

## ABSTRACTS.

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## OILFIELD EXPLORATION AND EXPLOITATION.

## Geology.

432. Schist Production is New Development at Edison. L. P. Stockman. *Oil Gas J.*, 29.12.45, 44 (34), 165.—The Edison pool, California, was discovered in 1934, and has produced over 13,038,170 bbl of oil. At the beginning of 1945 the output was 3683 bbl/day, but is now 8563 bbl/day as a result of developing new reserves in the fractured, weathered schist basement, and in two small adjacent pools at Playa del Rey there is production in both fractured schist and basal conglomerate, while Santa Maria Valley yields oil from the Knoxville sandstone and fractured Franciscan basement, which involves penetrating the basement for about 100 ft.

The Edison structure is a southwest-dipping monocline, with some rapid lithological changes and progressive overlap in places. The top of the basement schist is undulating, but rises generally to the east and northeast. The maximum penetration of the

schist is 880 ft, and the present average 375 ft. The fractured weathered schist is immediately below a relatively thin hard schist member. The drilling of 350 ft of fractured and weathered schist generally requires about two days.

Formerly the Edison production ranged 1250-2500 ft in depth. The new production is 2300-3022 ft deep. Schist production may cover 1000 acres, with a recoverable reserve estimated at 15,000 bbl/acre. G. D. H.

**433. More Manpower, Materials Spur Wildcat Completions.** Anon. *Oil Wkly*, 31.12.45, 120 (5), 17.—363 exploratory wells were completed in U.S.A. in November, making a total of 4018 wildcats in the first eleven months of 1945. The weekly average for November was 91, compared with 82 in October. 22.9% of the November wildcat completions were productive; the figure for October was 13.7%, and for the first eleven months of 1945 18.5%.

This year there have been fewer major extensions to existing fields than in 1944, but there have been 7% more new oilfield discoveries, and 3% more new oil pay-zone discoveries. 6% more gas-fields have been found than in 1944.

Tables summarize the types of discoveries in October and November 1945, and during the first eleven months of 1944 and 1945. The November wildcat completion results are summarized by States and districts, and similar data are given for the first eleven months of 1945.

The November discoveries are tabulated, with some details.

G. D. H.

**434. Large Exploration Campaign Under Way in Canada.** C. J. Deegan. *Oil Gas J.*, 29.12.45, 44 (34), 274.—In Alberta the Imperial Oil, Ltd., has 2 seismograph parties, 4 geological parties and 4 wildcat drilling rigs operating; in southern Saskatchewan it has a double-shift seismograph party, 2 geological parties, 4 core-drills, and 2 wildcat rigs; in the Norman Wells area a seismograph party, a gravimeter party, and 3 geological parties operated during the summer. Other companies had 7 seismograph parties, 4 gravimeter parties, and 12 geological parties at work.

A joint aerial photographic survey was undertaken in the Alberta foothills, covering 15,000 sq ml.

The bulk of the drilling activity is in the foothills and plains of Alberta.

In December 1944 gas and condensate were found at 9618 ft in the Madison limestone at the top of the Jumping Pound structure. A well 5/8 ml down flank and 1018 ft lower structurally gave on test gas-cut mud and salt water. A third test is to be drilled.

The Conrad field of the plains area was opened last July. It has about 8 producers, and is comparatively small. The Princess field has several producers, and may be of small to medium size. East of the Viking and Kinsella gas-fields a new gas discovery has been made. Gas reserve estimates for this area range 250-600 thousand million cubic feet. A second new gas strike has been made 6 ml north of the first. Both produce from about 2100 ft. G. D. H.

**435. Brazil Shows Good Geological Possibilities of Commercial Quantities of Petroleum.** H. J. Langley. *Oil Gas J.*, 29.12.45, 44 (34), 162.—Tar and bituminous rocks have been known in the Parana basin since the last century. Devonian and Triassic beds occur, and wells drilled between 1918 and 1935, in Sao Paulo, Parana, and Santa Catarina, produced some oil and natural gas. Work began in the State of Bahia 25 years ago, and in Alagoas exploration was started around Maceio in 1920. Between 1924 and 1935 several wells were drilled in the Papajos valley of the State of Para. Some wells were drilled in the territory of Acre and in the region of Cruzeiro do Sul, commencing in 1935.

Search for oil in Bahia and Alagoas was restarted in 1939, after reorganization of the Government's oil agency.

In the belt of Cretaceous sediments of the Reconcavo region around the bay of Todos os Santos is a graben bounded on the east and west by curved faults some 77 ml apart. In Bahia fields have been discovered at Lobato-Joanes, Candeias, Aratu, and Itaparica. Wildcats have been drilled on a series of structures: Mata do Alianca, Mata de Sao Joao, Camacuri, and Maracangalha.

The Lobato-Joanes field has seeps. Production was found in 1939 at a depth of 700 ft. 7 producers and 10 dry holes have been completed; 2 of the wells are exhausted. The deepest well reached 7379 ft, being stopped in metamorphic rock. There are 3 oil-saturated zones, the lowest being most productive.

Candeias is on a closed asymmetrical anticline, 22 ml north-northwest of Salvador. Oil seeps occur near the axis. Production was discovered in 1941 at a depth of 3760 ft in a sandstone containing lenses of different degrees of coarseness. 26-6° A.P.I. oil is produced with a G.O.R. of 50-75 cu ft/brl. 11 wells have been drilled.

Aratu is 12.5 ml north of Salvador. An upper horizon gives oil and a lower horizon gas. The oil reserves, which are in lenses, are small. Gas reserves are estimated at 1,000,000 M.c.f.

Itaparica is on an anticline with an upper gas-sand and a lower oil-sand in the Cretaceous.

Some data are given on the outputs of individual wells, as well as the production of the fields year by year. G. D. H.

**436. Tests Continue in Shell Well in Eastern Ecuador.** Anon. *Oil Wkly*, 31.12.45, 120 (5), 48.—Vuano 1, on the eastern flank of the Andes, is reported to have shown considerable oil in tests of the Lower Cretaceous at about 5000 ft. Further tests were unsuccessful, and limestones in the Upper Cretaceous with showings are to be tested. G. D. H.

**437. War's End Brings Accelerated Activity in Yumen, China's Only Oilfield.** K. C. Lu. *Oil Gas J.*, 29.12.45, 44 (34), 253.—The Yumen field of Kansu province was opened in 1939. It is on the northern flank of the Chihlienshan Range. The initial well was completed as a pumper at 500 ft. A flowing well was completed in 1941 at 1430 ft. Development was slow because of supply difficulties, but since the war ended expansion of the production and refining capacity has been begun.

Production is from two Cretaceous sands, both medium-grained and of high porosity, and about 150 ft thick. Active seeps occur where the Shihyouho River cuts across the structure, and at an outcrop 2 ml to the east. Little is known about the subsurface structure, which seems symmetrical.

Seven wells were drilled between 1939 and 1941, the average depth of these pumps being 550 ft. Since then 18 flowing wells have been drilled by rotary rigs. Several oil-sands have been found beneath the lower producing sand.

Drilling and production practices are briefly described. Output is 1500-2200 brl/day. Several topping batteries and a pipe-still have been built, and a thermal cracking plant is being erected. The crude gives about 21% of straight-run high-octane gasoline. G. D. H.

## Drilling.

**438. Economics of Deep Drilling.** I. W. Alcorn. *Petrol. Engr.*, Jan. 1946, 17 (4), 75.—A statistical study of all wells drilled below 12,000 ft in the U.S. other than California is made, and the conclusions are that drilling to depths below 12,000 ft is an economically hazardous undertaking. From a study of data used in this compilation combined with a review of published related material it appears that there are three basic factors that deserve considerable emphasis: (1) More emphasis should be placed on drilling costs. This could conceivably follow the line of complete change in drilling methods, as well as more intensive supervision and improvement of present technique; (2) emphasis should be placed on the productivity of possible productive zones. Undoubtedly this will be one of the foremost research problems to be attacked in the future. Present case-histories emphasize the importance of such studies; (3) the third factor is that of probability. This would involve a continuing and more detailed statistical analysis somewhat along the line of this report. A. H. N.

**439. Wells 12,000 Feet and Deeper.** E. Adams. *Petrol. Engr.*, Jan. 1946, 17 (4), 93.—Tabulated data are presented of all the wells drilled in the U.S. deeper than 12,000 ft. The number of 12,000-ft and deeper wells drilled each year was:

1935 . . . . .	1	1941 . . . . .	16
1936 . . . . .	1	1942 . . . . .	17
1937 . . . . .	4	1943 . . . . .	17
1938 . . . . .	15	1944 . . . . .	30
1939 . . . . .	23	1945 . . . . .	65
1940 . . . . .	16	1946 . . . . .	12 (Drilling)

Of the 217 wells described in the table of deep wells, 129 were dry, 76 are producers, and 12 are drilling. Of the producers, 31 were plugged back to sand above the 12,000-ft level. Data about the advisability of drilling to deeper levels than 12,000 ft is still too meagre to allow of any definite conclusions being drawn. A. H. N.

**440. Flame-Hardening Tool-Joints in the Field.** R. F. Arnoldy. *Oil Wkly*, 4.2.46, 120 (10), 24.—A flame-hardening unit that can be used in the field is described. The unit carries everything required with it, and in addition to operating during drilling operations will handle the work equally as well where nothing is on location except a rack and the pipe. It will harden 50 joints or 100 ends in 8 hours. The complete job on a 250-joint string can be done in five 8-hour shifts. The hardening element consists of an oxy-acetylene heating head with integral water quench which travels over the joint and progressively heats and quenches a surface depth as it travels. Travel is at variable speed, to compensate for changes in the section. A variable-speed motor with lead screw-drive provides this motion. Oxygen and acetylene are provided from a trailer on which is mounted a 300-lb acetylene generator and 6 standard oxygen bottles manifolded together. Water is supplied from an electrically driven pump. A gasoline-driven generator supplies current for this pump and the main drive-motor. Tanks on the truck are provided, as well as a large gasoline-driven pump, which is used to fill them. The unit is supported on a boom, which raises and lowers it off and on the pipe. The operation, which takes 5 minutes per joint, is described and illustrated. Graphs produced show a smaller rate of wear per ft of depth drilled when the joints are hardened than the rate of untreated joints. A. H. N.

**441. Drilling Mud Control in the Gulf Coast Area.** F. L. Wallace. *Petrol. Engr*, Jan. 1946, 17 (4), 196.—The materials used in controlling mud in the Gulf Coast Area are listed. Thus, for increasing weight barites is used, and bentonite is employed freely to increase the gel strength of the mud. The following chemicals are used to control viscosity: (1) Crude tannic acid crystals (pH 5.5); (2) Sodium acid pyrophosphate (pH 4.8); (3) Tetrasodium pyrophosphate (pH 9.9); (4) Caustic soda (pH 14.0); (5) Sodium tetraphosphate (pH 7.5). The term pH denotes the degree of alkalinity or acidity possessed by a solution of a substance. The scale extends from slightly below 1 to slightly above 14, the neutral point being the middle, or 7. Thus, a pH of more than 7 would be on the alkaline side and a pH of less than 7 would be on the acid side. The following materials are used to retain circulation: (1) A commercial product made from ground cane-stalks; (2) A commercial product containing small strips of cellophane; (3) A commercial flake mica; (4) A gel-type cement formed by adding a small amount of highly colloidal bentonite to Portland cement either in a wet or dry state; (5) Ground cotton-seed hulls, containing more linters than usually found in cotton-seed hulls; (6) Mixed ungraded chicken feathers; (7) Fine-shredded chicken feathers.

