in Fig. 2 shows the type of equipment used at the well. In this case the testing coil is attached at the well head, and the rods are tested as they are pulled from or lowered into the well by the usual methods.

When recording, two records are made since it has been found that the voltage changes indicative of the changes in the physical properties of the steel occur both in amplitude and in phase changes. The chart, therefore, shows both the amplitude and the phase of the voltage changes. On the accompanying chart there are shown records which have been made of sucker rods. The upper curve is indicative of the amplitude changes, and the lower curve is indicative of phase changes. Fatigue development on the chart is indicated by an upward deflection of the upper or amplitude curve, accompanied by the phase angle indicated on the lower curve which is indicative of fatigue.

The charts shown here are taken from records made on well tests. On the upper chart are shown characteristics of new rods together with changes which occur due to fatigue caused by bending the rods and by certain metallurgical changes caused by chill spots on the rods. The center chart indicates a char-

(Continued on page 15)

SOME VENEZUELAN EXPERIENCES

By Ed Layton, '24
Lufkin Foundry and Machine Co.

In June, 1939, I was loaned to the Caribbean Petroleum Company, Shell affiliate, for some special work in connection with oil field equipment in the Lake Maracaibo region of Venezuela. In my seven months' stay in South America, I had time to make many interesting observations, some of the most vivid of which I have attempted to recall in the following article.

Lake Maracaibo, located in the northeastern section of Venezuela, is some 120 miles long by 60 miles wide at its widest point. Open to the Caribbean through a narrow channel at its northern end, and with shifting sand bars at its outlet, the water is brackish in the upper portion. The numerous rivers emptying into the lower half discharge such a tremendous quantity of water during the rainy seasons that its level will actually rise during these periods. The fishing is reported as excellent and is one of main week-end recreations of the foreign (white) oil company employes. Water temperature is 80-85 degrees F. Because it is impossible for ships of more than 12 feet draft to cross the bars, even at high tide, only small or lightly-loaded ocean-going freighters are ever seen on the Maracaibo waterfront. The specially-built tankers of 11 feet draft, which carry crude from the various fields to the immense refineries on the Dutch West Indian islands of Aruba and Curacao, line up in single file to ride the high tides over the bars. Many native craft, almost exclusively sailboats, from small fishing boats to larger freight schooners and passenger boats, ply the lake's surface; and each week-end there is a Star-boat race between sailing enthusiasts among the oil companies' foreign staffs.

The city of Maracaibo, of some 140,000 population, is situated on the western shore at the northern end of the lake, and ranges from the dirt and smells of the typical tropical port to the attractive estates of wealthy upper-class Venzuelans and the well-landscaped grounds of the oil company offices and camps. The surrounding country is desert-like, with relatively little rainfall, and thorn trees and cactus are virtually the only natural foliage. The thorn tree foliage begins about 4½ feet above the ground and appears to have been clipped. This is the "goat line," or the maximum reach of a goat standing on his hind legs. Goats, with a few burros, are virtually the only domestic animals which can forage this area successfully.

TRAFFIC PROBLEMS

Except in the Bella Vista section, the location of the newer and better residences and the oil company camps, the majority of Maracaibo's streets are dirty and very narrow, with most of them for one-way traffic only. Driving, for a foreigner, is a gamble, since the streets are full of cars, mostly in taxi service, which are driven any place in the street which the driver may happen to fancy—either side or the middle. The average native driver appears to handle his car like a new toy, and the more horns the better. All electric horns are taboo in town, and by accepted convention the right-of-way belongs to the driver who toots first. Consequently, all drivers honk continuously, and the bedlam of rubber bulb horns, many of them asthmatic, is terrific. The traffic situation has been complicated recently by the digging of miles of ditch for new water mains—Maracaibo's first—which are left open for weeks, unprotected.

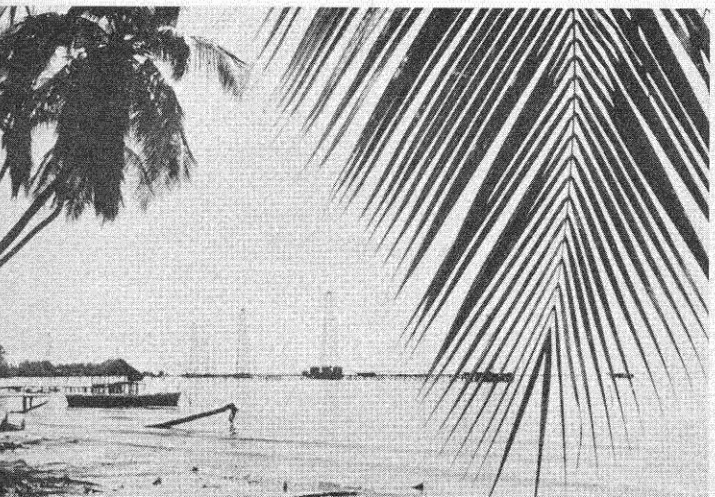
There are almost no street signs or house numbers. Many of the houses are painted in bright colors, most have plastered exteriors, and many have fanciful names posted over their doors. All windows are barred, with solid inside shutters, and almost none have screens. Window glass is unknown except in store windows and the few air-conditioned buildings.

The stores in the business section are hardly recognizable as such to a foreigner. Most are pretty dirty and dusty, with primitive interiors and antiquated fixtures, if any. There are many sidewalk "shops," peddlers, tobacco bootleggers, beggars, and lottery ticket sellers. Prices of everything are very high. The large central produce market is dark, dirty and very smelly. Until recently, meat on the hoof, and other produce was brought from far down the lake in the native schooners, which are slow and unequipped with refrigeration. With the recent extension of the lake road to connect with the Trans-Andean Highway, much of Maracaibo's food is now trucked in and arrives in much better shape. All meat is slaughtered at night and sold the next day because of lack of cold storage facilities.

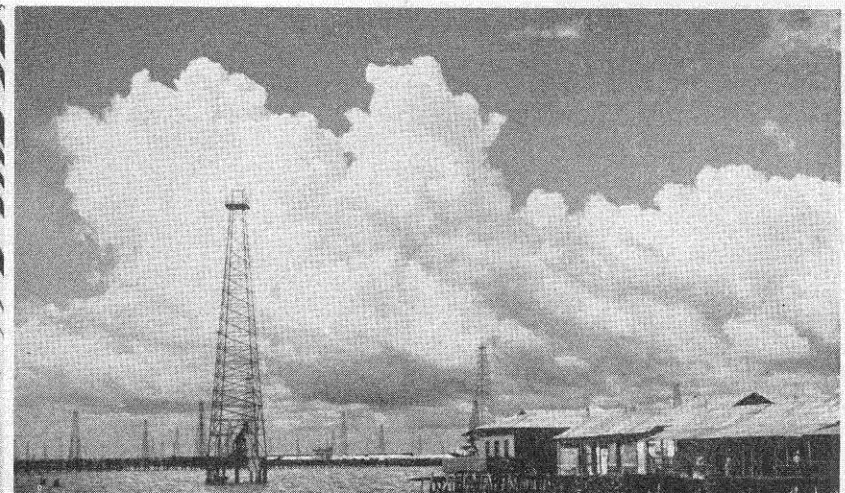
Each Monday a drawing is held in the government lottery. Tickets are peddled by old women and children, and from 1/10 ticket up can be purchased.

Green grass and lawns can be found only in the oil company

LAKE MARACAIBO FROM THE LAKE ROAD.



CORNER OF LAGUNILLAS VILLAGE WITH WHITE-ROOFED V.O.C. CAMP IN BACKGROUND.



camps, due to water scarcity. Beautiful flowering trees, in season, with red, white, yellow or purple blooms, surround some of the larger residences. Cocoanuts, mangoes, bananas and platanos are occasionally found growing along the streets.

The usual atmospheric temperature range is 85-90 deg. F., with personally observed extremes of 76-95 deg., although it is said that an occasional minimum of 69 deg. has been registered during the early spring rainy season. The humidity is always high, with one personal observation of 80%. Mosquitoes are scarce, but sand flies are abundant.

The people are typical of any tropical Latin-American seaport. Upper class Venezuelans are Spanish or perhaps Spanish-Indian, with an occasional admixture of German, Dutch, or English blood. With the peons—the great mass of the population—there is no color line. They vary from plenty black through brown to the lighter Spanish-Indian. Some oriental mixture is observed. There are many West-Indian negroes. It is not uncommon to see a very blonde baby or child in a much darker family. The typical Venezuelan peon is small of stature, small-boned, undernourished due to the preponderance of starchy rice and platanos in his diet, and with little resistance to disease. Few are legally married, due to the high cost of the Catholic religious ceremony, and illegality of birth is apparently no stigma. Few can read or write, although the school system is being expanded.

Crossing the lake from Maracaibo via modern passenger and automobile ferry, and driving south along the lake road through the oil fields, the country and climate change rapidly. Desert-like country gives way to rank jungle, which becomes very dense before Tia Juana is reached. Obviously the rainfall is much heavier here. A single oiled road, built and maintained by the oil companies, runs south from the ferry terminal at Palmarejo through the oil fields which line the eastern side of the lake and has recently been extended further south to connect with the Trans-Andean Highway at Mototan. Venezuelan Oil Concessions (Shell), Lago Petroleum (S.O. of N.J.), and Mene Grande (Gulf) oil companies, are all represented in Cabimas, Tia Juana and Lagunillas fields. The many wells on dry land are exclusively Shell, with Mene Grande's in the water, within 1000 meters of shore, and Lago's starting 1000 meters out and continuing into the lake to the present drilling limit of five miles. At this distance from shore the water depth is some 60 feet, making drilling operations more difficult, although the best wells are those farthest out.

Each oil company has established a well-equipped camp in each field for its white employes, and in addition one or more camps for native laborers. Complete recreational facilities are provided in all camps. Most of the food used by the white employes is imported from the U. S., and is expensive. It costs about $1.50 per meal per person to feed the men in a company mess hall.

Each company has its own large steam power plant with transmission and distribution systems, and all three systems are interconnected. V.O.C. generates 2300 V., 60 cycles, transmits at 33 KV., and distributes at 6900 V. with 440V. secondaries, except for a few large 2300-V. drainage pump motors. Most pumping wells are electrically driven, with conversion of older wells from gas engine to electric drive being carried on continually.

With the exception of the town of Cabimas, which is large enough to show a few urban characteristics, all lake shore villages are small and very primitive. Most originated as fishing villages built on piling over shallow water, with houses connected by plank walks; but many have since spread to the shore.

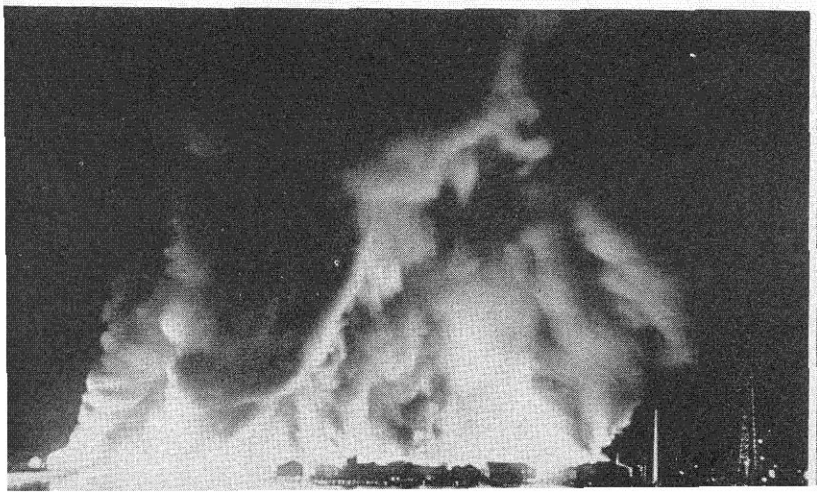
OLD PIRATE BASE

The ancient village of Pueblo Viejo was reputedly used as a repair base for his Caribbean operations by Sir Henry Morgan, the English pirate, and has changed little since.

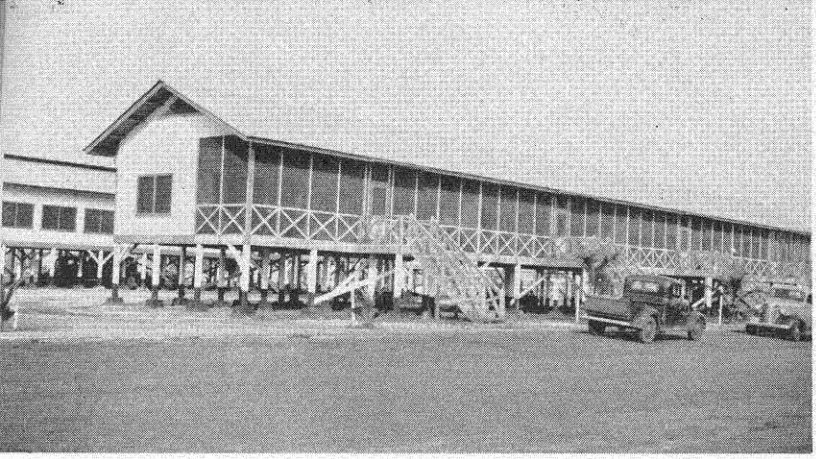
A few small farms have been hewn out of the jungle, their produce being principally corn, beans, and goats. The occasional tiny village in the back country jungle has bamboo-walled thatched huts. The only domestic water supply is from roof drainage. The residents of these jungle villages do practically no farming besides rasing a little corn. They pick platanos and fruit in the jungle, keep a few chickens, a pig or two, and perhaps a cow. They shoot small deer in the jungle, hunting at night with spotlights and shotguns, and occasionally get a wild pig. Some of the ancient muzzle-loading long-barreled rifles seen now and then are curious affairs, but the importation of both rifles and small arms has been prohibited for years.

The jungle in many places is impenetrable without a machete. The writer discovered that a bamboo thicket, with its innumerable thorns, is extremely dangerous and can cut a man to ribbons. Ants and mosquitoes, of course, are plentiful. Poisonous and constrictor snakes are numerous but seldom seen. Quiet and apparently lifeless by day, with few birds evident, the jungle wakes up at dusk. Bands of howler and spider

NATIVE PIER VILLAGE OF LAGUNILLAS, NEAR V.O.C. COMP, BURNING, NOVEMBER 13, 1939.



LAGUNILLAS VILLAGE THE MORNING AFTER THE FIRE.



