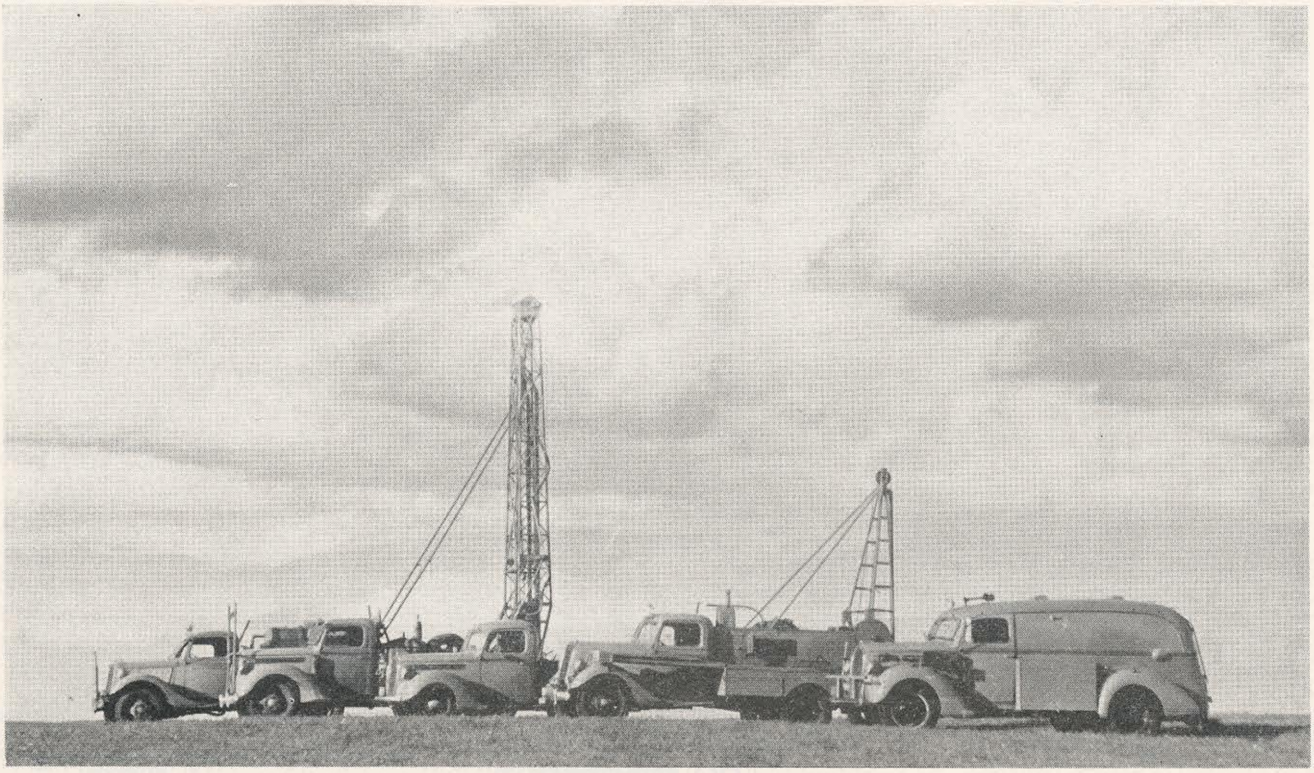
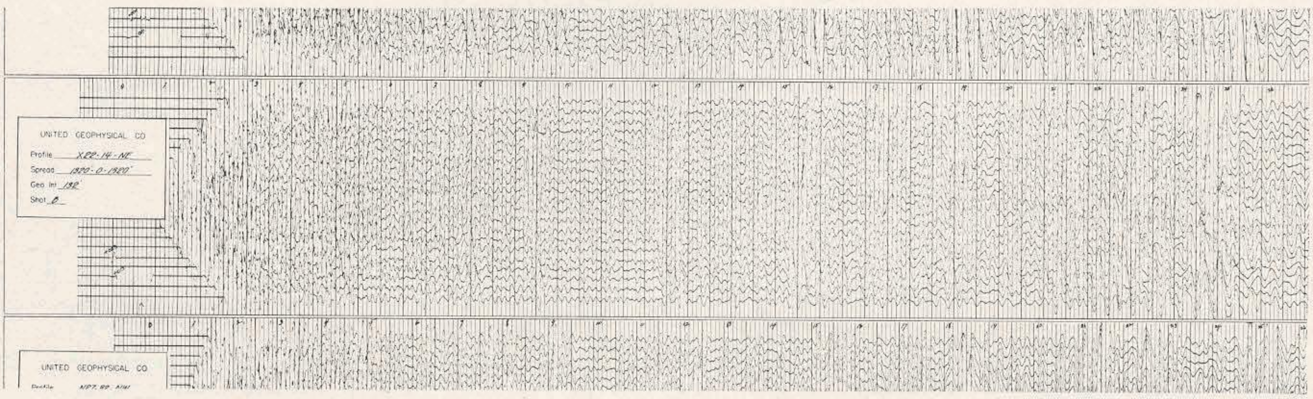
ALUMNI REVIEW