The different types of troubles encountered are discussed, and methods of solving them are given together with illustrative examples. A. H. N.

**441A. Effect of Arsenates on the Viscosity of Drilling Muds.** B. C. Craft and C. M. Moncrieff. *Petrol. Tech. (A.I.M.M.E.)*, Nov. 1945, 8 (6); *Tech. Pub. No. 1944*, 1-3.—The effect of arsenates on the properties of a bentonite-clay mud has been examined. Tetra-sodium pyroarsenate caused substantially the same reduction in viscosity and water loss as the complex phosphates. The complex arsenate showed a slightly higher reversion after heating for 16 hours than the complex phosphates. Neither trihydrodiorthoarsenate nor sodium dihydrogen orthoarsenate possessed good viscosity-reducing properties.

The arsenates are highly toxic, and their use would be limited in actual practice. G. D. H.

**442. Trinity's "Big Rig" Capable of Drilling to 20,000 ft in West Texas Area.** E. H. Short, Jr. *Oil Gas J.*, 16.2.46, 44 (41), 90-91.—The prime mover and the transmission system and a few other items of a rig which is expected to drill down to 20,000 ft in West Texas area are described. A. H. N.

**443. 5200 Quarts of Nitroglycerine Exploded in Canadian Well.** G. M. Wilson. *Oil Wkly*, 4.3.46, 121 (1), International Section 25.—In a Turner Valley well 5200 quarts of nitroglycerine were detonated inside the voids of the formation. Using a revolutionary method of handling explosives in connection with well rejuvenation, the engineers, employing only the hydrostatic pressure created by an 800-ft column of water above a 3500-ft column of nitroglycerine, successfully forced back into the crevices of the limestone formation all but 28 quarts of the explosive. Heart of the experiment was in the ingenious device, or "gun," which automatically detonated the charge at precisely the time when all but the last few quarts of nitroglycerine had been forced out into the open voids of the formation. The placing of the explosive and the special shoe used are described. Many interesting and novel effects of the more-than-a-mile deep record explosion were noted by both witnesses at the well and persons living in nearby communities. Contrary to what many of those near the well had believed, the shock was not felt at all at the derrick; in fact, observers standing 100 yards from the derrick had to be told that the blast had gone off. The only effect on the well itself was the lifting of the string of tubing when the shot went off. Prior to the final pouring of the water-tamp, the tubing was anchored down with steel rods and cable, in order to hold to a minimum any possible damage that might be caused by the tubing being kicked out of the hole. When the shot went off, however, these tie-rods were snapped like rubber bands and the tubing string jumped some 6 to 8 ft into the air, then fell back to within 3 to 4 ft of their original position, at which point the packer-slips took hold again. Water in the annular space between tubing and casing also was spilled out on the rig floor—a volume approximately equivalent to the volume displaced by the lifting of the packer. Shock of the explosion appeared to follow the general northwest-southwest trend of the structure. Sharply defining the known faults of the field, the shock-wave did not cross the fault-line into the gas-cap, which is cut off to the east, nor did it pass into the fault to the south. An amateur seismograph made by two schoolboys recorded the shock a mile south of the well. In a nearby town a man was almost thrown from the barber's chair, yet the shock was not noticed by other town-folk. Light snow covering the ground  $\frac{1}{4}$  mile from the well was seen to lift off the ground and remain suspended for a fraction of a second.

A. H. N.

**444. Use and Chemical Removal of Aluminium Pipe.** G. E. Clason. *Oil Wkly*, 4.3.46, 121 (1), 36.—In the California area long, perforated liners are used which allow easy removal for either reconditioning or deeper drilling. In the Illinois area blank sections are used opposite secondary pays, and are removed on the depletion and plugging back from a lower pay. Some few cases exist where the pipe is set through the pay and cemented with a secondary section on the bottom. This may then be gun-perforated, or removed entirely if necessary, to increase production. Oklahoma and North Texas now have many wells with the type of blank section installation usually called windows. There are still many areas where the advantages of this practice have yet to be learned. Use of the aluminium pipe sections should grow as more is known of its resistance to action of corrosive waters and the knowledge of its benefits are more widely disseminated. The removal of aluminium pipe by means of acid and caustic is discussed, but there are several disadvantages to such reagents. Sodium nitrate under certain conditions is found to be effective in dissolving aluminium with the production of sodium aluminate and ammonia. This method is briefly discussed.

A. H. N.

## Production.

**445. Colombian's Operations in Barco Concession Continue Expansion.** Anon. *Oil Gas J.*, 29.12.45, 44 (34), 245.—The daily average production in the Barco concession was about 16,500 bbl in the third quarter and over 15,000 bbl for the first ten months of 1945. The total for 1945 may be 3,850,000 bbl from the Petrolea field and 1,650,000 bbl from Tibu. 66 wells were producing Cretaceous oil from the Petrolea North Dome in October, 26 were shut in because of high gas/oil ratios, 7 were idle, and 31 abandoned. On the South Dome 1 was producing, with 6 abandoned.

The small Carbonera field has 2 wells giving about 30 bbl each per day. Tibu has

13 wells yielding Tertiary oil at the rate of about 200 brl/day. 7 Tertiary wells and 2 Cretaceous wells are shut in. At Rio de Oro 4 wells are abandoned and 9 shut in.

14 Tertiary producers have been completed on the northeastern part of the Socuavo structure in 1945.

Two deep Cretaceous tests are under way at Tibu. Stepouts in the Tibu structure have found the Tertiary sand development to be erratic. G. D. H.

**446. The Optimum Rate of Production.** P. J. Jones. Part 22. *Oil Gas J.*, 26.1.46, 44 (38), 289.—Rates of production proportional to reserve are uniform rates of depletion. The rate of production decline is uniform and equal to the rate of depletion. The initial rate of production is numerically equal to the rate of depletion. The optimum rate of production is the initial rate of production for which the rate of depletion is optimum. In terms of production decline, the optimum rate of production for the reserve recoverable at uniform rates of depletion is the initial rate of production for which the rate of production decline is optimum. Operating expenses usually increase as rates of production decline. So optimum initial rates of production are expressed in terms of average operating expenses that are equivalent to the increasing expenses which usually accompany declining rates of production. These considerations are illustrated graphically and by examples. A. H. N.

**447. The Optimum Rate of Production.** Part 23. P. J. Jones. *Oil Gas J.*, 2.2.46, 44 (39), 72.—The optimum rate of production is slower for uniform than for declining rates of production. If a fraction of a reserve is recoverable at uniform rates of production and a fraction at declining rates of production, the optimum rate of production is some value between the optima for uniform and declining producing rates. The optimum rate of production also varies with the rate of production decline. This article is limited to declining rates of production for uniform rates of depletion. A procedure is illustrated for estimating the optimum rate of production for any combination of fractional reserves recoverable at uniform rates of production and depletion. A. H. N.

**448. The Optimum Rate of Production.** Part 25. P. J. Jones. *Oil Gas J.*, 16.2.46, 44 (41), 94.—The optimum investment in a reservoir and the optimum present value of a reserve area are reviewed in this final article of the series. The data are relative to a given producing and operating method. But the size of a reserve for a given reservoir may vary significantly with producing and operating methods. Investments and operating expenses also vary with producing and operating methods. This brings us to optimum producing and operating methods. The problem of selecting the optimum producing and operating method for a reservoir may be more significant than that of estimating the optimum rate of production for a given producing and operating method. On the other hand, from the viewpoint of individual leases and migration of hydrocarbons in reservoirs, producing and operating methods are probably always more significant than the optimum rate of production.

However, the optimum rate of production is the background on which estimates of optimum producing and operating methods are made for reservoirs and for leases. This is why optimum producing and operating methods in the order of presenting these series on the production of oil, condensate, and natural gas. A. H. N.

**449. Reservoir Engineering in 1945.** M. Muskat. *Petrol. Engr*, Jan. 1946, 17 (4), 51-54.—A review of the technical achievements in reservoir engineering made in 1945 and of the important papers which appeared in the press is presented. 41 references to important papers are given. A. H. N.

**450. Running Instruments in Annulus of Tubed Wells.** C. C. Olson. *Oil Wkly*, 4.3.46, 121 (1), 33-34.—In pumping wells time and labour can be saved when making subsurface pressure studies if an annulus head is installed so that instruments can be lowered without pulling the well. In order to reduce the down time, and also to eliminate the use of the pulling unit and crew, 100 wells were equipped with annulus-type tubing heads. In these key wells 180 runs were made. The instrument fouled

around the tubing, preventing its removal 33 times. This required the use of the pulling unit and crew to raise the head in order to free the instrument. In order to eliminate the use of the pulling unit and crew, a hydraulic lifting device was designed and constructed, and the instrument was then removed in approximately 1 hour by two men. The use of the annulus head and the portable lift equipment saved 8 crew hours on each pressure measurement. The development of the well-head and the use of the system are detailed.

A. H. N.

**451. Impact of Wartime Conditions on the Petroleum Producing Industry.** L. C. Uren. *Petrol. Engr*, Jan. 1946, **17** (4), 203.—Professor Uren discusses briefly the significance of recent advances to the oil industry. In his view, for instance, there is nothing in present knowledge of nuclear physics to justify the idea that energy from this source will seriously influence the demand for petroleum products, within the foreseeable future. However, advances in the electronic field have contributed to the analytical side of the industry in large measures. Briefly these advances, as well as those made in synthetical operations, metallurgy, and radioactivity logging, are reviewed.

A. H. N.

**452. Oil Reservoir Energy—Analyzing Its Source.** K. M. Fagin. *Petrol. Engr*, Jan. 1946, **17** (4), 218.—The mechanisms of water, gas-cap, and dissolved gas-drives are described. The simultaneous functioning of all three drives in producing oil from a reservoir is explained. A table gives the main characteristics of reservoirs under the different types of drives.

A. H. N.

**453. The Electrolytic Model and Its Application to the Study of Recovery Problems.** H. G. Botset. *Petrol. Tech. (A.I.M.M.E.)*, Nov. 1945, **8** (6); *Tech. Pub. No.* 1945, 1-10.—Electrolytic models allow the simulation of water-flooding and gas-recycling systems, as well as the encroachment of a natural water-drive. In a few days, and at a negligible cost, it is possible to obtain qualitative and roughly quantitative data on the effects on recovery of variation in the distribution and rates of operation of input and output wells in a given field.

The results from these model experiments represent highly idealized conditions practically never found in actual field operations. Nevertheless, the pictures obtained in experiments on a given field, when considered in conjunction with the variations in porosity, permeability, sand thickness, etc., afford information obtainable in no other way, and should aid in planning a better operating technique.