BACHELORS' BUNK HOUSE, V.O.C. CAMP, LAGUNILLAS, ONE ROOM DEEP. EIGHT ROOMS LONG. BUILT ON DRAINED SWAMP.

NATIVE HOUSES IN TINY JUNGLE VILLAGE OF PICA PICA; IN JUNGLE 25 MILES FROM LAGUNILLAS.

monkeys in the trees, and flocks of screaming parrots overhead provide plenty of noise. The jaguar makes good hunting, and the colorful iguana is much prized for its succulent meat.

To a person accustomed to driving a car in the U. S., automobile operation on the lake road appears extremely hazardous. The national speed limit is 45 kilometers per hour—28.5 miles—and for good reason. It is not only necessary to dodge peons, naked children, pigs, burros, chickens and cattle (the many goats are too smart to get hit), but the average native driver holds the middle of the road until forced to move over. And he is likely to suddenly stop anywhere at any time without warning. A large number of native-owned cars have their front wheels toed in at the top. This is apparently king-pin wear, since their owners never give them any attention beyond gas, oil and water, so long as they will run.

A driver's license costs $50.00, but is good for life. In addition to this document, the foreign driver must have in his possession his passport, vaccination, health and good conduct certificates, a statement certifying that he is not a political agitator, his identification cedula with photographs and fingerprints, and his bill of sale if the car is privately owned.

PETROLEUM PRODUCTION

There are a number of oil fields in western Venezuela, on and near the lake. Two small Shell-owned fields, Concepcion and La Paz, are some ten to fifteen miles west of Maracaibo; each with less than 50 wells producing relatively small amounts of high-gravity oil. Production is pumped to Maracaibo for shipment. A small amount of production is also obtained at Casigua, some 45 miles N.W. of Maracaibo.

The important fields, however, are all located along the eastern lake shore south of Maracaibo. Cabimas has probably 500 wells ranging from 1400 to 3000 feet in depth, producing crude of from 16 to 26 A.P.I. gravity in quantities which would probably average less than 50 barrels per well per day, since this is the oldest field in the region. Many of the dry-land wells are on jacklines operated from central pumping powers. In June of 1939, when these and the following figures were obtained, Shell in this field had 254 wells pumping, 63 on gas lift, and 40 flowing. No figures for the other operators are available.

Tia Juana, south of Cabimas, produces 13 gravity oil, almost exclusively by pumping, from 2400 to 2700 ft. Lagunillas, the largest field on the lake, is only a short distance south of Tia Juana, and the production figures of both these fields are lumped together. Lagunillas wells are from 2000 to 4000 ft. deep and produce sizeable amounts of crude averaging 16 gravity. Almost all wells come in flowing 400 to 1000 barrels, and some will continue this flow for several years. Shell had 538 producers in the two fields; 215 flowing, 3 on gas lift, and 320 pumping.

The present figure is between 750 and 800 producers, with several drilling strings operating continuously. Total wells for all operators in both fields is close to 1500, with an average potential production per well of some 150 barrels a day.

Lago Petroleum Co., Mene Grande Oil Co., and V.O.C. (Shell) are all represented in each of the foregoing fields, with Shell operating entirely on land and the other two companies dividing the seagoing territory. Shell digs its wells and puts them on production within a week's time; while the other operators, drilling in the lake from barges, require somewhat longer.

Mene Grande field, also exclusively Shell, is some 20 miles east of the lake shore. It had a total of 122 wells bottomed at from 1700 to 5000 ft. and produced crude ranging from 16 to 29 gravity. 51 wells were flowing, 19 on gas lift, and 52 pumping.

Mene Grande crude is pumped to San Lorenzo, on the lake shore, where the Shell has its single Venezuelan refinery, and some of it is refined to obtain a very vile grade of gasoline for local distribution. Apparently they never heard of octane, and only one grade is sold. The remaining crude is carried by tanker to the immense refinery at Curacao—second largest in the world.

Each operating company in each of the other fields has its own loading dock where its fleet of shallow-draft lake tankers are loaded. Lago's goes to their largest-in-the-world refinery on the Dutch island of Aruba, while Mene Grande's oil is transferred to ocean-going tankers at a terminal on the Gulf of Venezuela and carried to their Port Arthur, Texas, refinery, from which most is re-shipped for export.

For almost a year, due to the lack of sufficient convoyed tankers to carry refined products from Curacao and Aruba to Europe, the lake fields have been at least 25% shut in.

Eastern Venezuela has relatively small established producing fields at Caripito and Quiriquire, with others in process of development. Companies represented there are Standard of

(Continued on page 20)

ACTIVITIES OF THE DEPARTMENT OF CHEMICAL ENGINEERING RELATING TO THE PETROLEUM INDUSTRY

B. H. SAGE, PH.D., '34
Associate Professor of Chemical Engineering

In recent years the petroleum industry has increased the relative proportion of its technical personnel and it became desirable to include in the Institute's chemical engineering curriculum additional work of an engineering nature in order that graduates might cope more effectively with the technological problems associated with the advances of the industry. With this objective in view a fifth-year course leading to the degree of Bachelor of Science in Chemical Engineering was initiated for the school year 1939-40. This fifth-year work includes training in the fundamentals of chemical engineering from both an analytical and experimental viewpoint and is open to a limited number of men who have completed a four-year course in the applied chemistry option. Business economics and administration is studied throughout the year and time is available for the student to pursue advanced academic work of a more specialized nature than was possible during the basic training period of the four-year course.

A sixth year of academic work is available for a small number of men. This leads to the degree of Master of Science in Chemical Engineering and affords the student special opportunity for engineering research experience, since at least half of the student's effort is devoted to research activities. This work is apparently being well received by the students since during the present year the maximum number of eight men that can be adequately handled with existing laboratory space is filled entirely with high quality men from the Institute, leaving no room for outside applicants. Further increases in the number of either fifth- or sixth-year students cannot be made without additional space for both research and course work.

A.P.I. PRODUCTION PROJECT

The laboratory has been fortunate in retaining since 1928 a research project sponsored by the Production Division of the American Petroleum Institute. The initial objective of this project was the investigation of the "solubility of natural gas in crude oil" under the conditions encountered in underground reservoirs. This limited objective has since been expanded to include a general study of the volumetric, phase and thermodynamic behavior of pure hydrocarbons and their simple mixtures, as well as the behavior of samples of oil and gas mixtures obtained from a number of oil fields throughout the country. In order to cover the range of conditions of industrial interest the experimental work initially included pressures up to 2,000 pounds per square inch in the temperature interval between 100° and 220°F. At the present time most of the measurements of the laboratory are made with pressures up to 10,000 pounds per square inch and at temperatures from 100° to 460°F. This increase in the ranges of both pressure and temperature has been made necessary by the rapid increase in the depth of active producing formations. The primary objective of this work for the American Petroleum Institute is the prediction of the properties of hydrocarbon mixtures under the conditions that are found in nature from a minimum amount of factual information concerning the nature and condition of the system in question. A lengthy series of articles presenting the data obtained has appeared in *Industrial & Engineering Chemistry* during the past several years, in addition to publication by the A.P.I.

Experimentally, the measurements include specific volume, heat capacity, JouleThomson coefficients, composition of coexisting phases, and the viscosity of homogeneous systems These properties are determined as a function of pressure, temperature and composition. Owing to the high pressures involved it has been necessary to develop special equipment for the purpose. From these measurements the thermodynamic properties of both simple and complex hydrocarbon mixtures have been evaluated as a function of state. These data then form the basis of more generalized predictions which may permit the estimation of the properties of naturally occuring hydrocarbon mixtures as a function of state. At the present time the experimental background is not sufficiently complete to permit such predictions to be made with accuracy at the higher pressures and temperatures currently encountered in practice, but it is believed that the same methods now successfully applied at the lower pressures may be extended in scope as soon as the necessary background of experimental data is available.

Information of this nature may be applied to many of the problems relating to the behavior of fluids in underground petroleum reservoirs and in the processing of hydrocarbon fluids, if it is assumed that equilibrium obtains. Volumetric measurements are of interest in petroleum production in connection with the estimation of reserves, proration of production, and the flow of homogeneous and heterogeneous mixtures in both porous media and in conduits. Phase equilibrium data in the same division of the industry find their primary use in the estimation of the state of fluids under subsurface conditions and in predicting the influence of trapping and other surface operations upon the separation of the desirable constituents from the well production. Thermal data permit the evaluation of the heat and work associated with the changes in state of fluids during production and in subsequent surface operations. The design of certain processing equipment and the estimation of optimum operating conditions both in refining and natural gasoline plant installations finds use for volumetric, phase equilibrium and thermodynamic data. The measurements of the viscosity of homogeneous fluids are of interest primarily in connection with the study of the movement of such fluids in the production and processing of petroleum.

OTHER RESEARCH PROJECTS

In addition to the work for the American Petroleum Institute the laboratory has been favored by research projects sponsored by a number of the major oil companies such as the Union Oil Company, Standard Oil Company of California, Texaco Development Corporation, General Petroleum Corporation, Shell Oil Company, and the Polymerization Process Corporation. Experimental work relating to the volumetric and

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POWER DRILLING RIGS FOR ROTARY OIL WELL DRILLING

By NICHOLAS A. D'ARCY, JR., '29
Emsco Derrick & Equipment Co.

Power drilling rigs are playing a very important part in the production of oil all over the world. Among those who have been instrumental in the development of this type of equipment are several Cal Tech Alumni including R. W. Craig '21, Harold Puls '23, Walter Moore '23, B. R. Schabarum '25, Leroy Newcomb '25, Nick D'Arcy '29, Bob Ramey '30, Spencer Long '30, Ed Foss '32, Jim Keeley '31, Bob Gardner '36, Don Blodgett '36, M. W. Hinshaw '36, and S. M. Brose '40.

FIRST POWER UNITS

The conventional power for drilling oil wells has been steam generated in large boilers at the well site, but as early as 1927 the Shell Oil Company was drilling wells with gasoline powered rigs. These early drilling units were powered by single 125-horse power engines and drilled a number of wells in the Poso Creek field. These units saved several thousand dollars per well in drilling cost although they did not receive a hearty reception from the oil industry.

Interest increased in power drilling equipment in 1934 due to improved methods of compounding the power of two internal combustion engines. With information and material available at that time, it was possible to manufacture units recommended for drilling wells to a depth of 5000 feet and having 325 horse power available. These units drilled to 8000 feet on several occasions and filled a great need in export fields. Development kept pace with export demands for several years.

The power drilling rig came into its own in California in 1940 and competed very successfully with steam power with the event of 1000-horse power rigs.

APPLICATIONS FOR POWER RIGS

The development of the power rig from a small unit suitable for specific drilling conditions to the present unit capable of drilling under any condition has been the solution of three major problems: first, a unit requiring a minimum of fuel and water; second, a portable unit which could be broken down into small packages; third, a unit that would compete with steam under all conditions.

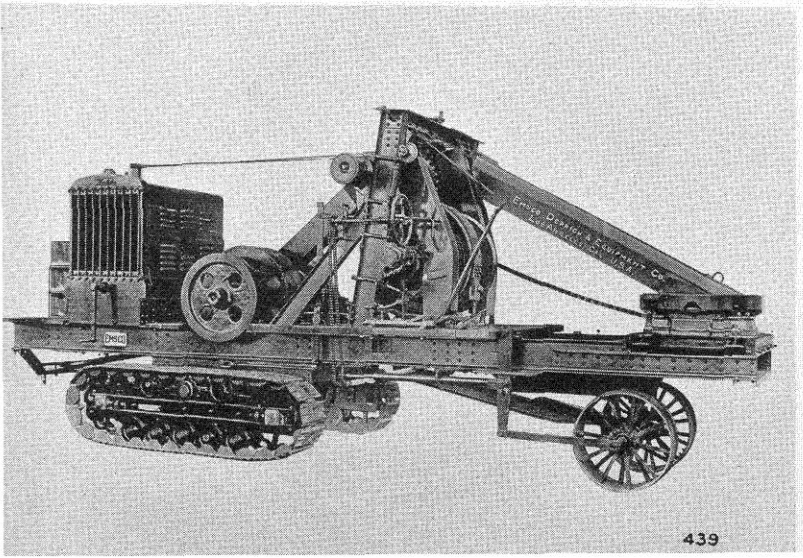
An examination of the results obtained with power drilling rigs soon shows why they received such a hearty welcome in export fields where both fuel and machinery had to be transported under exasperating conditions. The internal combustion engine was not subject to that eternal boiler problem of "soft water." Wild cat operations did not require extensive exploration for suitable water nor expensive water treatment plants. It was logical to find some of the early power rigs in operation in Egypt and Persia where water was a prime problem. California installations reveal that water consumption is reduced from 60 barrels per hour for the boilers to 10 gallons per week for the internal combustion engines.

Fuel consumption on internal combustion rigs is only about 10 per cent as great as on steam rigs. This is a major saving when all fuel has to be transported hundreds of miles to remote wild cat locations but it has not been given great consideration in California due to the abundance of natural gas in most fields. Operators now realize that gas consumed under the boilers makes production problems for the future and are giving fuel economy serious thought.

Export operators were also interested in portable units. Power driven rigs can be broken down into packages none of which weigh over 10,000 pounds, whereas steam boilers weigh approximately 30,000 pounds and are very bulky. In local fields modern roads and well equipped trucking companies reduce the demand for readily portable units, but the quick moves made with power outfits appeal to the local operators. In shallow fields the entire power rig can be moved on one truck without disconnecting the engines, reverse gear or drawworks. This saves several hours rig-up time as compared to steam rigs, and as these shallow wells are drilled in from 18 hours to 3 days this is a major saving.

California manufacturers developed for California contractors power drilling rigs that would compete with steam on California deep drilling operations.

First known rotary drilling rig designed for use with internal combustion engine operated in Poso Creek Field, California.



PERFORMANCE

The two largest power drilling rigs now known to be operating are in California, both having been placed in operation in 1940. Each rig is powered by three internal combustion engines developing a total of over 1000 horse power. These rigs have both drilled to depths in excess of 9000 feet in from 60 to 70 days, which is equal to or better than steam rigs drilling in the same field for the same operators.

Power has to be applied to three major machines in rotary drilling. The rotary machine is located directly over the hole to be drilled. It rotates the drill pipe which in turn rotates the drill and digs the hole. The slush pump or pumps are located on the ground outside the drilling derrick. The slush pump forces "mud" through the drill pipe, down to the bit, and washes the cuttings from around the bit up the outside of the drill pipe to the surface. The drawworks is the largest

and heaviest of the three machines and it is located on the drilling floor. It is used to hoist drill pipe out of the hole when the bit is dull and lower the pipe back into the hole when the new bit has been installed. It also controls the weight carried upon the bit while drilling by feeding off the line as the hole is deepened, allowing the drill pipe to descend.