CALIFORNIA INSTITUTE OF TECHNOLOGY





Complete reflection of seismograph outfit with water truck, drill, survey car, explosives truck, and recording truck. Lower picture is a reflection seismogram showing recording of ground motion at 21 geophone positions. Numbers refer to time in tenths of seconds. A number of reflections are visible on the record.

GEOPHYSICAL PROSPECTING FOR OIL

SEE PAGE 4

Vol. 3 No. 2 December, 1939

ALUMNI REVIEW

ALUMNI ASSOCIATION, INC.
CALIFORNIA INSTITUTE OF TECHNOLOGY

Vol. 3, No. 2 | Pasadena, California | December, 1939

Published four times a year—September, December, March and June by the Alumni Association, Inc., California Institute of Technology, 1201 East California Street, Pasadena, California. Annual Subscription $2.50, Single Copies $0.65. Application for entry as second class matter pending at the Post Office at Pasadena, California.

ALUMNI Association plans for this year include the stressing of better student-alumni relationships. Judging from questions asked of some of our members who have accepted invitations from the Student Houses to attend informal discussions, many students do not know just what our Association is doing, nor do they recognize that many of the alumni are in a position to give of their time in helping these men become oriented in a complex world after leaving the Institute. Plans are afoot to compile a list of alumni capable of helping in discussions dealing with questions which may be bothering some of the undergraduates, and subjects will include general employment advice, and discussions of various vocations and hobbies. If you are contacted in such connection, give us your cooperation.

Another method adopted this year to show our interest in student activities and to offer some additional incentive toward intercollegiate competition was our presentation to the students of a large, perpetual trophy to be awarded annually to the House having the highest number of points in intercollegiate competition, judged by existing schedules evaluating all such competitive sports. This trophy has been termed the Alumni Athletic Award and will serve to show our continued interest in student activities.

Additionally, the senior class will again be our guests at the annual dance on January 27 announced elsewhere in this issue. Last year we had a large number of seniors as our guests, and we feel it helpful to even better relations with the students to continue this practice.

Every member can help in achieving our aims by making it a point to visit the campus and have a few words with some of the students, and by supporting student-sponsored activities. We can, for example, lend our help by our individual contributions to the Tech Y. M. C. A., by attending campus plays and the annual Exhibit Day, by subscribing to the California Tech, and in many other ways. Regardless of how you help, mention that you are an alumnus and help us show the students that we are backing them in every way.

CLARENCE F. KIECH, '26,
President, Alumni Association.

FORTHCOMING EVENTS *

San Francisco Chapter—Every Mon. Noon, Fraternity Club at Palace Hotel.

Varsity Football Banquet, January 12, 1940
Pasadena Athletic Club, 6:30 p.m.
Tickets $1.00 per plate. Make reservations with Coach Musselman at the Institute.

Annual Dance — **Jan. 27, 1940**
Blue Room, Biltmore Hotel, Los Angeles. Informal, $1.85 per couple, further particulars elsewhere in this issue.

Seminar Week End . March 16-17, 1940
Exhibit Days . . . . April
Annual Stag and Field Day . . May
General Meeting & Commencement June

* Listings in bold face type are final announcements. Other events will be announced in due time, following completion of plans.