The principles of operation and the apparatus are described in some detail, together with the method of operation and the limitation of the electrolytic model technique.

G. D. H.

**454. A New Technique for Determining the Porosity of Drill Cuttings.** M. A. Westbrook and J. F. Redmond. *Petrol. Tech. (A.I.M.M.E.)*, Nov. 1945, **8** (6); *Tech. Pub. No.* 1943, 1-4.—Cores are not always available for porosity studies, and therefore a method employing drill cuttings is of considerable value. The cuttings are washed, and extracted, after which a weighed quantity is saturated with water in a graduated vessel in order to determine the volume of the grains. The bulk volume of the cuttings is obtained by removing excess water by suction on a porous plate, after which the volume they displaced is measured.

Low-permeability cuttings may present difficulties.

The cuttings analyzed should be representative of the interval under study. They should be picked free of shale, and should be as large as possible. In zones of special interest it may be necessary to drill only about 2 ft and circulate all cuttings out of the well before drilling. Reverse circulation may be helpful in giving large cuttings without much mixing.

G. D. H.

**455. Predictions of Behaviour in Air-Gas Drive.** R. J. Day and S. T. Yuster. *Oil Wkly*, 18.2.46, **120** (12), 18.—A linear function is shown to exist between liquid saturation of long cores, under air drive in the laboratory, and the logarithm of the volume of air necessary to reach that saturation. The equation so obtained for laboratory performance is used as a basis for the derivation of an equation describing field behaviour under constant rate of air injection. The field equation states that the reciprocal of

the oil-production rate is a linear function of the elapsed time. The validity of the field equation was verified by the use of data from five leases. Fair correlation was obtained between the constants of the equation for the field relationship with the corresponding constants for the laboratory relationship. An equation for the accumulative oil production in the field is derived, which states that the production over a given period of time is proportional to the logarithm of the ratio of the initial and final oil-production rates. Agreement was obtained between actual production and that calculated by use of this equation.

A. H. N. \*

**456. Precision in Bottom-Hole Pressure Measurement.** E. R. Brownscombe and D. R. Conlon. *Petrol. Tech. (A.I.M.M.E.)*, Nov. 1945, 8 (6); *Tech. Pub. No. 1942*, 1-14.—Reservoir-pressure measurements involve gauge errors and interpretation errors. The former errors may be reduced by: (1) reading the charts with a comparator microscope; (2) using a stylus point with a special noble-metal tip, drawing on copper charts with uniformly heavy coatings, to give fine, clear lines; (3) ensuring temperature equilibrium; (4) making multiple tests. Check calibrations are quite as important as check well tests. A statistical study of such check tests shows the advantages of a standardized "zero pressure line," and of the making of field calibrations at bottom-hole temperature and their recording on the same chart as the well run.

Interpretation errors may be reduced by correcting fluid-heads to the top of the perforations on the basis of well-fluid gravity, and correcting from the top of the perforations to the datum level on the basis of reservoir fluid gravity. Allowance should also be made for the pressure gradients around the well. Conventional shut-in periods may be quite inadequate to eliminate the pressure gradients, and it may be necessary to make reservoir studies based on build-up curve data, reservoir history, core analysis, and any other available information.

When pressure data of high accuracy are available it is possible to employ them in such matters as reserve estimates at an earlier date than is otherwise practicable.

G. D. H.

**457. Effect of Reservoir Fluid and Rock Characteristics on Production Histories of Gas-Drive Reservoirs.** M. Muskat and M. O. Taylor. *Petrol. Tech. (A.I.M.M.E.)*, Sept. 1945, 8 (5); *Tech. Pub. No. 1917*, 1-16.—Theoretical investigations have been made on the performance to be expected of gas-drive reservoirs for various characteristics of the oil and gas and the producing rock. Such performance has been expressed graphically as curves for the reservoir pressure and gas-oil ratios of the production as functions of the cumulative oil recovery. The latter has been expressed in terms of percentage of pore space of the reservoir rock. Such curves automatically give values for the ultimate physical recovery, if the latter is interpreted as the recovery obtained when the reservoir pressure has declined to atmospheric or to any other pressure chosen as defining the state of practical complete depletion.

Calculations of these pressure and gas-oil ratio histories have been made for conditions in which the oil viscosity, the gas solubility and shrinkage, the size of the overlying gas cap, if present, the permeability-saturation characteristics of the rock, and the amount of connate water, have been separately varied. The results show the extent to which the ultimate recoveries are sensitive to the important physical parameters characterizing the oil reservoir.

The ultimate recoveries were found to decrease with increasing oil viscosity. Because of the predominating effect of oil shrinkage associated with the liberation of gas from solution, the ultimate recovery decreased with increased gas solubility. Increasing the gas-cap volumes led to higher recoveries, although the contribution made by the gas-cap was small as compared with the oil expulsion by an equivalent amount of solution gas.

On the whole, the oil recovery when expressed as a percentage of the pore space was not very sensitive to the details of the permeability-saturation relationship. However, if the rocks possess an equilibrium free-gas saturation the rise in gas-oil ratio will be retarded, and the ultimate recovery increased.

The oil shrinkage associated with the liberation of dissolved gas leads to the result that so long as the connate water is immobile and the permeability ratio curve for the rock is a function only of the total liquid saturation, the stock-tank oil recovery will



be less for a sand containing no connate water than for one with an original water content as high as 30%. The space voidage in the former case will be rather greater, but the effect of oil shrinkage will lead to smaller values for the equivalent stock-tank recovery.

Curves are given showing the variation of the productivity indexes of wells during the reservoir history. Because of decreasing permeability to oil and increasing oil viscosity, the productivity index will fall continuously as production proceeds, and may ultimately reach values as low as 10% of the initial productivity index.

G. D. H.

**458. Investigation of Factors that Affect Fluid Flow in Porous Media.** R. Sneddon. *Petrol. Engr*, Jan. 1946, 17 (4), 55-56.—Details of core analysis for grain-size, porosity, and permeability are presented. The use of such test results in the study of factors affecting underground flow of fluids is given in a brief, qualitative discussion.

A. H. N.

**459. General Value of Input and Producing Records in Secondary Recovery.** Anon. *Oil Wkly*, 4.3.46, 121 (1), 26-28.—The thesis of the paper is that study and control of volumes and pressures at the input well is a more definite and an easier way of controlling production from a pool than control or remedy at the outlet wells. Graphs for volumes v. pressure for normal and for channelling production are given. On injection of water or gas, there is a time lag after which an increase in production ensues. Following this first increase, the danger point in a normal repressuring project is present due to the possibility of input gas channelling to a producer and not establishing an oil-moving pressure gradient. Periodic gas-oil ratio tests will reveal channelling of input gas if a sudden and large increase is noticed in produced gas volumes. If channelling takes place, the producer affected usually shows an increase in both oil and gas production at first, followed by a decrease in oil production and an increase in gas production. The increase in gas production will depend on the completeness of the channelling as well as input gas volumes. It has been found that corrective measures applied to producing wells to prevent or stop channelling, such as holding back pressure on the well or raising the fluid level in the same, does retard gas movement through the channelled section, but also decreases or completely stops oil production, due to the increased back pressure applied to the producing well bore. It is being generally accepted that any corrective measures to control channelling should therefore be applied to the input well. Different cases are discussed.

A. H. N.

**460. Oil and Gas Reserve Estimation Charts.** D. G. Barnett. *Oil Wkly*, 4.3.46, 121 (1), 22-24.—The charts can be used for estimating reserves from the four primary factors: productive area, average thickness of sand, effective porosity which is the gross porosity minus the allowance for connate water, and the pressure under which gas exists, commonly taken as the well-head shut-in pressure.

A. H. N.

**461. Some Practical Aspects of Radioactivity Well Logging.** W. J. Jackson and J. L. P. Campbell. *Petrol. Tech. (A.I.M.M.E.)*, Sept. 1945, 8 (5); *Tech. Pub. No. 1923*, 1-27.—The principles and equipment employed in gamma-ray logging and in neutron logging are briefly described. Both can be employed in cased holes. Limestones and sandstones give minima on the gamma-ray curves. In neutron logging formations containing hydrogen-bearing substances, such as the fluids commonly found in the rock pores, give lower intensities than those which are denser and so contain less fluid. In this way a minimum on the neutron curve would indicate sandstone, and a maximum might indicate a dense limestone.

A series of examples of the application of radioactivity well logging are given. These include the following: selection of water shut-off; determination of formations in old wells with incomplete logs; location of formations for salt-water disposal; detection of water-bearing beds in old wells; location of porous zones in limestones; location of oil and gas zones; permeability studies by means of pumping in fluid with a radioactive tracer; determination of cement emplacement by carnotite in the cement; detection of direction of travel of cement in squeeze cementing; geological correlation; logging in salt-water muds and in oil-base muds; logging when difficult conditions such as

high pressures have required the running of casing without an electrical log being made; location of casing seats; clarification of doubtful data.

An experimental electrical collar locator has been devised to record the position of casing collars on the gamma-ray logs. G. D. H.

**461A. The Wire-Line Tubing Perforator and its Use to Complete Wells for Gas Lift in the Gulf Coast Area.** J. O. Farmer. *Petrol. Tech. (A.I.M.M.E.)*, Sept. 1945, 8 (5); *Tech. Pub. No. 1881*, 1-12.—The wire-line tubing perforator is a mechanically operated tool that is run on an ordinary steel measuring line into the tubing of a well, under pressure, to drive into the wall of the tubing, and securely lock in place, a tapered, cylindrical insert containing an orifice. Use of the perforator obviates the necessity of pulling and re-running the tubing to install jet collars or flow-valves, reduces the cost, and simplifies the task of placing an oil-well on gas-lift operation. Of more importance is the use of the tool with a removable check valve and stop, to provide a means of washing drilling mud from the annulus between the tubing and casing, and to complete the well for gas-lift operation without exposing the producing formation to the mud column and without moving the tubing-string.

The origin, development, and mechanics of the wire-line perforator are discussed, together with the various purposes for which the tool was designed and the method of selecting orifice sizes for any depth, and the results obtained thus far in practical operation are given. G. D. H.

**462. Salt Water Disposal Problems.** O. S. Jones. *Oil Wkly*, 28.1.46, 120 (9), 34.—The chemical constituents of oilfield brines are discussed. It is suggested that for those brines containing large amounts of magnesium, the recovery of the metal may pay for the whole disposal unit.

An interesting historical development of the practices of salt-water disposal from the early times of the industry up to date is presented. After a period of unchecked disposal into creeks and streams, ponds were used, but these were found ineffective, due to underground seepages and contamination. A. H. N.

**463. Subsurface Brine Disposal.** O. S. Jones. *Oil Wkly*, 4.2.46, 120 (10), 27.—This paper is a continuation of the paper abstracted above (No. 462). Shallow horizons—i.e., down to 1000 ft below ground—have not proved successful brine-disposal reservoirs in all circumstances. After a brief discussion of the advantages of deep-disposal sands, the structure of brine-disposal associations and their development are given in brief. The use of brines for secondary recovery has been successful in several projects. Legislation against pollution of fresh water and of land for cultivation is briefly discussed. A. H. N.