Most power rigs are designed so that the power from the engines can be applied to the rotary machine, slush pumps or drawworks. Some rigs have independent engines to drive the slush pumps. The two 1000-horse power rigs in California have the engines so compounded that the power from one, two, or three engines can be applied to the rotary machine, slush pump or drawworks. In normal drilling operations, one engine will drive the rotary machine, and two engines the slush pumps. All three machines are compounded into the drawworks when hoisting, and the slush pumps and rotary are idle.

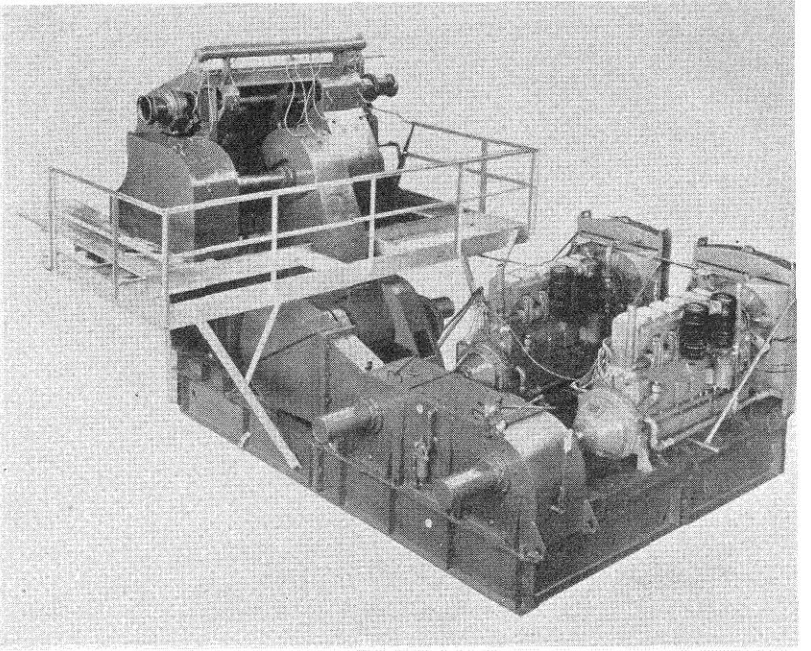
Two smaller power rigs in the Los Angeles basin have superseded steam rigs. These rigs have two 350-horse power engines compounded into the drawworks or rotary machine, with 200-horse power independent drives to each of two slush pumps. The independent slush pump drive allows for a more flexible unit, as the pumps can be placed without regard to the location of the drilling engines. However, this set-up provides less power to the drawworks for hoisting. Both the three-engine 1000-horse power rig and the two-engine 700-horse power rigs are drilling oil wells to depths of 9300 feet and 7500 feet as fast as the steam rigs they superseded.

DESIGN PROBLEMS

In 1927 portable well servicing units were adapted to rotary drilling in an attempt to do a man's work with the boy-size engines then available. These early units were powered by four-cylinder 125-horse power internal combustion engines to allow mounting the entire unit upon a truck and still stay within the 8-foot road limit. The first real advance in power drilling rigs came when two 150-horse power engines were compounded thru chain drives to provide 300 horse power for heavy work. The size of the engines used has steadily increased up to a pair of 450-horse power diesel engines now en route to Colombia, South America.

Numerous problems were encountered in compounding engines. A reverse rotation which cannot be obtained direct from the engines is often necessary on the drawworks and rotary machine. Single engine drives were equipped with a reverse and forward reduction gear in the bell housing of the engine but it did not prove substantial enough for rotary drilling. When two or more engines are compounded, a separate reverse and friction clutch is generally furnished. This clutch provides an instantaneous reverse or forward drive by throwing a lever at the driller's position. The reverse action is obtained through a differential gear and brake that is very efficient. The forward action is obtained through a large frition clutch and the load carried is so large that special friction clutches had to be developed before 1000 horse power could be handled.

Chain used to compound engines gave no end of difficulty on the first jobs but, through added experience, improved design and an increased factor of safety, compounding chain is now virtually trouble-free. On the early drives large (2½") pitch

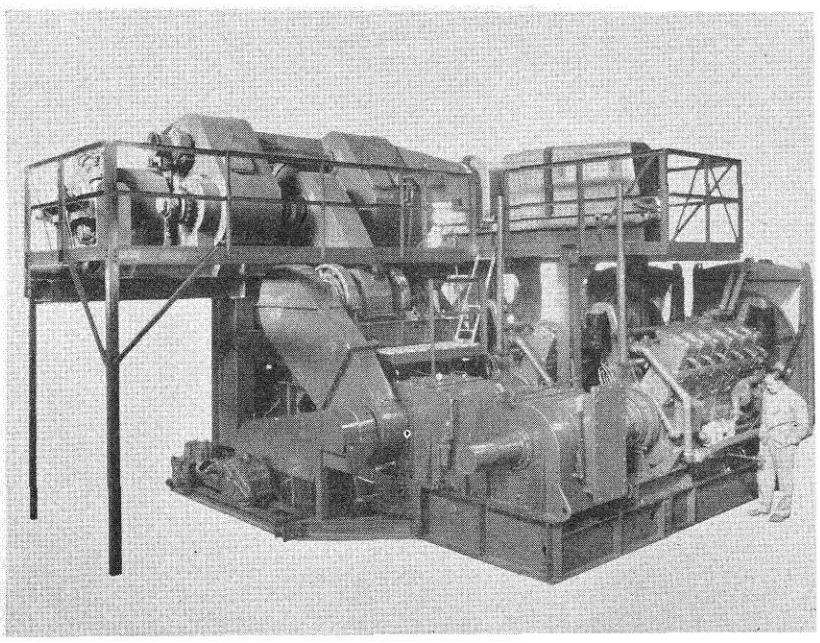


Modern power drilling rig which recently completed a 10,200 ft. well in Saudi, Arabia, equipped with two 225-horsepower Diesel engines and modern chain compounding transmission case.

single chain was used. It was almost impossible to keep oil on this chain, which traveled at between 4000 and 5000 feet per minute when the engines were operating at between 900 and 1000 R. P. M. Also, cotter pins used to fasten side bars were thrown out of the chain at these speeds. Chain speeds were reduced by the use of multiple strand small (1½") pitch chain, and cotter pins were replaced by rivets at an early date, but lubrication continued to be a problem. The latest development in compounding equipment is the oil-tight flood-lubricated compounding transmission. This unit is a large welded case in which all compounding shafts are lined up within very close tolerances with suitable clutches installed on the shafts to provide means of directing the power to the unit or units desired. Each compounding shaft has a drive to a small oil pump which circulates a steady stream of oil onto the chain and all the bearings. The compounding transmission cases hold up to a barrel of oil which is used without loss or waste. An efficient filter insures clean oil at all times. Early chain drives often failed after drilling 5,000 to 10,000 feet, but chain in the new compounding transmissions often lasts for well over 100,000 feet of hole.

Engine manufacturers have assisted in the development of power driven rigs by providing large engines. Although 150-horse power engines were the largest suitable engines in 1927,

Largest known internal combustion engines used on power drilling rig shipped November, 1940, to Colombian Petroleum Co., Colombia.



in 1940 engines developing 350-horse power are available and in frequent use. 450-horse power engines were used on a job shipped from Los Angeles to Colombia in November, 1940.

POWER DRILLING ECONOMICS

The month of November, 1940, has revealed many interesting figures on the performance of power drilling rigs, and all figures point to an increased use of power rigs. One operator reports the operating costs of a boiler plant on a steam rig for one well was $14,000, and for a power rig in the same field was $1,000. The cost on the steam rig included fuel, fireman's wages, and water treating costs; and on the power rig, fuel and mechanic's wages.

A prominent contractor in the Wilmington field reports savings up to $1.00 for each foot of hole drilled with power rigs when compared to steam rigs operating under the same conditions. These wells are being drilled to depths of about 6,000 feet by two engines, each developing 200 horse power.

A contractor running three strings of tools at Coles Levee obtained results shown in the accompanying table while drilling under as nearly identical conditions as it would be possible to obtain.

The power rigs show a decided saving in fuel and water consumption in all cases checked and the total drilling time is equal to or better than the wells drilled with steam.

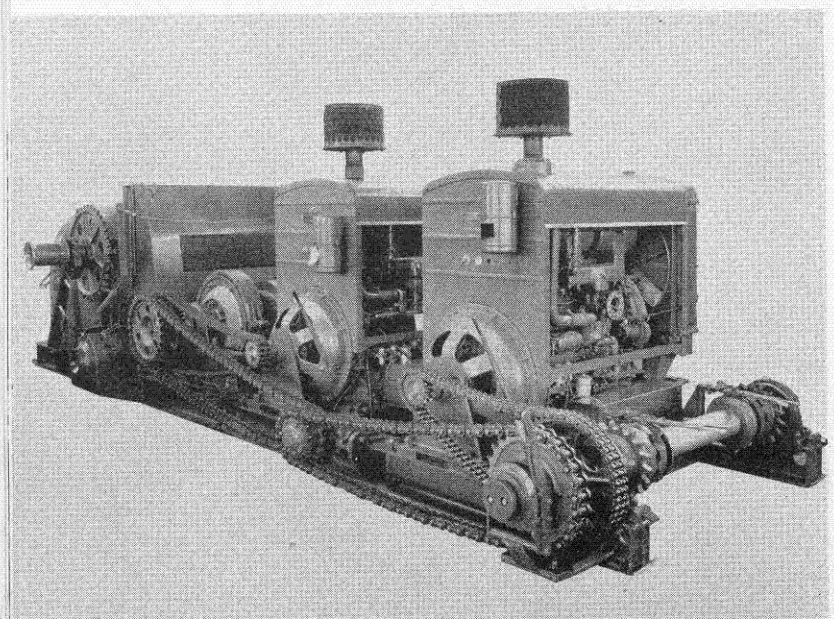
In addition to fuel savings, great savings can often be made through decreased costs in moving, smaller foundations and less grading, less expensive roads due to lighter equipment, and faster knock-down and set-up time when moving from one well to the next.

DEVELOPMENT TRENDS

There are several problems to overcome in power rigs. It is desirable to approach the smooth, even power developed by steam at low speeds, to hold pressure on the slush pump while cementing, to hold a strain on the drilling line while fishing for lost drill pipe, and to provide more power.

Hydraulic couplings, similar to the fluid drive in modern automobiles, are being tried on the latest power rig placed in operation in California. The hydraulic couplings eliminate the solid connection in conventional clutches between the engines and compounding transmission, and act as a cushion or shock absorber between the driven units and the engines. The kinetic energy is low at slow engine speeds and slippage occurs in the coupling when high torques are applied to the drive shaft. No motion is transmitted to the driven shaft when the torque in the driven shaft exceeds that delivered through the fluid in the coupling, and 100 per cent slippage occurs. This is just what is desired to hold pressure in a slush pump while cementing and tension on a line while fishing. It is possible to run the engines for many hours at a speed to develop maximum torque without producing any rotation in the driven shaft by installing a means of cooling the oil in the coupling. Many details have to be worked out in this type of installation, but it gives promise of providing an answer to the problems of smooth power, stalled slush pumps and fishing.

Early dual engine power drilling rig showing complex chain compounding system.



FIELD DATA ON POWER AND STEAM RIGS

Power —	POWER RIG	No. 1 STEAM RIG	No. 2 STEAM RIG
	3 - 350 H.P. Natural gas internal combustion engines	250-lb. Boiler Plant 14x12 steam engine	350-lb. Boiler Plant 12x12 Steam Engine
Well Depth—Feet			
1st	3 wells	9,025	9,225	9,350
2nd	3 wells	9,100	9,150	8,980
3rd	3 wells	9,190	8,980	9,050
Drilling Time—Days			
1st	3 wells	70	70	76
2nd	3 wells	50	56	57
3rd	3 wells	67	56	62
Gas Consumption—MCF			
1st	3 wells	5,426	39,076	48,882
2nd	3 wells	3,913	36,306	48,962
3rd	3 wells	6,095	38,508	47,083
Water Consumption—Barrels			
1st	3 wells	31,747	108,129	136,973
2nd	3 wells	35,815	93,959	114,550
3rd	3 wells	36,243	98,693	118,541

All of the above drilling times are figured from the day the well was spudded in until the day the liner was set to obtain production. Both the gas and water were metered quantities, and the water included not only that used in the boilers, but all miscellaneous water used on the rig, such as, wash-down water and water in the mud. Drilling in 50 days to 9100 ft. on the second power rig well was the fastest time made in the entire field.

It is likely that 1941 will see power rigs developing 1400 horse power supplied by four engines. This power will be equal to the largest steam rigs in common use and will provide a rig suitable for drilling the deepest wells.

Light power drilling rigs should again become popular due to the development of telescoping and folding drilling masts. It is now possible to mount a 200-horse power engine, drawworks and 90-foot drilling mast on a semi-trailer and meet all California road regulations. This unit is suitable for drilling 4000-foot wells without erecting an expensive derrick. The mast is a very interesting study as it has to be light, compact, easy to erect and tied with a minimum of guys. One 90-foot mast telescopes to 45 feet as the first step in moving, and then folds down over the drawworks and engine. Its height when folded is 13 feet, and it can be erected in less than an hour with power provided on the truck.

CONTRIBUTIONS OF TECH ALUMNI

Harold Puls, '23, Chief Engineer, The Texas Company,

(Continued on page 19)

A LUBRICATION ENGINEER LOOKS AT THE ORIENT

By ROBERT I. STIRTON, '30, Ph.D., '34
Research and Development Department, Union Oil Company of California

Singapore, Britain's "Gibraltar of the East," probable base for the U. S. Navy in the near future; Bangkok, capital of Thailand (formerly Siam), scene in recent weeks of rejoicing over successes in border, air, and naval skirmishes with the French forces of Indo-China; Soerabaya, chief naval base of the Netherlands East Indies and probably primary objective of any Japanese thrust southward to the Indies, Rangoon, port of entry for all supplies routed to China's beleaguered armies over the Burma Road—all of these have been the scene of my activities for the past two and a half years as representative of the Union Oil Company in the Oriental tropics.