Editorial Comment

Campus Relations

ONE of the most significant advances to be made by the Alumni Association during the current year is the establishment of a Committee on Campus Relations, chairmanned by *Theodore C. Coleman,* '26, which has as its principal purpose the offering of assistance of any type requested by the students.

So far the students have mainly requested discussion of the proper approach in securing employment, a topic on which Coleman recently spoke informally before a meeting of the Throop Club. In the coming months it is expected that invitations will be received from the Student Houses to meet with them and to take part in round-table talks, and the Committee intends to call upon Alumni to volunteer to attend the meetings and take part in the discussions.

However, in this approach toward better undergraduate relationships the Alumni Association has adopted a passive attitude in that the Association has offered its services to any or all groups of students, and any further Alumni participation depends on the voluntary request of the student groups themselves.

By this means, we hope to foster a better relationship between undergraduates and the Alumni, by giving the latter an opportunity to aid in the orientation of the students.

T

New Buildings

THE completion of the Seeley W. Mudd and the Charles Arms Laboratories of the Geological Sciences, located on the southwest corner of the campus, marks another milestone in the progress of the Division of the Geological Sciences.

The Seeley W. Mudd Laboratory of the Geological Sciences is the gift of Mrs. Seeley W. Mudd as a memorial to her husband, who was a very eminent mining engineer. The funds for the Charles Arms Laboratory of the Geological Sciences were provided by Mrs. Robinson and her husband, the late Henry M. Robinson, for many years a trustee of the Institute, as a memorial to her father, who was a successful owner of mines.

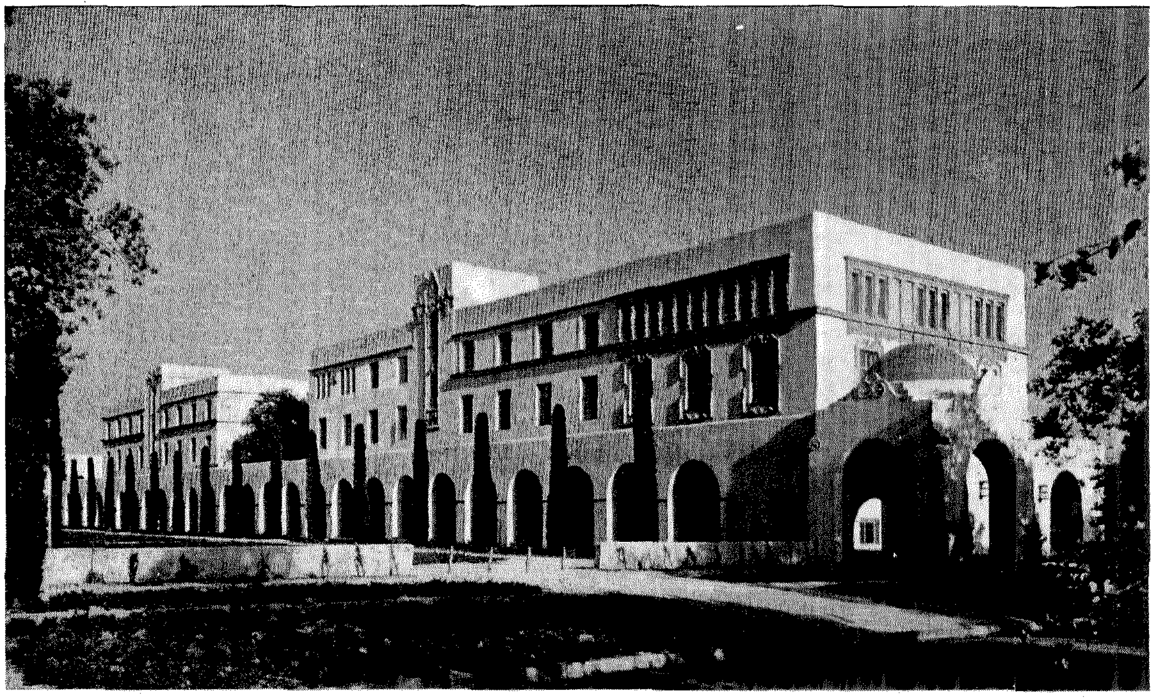
The Division of the Geological Sciences, though previously handicapped by the lack of physical facilities on the campus, has forged to the forefront in its fields of endeavor, many notable advances having been made in structural geology, petrology, mineralogy, paleontology, and geophysics by members of the staff and by graduates of the Division in the thirteen years since its establishment.