**464. The Engineering of Oil-Well Abandonments.** W. E. Schoeneck. *Petrol. Tech. (A.I.M.M.E.)*, Nov. 1945, 8 (6); *Tech. Pub. No. 1946*, 1-12.—The circumstances which lead to the abandonment of producing wells are worthy of study.

All available data on the drilling, testing, and completion of a well should be studied, together with its production history. The production trend may be deduced from curves, and by examining the results of acidizing, the possible effects of further acid treatment may be predicted. Maps showing features such as oil and water production, water encroachment, gas-oil ratios, and types of equipment are valuable.

After analyzing the data it is necessary to consider whether any treatment will provide sufficient increase in production to merit its application. Efforts may be made to reduce gas-oil ratios and water production, to increase the reservoir permeability by acid treatment, to remove clogging materials, or to raise the efficiency of lifting equipment. Production from other horizons may be considered, as well as the possibilities of secondary recovery. Costs must be examined, and salvage values taken into account.

If all the pertinent factors are properly considered, it is believed that there will be greater accuracy in the determination of non-profitable wells, and conversely production may be continued in wells which otherwise would be abandoned prematurely.

G. D. H.

## Oilfield Development.

465. Clay Research and Oil-Development Problems. J. C. Griffiths. *J. Inst. Petrol.*, Jan. 1946, 32 (265), 18-31.—The significance of the physical and chemical properties of various types of clay in the evaluation and development of oil reservoirs is outlined. A plea for a greater amount of research and study of reservoir rock petrology and mineralogy is made.  
A. H. N.

## TRANSPORT AND STORAGE.

466. Graphic Solutions of Design Problems. 1. Fluid Flow in Pipes. P. Buthod and B. W. Whiteley. *Oil Gas J.*, 20.10.45, 44 (24), 122.—The first of a series of twelve articles on the solution of fluid-flow problems.

Fluid flow involves all energy effects which in practice must be known in order to state power requirements, discharge rates, and other design information. For incompressible fluids and isothermal conditions this can be stated in the form of an energy equation, while for compressible fluids when heat effects are involved this equation is expressed in a different form, involving thermodynamic functions. It may be shown that for Reynolds number (a function of density and viscosity) under 2000 viscous flow is obtained, while above a Reynolds number of 3000 or 4000 the fluid motion becomes turbulent. The importance of the Reynolds number lies in that, knowing this, the friction factor may be readily determined, permitting reliable prediction of pressure loss, discharge rates, etc., for flow of liquids or gases of widely varying viscosities and densities.

Modes of expressing Reynolds numbers, and its determination for particular flow conditions by means of a chart (which is included) are given.  
T. M. B. M.

467. Design of Structural Details for High Towers. J. Yeakel. *Refiner*, Dec. 1945, 24 (12), 513-514.—The principles of designing anchor-bolts and ring-plates are detailed, and an example illustrates the method.  
A. H. N.

## REFINERY OPERATIONS.

## Refineries and Auxiliary Refinery Plant.

468. The Refiner's Notebook, Temperature Difference in Exchangers. Anon. *Oil Gas J.*, 22.12.45, 44 (33), 91.—The theory of heat exchangers is discussed, together with factors which determine their efficiency, and examples of typical calculations are given. The rules given introduce an error of less than 4½%, which is considered to be far less than errors introduced by lack of knowledge of transfer rate and other uncertainties.  
T. M. B. M.

469. Peacetime Utility of Wartime Petroleum Refining Processes. F. D. Parker. *Petrol. Engr*, Dec. 1945, 17 (3), 116.—A statistical report indicating the task performed by the U.S. refining industry during the war years and the size of the problem of reconvertng it to peace-time demands.  
T. M. B. M.

470. Cost Accounting in Refinery Construction. R. C. Lewis. *Refiner*, Jan. 1946, 25 (1), 30-35.—The advantages of keeping accurate and detailed cost accounts are given, followed by a description of the different cost codes which are used: those adopted by the U.S. Army Corps of Engineers, Aberthaw Co., and Morton C. Tuttle Co. of Boston, Massachusetts, and E. B. Badger & Sons Co., Boston. The application of the different codes is described.  
A. H. N.

471. New Refinery Construction under way and Projected in Venezuela. Anon. *Oil Gas J.*, 29.12.45, 44 (34), 273.—Turiamo, situated on Turiamo Bay (20 km. east of Puerto Cabello) has been selected by Creole for their new 40,000-brl refinery. This will cost about \$50,000,000, and will produce aviation and motor gasoline, kerosine,

industrial, automotive and marine diesel oils, lubricating oils of all types, greases, industrial and marine bunker fuels, and asphalts.

In addition to the 38,000 brl/day refinery of the Shell Group at San Lorenzo, Lake Maracaibo, a new refinery near Punta Cardon (Paraguana Peninsula) is planned. This plant will have a capacity in excess of 40,000 brl, and will be owned and operated by the Shell Co. of Venezuela. The cost is expected to be in excess of \$45,000,000.

The Compania Consolidada de Petroleo has also made plans for the construction of a 35,000-brl refinery. T. M. B. M.

**472. Germany's Progress in Straight Refining is Reported Inferior to U.S. Advances.** W. F. Bland. *Nat. Petrol. News*, 3.10.45, **37** (4), R763.—During the war, German methods of straight refining and production of high-quality products were far less efficient than those used by the Allies, but technological progress in synthetic fuels and lubricants was much more rapid.

The octane ratings of both their motor and aviation fuels were considerably less than the standard 80 and 100 octane used by the Allies. Synthetic production of petroleum products increased rapidly during the war from about one-third of total consumption to over 60% in 1944 (crude petroleum being the source of only 40%). At this peak aviation gasoline production was still less than 10% of that of the Allies (500,000 brl/day).

Two grades of aviation gasoline were produced, bomber and fighter, both comparable to our own on rich mixture, but about 91 and 95 octane respectively on lean rating. Modified engine design gave service on these fuels comparable with results obtained on our own. A fuel of rating less than 80 was used for ground transport.

Although the Germans had done a great deal of work on catalytic cracking, they never had any actual production units in operation, probably owing to their existing coal hydrogenation and reforming processes. Also they were limited in the supply of crude oil. Their aviation base stock was blended with small amounts of alkylate, and *isopentane* and T.E.L. was used to the extent of 4–5 cc/gal. Nothing was developed superior to T.E.L.

Two gasoline additives were developed to prevent corrosion due to water injection, these were: (a) Dodecylphenyl chloride condensed with glycine (*cyclohexylamine* salt); and (b) *isoButyl cyclohexyl butyric acid* (*cyclohexylamine* salt).

*Polyisobutylene* was used to improve the viscosity of lubricating oils, and *polyvinylol* ether and its copolymers with vinyl *isobutyl* ether were used as pour-point depressants.

A concerted effort by the Germans to move their refineries underground was made, but fewer than ten were actually in underground operation, with many more in various phases of completion. This did not include hydrogenation equipment, owing probably to the tremendous pressures frequently used and the risks inherent in mechanical failure and subsequent explosion.

The methods to be employed by the United States in disseminating technical information as to German refining and production methods are given. T. M. B. M.

**473. Improved Operating Techniques in Refining will Accrue from Atomic Bomb Research.** Anon. *Nat. Petrol. News*, 3.10.45, **37** (40), R836.—Among the peacetime technological advances from atomic bomb research which are important to petroleum refiners are the following: (a) *Corrosion prevention*. New methods have been worked out for pretreating metals to be resistant to highly reactive compounds such as uranium hexafluoride; (b) *Pumps*. A significant advance in pump design provides for utilization of supersonic velocities; (c) *Barriers for gas diffusion*. The new techniques worked out for diffusional separation may be used for isolating hydrogen from process gases and ethylene from cracked gas oil; (d) *Instruments*. New types of precise, continuous automatic analytical control instruments should become available to the industry; (e) *Leak detector*. The application of a highly sensitive leak detector which was used to locate leaks in high-vacuum plant, checking equipment, and testing welds is foreseen; (f) *Heat exchangers*.

A new type of mass spectroscopy developed at Oak Ridge is believed to be applicable to the control of cracking operations and transfer-line analysis, as well as accurate analysis of natural gas, continuous automatic control of gaseous processes such as alkylation, dehydrogenation, and vapour-phase cracking. T. M. B. M.

## Distillation.

**474. Compression Distillation.** A. Latham, Jr. *Refiner*, Dec. 1945, 24 (12), 515-518.—*Paper presented before American Society of Mechanical Engineers.* Compression distillation depends on mechanically compressing the steam or other vapour leaving the evaporation compartment of the still. This compression raises the temperature of the steam a few degrees. At the higher pressure the steam condenses at a temperature somewhat higher than the boiling point of the evaporating raw water, so that heat can flow from the condensing steam to the raw water and boil it. In engineering terms, the condensing vapour is used to supply heat inside the steam-chest of the still in place of steam from sources outside the unit. Efficient provision for reducing heat loss to the atmosphere and recovering heat from the distillate and the concentrate carrying out waste as they cool down to room temperature completes the system. No separate condenser or cooling water is needed. The overall fuel economy of the most recent Kleinschmidt compression stills—averaging at least 175 lb of distillate for each lb of fuel consumed—is believed to be the highest of any self-contained system of evaporation.  
A. H. N.

**475. Commercial Synthesis of Toluene by Hydroforming, and Recovery by Azeotropic Distillation.** F. L. Hartley. *Refiner*, Dec. 1945, 24 (12), 519.—*Paper presented before California Natural Gasoline Association.* The elements of hydrocarbon chemistry and of hydroforming are outlined, followed by a brief discussion of the isolation and purification of toluene of nitration grade by means of azeotropic distillation.  
A. H. N.

**476. The Refiner's Notebook. Number of Fractionating Trays.** *Oil Gas J.*, 6.10.45, 44 (22), 117.—The measurement of fractionation by means of the gap or overlap of the distillation ranges of the products is described. Using A.S.T.M. distillation temperatures, the gap or overlap of the temperature of the 95% point of the low-boiling product and the 5% temperature of the high-boiling product are compared, and tables showing the relation between these and the number of theoretical plates at various reflux ratios are given.  
T. M. B. M.

**477. High Recovery, Superfractionation Mark Superior's Lake Creek Operations.** A. L. Foster, *Oil Gas J.*, 2.2.46, 44 (39), 50.—A description of the Superior Oil Co's Lake Creek plant for gasoline recovery from wet cycle gas. The plant is designed to treat 58 million cu ft of gas containing 6.5 gal/1000 cu ft of  $C_3$ 's and heavier. It is said to be capable of recovering 65,000 gal/day of propane, 43,000 gal of isobutane, 65,000 gal of *n*-butane and 30,000 gal of isopentanes and should yield 150,000 gal of isobutane and isopentane-free natural gasoline along with a 2500-brl/day capacity for stabilized distillate. The range of the latter product includes gas oil and yields kerosine and motor gasoline.