Accordingly, I expected the first questions asked me when I returned to the United States last August would concern the wars, rumours of wars, etc., in this area. Actually, what my friends and acquaintances have been asking, almost without exception, is, "Are you glad to be back?" And my answer is, "Yes, indeed." I will try to explain why this is my answer.

It is probably just as well that few questions were forth coming on the subject of military and naval matters since as a civilian and alien it is impossible for the average American to obtain any authoritative information in more detail than that given in the press. In this connection it is to be remembered that my time has been spent in countries where censorship has been strict even before the outbreak of actual war. Opportunities for personal observation are also very limited. Thus, as the representative of the company which supplied the asphalt used in construction of the Naval Base at Singapore and which is presently supplying the lubricating oil used in the electric power generating equipment there, I once suggested that it might be desirable for me to look over the installation and equipment so that I would be in a position to be of assistance should any service difficulties arise. Such facilities were commonly afforded British representatives of British concerns, but I was informed that all of our products were proving entirely satisfactory and that should any difficulties arise in connection with any product, the proper authorities would communicate with me.

The Engineering Association of Malaya, of which I am a member, also made several conducted tours of inspection of various parts of the Naval Base, but only members of British nationality were permitted to participate.

SECRECY IN THAILAND

A similar situation prevailed in Thailand (Siam), where I had to decide whether one of our tankers would discharge bulk oil cargo at the chief Thai naval base or at an optional terminal. I was not allowed to see charts of the waters in the vicinity of the base, nor would the authorities divulge any information as to width of the channel, dimensions of the turning basin, mooring or anchoring facilities, etc. Needless to say, the cargo was discharged at the optional terminal, for which this information could be obtained.

The Union Oil Company has no producing or refining facilities in this area; consequently, I saw no oil wells or refineries, but I did see practically every other type of industrial installation in the Orient, and hence obtained a fairly comprehensive picture of the conditions in connection with engineering activity in general.

As regards the technical aspects of an engineering job in the Oriental tropics it is my opinion that the chief interest to an engineer is the opportunity to experience at first hand conditions which are only historical in this country. In general, the equipment and methods in common use are, from our standpoint, obsolete by some forty or fifty years. If you yearn to discover what problems confronted the construction engineers who laid our first transcontinental railways and would like to see if you could solve these problems, just sign up for a stretch with the Federated Malay States Railway or the Royal Thai State Railway! In construction work on new lines, these railways still clear their right of way, establish their grade, construct their road bed and lay their tracks with practically nothing but hand labor.

WOOD BURNING LOCOMOTIVES

Similarly, for a mechanical engineer, the rice mills of Burma, Java, and Thailand and the tin mines of Malaya offer an opportunity to plunge headlong into intimate and every day association with non-condensing steam engines operating on 50-pound steam of 80% quality. Some of the dredging equipment also affords an excellent chance to study the design and manufacture of replacement parts using the materials at hand, which usually consist of wrought iron, a charcoal forge, a drill press of sorts, and, if one is particularly fortunate, a lathe. Ample opportunity will also be found to look into the vagaries of wood-burning steam locomotives.

For the mining engineer there is the chance to study the methods of open-cart hydraulic mining which the Chinese have used in China for centuries and which they are still using today in some mines in Malaya.

In the preceding few paragraphs I have given a few examples of obsolete practices and equipment still to be found in the Oriental tropics. I would not wish to convey the impression that such methods and machines are all that are to be found in these sections. There are Diesel engines operating in central power stations; there are bigh-speed, high-pressure condensing steam turbines in operation; there are modern dredges working

the tin ore deposits in the Kinla valley; there are Diesel-electric locomotives in regular service on the Royal Thai State Railway; crawler type tractors and mechanical earth-moving equipment are used on some jobs; the shops of the Federated Malay States Railway at Kuala Lumpur are well equipped and under the supervision of well trained and competent men, etc. However, in thinking of the technology of these areas one must always remember that the "up-to-date," and that means up to 5 or 10 years ago by our standards, is the exception, not the rule.

THE LURE OF THE EAST

And that is the reason that, as a technical man, I am glad to be back in the United States. The "Lure of the East" is a very real thing. The comforts of having a silently efficient Oriental domestic staff which is not dismayed by the arrival of the Tuan at 7:00 P.M. with four guests for dinner, the joys of having the car washed every morning and polished every Sunday morning by the native driver, the pleasures of belonging to three or four excellent clubs, the social life of a large sea-port where one meets a constant stream of celebrities and interesting people on their way from one end of the world to another, the opportunities to travel and observe the strange customs of many peoples and to see and own the handiwork of craftsmen and artisans whose skill and art are so different from our own, these things more than counter balance the discomforts of a life in the tropics. The heat and humidity, the mosquitoes and insects of every sort, the minor hazards of pythons in the garden, the major annoyance of the ubiquitous mosquito net the indescribable smell of the river at low tide—these undesirable aspects of life in Singapore would never outweigh the

(Continued on page 21)

THE PROGRESS OF PETROLEUM

(Continued from page 4)

facturing high grade lubricants the use of additives also became extensive. Some of these additives are employed for reducing the congealing properties of oils (Santopour, Paraflow), others for improving lubricating properties or the so-called oiliness (mildly acidic substances, chlorinated and sulfurized or similar addition agents), still others to combat corrosion (Santolube, various organo-metallic or phosphorous compounds) or improve oxidation stability (phenols, amino- and sulfur compounds). In employing such additives, extensive tests are required in order to insure their satisfactory performance under all conditions of service which necessitates tremendous expenditures for the experimental work conducted by the large petroleum concerns. Moreover different machinery requires different types of lubricants and additive agents thus multiplying the research problems almost to infinity.

Methods similar to those described are also employed in the manufacture of other petroleum products such as asphalts, road oils, waxes, solvents, fuel oils, greases, and related materials. Each one of them presents special problems which are well beyond the scope of this article, although many remarkable inventions and discoveries have been made. Achievements in other branches of the petroleum industry such as prospecting, exploitation, and transportation have not been less remarkable, although they are not covered by the present review. As one example it is of interest to mention that the City of Cleveland is now supplied with natural gas (methane) by pipe lines, and the gas is liquified and stored as a liquid at about -260°F. before it is revaporized and distributed to customers.

INDIVIDUAL HYDROCARBONS ISOLATED

Rapid advances have been recorded recently by the branch of the petroleum industry which is occupied with the production of various chemicals. For a considerable length of time its development was handicapped by the difficulties encountered in isolating the individual hydrocarbons from petroleum for further organic synthesis, and by the relatively slight progress in chemistry and practical utilization of organic substances other than aromatics. Nevertheless these difficulties were gradually overcome and at the present time a large variety of derivatives of various petroleum hydrocarbons is manufactured on a commercial scale and sold to the public. Although the hydrocarbons employed as raw materials are principally the lowest boiling ones, continuous efforts are being made to hroaden the scope of the available raw materials for the manufacture of chemicals and to find new applications for the substances which can be made on a commercial scale. Chemicals which are now produced from petroleum as a starting raw materials include chlorinated and brominated hydrocarbons, alcohols, aldehydes, acids, ketones, glycols, amines, and many others. These compounds are employed for further, more complicated organic syntheses thus presenting unlimited possibilities for the future. Petroleum has ben also found to be a possible source for manufacturing aromatic hydrocarbons which until recently were obtained almost exclusively from the coal tar. Methane at high temperatures is converted into acetylene and further into benzol, while several methods are likewise available for converting certain petroleum hydrocarbons into toluol from which TNT is obtained. Due to these developments the supply of toluol in

case of war is now assured to be plentiful and no shortage of it could be expected as happened during the World War.

In addition to chemicals of the above type, a large variety of other similar materials is obtained from petroleum which find wide applications in various industries and in everyday life. Sulfonic acids of different types are used as detergents, emulsifying agents, and for other purposes. Naphthenic acids found in petroleum are utilized in the form of their various metallic salts in the manufacture of paints and lacquers or as emulsifiers and demulsifiers. Resins, such as bakelite, are synthesized from materials which are or may be obtained from petroleum. Manufacture of rubber from butadiene, a hydrocarbon which is obtained by thermal decomposition of certain petroleum hydrocarbons, is one of the very latest achievements. The resulting rubber is in many respects superior to natural rubber and should find wide application in the tire and other related industries.

PLACE OF DISTINCTION

The above outline barely scratches the surface of the petroleum industry and falls short in fully presenting its various aspects. Nevertheless, it is sufficiently complete to illustrate the complexity of problems which the industry has to meet at the present time and to permit some insight in its future trends. Petroleum is rapidly achieving the place of distinction as the major source of all types of organic chemicals and is already in direct competition with coal tar, from which such chemicals have usually been obtained. Rapid development of our knowledge of organic compounds other than aromatic promises the developments of new and hitherto unknown materials of commerce. This will inevitably lead to an increased everyday comfort directly traced to the petroleum industry which has already given innumerable benefits to mankind. The "flowing gold" of today will continue to be the "flowing gold" of tomorrow, far more beneficial than metallic gold which has only an artificial value as a medium of exchange but which can hardly be considered an asset unless it can be converted into other goods.

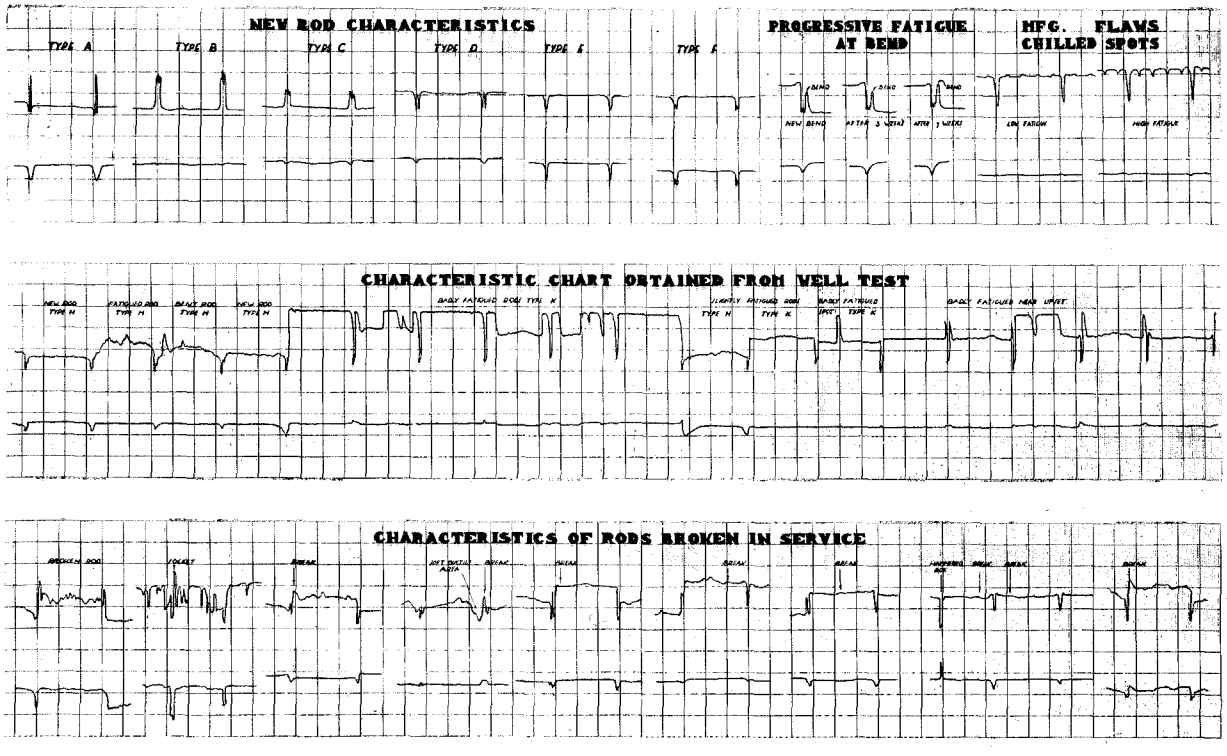
MAGNETIC TESTING OF STEEL IN THE PETROLEUM INDUSTRY

(Continued from page 5)

acteristic chart which was obtained from a well test. In this chart the development of fatigue is clearly shown in the rods. To those acquainted with oil production problems the appearance of fatigue near the upset will indicate clearly the case where rods break immediately adjacent to the upset. In the lower chart is shown the characteristics of a number of rods which broke in service. In this case the rods were first run on an experimental basis to determine the characteristics of the rods which later broke in service. By means of charts such as these it is possible to determine the rods which have fatigued the most, and to remove them from service before failure occurs.

Besides the author, who is the inventor of this method of magnetic testing, several other alumni assisted in this development. Among these alumni are Louis Kolb '39, who assisted in the early development, and Don Clark '29, who assisted in the metallurgical coordination of the work. Patent work for the Corporation is being handled by R. M. Bruce '22, who was formerly in the General Electric Company Patent Department. Field development work was assisted by efforts of A. C. Tutschulte '31, in the cooperative work between the Magnetest Corporation and the Associated Oil Company. A great deal of assistance was, also, furnished by Professor Sorensen, particularly in connection with the personnel.

MAGNETIC TESTING
SUCKER ROD CHARTS



Photograph by Sid Zipser

BALINESE GIRL

PARADISE, LIMITED

By SID ZIPSER, '30

Photography is a stimulating profession. Even on a holiday, a devotee rests in the pursuit of new beauties, and different ways of life. Personnally, I could think of no place more intriguing than the Far East, and a little less than a year ago I found myself on a Dutch freighter sailing westward toward the Philippines, the Dutch East Indies, Malay, and India. Sometimes, I wondered why, but as we sailed leisurely through rhythmic swells of the Pacific into the glorious radiance of tropical sunsets, and as I imbibed the more tangible glow of unparalleled Dutch beer, I felt that no logical explanation was necessary.

An American Professor bound for the Philippines, a tobacco buyer going to Sumatra, a plantation manager returning to Java, oil men investigating New Guinea, and a group of steel rolling mill operators bound for India all heightened the contrast of East and West, foreshadowing the impact of western technology and democracy upon the subtle philosophies and wierd charms of the orient. There were Javanese waiters aboard who couldn't understand English but merely brought forth the numbered morsels you might indicate on the menu. Sometimes, you would receive the desert before the entree because it hapened to be ready first, and very frequently the wrong number, but the easy going Javanese were too good-natured to be disturbed by the confusion and too amused by our antics with the silverware to worry about anything.