T

Future Growth

WITH the gradual utilization of all available building areas on the campus, provision must be made for future growth of the Institute. This is the tenor of a report made by a special committee to the Board of City Directors of Pasadena. This report recommended that the area north of the campus bounded by Wilson and Hill Avenues and the prolongation of Lura Street be zoned to allow occupancy by collegiate institutions, and that the southwest corner of California Street and Arden Road be zoned likewise.

The zoning of the Arden Road corner, already owned by the Institute, which adjoins Tournament Park, would provide a suitable site for the proposed gymnasium, and would be one step further towards securing this much needed undergraduate facility. It is sincerely hoped that the zone change will be acted upon favorably by the City.



The New Laboratories of the Division of the Geological Sciences.
Left: *The Charles Arms Laboratory.* Right: *The Seeley W. Mudd Laboratory.*

A Merry Christmas to All

Your friends and neighbors in the telephone company send you best wishes for a Merry Christmas.

Through the holidays, as always, we'll be on hand—doing our best to keep the Christmas spirit in telephone service.

BELL TELEPHONE SYSTEM

GEOPHYSICAL PROSPECTING FOR OIL

By Raymond A. Peterson, '31, Ph.D. '35

United Geophysical Company, Pasadena

The problem of locating oil is one of ascertaining the structural and stratigraphic relationships of the rocks near the earth's surface, and of correctly interpreting these data. This interpretation is based on a group of theories concerning the origin and accumulation of oil which have been formulated from a large amount of past experience and observation. The weight of evidence favors the theory of organic origin of oil from the remains of animal and vegetable material buried and disseminated in basins of sedimentary deposition. By a complex series of events this material has been transformed and collected into bodies of oil and gas.

The mode and place of accumulation are governed by two factors: stratigraphy and structure. The sedimentary rocks in which oil occurs are ordinarily deposited in layers or strata of alternating types — e.g., shale, sandstone, limestone, etc. Of these, sandstone is the most important as a reservoir rock for oil and gas because of its relatively high porosity and permeability. Shale strata, on the other hand, have an important effect on the migration and accumulation of oil. Because of the difference in specific gravity between oil and water in the rocks, the oil is subjected to an upward buoyant force. In alternating layers of shale and sand, however, the oil is largely constrained by the impervious shale layers to move in the more permeable sands, and aided by the driving force of circulating water, migrates up the dip or steepest slope of the strata until stopped by some "trap." The trap may be either structural or stratigraphic in nature, or both.

OIL TRAPS

The most common type of structural trap is the anticlinal fold or dome-shaped structure, formed by the warping and folding of rocks by horizontal compression. In this case, if the permeable reservoir rock extends over the entire structure, the oil and gas migrate to the top, being trapped by the buoyant force of the water on the flanks and by the impermeable rocks overlying the sand. Here the oil and gas remain, or at least escape only very slowly.

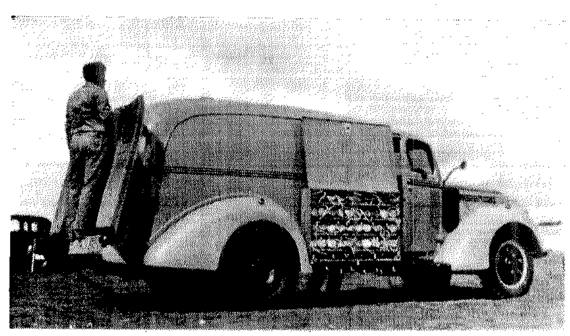
Another type of structural trap may be formed by faulting in sedimentary rocks. Oil may accumulate in upturned beds butting against impervious rock on the opposite side of the fault plane. Likewise, a trap may be formed by a fault cutting across a plunging nose-shaped fold, thus preventing further migration of oil up the structure.