The plant is similar in general operation to others of its kind, but embodies several distinctive features such as the following: (a) propane refrigeration system, controlling the gas and oil temperature, an important factor in ensuring good propane and heavier recovery; (b) automatic gas injection temperature control; (c) automatic booster compressors (two 225-h.p. Ingersoll Rand units increasing discharge pressure on any desired proportion of the injection gas from 4100 to 4900 lb/sq in); (d) automatic speed and pressure control of compressor engines; (e) automatic temperature shut-down device on compressor cylinder-packing glands to guard against rise above normal operating temperature.

A vapour-recovery system whereby all tank vehicles are loaded under slight pressure, the vapours being collected and returned to the plant, is employed, and is responsible for approximately 1% of production.

All plant processes are discussed in detail and a flow-sheet is included.

T. M. B. M.

**478. No Peace for Fractionators.** P. J. Harrington, B. L. Bragg III, and C. O. Rhys, Jr. *Refiner*, Dec. 1945, 24 (12), 502-506.—*Paper presented before American Petroleum Institute.* The war has increased the amount of engineering research in the petroleum industry to improve the efficiency and capacity of refinery process unit operation

equipment, such as fractionating towers, furnaces, heat exchangers, mixers and separators, compressors, and pumps. Examples of how this problem was approached in one company on one type of operation during the war are given. Minor changes in the internal structure of towers of representative pre-war design increased atmospheric crude pipe-still throughputs from less than 30,000 bbl capacity to 40,000-50,000 bbl, with excellent separating efficiency while representative light ends fractionators for separating iso- and normal butane were increased in limiting vapour loads from 20,000 to 45,000 bbl at over 100% efficiency. Through the Technical Advisory Committee of the Petroleum Industry War Council, and through the Petroleum Administration for War, the findings have been made available during the war to assist the industry in its war work. Extension of this type of engineering research is recommended.

A. H. N.

### Cracking.

**479. Vapour Phase Oxidising Cracking of Oil Products.** L. J. Berents and V. E. Glushner. *Nat. Petrol. News (Tech. Sec.)*, 7.11.45, **37** (45), R912.—An experimental study has been made of the vapour-phase cracking of oil products in the presence of oxygen with particular attention to the influence of temperature, reaction time, and concentration of oxygen.

The charging stocks included a gasoline fraction, a cracked kerosine, gas oil, and mazut, and the cracking experiments were performed in iron reaction tubes heated in ordinary laboratory furnaces.

Examination of both liquid and gaseous reaction products was carried out and compositions determined.

Results indicated that the presence of oxygen increased the velocity of reaction at temperatures not exceeding 700-720° C reaction velocity increasing with oxygen concentration. With the gasoline portion such cracking can be described by the equation for a first order reaction.

It is claimed that by oxidizing cracking a high percentage conversion and increased yields of aromatics can be achieved at temperatures lower than those required in ordinary cracking.

D. L. S.

**480. Simplified Catalytic Cracking Unit Meets Requirements of Smaller Refiners.** N. K. Anderson and M. J. Sterba. *Oil Gas J.*, 22.12.45, **44** (33), 77; *Petrol. Engr.*, Dec. 1945, **17** (3), 62; *Refiner*, Dec. 1945, **24** (12), 497-501.—A smaller capacity cracking unit has been designed for the use of the refinery of relatively small throughput, the details being based on experience in building and operating wartime fluid units. The plant operates at temperatures of from 800° to 1000° F on stocks ranging from naphthas to topped crudes, fed to the catalyst section without pre-flashing. Mechanical design is simplified greatly by placing the regenerator immediately above the reactor, in the same column. The microspherical form of catalyst is used in the new adaptation of the fluid process. Yields of 45-53% of gasoline are obtained, with octano ratings of 79-82 (A.S.T.M.).

Operating costs vary from 23.8 c/bbl of charge for a 4500-bbl unit with natural catalyst to 44.0 c/bbl of charge for a 900 bbl/day unit with silica-magnesia or silica-alumina synthetic catalyst.

Photographs, flow-sheets, and full details as to operating costs are included.

T. M. B. M.

### Isomerization.

**481. Fundamentals of Isomerization for Operators.** J. S. Finger. *Refiner*, Jan. 1946, **25** (1), 17-22.—The elementary chemistry of paraffin hydrocarbon is presented together with practical remarks on the running of isomerization plants, general types of units available, and pertinent warnings against corrosion hazards with aluminium and hydrogen chlorides and their mixtures.

A. H. N.

**482. Thoria-Alumina Catalyst Best for isoParaffin Synthesis.** Anon. *Oil Gas J.*, 19.1.45, **44** (37), 86.—A review of Technical Report No. 110-45 (U.S. Navy Office of

Research and Inventions) on research carried out at the Kaiser Wilhelm Institute in Germany on catalysts used in Fischer-Tropsch isoparaffin syntheses.

Thoria-alumina catalyst, in which the components are present in 1 : 4 weight ratio, is shown to be the most efficient discovered in Germany, being superior to zinc oxide, although more expensive. Higher gas velocities may be used, and alcohol formation tendencies are slight. Varying the  $Al_2O_3$  content of the catalyst between 20% and 40% makes little difference, but further increase gives higher methane formation. Methods of preparing the catalyst are given.

Pressures of 300 atm and temperatures of from 420° to 450° C were found the best conditions for the formation of isoparaffins from carbon monoxide and hydrogen. The yield drops rapidly below this pressure, but increasing pressure gives a greater proportion of oxygen-containing compounds. Temperatures below 450° C show increases of alcohol and unsaturated materials, but with increasing temperature the products become mainly naphthenic.

T. M. B. M.

### Chemical and Physical Refining.

**483. Regeneration of Caustic Solutions for Gasoline Treating by Catalytic Air Oxidation.** D. C. Bond. *Oil Gas J.*, 8.12.45, 44 (31), 33.—A description of the Mercapsol process of mercaptan sulphur removal from gasoline (as against the conversion of mercaptans to disulphides) which depends on air-blowing in the presence of an efficient catalyst composed of an inexpensive wood-tar fraction. The spent mercapsol solution can be regenerated by air-blowing, or steam if mercaptan sulphur concentration is above 0.02%.

A laboratory procedure for testing the efficiency of catalysts for oxidation using *n*-butyl mercaptan in caustic soda solution is given, and the results obtained with a number of catalysts tabulated.

The theory of the rôle of the catalyst in the oxidation of mercaptans is discussed, and the conclusion is reached that catalysts which are suitable for sweetening by oxidation of mercaptans and regeneration by air must be such as to form quinones when oxidized, and the hydroquinones upon reduction.

A flow diagram of a mercapsol-air regeneration unit is given. The gasoline to be treated is passed through a packed tower countercurrent to a mercapsol solution containing a small amount of wood-tar oxidation catalyst. Gasoline from the treating-tower is passed through a water washing-tower and a salt drying-tower. If the raw gasoline contains much hydrogen sulphide, it is given a caustic-soda wash prior to this treatment. Spent mercapsol solution is passed into a packed air-blowing tower kept at 100–120° F, from which it passed into a settling-tank when the small amount of gasoline separates, washing out a large part of the disulphides formed during regeneration. The settled catalyst solution then passes through a gasoline wash, when disulphides are removed more completely, yielding the completely regenerated solution.

The results of tests on representative samples of gasoline treated by this catalyst are given, as well as costs of catalyst, steam, air and equipment, and details as to gasoline loss. A list of references to the literature is appended.

T. M. B. M.

### Special Processes.

**484. Fischer-Tropsch and Hydrogenation Plants in Ruhr Valley, Studied by Joint Mission.** Anon. *Nat. Petrol. News (Tech. Sect.)*, 7.11.45, 37 (45), R861.—C.I.O.S. Report (Index No. 17), *Investigation of Ruhr Synthetic Oil Plants*, is an account of a visit made by a combined group of British and American petroleum technologists to ten Ruhr plants in April 1945.

Seven Fischer-Tropsch plants were visited, and particular interest was shown in the medium-pressure catalyst ovens, which consisted of a nest of pairs of vertical tubes one inside the other with the catalyst in the annular space. The ordinary Co-Th-Mg-kieselguhr catalyst was apparently used, although an Fe catalyst was being considered for a new projected plant.

Three hydrogenation plants were examined, and it was concluded that in coal hydrogenation little that was new or different from British practice had been developed.

A process (D.H.D. operation) for preparing aromatic gasoline by hydrogenating naphthenes was studied, but no information on the catalyst used is given.

The report concludes that scientific developments in these fields during the war were not very impressive, due perhaps to the need for concentrating on maximum production rather than on new methods and processes.

D. L. S.

**485. Synthetic Lubricants Made at Two Plants in France.** R. C. Aldrich. *Nat. Petrol. News (Tech. Sect.)*, 7.11.45, 37 (45), R859.—T.I.I.C. Report (Index No. 365) *Synthetic Lubricating Oil Production in France* describes two French plants producing synthetic lubricating oils—a pilot plant operating a German process at Harnes (Lille), and a plant producing 25 tons products per day, using a French process and operating at Lestaque (Marseille). Both plants use a Fischer-Tropsch oil as the basic raw material.

The pilot plant uses a gasoline cut which is reacted with 3% aluminium chloride in a revolving cylindrical drum.

The oils produced are not of first-class quality, and tend to oxidize readily.

The Marseille plant uses a paraffinous Fischer-Tropsch gas oil, benzol, and dichloroethane as raw materials. The gas oil is chlorinated in a series of lead-lined tanks, while the benzol and dichloroethane are mixed in the presence of aluminium chloride in a mechanically stirred tank. The two products are then mixed, and the resulting liquid stripped of uncombined benzol.

Two grades of oil are produced by this process—a general machine lubricant of medium quality, and a high-quality product of K.V.I. 100 and claimed to consist of a polybenzene with a long saturated paraffin chain.

D. L. S.

**486. Acetylene Production by Electric Arc Cracking and Its Purification.** Anon. *Nat. Petrol. News (Tech. Sect.)*, 7.11.45, 37 (45), R866.—T.I.I.C. Report (Index No. 189), *Synthetic Rubber Plant Chemische Werke Hüls*, describes the production of acetylene at Hüls synthetic rubber plant by the electric arc cracking of natural gas (methane) or by product gas from coal hydrogenation (methane/ethane), using direct current at 7000 v. Conversions per pass through the arc is approximately 50%.

The exit gas from the reaction tube is cooled to 150°C and sent to two cyclones in series, where 60–70% of the carbon black is knocked down. Water spraying and filtering removes the remainder of the carbon, and this is followed by counter-current washing with an aliphatic oil to remove higher-boiling constituents. Passage through iron oxide boxes removes sulphur. Further purification by low-temperature distillation, low-temperature condensation, and evaporation using liquid ammonia and scrubbing with a petroleum distillate yields a 97–98% pure product.

D. L. S.

**487. Arc Cracking of Gases Yields Acetylene for Butadiene in Hüls Rubber Plant.** Anon. *Nat. Petrol. News (Tech. Sect.)*, 7.11.45, 37 (45), R865.—T.I.I.C. Report (Index No. 189), *Synthetic Rubber Plant Chemische Werke-Hüls*, is an account of a visit by a team of technologists to the Chemische Werke at Hüls in April 1945.