The Pacific, as the story goes, was unappropriately named by a gentleman who never sailed upon its surface. When smooth swells turned to choppy seas and these suddenly assumed titanic proportions, we detoured a bit so that we were just on the edge of a typhoon. The dark waves came ominously over the prow of our 10,000 ton ship, crashing against the bridge, and I amused myself by trying to visualize just how one of our little lifeboats would tople over those fierce swift crests. Fortunately, my theories remain unconfirmed.

We were all very glad to see the Philippines, and especially to set foot upon them. There was an island for every mile of ocean we crossed, over 7,000 in fact, and even the least of them would have been a refreshing sight.

CONTRASTS IN MANILA

Manila is the capital of the Philippines and was our first stop. We drove through the sombre walls of the old town, built by the Spaniards, and crossed one of the bridges to the new, modernized city whose air-conditioned stores and office buildings might have been in the United States proper, excepting the heat and humidity. Contrasting this section were outlying districts such as those seen in Cebu where bamboo woven nipa shacks were raised above the sandy coastline on stilts and where the high tide performed the same function on the adjacent littered beach that plumbing does more privately in the average American home. But the jolly inhabitants, honored by our visit, gleefully posed for pictures undirected, and invited us to play ping-pong and volley ball in safer areas of their slums. My comrade, better at ping-pong than I, accepted, and his strokes and eventual overcoming of the local champion were sportingly cheered.

The Philippines have been an embarrassing United States possession ever since Admiral Dewey captured them in 1898 during the Spanish-American war. In the spirit of fair play we paid Spain for what we won hy military conquest, protected feudal Spanish landholders, raised the general standard of living, developed the natural resources, helped raqueteering politicians to power, and gave enterprising Japanese the opportunity to dominate the important hemp and fishing industries.

AMERICAN SANTA CLAUS

Quite naturally the legend has grown in these islands of an inconsistent good-natured Santa Claus who sails from the rising sun on the most powerful battlefleet in the world with a bag overflowing with gold and democracy. Someday, they believe, Santa Claus will give them their freedom, and leave his gold and his democracy, and most important of all, his battlefleet for their protection.

That mutual benefits as well as exploitation can exist in the administration of industrially backward countries which are rich in raw materials is admirably shown by the administration of "The Netherlands across the Seas" which include Java, Sumatra, Borneo (partly), New Guinea (partly), the Celebes, and the Moluccas, all south of the Philippines. In the lower center of this tremendous archipelago which forms the East Indies, midway between Asia and Australia, lies the tiny self-contained island of Bali, only fifty miles across but inhabited by over a million contented people.

Our huge freighter was not at home in Padangbali. There were no docks, no cranes, no cargo. There were no buildings of any importance, no railroads, no maze of power lines. I looked up from the waves lapping the sandy shores and the sunlit palm trees, up past terrace after terrace of intricate rice sawas to blue mountain slopes that lost themselves in clouds.

BALINESE TEASE

Outriggers were rowed from the shore to meet us, just as you would expect from reading travel circulars. But the smiling dark-skinned natives pointed to large baskets in which we could throw something, money obviously. Curious, we dug in our pockets for Dutch coins and flung them to the natives, expecting to see them dive, but they did this only when necessary for the coins were usually captured with the baskets, and then a strange performance began. The girl of the party, for there was one in each outrigger, unfastened the simple jacket she wore, and in a modified strip-tease, simply removed the jacket, revealing the Balinese torso as it is so frequently seen on picture postcards. Obviously, the Balinese are quick to capitalize on their natural resources.

A few of us left the huge freighter by means of a tiny launch, waving goodbye to the other passengers who only had this burlesque version of the charms of Bali. Radiant faces of guides and chauffeuers who had broken down foreign cars greeted us. Calm women sat beside the road with colorful displays of papayas, mangoes, watermelons, and a prickly fruit. There were no deformed beggars, no outstretched hands, no cries for money: in the Far East, that was news!

We went through the courtesy and favorite oriental sport

of bargaining, securing a rambling vehicle that might get us to Den Pasar which was the center of Balinese life. As usual, the gas tank was practically empty so our first stop was the nearby dispensory underneath a palm tree where just enough gas was purchased to get us to our destination.

I intended staying a few days but they easily stretched into a week, and then I stayed another week, captivated by the almost unbelievable charm and gayety of Balinese life.

LET LIZARDS LIVE

For awhile, my headquarters were at a Dutch hotel in Den Pasar which faced a beautifully carved temple across the street. Every morning, two little girls placed flowers on our driveway as an offering to the gods who might bring tourists that way to buy their curios. Every evening, a friendly lizard crawled into the parchment shade on the dinner table to warm himself and ants crawled over the tablecloth. At first I indicated these to Marda, the grinning best boy, expecting their subsequent removal, but he only shrugged and replied, "That may be," and did nothing. "Live and let live," is the good-natured policy of the Balinese.

Leisurely, I roamed from one village to another; sometimes in a car, sometimes in a pony cart, and often on foot, alone. I have never seen such a completely satisfying cycle of life anywhere. Each village is a little world of its own, supported largely by the surrounding rice fields, and ruled by a democratic council of which every man becomes a member automatically after marriage. Hereditary princes, a mild caste system, and Dutch "Elder brothers" have been unable and in the latter case unwilling to seriously alter this basic communal organization. Money is not a power there as the need of it is only incidental; and exploitation, thievery and unemployment (excepting those unfortunates who have depended on tourist trade which has become almost nil since the war) are hardly known. Private property exists mainly for personal use, not as a threat or a menace to other people. They accept the land and water as gifts from the gods and try to arrange them as justly as possible amongst themselves. The enjoyment of their family life, their music, their dancing, their cock-fights, their festivals, their handicrafts, their temple offerings, their legends as well as their work is life to them all centered in their community, all dependent on the good-will and cooperation of their neighbors. Individualism thrives because it is primarily a human manifestation and not a legal abstraction of corporation lawyers.

PEACE IN BALI

So happy are the Balinese in their way of life, that they have no desire to leave this favored isle, indeed, that would be the greatest tragedy that could befall them. And there is always rejoicing at a cremation (where most of their savings go up in smoke) because they believe implicitly that the deceased will return to Bali, reincarnated as a grandchild, for these imaginative earthly people can conceive of no finer paradise than a repetition of their own existence.

Wandering through the thatched mud-walled lanes of Bali where woven bamboo shacks and delicately carved red and gray brick temples rest so naturally beneath palms and papaya and banyan trees makes sidewalks and skyscrapers seem very silly. You see old women proudly arranging colorful temple offerings, young bare-breasted girls sitting under little stands by the road selling black-pitted slices of thick orange papayas and green bottles of fermented cocoanut juice. Flocks of ducks are driven along the road by attentive boys, and playful youngsters make faces at fighting cocks which are placed in bamboo cages beside the road so they can amuse themselves by the sight of people walking by. Ugly sway-back hogs and yelping dogs lend an atmosphere of fabled villainy. Then a continual procession of women, bare-breasted and well-poised, walk to the fields and markets and temples and homes, balancing heavy loads on their heads, for they are the means of transportation, wagons or trucks being almost unknown.

The men care for the fields mainly, creating a quality of rice and an irrigation system which in appearance and efficiency are unparalleled anywhere.

There are not many white people living in Bali for it is not a white man's paradise. It does not have the rapturous lagoons or easy indulgences of some of the South Sea islands. Then the tempo of living is different than ours, the desires and joys being infinitely simpler, and infinitely richer in their simplicity. Seeing their way of life makes an engineer a humbler man for they seem to have found the secret of life without any machinery or even a wheel to guide them. Certainly, those old platitudes

POWER DRILLING RIGS

(Continued from page 12)

is assisting with the specifications relative to portable drilling masts suitable for drilling to depths of 4000′. Harold has been actively connected with development of portable drilling rigs and has made many valuable recommendations and suggestions for improvement.

Ed Foss, '32, supervised the technical details and kept accurate performance records of the two new power rigs of the Barnsdall Oil Company, Barnsdall's preference being for pumps driven by independent internal combustion engines with other compounded engines driving the drawworks and rotary machine.

Bob Gardner, '36, and Don Blodgett, '36, of the Richfield Oil Corporation, have been checking the hoisting characteristics of drilling rigs powered by both steam and internal combustion engines. Unfortunately, Don is now on sick leave with his folks at Balboa Island.

Bob Ramey, '30, and Walter Moore, '23, of the Machinery Division, Republic Supply Company, have been active in sales of power drilling rigs. Both have been very helpful in assisting with new developments required for power drilling rigs in addition to their sales work.

Leroy Newcomb, '25, of Emsco Derrick & Equipment Company, has designed the new friction clutch drawworks developed largely for use with large power rigs. Leroy has also designed Emsco's hydraulic controls, oil-tite drawworks, hi-speed rotary machine, and is regarded as one of the best engineers in the Emsco organization. Nick D'Arcy, '29, is in charge of the Sales Office at Emsco and works closely with the Engineering Department on new products, relaying to the Engineering Departments trends reported from the fieldmen.

Jim Keeley, '31, of Hillman-Kelly, is now selling the portable mast developed by the Franks Manufacturing Company. This mast is used with power drilling rigs on shallow holes where no derrick is erected.

At National Supply Company, five Cal Tech men are connected with power drilling equipment. Bob Craig, '21, and B. R. Schabakum, '25, have been actively engaged in sales engineering work in the Mid-Continent, reporting many developments directly to National's Engineering Department. Spencer Long, '30, has been doing interesting stress analysis work in connection with rotary drilling equipment. M. W. Henshaw, '36, is preparing sales data on power rigs in addition to development work on drawworks, and S. M. Brose, '40, is connected with drawworks design.

(The writer wishes to thank at this time Barnsdall Oil Company, Richfield Oil Company, T. P. Pike Drilling Company, and Bell & Loffland for information and data contained in this article.)

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about not being able to change human nature, and about beautiful and impractical forms of society, and all this folderol about progress are due for some revision.

Rather wistfully, I sailed from Bali to Java, wended through its rice fields and tea plantations, circling around numerous volcanic peaks and climbing atop three of them. Then I sailed from Batavia to Singapore where I hoped to meet Bob Stirton, '30, then representing the Union Oil Company as a lubricating engineer, but he was in Bangkok. Fortunately, I met him on my return trip from India and he and his charming wife showed me the town. Later, under the flattering glow of cocktails, we recalled and eulogized other Caltech Alumni.

SECOND CLASS TO SINGAPORE

From Singapore, I sailed to Penang, Rangoon and finally Calcutta aboard a blacked-out British ship. A five-inch gun aft was constantly and itchingly attended, but no subs were sighted. The heat was terribly oppresive, but the company of a Chinese merchant, a poetic Hindu textile buyer, and a group of Indian soldiers including Sikhs, Hindus and Moslems was most informative and entertaining. Ordinarily, a white man wouldn't travel second class in India, which is one reason I was taken for a missionary, but in spite of certain difficulties it gives one a chance to "meet the people." None of the natives addressed me first, and they were reluctant when approached, but frequently became very talkative especially when they found I was an American. Stern Britishers looked on in horror from the adjoining first-class deck.

India formed the most amazing and impressive pageant I ever hope to see. I left the glittering golden pagodas of Burma where I had to walk barefoot amongst the Buddhist pilgrims and leprous begars to get my precious snapshots and see a weird misinterpretations of one of the world's greatest teachers. In Calcutta, I saw live sacrifices of goats to the awful goddess Kali in the old city of her name, Kalighat, which the English adopted as Calcutta. In the same city, I visited the Jain Temple, built with infinite care from millions of mozaics.

(Continued in Next Issue)

VENEZUELAN EXPERIENCES

(Continued from page 8)

N.J., Socony-Vacuum, Mene Grande Oil, and The Texas Co. The great savannah country of the Orinoco basin has been more or less covered by geophysical crews, but a great deal of exploratory work has been postponed until *after the cessation* of European hostilities.

HIGH COST OF OPERATIONS

In general, oil operations in Venezuela are carried out only with difficulty. Cheapest oil field labor is 12 Bolivares ($4.00) per day, and 1000 Bolivares per month ($330.00) is not uncommon for native foremen, if they can read and write. National law requires that 90 per cent field labor and 75 per cent office help be native, regardless of its efficiency. The companies must provide housing, medical attention, transportation and profit-sharing for all employes. The law also prohibits firing a man, even for cause, without 60 days' severance pay.

Native drillers and crews are used, with American tool-pushers, each of whom looks after three rigs, and has his hands full continually.

Machinery for drilling and production is admitted duty-free; but any imported material competing with the few products in the country is heavily taxed. There is a tiny nail factory in Caracas which cannot begin to supply the oil companies' requirements; but imported nails carry a high duty. Although a certain amount is cut locally, lumber is high because of transportation difficulties. An imported rig floor plank 3 in. by 12 in. by 24 ft. long costs about $22.50 laid down in Maracaibo. Obviously there are no wooden derricks.

The foreign (white) staff employes of the Lago and Mene Grande Companies are largely American, but there are very few of the latter in the Shell camps, perhaps half a dozen in Maracaibo, and a dozen at Lagunillas. The majority are English and Dutch, but 21 different nationalities were represented at Lagunillas.

The company camps provide good accommodations and a bachelor with subsistence furnished doesn't do too badly. But it costs a married couple with no children the equivalent of some $300 per month for overhead—if they don't do much entertaining.

Since the lake shore road and the Trans-Andean Highway are the only Venezuelan roads of any consequence, it is virtually impossible to go any place by car. Planes are much in use for getting from one section of the country to another.

R. W. "PARKY" PARKINSON, '13, is Chief Engineer for Caribbean Petroleum, with his office at Maracaibo, and has been in the country some 26 years. During my stay there I saw him every couple of weeks, and he was of much assistance in helping me to meet and work with the various European staff members.

At a dance in Maracaibo one Saturday night I ran into BOB MCRAE, '35, who was just in from a several months' stretch of surveying concession boundaries in the southeastern corner of the country, which is Motolone Indian territory. He was the only white man with a crew of a dozen or so natives, and was expecting a recurrence of a bad attack of malaria, which was why he had come to "town." After hanging around Maracaibo for two or three weeks, the attack failed to materialize, so he went back into the bush. Bob attended last year's Seminar session and announced that he had "gone native" to the extent of leaving Shell and acquiring a ranch near the Andes mountains southeast of Lake Maracaibo. He expects to do very well for himself, raising produce for Maracaibo consumption.