In the Gulf Coast region of the United States a common type of structure is the salt dome. Here masses of salt have been forced up from considerable depth into the overlying sedimentary rocks, forming plug-shaped salt masses surrounded by the upturned beds of the disrupted sediments. Oil is then trapped in the sand members terminating against the salt, or may accumulate in arched beds above the salt plug.

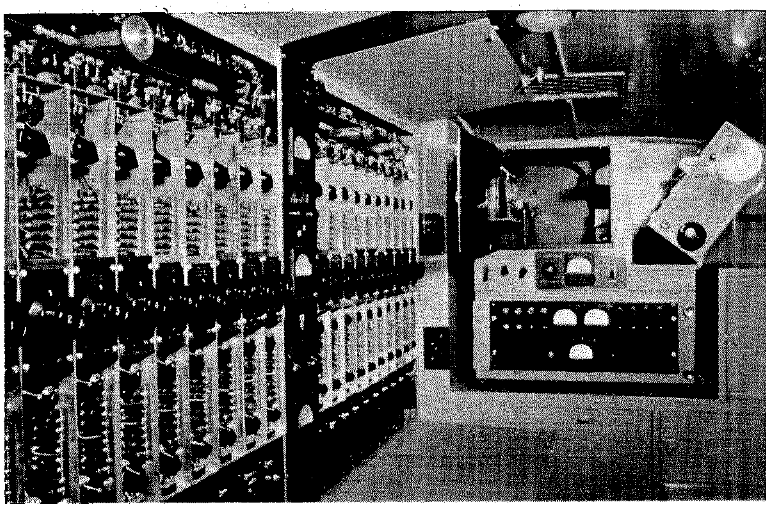
Stratigraphic traps are so-called because they have resulted from lateral changes in sedimentation at the time of the deposition of the strata. Thus coarse sands deposited near the shore of a basin may grade into finer sands off-shore and finally into impervious shales. On the other hand, near-shore sands in a slowly submerging basin may have been covered by overlapping shales as the shore line moved inland. In either case, there is a boundary, either abrupt or transitional in character, between sand and shale. Subsequently, when the sediments are deformed by warping and folding, traps for the accumulation of oil may be formed along the shale-sand boundary. For example, if the boundary cuts across a plunging nose-shaped structure, a trap may be formed where the shale-sand demarcation intersects the crestline of the fold. Likewise, a trap may be formed in a series of more or less uniformly tilted beds if the shale-sand boundary cuts obliquely up the slope of the beds and then bends obliquely down the solpe, forming a reentrant bay. The oil then accumulates in the apex of the reentrant, being prevented from further migration up the slope by the transition from sand to impervious shale.

The types of traps for the accumulation of oil described above are only a few of the many which occur. Usually the trap is much more complicated than those described, with a combination of factors present. Thus, dome-like structures are often cut by faults which affect the accumulation of oil. Furthermore, the porosity of the sand reservoir rock may vary over the extent of the structure, greatly influencing the accumulation. Accumulation is not always limited to one sand member. Often there may be a number of sand strata at various depths, some giving rise to separate accumulations of oil or gas, others containing only water.

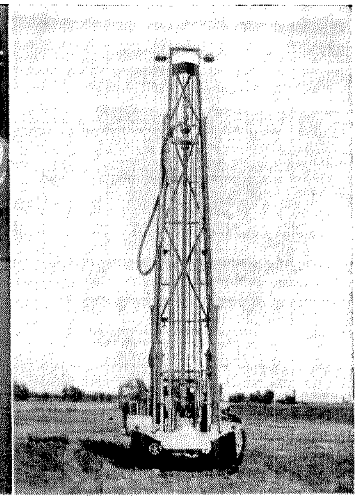
The problem of the geologist in exploring for oil is first to ascertain whether or not there are strata present which would be likely to contain oil or gas, and secondly, to locate the structural and stratigraphic traps which are the most probable locations for oil and gas accumulation. He has available two sources of information: observations at the surface of the ground, and subsurface information from previously drilled wells. The amount of information available from surface observations varies with the locality. In elevated regions, considerable areas may be exposed to observation by erosion which has removed the mantle of surface soil.



Exterior of recording truck, showing racks with geophones.



Interior of recording truck, showing amplifiers and oscillograph.