Buna S. type rubber was produced in this plant by polymerizing butadiene and styrene in a continuous process using six reactors in series. The butadiene was prepared from acetylene made at Hüls by the electric-arc cracking of methane and/or methane-ethane mixtures obtained essentially from nearby coal-hydrogenation plants. The acetylene was converted to acetaldehyde, which was in turn condensed to aldol. This was hydrogenated to butylene glycol, and subsequently dehydrated to butadiene.

Styrene was made by reacting benzene and ethylene in the presence of an aluminium chloride catalyst to form ethylbenzene, which was then dehydrogenated.

The plant had a rated capacity of 4000 tons/month, and made four types of Buna S, together with such by-products as carbon-black for tyres and diethylbenzene for blending in aviation gasoline.

D. L. S.

**488. Patent Trends in Petroleum Refining.** P. J. Gaylor. *Nat. Petrol. News*, 3.10.45, 37 (40), R833.—*Direct Amination of Olefines*. The Sinclair Refining Co. have announced a process for producing amines and nitriles by reacting olefines with ammonia in presence of a catalyst (U.S. Patents 2,381,470–3 and 2,381,709). Previous processes of this kind are briefly referred to, and flow-sheets of Sinclair's processes, and a list of suitable catalysts, promoters, and supports are given.



In one example *n*-dodecene-1 is reacted with anhydrous ammonia in presence of an active unpromoted cobalt catalyst suspended on asbestos at a temperature of 500–550° F for 20 hrs at 2000 lb/sq in. 50–60% of the olefin is consumed under these conditions, and nitrogen compounds are produced to about 12% of the weight of the olefin charged (20–25% of the olefin consumed). The nitrogen compounds are mainly lauryl and dilauryl amine and laurionitrile, with possibly lauric acid amide. Little data are given for lower olefines. Diolefins: A method covered by du Pont (U.S. Patent 2,381,038) involves the continuous production of diolefines by pyrolysis of chlorinated hydrocarbons. Pyrolysis of 2:3-dichlorobutane at 650° C results in a yield of 0.8 mole 1:3 butadiene, 0.15 mole chlorbutadiene, and 1.75 mole HCl per mole of dichlorobutane introduced. A flow-sheet is included.

*Polysilicones from Petroleum.* U.S. Patents 2,258,218–22 disclosed the production of silicone polymers by reaction of ether solutions of phenyl and methyl magnesium bromides with silicon tetrachloride under reflux for several hours. The mixture is hydrolysed over cracked ice, and the silicols thus produced washed with water and partly condensed to silicones. The condensation and partial dehydration take place in toluene solution as the toluene is driven off, followed by subsequent heating to 175° C.

The Montclair Research Corp. recently combined 10 of its patent applications in Brit. Appl. 7382/45 covering the production of organo silicon compounds from hydrocarbon halides. Silicon hydride is reacted with Grignard reagent, and an alkyl or aryl halide in presence of magnesium or lithium at refluxing temperature.

A list of selected patents of the month are also included.

T. M. B. M.

### Metering and Control.

489. Maintenance of Mercury-Type Orifice Meters. M. Welch. *Refiner*, Dec. 1945, 24 (12), 531–532.—This forms part of Southern California Meter Association Meter Course. A. H. N.

490. Telemetering and Remote Control. H. J. Keeling. *Refiner*, Jan. 1946, 25 (1), 40–41.—This paper is a reprint of a paper by the author which was presented in 1940 before the Southern California Meter Association, but it has been brought up to date. A. H. N.

491. Fundamentals of Control Equipment. C. Cortelyou. *Refiner*, Jan. 1946, 25 (1), 38–40.—This paper forms a part of Southern California Meter Association Meter Course. A. H. N.

### Safety Precautions.

492. Safe Practice in Oxy-Acetylene Welding. D. Attaway. *Refiner*, Dec. 1945, 24 (12), 493–496.—Safety rules are given for the generation and use of acetylene and oxy-acetylene welding and cutting. Safety precautions to be adopted with the use of the cylinders, hose, regulators, torches, and personal protection to be insisted upon are presented. A. H. N.

493. Some Notable Wartime Oil Fires. W. J. Wilmoth. *J. Inst. Petrol.*, Jan. 1946, 32 (265), 1–17.—Oil-fires which took place in Britain during the late war, and the practices adopted in fighting them are presented. A report of a discussion follows the paper. A. H. N.

## PRODUCTS.

### Chemistry and Physics.

494. Method for Predicting Phase Equilibrium Constants. C. G. Kirkbride. *Refiner*, Dec. 1945, 24 (12), 485–492.—An empirical method is presented for calculating the phase equilibrium constants of hydrocarbons, which appears to give results in some-

what better agreement with observed values than any previous method published. An empirical correlation for fugacity coefficient (fugacity divided by absolute pressure) has been developed which permits reasonably accurate predictions of phase equilibrium constants up to pressures of 2000-3000 psiA. The empirical fugacity coefficient is correlated with reduced pressure (absolute pressure of system divided by absolute critical pressure of component) and reduced temperature (absolute temperature of system divided by absolute critical temperature of component). The accuracy of the correlation has been checked against experimentally determined phase equilibrium constants for ethylene, ethane, propylene, propane, *isobutane*, *n*-pentane, benzene, *n*-heptane, toluene, *n*-octane, and *n*-decane. With the exception of *n*-decane, the predicted equilibrium relationships for all hydrocarbons investigated are in reasonably good agreement with experimental data reported in the literature by several investigators. Previous methods are evaluated, and are shown to be inferior in accuracy to the proposed method.

A. H. N.

**495. Fundamentals of Consistency and Viscosity. Part I.** J. J. Bikerman. *Refiner*, Dec. 1945, **24** (12), 507-512.—The fundamental concepts involved in the rheology of ideal liquids (Newtonian fluids) and ideal (Hookian) solids are given. The principles of viscometry are very briefly explained, and finally Maxwell's ideas about relaxation times and interrelationship between viscosity, elasticity, and relaxation times are outlined. The behaviour of viscous liquids under suddenly applied stresses becomes understandable through these concepts, as these liquids shatter like solids due to the shortness of time allowed them in which to relax.

A. H. N.

**496. Fundamentals of Consistency and Viscosity. Part 2.** J. J. Bikerman. *Refiner*, Jan. 1946, **25** (1), 23-29.—Non-Newtonian systems are discussed, and it is pointed out that there are a great number of ways in which a system may deviate from the "normal" or Newtonian behaviour. Thus it may not be possible to generalize the behaviour of all non-Newtonian systems, as is possible with Newtonian systems.

Plastic, pseudoplastic, and dilatant systems showing thixotropy or being independent of previous history are discussed. An important distinction is drawn between quartz suspension in water giving dilatant behaviour and, say, calcium naphthenate colloids showing similar behaviour, but probably due to a different mechanism.

A. H. N.

**497. Experimental Determinations of Vapour-Liquid Equilibria Between Natural Gas and 95% Diethylene Glycol, up to a Pressure of 2000 lb/sq in.** G. F. Russell, L. S. Reid, and R. L. Huntington. *Refiner*, Dec. 1945, **24** (12), 525-529.—*Paper Reprinted from Transactions of the American Institute of Chemical Engineers.* This experimental study, which is related to the dehydration of natural gas by diethylene glycol, was undertaken because of the need for equilibria data in the design and operation of high-pressure absorption plants. In the laboratory a concurrent vapour liquid contactor was used for the dynamic mixing of natural gas with a glycol-water solution of known composition. The total water and glycol-vapour content of the natural gas was determined by sorption in anhydrous magnesium perchlorate, while separately the glycol vapour was absorbed in distilled water. The water-vapour content was calculated by difference. These equilibria data are presented as a ratio of the mol fraction of the component in the vapour phase to the corresponding mol fraction in the liquid solution. Both water and diethylene glycol equilibrium ratios exhibit minimum values at approximately 1500 psi, passing into the retrograde condensation range above this pressure. A rapid decrease in dehydration efficiency at pressures exceeding 2000 psi is indicated.

A. H. N.

**498. Behaviour of Sodium Stearate with Cetane and Water.** R. D. Vold and J. M. Philipson. *J. Phys. Chem.*, 1946, **50**, 39-53.—The transition temperatures and solubility relationships of the binary system cetane-sodium stearate and the ternary system cetane-water-sodium stearate are presented, together with a description of the various phases, which are of a colloidal nature ranging through clear solutions of "solubilized oil" and emulsions to gels varying from transparent jellies to waxy solids.

The transition temperatures, determined by visual observation between crossed polaroids, were :

- $T_i$ , temperature of formation of a liquid isotropic to polarized light ;  
 $T_u$ , temperature at which an opaque anisotropic gel becomes relatively clear ;  
 $T_g$ , in the binary system, the temperature at which a gel melts sufficiently to flow, and is usually in the neighbourhood of  $T_i$  or  $T_u$  ;  
 $T_m$ , in the ternary system, the temperature at which the translucent gel formed below  $T_i$  becomes slightly opaque ;  
 $T_h$ , in the ternary system, the temperature below  $T_m$ , at which the gel becomes densely opaque.

In the binary system homogeneity occurred between 30% and 60% soap ; below and above these limits free cetane and sodium stearate respectively separated out. With decreasing concentrations of sodium stearate both  $T_i$  and  $T_u$  decreased in a series of steps.

The ternary system was examined by adding increasing concentrations of sodium stearate to the two other components, which had the compositions 1 : 3, 1 : 1, 3 : 1 cetane : water. At low stearate concentration each mixture consisted of two phases, which became harder and less gel-like as the soap concentration was increased.

$T_i$  for the binary system contained two maxima, corresponding to the presence of supernat and middle soap. For the ternary system one maximum, corresponding to the formation of supernat soap, was obtained when the solvent composition was 1 : 3 and 1 : 1 cetane : water ; and a minimum occurred when the composition was 3 cetane : 1 water. In all three cases  $T_h$  fell with decreasing concentration in an irregular manner.

Conclusions are : (1) the addition of water to the binary system diminishes the number of transitions undergone by the system ; (2) the effect of increasing the cetane content of the system, keeping the soap concentration constant, is to increase the temperature range of the resulting gels. Increasing the proportion of water promotes the formation of emulsions rather than gels at lower temperatures ; (3)  $T_i$  does not represent a phase change, although the change is from anisotropic gel to liquid ; (4) syneresis at a given temperature depends partly on whether isotropic liquid is present as an equilibrium phase.

H. C. E.

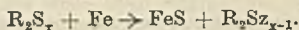
**499. Thermodynamic Properties of Propane and Butane.** Anon. *Oil Gas J.*, 2.2.46, 44 (39), 89.—The following properties of saturated propane and butane are given at 5° F intervals over the temperature range 0–100° F : (i) pressure in lb/sq in (absolute and gauge) ; (ii) specific volume in cu ft/lb for liquid and vapour ; (iii) density in lb/cu ft for liquid and vapour ; (iv) enthalpy in B.Th.U./lb for liquid and vapour ; (v) latent heat in B.Th.U./lb ; and (vi) entropy in B.Th.U./lb/° F for liquid and vapour.

(iv) and (vi) are referred to saturated liquid at –200° F where the values are zero.