MISCELLANEOUS SIDELIGHTS

Because of the bugs, a spray gun is standard equipment in every bedroom in company camps. Most Venzuelans sleep under netting, since window screens are lacking. Due to the high humidity, it is necessary to burn a 100-watt lamp in each clothes closet to prevent the rapid growth of green hair on shoes, leather luggage and wool clothes. Before leaving the States, the writer was warned that a hat and sun glasses were absolutely essential. He used neither, although a hat would undoubtedly be of use during a hard rainy season. Because of the higher concentration of actinic rays in the tropics, an exposure meter is a useful accessory for picture-making. The light fools one.

A "sack of beer" is not a few bottles in a paper bag. The standard shipping package is 60 bottles, each in a straw cone, sewn into heavy jute sacking to make a rectangular package. These sacks are tossed on and off boat and trucks, and are carried through the mountains on burro-back with few bottles ever broken. Retail, beer is 30c per bottle and cannot be purchased cold except in the larger towns or in company camps. Although of higher alcoholic content than our beer, the Mara-

AN ENGINEER LOOKS AT THE ORIENT

(Continued from page 14)

general ease and luxury. To this effect, witness the goodly number of Americans who live happily in these parts for indefinite years. But for an engineer the glamour wears thin when the realization comes sharply one day that here there is no chance to keep really abreast of new developments and that a few more years will see him cut off forever from the possibility of earning his way in technical pursuits "at home." And for all the Americans I met in my travels even thirty years of residence abroad didn't change the fact that "home" was still the U.S.A.

THE RISE OF NATIONALISM

With war conditions spreading slowly but surely over most of the area there is little chance that many American engineers will be going out to the Orient in the next few years but there will undoubtedly be openings for white engineers after the war is over. It must be remembered that in China and Thailand particularly, the spirit of nationalism is newly risen to great heights. Young China is especially keen on the necessity of providing its own "working" engineers. As an instance, I cite the case of the young Chinese girl, a fellow passenger on the ship on which I returned. She was coming to study engineering—at a California university. She came under protest, at the insistence of her family. She wished to study in one of the Chinese universities near Chungking and when I inquired whether she would teach when she returned, she said, "No, China needs less intellectuals and teachers and more of her own engineers actually on the job. I hope to fit myself to go out and work in the construction of New China."

Although this trend probably means the end of the white man's domination of business and industrial enterprise in the Far East, it may well afford increased opportunity for white engineers to serve as training supervisors during the coming expansion of industrial enterprise. From my own experience this would be an ideal opportunity for American engineers since it would offer a chance to see these foreign countries and yet would not offer the enticement of too permanent employment.

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caibo beer isn't bad. The Caracas beer, however, from the capital city, is terrible. Apparently they don't believe in aging it.

Bourbon whiskey is unknown. The much-touted "cheap imported Scotch," of which I heard in the States, was also non-existent. It costs as much as $12.00 per fifth last December. The only cheap drink is native white rum, plenty powerful, and aged perhaps a couple of weeks. $1.50 per quart.

White Owl cigars are 50c each. Native cigars, not bad, are 2c each and up. Native cigarettes ("firecrackers" to us) are 15c for 15. U. S. cigarettes are 75c per pack tax-stamped and 50c from bootleggers. There is no Venezuelan-made pipe tobacco. I tired of paying 80c per small tin of P. A., much of it mildewed, and had a pound of my favorite smoking mailed from the States. The import duty was almost $9.00, and thenceforth P. A. was good enough. No trouble is experienced with tobacco drying out, but quite the opposite. One can tie a knot in a cigar any time.

ACTIVITIES OF CHEMICAL ENGINEERING DIVISION

(Continued from page 9)

phase behavior of naturally occuring hydrocarbon mixtures from specific oil fields has been the objective of two of these projects. This experimental work supplements and expands the program sponsored by the American Petroleum Institute and permits the latter work to be directed toward a study of the more fundamental aspects of the problem.

The direct measurement of the composition of coexisting phases is one approach to the evaluation of the phase behavior of both simple and complex hydrocarbon systems. One Fellowship of the Department has been directed toward the investigation of the composition of the phases of ternary hydrocarbon system throughout the heterogeneous region at temperatures of industrial interest. Furthermore, the refining division of the petroleum industry is becoming increasingly interested in the phase behavior of mixtures of paraffinic and olefinic hydrocarbons and a study of the phase behavior of a binary mixture nof n-butane and i-butane is in progress.

Equilibrium is aproached only as a limit in many operations encountered in the production and processing of petroleum. A study of the non-equilibrium behavior of these systems, including the formation and growth of bubbles from supersaturated solutions, and material transfer between the phases of heterogeneous systems under a variety of conditions has constituted a part of the objectives of one of these industrial research projects for a number of years. The migration of sand into oil wells has been a source of difficulty in connection with petroleum production operations and the effectiveness of the subsurface placement of gravels to inhibit such movements has been studied in detail.

The personnel of the Department may be divided into two general categories, one embodying students and the other full-time investigators and technicians. The fifth-year students are occupied primarily with laboratory course work relating to the fundamentals of chemical engineering operations while the sixth-year men are associated directly with the industrial research activities of the laboratory. The greater part of the experimental work of the research projects results from the activities of nine full-time research assistants and technicians. It is believed that the close contact between the investigators and fifth- and sixth-year students is a desirable one in that the student is placed in an environment more similar to that encountered industrially than is usually the case in academic laboratories.

OF INTEREST . . .

ALUMNI PRESIDENT WIELDS GAVEL IN ARMY

Theodore C. Combs, '27, late director of business in the Los Angeles office of the West Coast Timbermen's Association, and past president of the Alumni Association, was called to active duty with the army in November.

Ted received his commission as Second Lieutenant in the Engineer Reserve after completing his R.O.T.C. training at Tech in 1927. Prior to the latest call to active duty, Captain Combs had already earned an enviable record as an authority on timber bridge design and construction for use by the army engineers. All Tech men who have been privileged to serve under Ted have considered it an honor.

In November he was called to active duty at the Presidio of San Francisco and assigned as technical aide to the Commanding General, Ninth Corps area.

BOARD ORGANIZES

The resignation of Theodore C. Combs, '27 as president of the Alumni Association, after being called to active duty as a captain in the Corps of Engineers Reserves, has necessitated a reorganization of the Board of Directors of the Association.

John E. Shield, '22, who has been vice-president, has moved up to president of the Association. Jack did a very efficient job as social chairman last year, and is in charge of chapter organization this year.

Loys Griswold, '24, was elected vice-president of the Association in addition to his duties as secretary. Allen Dunn, '29, is serving as treasurer.

Other members of the board and their functions are as follows:

Herbert B. Holt, '15—membership
Paul C. Schaffner, '36—athletics
Al Knight, '22—social
George Langsner, '31—publications.
Ted Coleman—Institute relations.

ALUMNI DIRECTORY

Plans for the Biennial Directory of all Cal Tech Alumni are rapidly maturing and it is expected that it will be ready for mailing to all paid members of the Association about April 1, 1940. Work has been carried forward since the publication of the last directory in tracing Alumni listed as missing in 1939.

In order for the publication plans to function efficiently it is quite important that all Alumni, whether members or not, reply promptly to the inquiry cards which are being sent out. Besides the directory use, the information secured is of value to the Institute and the Alumni Placement Service.

The Directory Committee consists of Sidney Bamberger, '33, chairman, Mott Prudames, '32, and Ray Labory, '31. The Committee expects to better the accuracy standard set by the 1939 Directory.

Another Smash Hit

DON'T MISS THE

Annual Alumni Dance

Biltmore Hotel - - February 15, 1941

NEW SEMINAR BOARD SETUP OUTLINED

Plans are in progress for another interesting and stimulating series of events when the Fourth Annual Alumni Seminar Week-End convenes on April 5th and 6th, 1941. The Seminar Board, appointed by the Directors of the Alumni Association in June, 1940, has been considering plans for the 1941 Program, and laying the foundation for an administrative organization to provide a continuity of thought and action through succeeding years.

The present Seminar Board is composed of four members, two of which will serve for one year and the others for two years. Two new Board members will be selected annually by the Directors of the Alumni Association from a list of four to six candidates submitted by the Seminar Board. It is readily seen that continuity of method and organization plus the ideas and stimulation of new personnel will be obtained by this plan.

Each member of the Seminar Board has a definite function. One of the senior members, serving his second year, will be General Manager and the other the Program Chairman of the Seminar for that particular year. The Junior members will serve as understudies and assistants to the senior members. This year, however, the Board is set up differently due to the fact that two members will serve for only one year. Fred A. Hough, '24, and Donald P. MacFarlane, '26, are Program Chairman and Assistant Program Chairman, respectively, this year, and will serve as General Manager and Program Chairman with two new Board members for understudies on the 1942 Seminar Board.

NATIONAL DEFENSE RESEARCH COMMITTEE

Dr. Vannevar Bush, president of the Carnegie Institution of Washington, acting as chairman of the National Defense Research Committee, has made public a list of scientific men and engineers who have thus far accepted definite appointments to work with the committee on particular National Defense problems as they arise.

Of the eight members of the Committee, created by order of the Council of National Defense on June 27, 1940, two of the committeemen in key positions, are affiliated with the California Institute. **Dr. Richard C. Tolman,** dean of the Graduate School is **vice-chairman** in charge of the Division dealing with armor and ordinance. **Dr. Frank B. Jewett, '98,** chairman-of-the-board of Bell Telephone Laboratories, is chairman of the Division dealing with communication and transportation.

Vice-chairman of the ordnance and armor division, is Professor **Charles C. Lauritsen, Ph.D. '29.** Other members of Dr. Tolman's Division, who are affiliated with the Institute, are **Robert A. Becker, M.S. '37, Donald S. Clark, '29, Ph.D '34, William A. Fowler, Ph.D. '36** and **John F. Streib, Jr., '36.**

Dr's. Linus Pauling, Ph.D. '25, and **Don M. Yost, Ph.D. '26,** are serving in the Division dealing with chemical problems, under the chairmanship of Dr. James B. Conant of Harvard.

PETROLEUM GEOLOGISTS FROLIC AND FORECAST

The California Institute is well represented in all phases and departments of the petroleum industry from prospecting to refining. The Tech contingent of petroleum geologists is no small one. Practically every major company is represented.

Almost without exception, Tech's band of oil geologists convened with others of their species on November 7-8, at the seventh annual meeting of the Pacific Coast Section, American Association of Petroleum Geologists, at the Ambassador Hotel in Los Angeles. The mid-Continent and foreign contingent, of course, were present only in spirit.

Papers were presented by **Wendell Woodring,** formerly professor of invertebrate paleontology at the Institute, now of the U.S. Geological Survey; and **Rollin Eckis,** M.S. '30, Bakersfield district geologist for Richfield.

The Institute geological faculty was represented by **Dr. Ian Campbell, Dr. F. D. Bode, '30,** and **Dr. J. H. Maxson, '27.**

Various other Tech men, lounging or alert, presented less formal discussions or engaged in varying banalities. For example:

Dr. Layton Stanton, '27, Bakersfield district geologist for Union, was observed collaring listeners to tell them about his two daughters, 5 and 7. **Dr. Hampton Smith** of the Texas Company was seen in the bar collecting donations for a baby shower.

Kenneth Lohman, '29, of the U.S.G.C., now recognized as one of the country's experts on diatoms, discussed recent findings of deep-sea dredging in the Atlantic Ocean. **John Warlemont Daly,** '29, stayed awake during all papers on geophysics, since that is his line with the Shell Company.

Ed Joujon-Roche, '28, scout for the Shell Company, darted in at the last moment to glad-hand all hands . . . **Frank Bell, '28,** micropaleontologist with the same company, turned down all poker invitations to hurry home to the little woman.

Conversely, **Alex Clark, '28,** of the Shell Company, and **George Schroter,** '28, of the Filtrol Corporation, were kept busy turning down the little woman to play poker.

Seriously, however, the meeting was a huge success, and the Tech men's papers were well received and timely. Both Woodring's topic, "Late Miocene and Pliocene Stratigraphy and Paleontology of the Santa Maria District, California," and Eckis' contribution on "The Stevens Sand, Southern San Joaquin Valley, California," were timely and well-received contributions.

BORSOOK BOOK

A book, "Vitamins: What They Are and How They Can Benefit You," written by Dr. Henry Borsook, professor of biochemistry, has recently been published by the Viking Press, Inc., of New York.

Dr. Borsook is one of the nation's outstanding research men in the field of vitamins, and already has made many notable contributions to this science. His investigations of vitamin B have resulted in aids to the medical profession in dealing with some of man's chronic aches and pains.

An article written by him especially for the Alumni Review appeared in a recent issue.

Faculty Appointments

Dr. Robert A. Millikan, as chairman of the executive council, has announced two important faculty appointments at the Institute.

Dr. William V. Houston, professor of physics, has been named acting dean of the graduate school. He will continue the work of Dr. William R. Smythe.

L. Winchester Jones, assistant professor of English, and associate of the Throop Club, has been appointed to the newly created position of assistant dean of upper classmen. He will work with Frederic W. Hinrichs, Jr., dean of upper classmen.

With the number of upper classmen so much larger than the enrollment of 160 freshmen, and in view of the increasing duties of the dean's office, the position of assistant was added.

1940 FOOTBALL SEASON

Beginning the season in impressive style, the Engineer varsity defeated Cal Poly 12-6 on the latter's home field with the Beavers completely outplaying their opponents. Captain Sohler scored all of the points for the Beavers. In the second preconference game with Glendale J. C. the Tech squad was held to a 7-7 tie.

In the league opener, Caltech met Whittier at the Rose Bowl, and although they played the Poets to a standstill in the first three quarers, they were turned back by the Conference champs, with a 19-0 score. The game was marked by long marches up the field by both teams. The Beavers next traveled to Flagstaff, where they played listless ball in the high altitude, and lost a one-sided game to the Arizona State Teachers by a score of 33-14. Cooper and Gillette both sustained leg injuries that dogged them for the rest of the season, finally resulting in their complete inability to play at the season's end.

The Sagehens from Pomona swamped Coach Stanton's squad the following week, and Stan Sohler sustained a badly injured ankle. But the Beavers hit the win column again when they trounce La Verne 7-0 in a hard fought game. Jack Anderson ran for the spectacular 102-yard sprint to a touchdown in the early part of the match, and the Beavers never lost the lead.