Portable shothole drill.

SURFACE MAPPING

The first step in exploration is to prepare an accurate surface map showing the rocks exposed; measuring their thickness; noting their composition (whether shale, sandstone, limestone, etc.); noting their fossil content; showing the location of surface oil seeps, if any; showing the bedding planes, and particularly the boundaries between different types of rock; showing the direction and amount of slope or dip of the bedding planes in the rocks; and showing the location of folds, warps, and faults in the rock. Where information is concealed by a shallow mantle of surface soil, it may be obtained by digging ditches or taking auger samples. Mapping is often done with the use of a plane-table, the elevations as well as locations of important points being obtained. In many places, airplane photographs serve as excellent base maps and reveal many features not readily apparent from the surface. After the surface map has been completed, subsurface contour maps on significant horizons may be constructed by extrapolation from surface data. The geologist also attempts to reconstruct the past geological history of the region, outlining former seas and basins of deposition, and noting the location and extent of sands and shales. With all this information assembled, he is in a position to make an intelligent recommendation as to the most desirable location for drilling an exploratory well.

SUBSURFACE MAPPING

A great many oil fields have been discovered by the above described procedure of surface mapping and extrapolation from surface data. However, it so happens that many areas of potential oil production are located in depressed regions which are being subjected to surface deposition rather than erosion at the present time. That is, the areas are covered by flat-lying deposits of alluvium, recent stream deposits of gravel, sand, and silt which almost, if not completely, mask the underlying rocks.

It is also many times true that even in areas where rocks are exposed by erosion, the information obtained at the surface does not give a reliable or complete indication of the structure at depth. Here the information obtained from previously drilled wells is of considerable value. In practically all drilling of wells a careful log is kept of the mud and cuttings washed from the hole. Also, at critical points actual rock samples are cored from the bottom of the hole as drilling progresses. These core samples are carefully studied as to their content of microscopic fossils, composition and mineral content, porosity, permeability, the dip of bedding planes, etc. In addition the well is surveyed electrically by recording variations in current and potential across a set of travelling electrodes lowered in the hole. This record shows in minute detail the boundaries between various strata — e.g., sands and shales — as revealed by the measured changes in resistivity and porosity of the wall rock. By comparing all the assembled data from a number of wells not too distant from each other, it is possible to correlate similar points, as for example, the top of a particular sand stratum which may be important as a reservoir rock for oil. If the wells are close enough together, subsurface contour maps may be drawn showing accurately the elevations and structure of pertinent horizons.

When wells giving subsurface information are widely separated, however, the interpolation of data between wells becomes more uncertain, and there are large areas for which the subsurface structure remains unknown. In some regions with shallow oil production, exploration is conducted by drilling a number of relatively shallow core holes, one or two thousand feet in depth, and correlating information obtained. In general, however, with the increasingly greater cost for deeper wells, it is not economically feasible to carry out detailed exploration by drilling.

GEOPHYSICAL PROSPECTING

One of the main objects of all methods of prospecting is to furnish a guide for the successful location of wells so as to minimize the number of dry holes and keep the cost of discovery as low as possible. It is in this regard that the physicist and engineer have been of invaluable assistance to the geologist. Various types of rocks show appreciable differences in physical characteristics — e.g., in density, magnetic permeability, electrical resistivity, elastic rigidity, etc. It is

(Continued on page 10)

ADSORBENT CLAYS

By G. Austin Schroter, '28

Manager Mines and Exploartion, Western Division, Filtrol Corp.

In the limited space available in the Review, it is impossible to more than touch upon the production, manufacture, and utilization of the adsorbent clays. The field is a large one, and new applications are being developed by researchers almost daily.

In chemistry, the noun *adsorption* is defined as the gathering of a liquid, gas, or dissolved substance at a surface, and this is the phenomenon most frequently utilized in applications of the bleaching or adsorbent clays.

Such clays fall into three subdivisions, based upon geology, method of preparation, and ultimate utilization, *viz*: (1) naturally adsorptive clays, (2) bauxite clays, and (3) acid-activated clays.