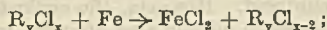
A general discussion together with definitions is included.

T. M. B. M.

**500. Mechanism of Action of Organic Chlorine and Sulphur Compounds in Extreme-Pressure Lubrication.** C. F. Prutton, D. Turnbull, and G. Dlouhy. *J. Inst. Petrol.*, Feb. 1946, 32 (266), 90–117.—A detailed experimental and theoretical study of the subject leads to the following conclusions : (1) Reaction of organic sulphides with iron probably takes place by the following mechanism :

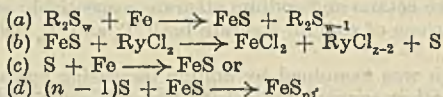


It is not possible to ascertain from the present data whether or not there is splitting of the additive on the iron surface to give sulphur prior to reaction ; (2) Under mild or slowly applied loads, reaction of organic chlorine compounds with iron probably takes place as follows :



(3) In general, iron sulphide films from active sulphur additives form much more rapidly than ferrous chloride films from active chlorine additives at temperatures above 200° C ; (4) When both active sulphur and active chlorine compounds are present in oil the following effects are generally observed when interaction with iron takes place : (a) a rather small proportion of iron sulphide (as  $FeS_n$  rather than as HCl soluble  $FeS$ )

is found in the reaction product relative to the amount of ferrous chloride present; (b) considerably more ferrous chloride ( $1\frac{1}{2}$  to 3 times as much) is formed than would be formed by the action of the chlorine additive by itself; (c) for chlorinated paraffin wax HCl evolution is about the same as it is in the absence of the sulphur additive; (d) amounts of  $H_2S$  evolved when the additives act together are generally much less on an equivalent basis than the increased amount of ferrous chloride formed; (5) Active chloride additives react more rapidly with iron sulphide or with sulphide-coated iron than with iron itself. Active sulphur additives react much less rapidly with a ferrous chloride coating on iron powder than with iron itself, but this reaction is more rapid than the reaction of chlorine additive with iron; (6) On this basis the following mechanism is proposed for the joint action of active sulphur and active chlorine additives on iron:



These reactions are comparatively rapid, the ferrous chloride is formed more rapidly by this mechanism than by the reaction of the chlorine additive alone with iron, thus providing a lubricant film under shock loading conditions; (7) Ferrous chloride formed by chloride additives represses the excessive action normally associated with active sulphur compounds on iron; (8) It is proposed that extreme-pressure lubrication is accomplished by a combination of sulphur and chlorine additives in the following steps: (a) as the contact points of the gear-teeth heat up, a film consisting principally of ferrous chloride is formed on the points according to the mechanism outlined above; (b) as the temperatures become higher, resistance of the ferrous chloride films to shear becomes small, possibly due to fusion (melting point of ferrous chloride =  $690^\circ C$ ) or low shear strength of the solid films at high temperatures; (9) Ferrous chloride formed by chlorine additives represses the excessive action normally associated with active sulphur compounds on iron.

A. H. N.

**501. Recent Advances in the Chlorinated Paraffins.** R. Strauss. *Refiner*, Jan. 1946, 25 (1), 36-37. (Translated by E. J. Barth from *Oel u. Kohle—Erdoel u. Teer*, 83/85, Feb. 1935.)—Experimental procedure and results obtained from chlorinating paraffin waxes of different types and methods of obtaining substitution products (e.g., amino-waxes) from chlorinated waxes are described. Chlorinated waxes are found to be miscible in all proportions with castor oil and to solubilize it in mineral oil.

A. H. N.

### Analysis and Testing.

**502. A Jet Viscometer with Variable Rate of Shear.** W. J. Morris and R. Schurmann. *Rev. Sci. Instrum.*, Jan. 1946, 17 (1), 17.—A viscometer consisting of a glass jet which is inserted in a closed system is described. This was developed for the measurement of the viscosity of hydraulic oils at high rates of shear of the order of  $100,000 \text{ sec}^{-1}$ .

The jets made by almost sealing off a piece of Pyrex tubing were not true capillaries of constant diameter and definite length, but observations on straight mineral and some fatty oils of viscosity sufficiently high to exclude turbulence showed that Poiseuille's law was obeyed.

Results with colloidal solutions showed that temporary viscosity reductions occurred at high rates of shear—indicated clearly by plotting the reciprocal of time of flow against pressure difference. The onset of turbulent flow was also easily recognizable from such curves.

With this instrument laminar flow was found to persist when Reynolds' numbers up to about 44,000 were encountered. However, the critical Reynolds' number is not necessarily the same for the same oil and two different jets, since the beginning of turbulence may depend upon the geometrical shape of the jet.

D. L. S.

**503. Modified Aniline-Point Apparatus for Dark Oils.** N. Madsen. *Refiner*, Dec. 1945, 24 (12), 530.—The apparatus used in an ordinary aniline-point apparatus fitted with a ring stirrer displacing such a volume that the level of the oil-aniline mixture

drops several millimetres when the stirrer is withdrawn from the liquid. The point on the tube wall where the film is observed is thus in contact with the bulk of the liquid except for a brief moment of observation. A shield is provided to decrease the heat transfer between the wall of the aniline-point tube and the surroundings at the point where the film is being observed. This shield also makes it easier to observe the appearance of the film.

A. H. N.

### Crude Oils.

**504. Bahrein Island Producers 20,000 Brl and Refines 70,000 Brl/Day.** C. O. Willson. *Oil Gas J.*, 20.10.45, 44 (24), 110.—The refinery and oilfields owned by the Bahrein Petroleum Co., Ltd., are described. The island, on which the discovery well was completed in 1932, is the largest of the group being 30 miles long and 10 miles wide. Oil production is secured from three pays which contribute 20,000 brl/day of crude, the 50,000-brl difference between the field and refinery capacity being supplied by submarine pipeline from the Arabian American Oil Co's fields in Saudi Arabia. A large proportion of the oil is obtained by gas injection.

The principal operating equipment of the refinery consists of two low-pressure atmospheric tower crude-oil distillation units, one low-pressure atmospheric and vacuum tower crude-oil distillation unit, one fluid-type catalytic cracking plant, two thermal reforming, and two thermal cracking units, one thermal gas-recovery plant and one fluid-type isomerisation plant, a sulphuric-acid-type alkylation plant as well as sulphuric-acid manufacturing plants, and the usual treating and sweetening plants for gasoline and kerosine. Previous to the installation of units for the production of 100 octane gasoline in 1944 the refinery was operated for several years as a 34,000-brl refinery in a balanced crude oil distillation, thermal cracking, and reforming operation. The plant output now consists of 100-octane gasoline, 67-80 octane motor fuels, illuminating and power kerosines, as well as diesel and fuel oils.

The Bahrein and Arabian crude oils, which have the following properties, are usually batched in refinery operations :

	<i>Bahrein.</i>	<i>Arabian.</i>
Gravity (° A.P.I.) . . . . .	33.2	34.7
Sulphur, % wt. . . . .	2.21%	1.75%
Viscosity (S.U./100° F) . . . . .	58.5	42.7
Pour point (° F) . . . . .	+20	+10

The Bahrein crude yields approximately 37% of 437° EP gasoline of 40 octane number (C.F.R. M.M.) and a 62% residuum of 20° A.P.I., while the Arabian about the same quantity of 37 octane gasoline with a residuum of about 25° A.P.I. gravity.

On completion of the second steam plant the total capacity will be 430,000 lb/hr at 550 lb. The generating capacity will be 14,000 kw.

Full details as to refinery operations are given, and a brief description of the geological formation of the island is included, together with a map.

T. M. B. M.

**505. Evaluation of Lubricating Oil Crudes.** V. A. Kalichevsky. *Nat. Pet. News*, 3.10.45, 37 (40), R765.—A simple method is presented which permits an estimation of the composition of lubricating-oil fractions of crude oil in terms of the four basic components: asphalt, wax, undesirable oil, and desirable oil fractions.

When the crude oil is received by the laboratory, it is first split into various fractions on the basis of individual plant procedures, determining viscosities, and flash points or similar physical properties of the fractions. Distillation procedure should approach as closely as possible the true boiling-point analysis.

Asphalt may be separated from the oil by solvent extraction, using propane or higher alcohols. Wax is separated, preferably prior to deasphalting using solvents such as mixtures of methyl ethyl ketone and toluene, or chlorinated solvents, adjusting conditions on a typical sample to obtain some predetermined pour point. The de-waxed and deasphalted sample is then subjected to a single-stage extraction with a solvent adjusting the quantity of the latter so as to obtain approximately the specification viscosity index on the reference crude-oil sample. The lowest practicable temperatures and largest possible quantities of solvent should be used. Full details of the calculations necessary and the interpretation of laboratory results are given.

T. M. B. M.

## Gas

**506. Utilization of Natural Gas in the United States.** G. G. Oberfell. *Refiner*, Jan. 1946, 25 (1), 6-16.—*Paper presented before American Institute of Mining and Metallurgical Engineers.* An examination of the past and present uses of natural gas clearly indicates its superior qualities for fuel purposes. While considerable quantities are employed in carbon-black plants, nevertheless such use disappears when higher-priced markets and pipe-line outlets become available. The future prospects of the use of natural gas for fuel purposes is very bright. It is expected that as more value is placed upon this commodity and transportation facilities are increased, less natural gas will be used in present low-priced markets. Natural gas as a raw material in the manufacture of chemicals is of considerable economic importance to the chemical industry, but the quantity of natural gas used for producing chemicals is and will probably continue to be relatively small in comparison to the amount used for other purposes.

Natural gas is a more economic raw material than coal for conversion into liquid hydrocarbons by the Fischer-Tropsch process. Modifications of the Fischer-Tropsch process, using natural gas, will undoubtedly find useful applications, particularly where the process can be combined with other processes or with existing facilities. The production of natural gasoline and the manufacture of chemicals afford opportunities for such combinations. However, without the economic advantages of such combinations the available information indicates that as a means of producing gasoline alone the Fischer-Tropsch process would not be competitive with present refinery operations, using crude oil as a raw material, under present prices. Furthermore, the peak of gasoline production from natural gas by the Fischer-Tropsch process will amount to only a minor proportion of the total gasoline supply of the U.S.