The big game with Oxy was played in the Rose Bowl on the night of November 8. The two old rivals fought on even terms until the last few minutes of the final period. Tech drove to the Bengals' seven yard stripe with what seemed to be the winning spurt, but Oxy intercepted a pass, drove down the field, and hit pay dirt twice in the last five minutes. Elliot's playing, as well as exceptionally good linework on the part of the entire line wer features of the game—the Beavers outplayed the Tigers in nearly every way, having plenty of good interference, almost twice as many first downs, and similar advantages in other statistics of the tussle.

The squad closed its season with the Redlands match, where the new league champions swamped the Engineers 40-0.

Although the bright hopes with which the squad began the season failed to be entirely fulfilled, injuries and the bad breaks of the game can be blamed for most of the Engineers' tough luck. The team had several outsanding players, who did their best even when they had little support because so many positions were weakened by injuries.

DEFENSE EDUCATION

Representatives of engineering colleges and universities of the southwest met recently at the Institute to discuss participation in the federal educational program for technical experts. Professor R. L. Daugherty presided.

The federal program calls for instruction in special courses at government expense of more than 30,000 students at more than 150 institutions of learning.

The courses to be conducted at these 150 engineering schools are for students with technical backgrounds, and are designed to meet the future needs of industry and government in carrying out the defense program.

The first objective is to forestall potential shortages of inspectors of materials, chemicals, explosives, instruments and power units; designers of machinery, equipment, tools and dies, and aircraft power plants, structures and instruments; production engineers and supervisors, physical metallurgists, marine engineers and naval architects.

A Caltech committee, with Professor Franklin Thomas chairman, and including professors Royal W. Sorensen, W. Howard Clapp, R. R. Martel, and W. R. Sears, has been conferring on courses of study that can be undertaken at the Institute.

SANITARY AWARD

A. Perry Banta, assistant professor of sanitary engineering at Caltech, and two collaborators have been awarded the James Laurie Prize by the American Society of Civil Engineers.

Mr. Banta, with A. M. Rawn, chief engineer of Los Angeles County Sanitation Districts, and Dr. Richard Pomeroy '26, who has been research chemist for the districts, was awarded the coveted prize for a paper entitle "Multiple-Stage Sewage Sludge Digestion."

The prize, which will be awarded publicly at the annual meeting of the society in January at Cincinnati, Ohio, was given the paper for showing excellence in "describing in detail accomplished works of construction, their cost, and errors of design and execution."

Mr. Banta, at Caltech on a part-time basis, is assistant engineer on the staff ot the sanitation districts. He obtained his master's degree at Tech in 1928, after being graduated from Stanford University.

STRANGE BEDFELLOW

When George Cohn, a junior, returned to his room, 47 Ricketts House, recently, he found an automobile with its motor running, parked beside his bed! Strolling into the room behind him and feigning surprise were a score of students.

"Can't you afford a garage?"

"Is this the way you keep your room warm?" they asked.

George noticed a suspicious smile or two and began laughing.

It developed that the house men had pooled $9.50 to buy the car, an ancient model, had taken it apart and reassembled it in George's room.

After the crowd had had its fun, the men brought out wrenches and hammers, removed the body and axles from the chassis and hauled the parts outside, where they were once more assembled. The car has the distinction of having more owners than any other automobile at Caltech.

IN THE NEWS

After completing nearly a quarter of a century as secretary of the Caltech faculty, Dr. Harry Clark Van Buskirk has retired in favor of Dr. J. E. Wallace Sterling, associate professor of history. Dr. Van Buskirk, professor of mathematics, has been with the Institute since 1904, and was registrar from 1915 to 1935. Professor Franklin Thomas replaces Dr. Linius C. Pauling as chairman of the faculty.

* * * *

California is slipping towards the sea, but not fast enough to cause a sinking feeling among its inhabitants. Something like two or three inches a century is the present decline in altitude in this area, according to a study of changes in the earth's crust made by Dr. Beno Gutenberg, Caltech seismologist, as reported by AP.

Likewise the sea level has risen, Dr. Gutenberg says, on an average of four inches in the past century, probably because of melting glacial deposits and filling of the ocean bed with sediment carried by rivers.

* * * *

Professor Royal W. Sorensen, president of the American Institute of Electrical Engineers, reported upon his return from a swing through the east and south a tremendous interest in his campaign for engineers to educate the public on how an engineer functions in society. The many addresses which he delivered on this tour were illustrated with slides showing the uses of electricity and electrical devices in non-electrical research at Caltech.

* * * *

A gigantic 5,000,000 volt "atom gun" to investigate the atomic structure of various elements has been designed and possibly will be built in the W. K. Kellogg laboratory of radiation at the Institute. J. F. Streib '36, who hopes to build the device under the direction of Dr. William A. Fowler, said all the major plans for the instrument have been completed, but that some of the details of the construction are yet to be drawn.

The machine would be as tall as a two story building, as large around as a locomotive, and would weigh 15 tons. In the 22 foot porcelain barrel, protons and other atomic particles would be shot at velocities 100,000 times as great as the velocity of a rifle bullet, at targets of whatever element it is desired to break down.

Power to accelerate the atomic particles would be supplied by a Van de Graff generator of a type recently developed at the University of Wisconsin.

FOR SUPER SEEING

Dr. Thomas F. Anderson, Institute physicist, is to be the first recipient of the R. C. A. electron microscope fellowship.

He will work at Camden, N. J., on the newly developed super-magnification instruments that use streams of electrons instead of beams of light. The electron microscope is capable of producing magnification as great as 100,000 diameters, contrasting with an ultimate performance of 3,000 diameters for the ordinary type of microscopes, even when using ultraviolet light.

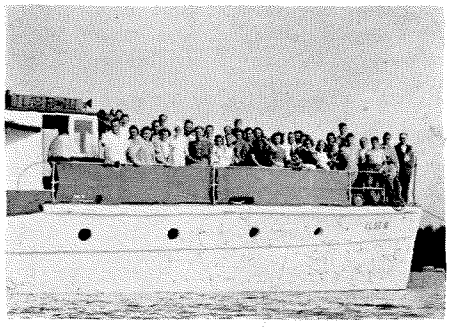
Dr. Anderson, a native of Wisconsin, has studied at the Universities of Wisconsin and Chicago. In addition to his work at Caltech, he has had one year of graduate study in Munich, Germany.

NEW YORK

Thirty members of the California Tech Club of New York were given an insight into the petroleum industry on November 15th by a pair of Tech men well qualified to present their respective subjects. Loren P. Scoville, M.S. '30, spoke on "The Essential Parts and Operations of a Modern Refinery." Following this, Vladimir A. Kalichevsky, '24, spoke on "Modern Methods of Manufacturing Motor and Aviation Gasolines." Not content with letting the two speakers relax after delivering their well prepared talks, thirty men fired questions at the speakers until both popular and scientific phases of the industry were thoroughly covered.

* * *

Last September 8th proved to be a red-letter day for the California Tech Club of New York. On Sunday morning at an early hour, an enthusiastic group of men, women, and children assembled at a mid-town pier on the East River for a cruise along beautiful Long Island Sound. With all hands on board, bathing suits and lunches stowed away for the landing hour, the trim craft slid under many a towering bridge and nosed out into the Sound. Away from the skyscrapers of Manhattan —past the World's Fair and the large and imposing estates of the late Walter P. Chrysler, Wm. Randolph Hearst and others—past civilization itself, so it seemed, sped the happy crowd.



Ladies and gentlemen's lounge cabins acted as spots for cozy chats for some of the girls and "bull sessions" for those men who like to re-live the old Tech days in that fashion. The anchor was cast on a private beach at Lloyds Neck where many of the group took luncheons ashore while others ate on board. Hot coffee and ice cream were served to all, the ship's mate obligingly taking a huge kettle of coffee to those on the beach. Following lunch, the majority donned bathing suits and enjoyed a swim while others took their accustomed Sunday afternoon siesta, or played softball. A number lounged about reading the Sunday papers which had thoughtfully been brought aboard.

The party was made up of friends and families of the following Cal Tech men:- Edward A. Bertram MS '35, Paul G. Burman '32, Chester F. Carlson '30, William G. Cox '35, James A. Davies '35, Beverly F. Fredendall '29, George T. Harness '28, S. B. Ingram Ph.D. '28, Archie P. King '27, Vince Rideout MS '39, Vladimir A. Kalichevsky '24, George S. Lufkin '29, Frederic H. Moore '38, James W. McRae Ph.D. '37, Lloyd E. Swedlund MS '28, Loren P. Scoville MS '30, Edwin F. Thayer '25, Walter D. Wilkinson '30, Bruce T. Weber '36.

SAN FRANCISCO

Will you kindly let me know the scheduled date for the Football Banquet at your earliest convenience? I am sorry not to have asked sooner but expected to receive some word from you.

I will give you a brief report of our activities since our meeting at Howard Vesper's last spring.

Eleven golfers enjoyed a swell afternoon and evening at the Berkeley Country Club on June 22nd for our Field Day outing. Art Allyne, '26, won low gross and split the blind bogey prize with Francis Wyatt, '34.

On Tuesday, October first, Clarence Weinland, Sales Engineer for Johns-Manville Sales Corporation gave a very interesting and instructive talk supplemented with a movie entitled "Heat and Its Control." This picture can be highly recommended because of its very fine quality and minimum of advertizing. Any group interested can get in touch with Clarence at 116 New Montgomery St., San Francisco.

Twenty-four couples met with the Paul Scherer, '18, family on October 19th for a very enjoyable evening. Unfortunately, Paul at the last minute was detained in the East on business but Mrs. Scherer graciously opened their home for the party. Dr. James A. B. Scherer, Paul's father and former president of Throop College of Technology, was present.

Our sympathies have been extended to the family of Duroc A. Jecker, '31, who passed away on October 15, 1940, at his home in Mill Valley. Duroc had been in ill health for some time and suffered a paralytic stroke last summer from which he did not recover.

Our regular Monday luncheons at the Palace Hotel Fraternity Dining Room are being continued and a hearty welcome is extended to all.

Very truly yours,
Robert B. Freeman,
Secretary.

MISSING ALUMNI

The Alumni Association's files are lacking information on the present whereabouts of the following men. A post card dropped to the Alumni Office will assist in completing the files and in the preparation of the Alumni Directory which is expected to come off the press next March. Please help us locate these men.

1900-20
Davidson, Leonard E
McCutchan, H. C.
Norton, Frank E.

Craig, Robert W.

Fleming, Thomas J.

Alcorn, Max B.
Ramseyer, George N.

Miller, Palmer

Aggeler, Wm. F.
Blunt, Alyn W.
Hansen, Raymond J.
Jones, Herbert J.

Anissnioff, Constantin I.
Campbell, John S.
Foster, Alfred

Marslaud, John E.

Eastman, Luther J.

Clark, John D.
Ellis, Eugene
Scharf, David

Webb, Glenn M.

Ferguson, Robert S
Holmes, Wm M.

1921
Fox, Joseph

1922
Keith, Clyde R.

1923
Roberts, Frank F.

1924
Stone, George B.

1925
Scott, Percival T. W.
Waller, Conrad J.
Watkins, Robie T.

1926
Hsiao, Chuan-Yun
Huang, Jeu Chieh

1927
Medlin, Lewis E.

1928

1930
Van Beveren, Oscar
West, Stewart
White, Dudley

1931

1932
Rau, William C.

1933
Herlin, Robert G

1934
Root, Leonard E.

1935
Higley, John B.
Karp, Nathan
Obatake, Tanemi
Stanley, Robert M.

1936
Kurihara, Hisayuki

1937
Horovitz, Leon

1938
Carr, Robert Broadwell
Hayward, Russell Edward

1939
Fan, Hsu Tsi

EDITOR'S NOTES

ABOUT OUR AUTHORS

One of the world's outstanding authorities on the chemical refining of petroleum is **Vladimir Anatole Kalichevsky,** '24, who took time out from his myriad activities as General Supervisor of the Research and Development Department of the Socony-Vacuum Oil Company to contribute our feature article on "The Progress of Petroleum." Kalichevsky has had one of those careers you read about in books—fighting as a Captain in the Russian army during World War I, mining in the Chukotsk Peninsula for a Japanese firm, graduating from Tech in 1924, working for the Union Oil Company and the Standard Oil Development Company as research chemist, and finally rising to his present post. His two books, "Modern Methods of Refining Lubricating Oils," and "Chemical Refining of Petroleum," (with Stagner) are classics of petroleum literature. But he has always found time to be an active member of the New York Alumni Chapter.

Emmett Irwin, '24, writes about magnetic testing of steel with considerable authority for a large part of the work in this field has been done by himself. He is now Chief Engineer of the Magnetic Corporation, exploiting one of his own inventions.

The class of '24 must be unusually prolific of literary ability. Certainly we think **Ed Layton's** description of life in the Venezuelan oil fields ranks near the top. Ed's six months in Venezuela took him to many interesting scenes, including the famous fire which destroyed the lake-village of Lagunillas. His pictures of the fire were destined for **Life** but were intercepted by the oil companies to serve as evidence in a threatened Venezuelan government suit. Ed is now in the Los Angeles office of the Lufkin Foundry and Machine Company.

Nick D'Arcy, Jr., '29, provided us with a very interesting article on internal combustion power for drilling. Nick is now in charge of the Sales Office at Emsco Derrick and Equipment Company in Los Angeles and an ardent Alumni Association booster.

Bob Stirton, '30, claimed he was too busy researching on fuels and lubricants for Union Oil to write much of an article for the Review. But after persuasion he turned out one that's really a corker, on the position of engineering in the Orient today. Bob apparently had a good time during his two and a half years in Singapore, but he's also glad to be rid of his share of the white man's burden in the East.

Sid Zipser, '30, also takes us on an Oriental adventure, but through the eyes of a photographer. If Technicolor doesn't keep Sid away from home he'll write another article next issue, and with more illustrations of the photographer's art, we hope.

NEWS OF CLASSES

1919

Clayton Charles LaVene, ex '19, is in charge of engineering employment at the Douglas Aircraft Corporation.

1920

Chase S. Story, ex '20, died on October 6th, 1940 in Burbank. He was a member of the firm of Story and Gauley, Manufacturers of Airplane Propellors.

1922

Capt. Ben Benioff is engaged in construction work for the army at San Luis Obispo, California.

Capt. Donald Shugart, Air Corps Reserve, has been ordered to active duty at Sacramento.

1924

E. D. Lownes, Santa Monica contractor, has been building the St. Albans Episcopal Church at Westholme and Hilgard Aves. in Westwood.