The geology of these clays is so complex that it will not be dwelt upon here. Suffice it to say that the seat of adsorptive action in most of these clays apparently lies in the clay mineral, montmorillonite, a sub-microscopic, crystalline mineral, with a planar space lattice. This theory, however, has never been verified.

The naturally adsorptive and activable clays occur in sections from the Ordovician to the Tertiary, with by far the bulk of the production coming from the Cretaceous and Lower Tertiary. Geographically, they are known from a point north of Lake Winnipeg, to the Gulf Coast; and from Georgia to California. Most deposits are stratiform, hence mining is either by open-cut stripping, or underground by some modified coal mining method, usually room-and-pillar mining.

PREPARATION

The naturally adsorptive clays are prepared either by fine grinding, or by crushing and screening into sized grades. A late development utilizes extrusion to form pellets and eliminate waste in fines. The active clays are prepared by controlled acid leaching, followed by counter-current washing to reduce pH, free-settling classification, grinding, and bagging. The bauxites are prepared by roasting, grinding, and bagging.

The naturally adsorptive clays (also loosely known as Fuller's earth), find their especial forte in the "percolation" treatment of petroleum oils. A sized column of meshed clay is the medium through which the oil, fat, or wax, in either liquid or vapor phase, is "percolated." The purified product issues from the tower, minus a certain proportion of the impurities and objectionable coloring matter, which are left behind in the clay. Such clays are of limited efficiency and selective action, but have moved in large volumes for the treatment of both petroleum and fatty oils.

The second class (bauxite) has only recently entered the field. Although the raw mineral may have little or no adsorptive efficiency, a careful heat treatment may develop a cheap material of limited efficiency, for the treatment of certain types of paraffinic petroleum stocks.

The third class of clays, known as activated clays after leaching with acid under controlled conditions of temperature and pressure, is perhaps the most highly efficient, as well as the most versatile material in the category. Such acid-activated clays are exported all over the world for consumption in a host of different industries. Although at least 75% of the domestic output is consumed by the petroleum industry, the remainder is enough to account for the clarity and sales appeal of practically all premium edible oils, hydrogenated shortenings, soap stocks and paint oils, some oleomargarines, etc. Many thousands of barrels of lubricating oils are annually treated with this material in refineries throughout the world.

With the activated clays, the common method of treating any given stock is by the method of *contact filtration*. In this method, predetermined percentages of finely ground activated clay are admixed with the oil, and the mixture is agitated at elevated temperatures. The oil-clay slurry is then sent to the filter press or continuous filter, from which the oil issues in purified state, and the impurities and objectionable colors remain behind in the filter cake.

An interesting development of recent years is the so-called Filtrol-fractionation of petroleum oils. In this method, the finely ground activated clay is added to the hydrocarbon oil before the latter enters the fractional distillation equipment. The slurry is then subjected to normal fractionation, and the various fractions which pass off are decolorized and purified *en transit*. By this method fractionation and contact filtration are combined into one simple operation.

CATALYST-CARRIERS

The most spectacular innovation of recent years, is the use of the activated clays for catalysts, or catalyst-carriers, whereby the heavier hydrocarbons are broken up into smaller structures to increase the gasoline yield. This enables many tars, asphalts, and refinery wastes, as well as crude oils, to be converted into *high octane* motor fuels.

In normal refining, the fuel, and other light oils, are removed from the crude by distillation, after which the heavier hydrocarbons remaining are broken up by thermal cracking into smaller structures to increase the gasoline yield. Such cracking may require pressures as high as 1,000 pounds, and temperatures as high as 1,100°F., and even under the most favorable conditions, large quantities of heavy oils and objectionable residues remain, which must be stored or cheaply sold.

In catalytic cracking, with the aid of the activated clays, pressures of 20 to 40 pounds may be used, with temperatures as low as 900°F. In addition, about 50% of the heavy residues which would remain in thermal cracking, will be converted into gasoline with a natural octane rating of 78 to 81, the equivalent of the best motor fuels on today's markets. (Continued on page 15)

ALUMNI YOU SHOULD KNOW

CHEMICAL ENGINEER

The name of Vladimir Anatole Kalichevsky, '24, to some of his friends would conjure up the vision of an energetic young officer in the army of H.I.M. the Emperor of Russia during the World War I, while to others he would represent a brilliant chemical engineer in the field of oil refining.