F. Douglas Tellwright has been promoted to the position of General Manager of the Oregon Division of the Pacific Telephone & Telegraph Company. The promotion, effective December 10, will give Tellwright headquarters in Portland.

1925

Carl Heilbron has joined the staff of the Engineering Department at Lockheed.

1926

Art Werden is Resident Engineer for the Southern California Edison Company at Boulder Dam on the installation of the new 82,500 KVA generators.

1927

A. E. Capon has recently been appointed an Associate Electrical Engineer on the Bonneville Project with the Department of Interior. His address is now 2217 N.E. Fremont Street, Portland, Oregon.

Edward M. Browder, Jr., who is employed in the Division of Operation and Maintenance, Panama Canal Zone spent his vacation visiting relatives in the L.A. area.

Kenneth Fenwick has been promoted from the rank of Lt.-Jr. Grade to that of Lt. in the Civil Engineering Corps, U.S. Naval Reserve.

Lt. Sherman Hale is on duty as a construction quartermaster on an army base in Alaska.

Johnny Maxson, '27, staff member of the Institute's Geological Sciences Division, is passing out the cigars. It's an 8½ pound girl, Marilyn Maxson, born in Los Angeles Queen of the Angels Hospital on November 30.

1928

Al Miller's new baby is named Linda Lee. She was born at Santa Monica, September 4.

Henry E. Nash, who was connected with the Hercules Powder Company, died September 22, 1940.

Gunner Gramatky, formerly with the Los Angeles Paving Company, has now established his own contracting business. He was recently awarded the contract by the City of Pasadena for resurfacing of Oakland Avenue between Glenarm Street and the southerly city limits.

1929

William Berry, now with the California Division of Water Resources, was a successful candidate in the recent examination for registration as a civil engineer in California.

Thomas H. Evans has been promoted from the position of Assistant Professor of civil engineering at the University of Virginia to that of Associate Professor.

Bill Mohr, Captain in the U. S. Army Engineer Corps Reserve, has been ordered to active duty at Fort MacArthur in the capacity of Post Engineer.

Lt. Otto Reinen has been ordered to extended troop duty at Fort Ord, California.

Fred R. Cline is at present on a vacation in the Hawaiian Islands.

J. Clark Sutherland has moved into his new Pasadena home, where he is prepared to welcome his friends and pass out sample gold nuggets from a California placer operation that he has been nursing.

1930

Kenneth L. Miles and Katherine Dodge of Tucson were married in Tucson on October fourth. Kenneth, if you don't know it, already is professor of areonautics at the Institute.

1931

George Langsner is now a registered civil engineer in California, having passed the recent examination. He is principal assistant resident engineer on the State Division of Highways' $2,000,000 project for the southerly extension of the Arroyo Seco Parkway through Elysian Park in Los Angeles.

Everett Trostel is now teaching an evening course at the University of Southern California from 6:30 to 8:50 P.M. The course covers the Petroleum Industry from an economic standpoint.

Joseph C. Harker is now working at Shasta Dam and can now be reached in care of the U.S. Bureau of Reclamation, Redding, California.

Charles K. Lewis has recently been transfered from the U.S. Engineers Office in Los Angeles to the Canal Zone. In the Zone he is in charge of Reports and Records in connection with the construction of the third set of locks. As the cost of the Project will be $277,000,000 there will no doubt be quite a few records to keep track of. It looks like for the next five years Charles can be reached at his present address of Box 328, Diablo Heights, Canal Zone.

Edward S. Peer writes that he is the proud father of a seven pound eleven ounce baby girl, Loretta Carole. The day was September 28th. Don't pop too many buttons on your shirts Ed.

Dr. Carl Overhage was married August 16th in San Francisco to Miss Katja Leventon.

Maynard Anderson is now on duty as a lieutenant, Civil Engineering Corps, U.S. Naval Reserve, at San Francisco.

1932

Millard Barton writes from Cornell, where he has just completed his work for his Doctors Degree, that for the coming year he will be stationed for a part of each week in Buffalo conducting a course for the Engineers at the Curtiss and Bell Aircraft Plants. His permanent address is 310 Ithaca Road, Ithaca, New York. While in Buffalo he can be reached at the Buffalo Athletic Club.

Phillip Schoeller, Civil Engineer, is employed by the Turner Construction Company, in Honolulu. He has been placed in charge of purchasing all materials for the Naval base developments on Wake, Midway, and Guam Islands.

Bob Carey has joined Lockheed Aircraft in the Finance Department.

1933

Charles Tillman was married on November 2nd in Las Vegas, Nevada.

Only a chance newspaper clipping kept the class of 1933 in the running. Where are you fellows? Let's hear from you.

1934

Dr. Thomas Thayer recently visited the Institute en route to Washington, D.C., and thence to Cuba where he is to examine chromite deposit for the Government's strategic minerals program.

Alfred Switzer was married to Miss Catherine Johnson in the Church of the Angels on August 9th.

Francis Nivens has been made Chief of Technical Data at the Douglas Aircraft Corporation, Santa Monica.

Edwin Core is now Assistant Engineer with the U.S. Department of Agriculture Flood Control Surveys. His address is 4133 Main Street, Riverside, California.

Duncan Douglas was married to Miss Lila Robards of Inglewood on August 10th. They are now living at 3130 Norwich Ave., Alhambra, California. His business address is Utility Trailer Co., 3608 Terminal Annex.

1935

Dr. Arther E. Engelder who has established himself in a medical practice in Tucson, Arizona, paid the campus a visit recently. Not having seen the campus for five years, he was much surprised at the progress made in the way of new buildings and other improvements.

James Jennison is now conducting a course in Reinforced Concrete Design in the University of Southern California's Evening Professional Training Program.

Lind Davenport is now employed by the Air Conditioning Company of Southern California, in Los Angeles. He was married to Miss Cleona White of Monrovia last June.

1936

Dr. William Fowler was married to Miss Ardiane Olmsted on August 24th. They are now living at 1517 South Los Robles.

Verne L. Peugh, who has been with the Winston Brothers Construction Company since graduation, has recently been transfered to the head office in Minneapolis, Minn. to take the position of Chief Engineer.

Victor Veysey is now an assistant in the Stanford University Graduate School of Business Administration. Last year he was in the Cal Tech Industrial Relations Department. Vic and his wife are now living in Palo Alto.

J. A. Legge writes from Bogota, Colombia, South America that he is now employed by the Richmond Petroleum Company and that his address is now in care of the Richmond Petroleum Company, Apartado Aereo No. 3631 or Apartado Nat. no. 2760., Bogota, Colombia, S.A.

Paul Hammond is now employed by the Holly Heating Company of Pasadena, managed by **Stan Johnson** '33. He is also the father of a baby daughter, born in November.

Vincent Jones is in South America selling gravity meters to the Argentine government.

1937

Willard Farnham is now Junior Electrical Engineer on the Bonneville Power Administration, Portland, Oregon.

George Horne was married on August 24th to Miss Carolmae Custer. Miss Custer is the sister of **Bob Custer,** '38.

Mr. Harry Miller, who is in his Senior year at Harvard Medical School, was married September 25 at Valley Forge, Virginia, to Miss Alegra Ruth McFadden. They are at home at 137 Park Drive, Boston.

Ellsworth W. Cornwall was married on October 12, 1940 to Miss Elizabeth Dickel, of Abington, Pa. Ellsworth is with the Reda Pump Company in Los Angeles.

Dudley Auger married Miss Evelyn Branstetter of Sacramento last October.

Erling Walseth is now employed by General Petroleum in Bakersfield.

1938

Phillip Saurenman was married to Miss Louise Bell, daughter of Dr. J. E. Bell of the Chemistry Department. The wedding was at the Institute on August 31, 1940.

Roland Stone, formerly fatty oil chemist in the Los Angeles laboratory of Filtrol Corporation, has been promoted to field representative in the technical sales department of the same company.

1939

Winthrope G. Jones is now an Instructor in Electrical Engineering at Vanderbilt University. His address is 2212 Highland Ave., Nashville, Tenn.

W. F. Ropp is job engineer with Robert E. McKee, General Contractor, of Los Angeles, on the construction of Camp Brownwood (Texas) erecting 600 buildings on a 2000 acre site. His work consists of ordering materials and routing their delivery.

Perry A. Brown has shaken the smoke of New York from his heels. He has given up subway fighting for differential equations with the Pomona office of Pomona Pump Company.

NEWS

Have you any bit of news about yourself or fellow Tech men? Marriages, births, promotions, job changes, papers published, or new honors received are all items of interest to the rest of us so write your information on a penny postcard and address it to the Editor,

CALTECH ALUMNI REVIEW
Pasadena, California

Warren Wilson, M.S. '39, this fall became Professor and Head of Department of Mechanics, Colorado School of Mines.

Curtis M. Lee was married to Miss Evelyn Thomas of Highgrove, California on October 4th. They will live at 148 W. 9th Street, Claremont, California. Curtis is employed as an engineer with the Vortox Manufacturing Company.

Walter Diehm sent the following letter from New England: "Armistice Day we had a small C.I.T. alumni reunion. **Bob Kimball** came over from Pittsfield, where he is now on transformer test. **Richard Fischer**, the great Glendale lover, is now at the West Lynn works. **Dave Hoyt** and **Marcus Hall** are at the Harvard Business School. **Dan Schuman**, the one-handed dead-eye shot of the Tech basketball teams of a few years back, and **Joe 'Sarazen' Manildi** are also at the Business School, as well as **Professor Gilbert** and a couple of fellows of the class of '40.

1940

Dr. Van Driest, Ph.D. 1940, is now at Cornell University where he is in the Department of Mechanics of Engineering. He is teaching fluid mechanics.

Carl G. Schrader is to be married to Miss Gysje Ekdom in Washington, D.C. some time in December.

Bernhard Haffner was married to Miss Ann Janet Duncan in the Wee Kirk o' the Heather on August 20th.

Norman Oldson is now employed in the Bureau of Ships of the Navy Department. His present address is 1519 N.W. 20th Street, Washington, D.C.

Rolph Langerud is the papa, and no doubt very proud, of a daughter, Rondi Jean who was born last August.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of Alumni Review—California Institute of Technology—published four times a year at Pasadena, California, for October 1, 1940.

STATE OF CALIFORNIA)
COUNTY OF LOS ANGELES) ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared Hugh F. Colvin, who, having been duly sworn according to law, deposes and says that he is the Editor of the Alumni Review—California Institute of Technology and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Name of— Post office address—
Publisher .....
Editor, Hugh Colvin, Union Oil Bldg, Los Angeles
Managing Editor .....
Business Manager, Robert J. Barry, 634 N. San Jose St., Burbank

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

Alumni Association Inc., California Institute of Technology, 1201 East California Street, Pasadena, California; no stock, a non-profit corporation.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustee, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is ..... (This information is required from daily publications only.)

HUGH F. COLVIN,
(Signature of editor, publisher, business manager, or owner.)

Sworn to and subscribed before me this 30th day of September, 1940.

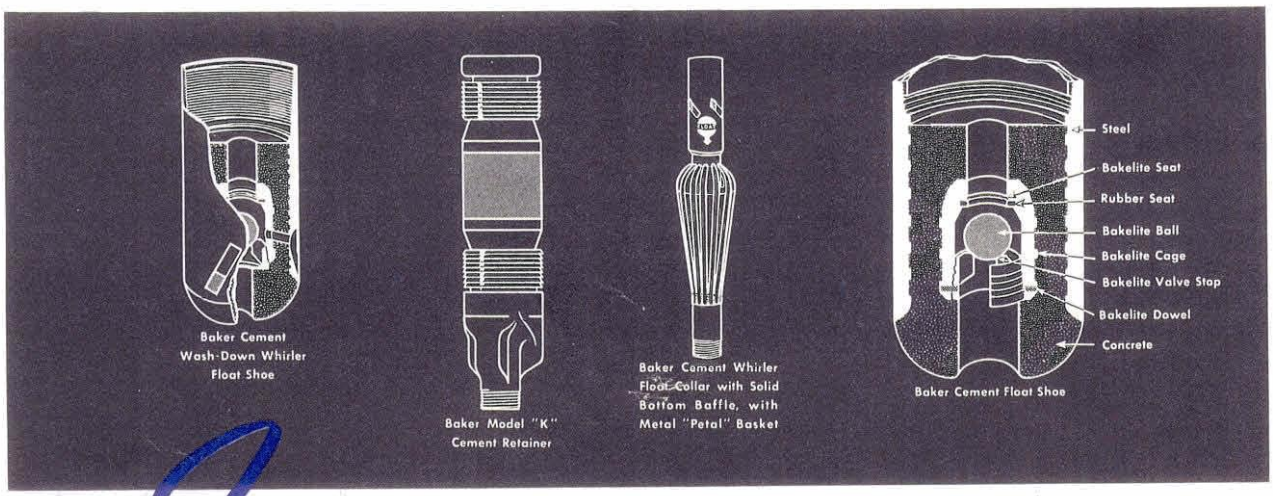
(Seal) Margaret G. Kearney
(Signature)

(My commission expires June 30, 1941.)

"Best Wishes for Your Happiness"

from your friends and neighbors in the telephone company. May the friendly spirit of the holidays carry through all of 1941.

BELL TELEPHONE SYSTEM



Successful Oil Tools

ARE "DEVELOPED" NOT "DISCOVERED"

THE HISTORY of the machine age is a continuous story of discoveries . . . discoveries which opened the vistas to the remarkable period in which we now live. Discoveries, however, while tremendously important, are only the nucleus or starting point, for to be of commercial value most "discoveries" or inventions must be "developed."

It is both fortunate and unfortunate that oil tools are no exception to this rule. Fortunate because it is only through this tedious development period of trial and error that the refined product or tool can result . . .unfortunate perhaps (from the manufacturer's cost standpoint), because usually the development period continues more or less indefinitely as the result of constantly changing conditions under which the tool must operate: or requirements such as higher efficiencies which must be met.

Thus, products, such as make up the Baker Line of Oil Tools, which have been some thirty years in the development process, acquire a certain "face value" which operators have been quick to recognize and appreciate. Oil men the world over know that a tool or device bearing the word "Baker" reflects an invaluable background of accumulated experience . . . a background that results in the ability of each and every Baker tool to successfully perform the task for which it was designed.

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The familiar Baker slogan "Practical and Dependable," is more than simply a play upon words . . . it means just that, for to be successful, oil tools must necessarily be "practical and dependable" and practibility and dependability result from constant *development* . . . not *discovery* alone.

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