After a brilliant military career, in which he advanced to the rank of captain, and upon the collapse of the forces of Admiral Kolchak after the Russian Revolution, he became manager of the Topographical Department of the Chukotsk Peninsula Mining Corporation of Tokyo, Japan. He emigrated to the United States in 1921 and enrolled in the California Institute of Technology, graduating in chemical engineering in 1924.

Upon graduation he secured a position as Research Chemist with the Union Oil Company of California. He spent a short period with the Standard Oil Development Company in New Jersey, and in 1931 went to work for the Socony-Vacuum Oil Company as a Research Chemist, rising through intermediate steps to the position of General Supervisor of Research and Development Department of the Company, which is one of the largest producers, refiners, and distributors of petroleum products in the world.

He is the author of "Modern Methods of Refining Lubricating Oils," and of "Chemical Refining of Petroleum" (with Stagner), which are the standard reference texts of the oil industry. In addition, he is a frequent contributor of authoritative articles in petroleum trade journals.

OPPORTUNITIES FOR ALUMNI IN NAVAL AVIATION

By LIEUT. F. A. BROSSY, x26, U.S.N.R.
Flight Instructor, Naval Reserve Aviation Base
Long Beach, California

Through a recently expanded training program the United States Naval Reserve Aviation Training is available to more college men. Selections are now being made for flight classes which under the increased program will be convened each month throughout the year.

The training course, the value of which has been estimated at $20,000, is unique in that not only does it prepare the individual for many highly paid positions in civil aviation and the aviation industry, but pays well during training. The course includes flying in varied types of aircraft as well as complete ground school instruction in technical subjects, including navigation and overwater flying. Preference is given naval and military trained pilots by the major airlines in their employment of personnel, and those airlines whose routes are overwater naturally favor the aviator with ocean flying and navigation experience. The general consensus is that tremendous expansion will take place within the next few years in aerial transportation, particularly in trans-ocean and inter-continental routes. This expansion will increase the already growing demand for properly trained personnel in many lucrative branches. There is no doubt that the Naval Reserve Aviator, especially with an engineering degree, will find himself in an enviable position to profitably take advantage of the opportunities now offered and those that the future will bring.

The Naval Reserve Aviator begins his training at a Naval Reserve Aviation Base, in Southern California at Long Beach. Classes start the 15th of each month and the student aviator is put through a 30 day course which includes 10 hours of dual flight instruction by Naval Aviators. Students who qualify in this Primary Training, for which the remuneration is approximately $110.00, are appointed Aviation Cadets and are sent to the Naval Air Station, Pensacola, Florida, for further training.

At Pensacola the Aviation Cadet receives $105.00 per month, uniforms, quarters, medical and dental care, and is protected by a $10,000 Life Insurance Policy, the premiums being paid by the Government. His instruction consists of a complete flight training in varied modern aircraft, instrument flying and comprehensive classroom instruction in practical and theoretical aviation subjects.

The Aviation Cadet spends about one year at Pensacola and upon graduation is commissioned an Ensign in the United States Naval Reserve and is assigned for a three year period to one of the Aviation Squadrons of the U. S. Navy. This assignment includes flight duty and may take the Reserve Aviator to any part of the world where U. S. Naval activities are conducted. Remuneration is now better than $200.00 per month and the opportunities for knowledge and experience in aviation are many times increased.

At the termination of the three years of Fleet duty the Naval Reserve Aviator is paid a cash bonus of $500.00. He may now, at his volition, serve another four years of active duty as Lieutenant (junior grade) with increased pay and allowances, or return to civilian life. In this latter case he will probably become attached in an inactive status to one of the Squadrons at one of the several Naval Reserve Aviation Bases in the Country. Here he may maintain his flight proficiency, without interference with civilian pursuits, and receive $400.00 to $700.00 per year drill pay.

Some of the Caltech Alumni who have taken this training in recent years are: Frank W. Davis '36
Phillip H. Craig '33 Richard M. Rowell '38

Inquiries concerning the training may be made in person or by mail of Commanding Officer,
U. S. Naval Reserve Aviation Base,
Long Beach, California.