A. H. N.

## Engine Fuels.

**507. A Review of the Development of Reference Fuel Scales for Knock Rating.** D. H. Brooks. *Refiner*, Jan. 1946, 25 (1), 42-48.—*Paper presented before Society of Automotive Engineers.* This is a Report of the Co-ordinating Fuel Research Committee of the Co-ordinating Research Council, Inc. The past quarter of a century has witnessed practically all the development of the art of knock rating. The pioneer Ricardo engine and reference scale gave way to a miscellany of engines and scales, from which emerged the CFR engine and the octane-number scale. With the advent of fuels rating above 100 octane number, several systems of extending the octane-number scale were proposed. Of these the principal survivors are the AN performance number, and the AGAC extended octane and index-numbers. Experimental fuels have now exceeded in knock rating the range of these systems. With increasing study of the problem it has become apparent that a single rating scale will not satisfy the needs of all concerned. A scale is needed in terms of which fuel-blending computations can be made readily, and an interchangeable scale is needed by means of which relative engine performance can be expressed. While it is true that such a performance scale can be exact only for the engine on which it was developed, it is likely that with increasing understanding of the problem we shall be able to estimate accurately the performance of the fuel in any given engine, from ratings of the fuel under mild and severe test conditions. The exploratory work of the AFKRS Group of the CFR Aviation Fuels Division leads to the conclusions that the leaded triptane-heptane scale appears to have much promise; that this scale, which is expressible either as triptane number or detonation index, being extensible with accuracy to the upper limit of antiknock quality, is of adequate coverage; and that it is definitely superior in important respects to present reference-fuel scales. Research now in progress may be expected to provide information on which adoption of this scale can be based. Experimental results are presented on all these points, and graphical interpretations are submitted. An interesting graph gives a linear relationship between the reciprocal of indicated mean effective pressure and the per cent leaded triptane-heptane scale, the graph being extrapolated to infinite pressure—i.e., to the absolute maximum possible in engines present and future.

A. H. N.

**508. Knock Ratings of Gasoline Substitutes.** A. D. Puckett. *Bur. Stand. J. Res. Wash.*, Oct. 1945, **35** (4), 273.—Knock ratings of gaseous paraffins and olefins up to  $C_6$ , and of carbon monoxide, were determined by current motor and aviation test methods. Auxiliary apparatus and modifications of test engines necessary to rate gases are described.

Antiknock qualities of ethyl and normal butyl alcohol and acetone, both alone and in blends, were determined by current motor-fuel rating procedures. Blending characteristics of these materials with straight-run gasolines and naphthas were investigated.

Conclusions were: (a) Knock ratings of carbon monoxide and gaseous paraffins indicate that they can be used as fuels in supercharged or normally aspirated engines of higher compression ratio than those available in normal automotive equipment; (b) Knock ratings of gaseous olefins will allow their use in present automotive engines; (c) Ethyl alcohol/ether blends containing less than 45% vol. ether give relatively knock-free performance; (d) Acetone, ethyl, or *n*-butyl alcohol, either separately or in blends, give satisfactory antiknock value; (e) The products under (d) can be used to extend supplies of gasoline for motor fuels of satisfactory rating; (f) Blending 30% vol of ethyl alcohol with 40–60 A.S.T.M. motor octane-number gasoline improves knock rating by approximately 1 octane number for each percent of alcohol; (g) Acetone, though giving a higher octane number when tested neat, is less effective in blends than in ethyl alcohol.

T. M. B. M.

## Lubricants.

**509. Bearing Corrosion.** H. H. Zuidema. *Oil Gas J.*, 16.2.46, **44** (41), 100.—Many properties must be considered in the selection of a bearing metal for a given application. The metal should not develop fatigue cracks, and should possess antifricition, non-scoring, and bonding characteristics.

The alloy should have mechanical strength above the fatigue limit, and possess conformability to enable the bearing to adjust itself to slight deflections.

The metal should be capable of embedding small dirt and metal particles. Corrosion is a serious problem with the newer bearing metals containing cadmium or lead.

Bearing metals can be classified into ten groups, mainly according to composition. Tin-base babbitt is the best all-round bearing metal for moderate loads and temperatures, whilst lead-base babbitt is somewhat inferior to the former, but costs less. Lead can be hardened by the addition of a small amount of alkali, usually about 1%, and the alloy has been used in locomotives. It has not the corrosion resistance of babbitt.

Cadmium alloy bearings have excellent mechanical properties, but are subject to corrosion; as are copper-lead alloys, used extensively in diesel engines.

Copper is the principal ingredient of bronzes, and silver finds use with other metals in aircraft engines. Aluminium alloy bearings have many good properties, but possess poor run-in characteristics and are difficult to bond. Zinc alloys are used under mild loads and temperatures, and sintered powdered metals find application under similar conditions.

An appendix lists compounds claimed in U.S. patents as bearing corrosion inhibitors.

G. A. C.

**510. Bearing Corrosion.** Part 2. H. H. Zuidema. *Oil Gas J.*, 23.2.46, **44** (42), 151.—Data based on a survey of the literature and the results of "Shell" Wood River Research Laboratories investigations on bearing corrosion and its mechanism are presented. Tests on the behaviour of bearing metals under various laboratory conditions indicate that babbitts were attacked to a negligible extent, whilst at the other end of the scale cadmium alloys were attacked to the greatest extent.

Engine tests showed greatest corrosion with cadmium-silver alloy, with copper-lead most resistant. Tests showed that fineness of structure in the alloy is an important factor in corrosion, coarse-structure alloys being least resistant. Corrosion can be prevented by the addition of a small amount of certain metals such as zinc or indium.

Bearing corrosion is of three types: (1) "acid"; (2) "sulphur"; and (3) by aqueous acids. Cadmium and lead are affected by oil solutions of organic acids only

in the presence of oxidizing agents such as molecular oxygen at low temperatures, and peroxides at temperatures above 100° C. Sulphur corrosion of bearing metals containing silver or copper is serious under high-temperature conditions, due to the formation of a complex of bearing metal with a sulphur compound. This forms a beneficial passivating film on the surface, which is decomposed at high temperatures to produce brittle metal sulphides, which are flaked off, resulting in loss of bearing metal. The presence of "fuel acids" of low molecular weight leads to the preferential solution of copper, the mechanism being of the same type as in "acid" corrosion. G. A. C.

**511. Viscosity of Lubricating Oils at Low Temperatures (2).** L. S. Zhedera, Z. Vozzhinskaya, and O. Fedoseeva. *Petroleum*, March 1946, 9 (3), 62.—The fluidity of synthetic oils at low temperatures differentiates them from petroleum oils, but at 100° C the synthetic oils usually have a higher viscosity—for example, Karachukhuri oil ceases to flow at -20° C, whilst the synthetic is still fluid at -30° C, yet is more viscous than the former at 100° C. A table shows the deterioration in an oil when dewaxed at temperatures below -25° to 30° C.

The pour point of an oil should be viewed in conjunction with its viscosity index. The effect of the addition of paraffin wax on the fundamental constants of the oil is tabulated, and it is shown that the higher the viscosity index the greater the mobility of synthetic oils at low temperatures. G. A. C.

**512. Engine Oil Filtration.** M. W. Webber. *Petroleum*, March 1946, 9 (3), 58.—A review is presented of various articles in the literature on full-flow and by-pass filters, mechanical filters, and those of the ultra fine and adsorptive types.

The presence of a contaminated filter cartridge in a lubricating system is a source of trouble, and filters will not solve lubrication problems. Adsorbent-type filter materials tend to disintegrate and introduce abrasive matter to the oil, whilst filters of the absorbent (cotton waste) variety treat only 10% of the oil. Additives are adsorbed from compounded oils and lead salts from leaded fuels.

Claims made for adsorbent type of filter are extravagant.

Felt-type absorbent filters require cleaning every 14 days, and are inoperative after 6 weeks in service. Fine filters, mechanical or adsorbent, are of the by-pass type; and as solid particles are continually entering the oil, this type is not really efficient. Dilution troubles in tractors using kerosine or vaporizing oil as fuel are accentuated by adsorptive filters by removing active molecules which increase viscosity and oiliness. Really efficient filters for air-intake and crankcase breathers are required. Rolls-Royce have developed an efficient filter of the centrifugal type which gives a pressure drop of only 15 lb/sq in when 18,000 pt/hr of oil at -30° C are flowing through it.

G. A. C.

**513. Action of Lube Oil Detergents on Automotive Engines.** F. M. Watkins. *Refiner*, Jan. 1946, 25 (1), 1-5.—The term detergency in an oil is explained, and is given a wider meaning than usually is associated with it. Generally speaking, a detergent is a cleansing agent. In lubricating-oil terminology, however, detergency has a wider reference. Detergents present in modern oils are expected to maintain a clean engine as well as to aid in cleaning an engine already containing deposits. Thus an oil which leaves a clean engine may be said to have a high degree of detergency. Synthetic detergents, however, are not solely responsible for engine cleanliness, for deposits are formed in many ways, each of which contributes to the total, and any factor which eliminates one source may aid in effecting an overall improvement. Antioxidants retard deterioration, and in some cases may thereby be said to exhibit a mild detergent action. Oils themselves differ in the rate at which they form and deposit more sludge. Naphthenic oils, for example, dissolve more sludge than paraffinic oils, but oxidise more readily to form oil-insoluble materials. As a result they appear to have greater detergency under mild test conditions, but less detergency under severe test conditions. The common types of detergents are oil-soluble salts of sodium, potassium, calcium, magnesium, barium, aluminium, or cobalt with molecular weight between 500 and 1000. These are discussed under the four classes: soaps, phenoxides, phosphates, and sulphonates. Typical test results on engine parts are described and illustrated. Precautions and procedures to be adopted in using detergents and mixing oils with detergents are outlined. A. H. N.



**514. The Development and Lubrication of the Automotive Hypoid Gear.** F. F. Musgrave. *J. Inst. Petrol.*, Jan. 1945, 32 (265), 32-44.—The history of the use of the hypoid gear and its lubrication since 1925 is given, together with an outlook into the future of such gears.  
A. H. N.

**515. Investigation of Piston-Ring Sticking in High-Duty Aero-Engines.** A. Lahiri and E. Mikolajewski. *J. Inst. Petrol.*, Feb. 1946, 32 (266), 59-89.—A theory of the mechanism of ring-sticking due to oil deterioration, from the physico-chemical aspect, is presented, with due note of the mechanical factors involved. Ring-sticking is due mainly to the wedging action of carbonaceous "coke-like" substances formed in the grooves by decomposition of products of oil deterioration. There appears to be a critical and optimum set of conditions under which ring-sticking takes place. Under such conditions a maximum amount of asphaltenic substances is formed and coked. A consideration of the asphaltic systems leads to the conclusions that flow behaviour of the deteriorated oil and the nature and proportion of the intermediate products of oil deterioration are the governing factors in ring-sticking, mechanical conditions remaining constant. A report of a discussion follows.  
A. H. N.

**516. Lubrication Vade Mecum Addendum (3).** E. W. Steinitz. *Petroleum*, March 1946, 9 (3), 67.—In this third part of the Addendum to the Lubrication Vade Mecum notes are given on lubricants for general equipment, including chocolate-making machinery, dryers, sugar-beet graders in the food and allied industries; breaking-up and waste opening machines, flyers and spindles, knitting, wet spinning lace, and jacquard machines in textile and laundry industries; and aluminium, brass and cold-rolling mills and heavy air hammers in the metal industry.  
G. A. C.

### Asphalt, Bitumen and Tar.

**517. Utilization, Trends, and Future Prospects of Petroleum Asphalt—A Statistical Report.** G. R. Christie. *Oil Gas J.*, 26.1.46, 44 (38), 270.—In the past five years the 10 oil-refining fields of the U.S. have produced 7-8 million tons of petroleum asphalt each year. 70% has been used for paving and 30% for industrial uses, mainly roofing. The proportion used for paving has steadily risen to this figure from 55% in the early 1920's, and has coincided with the development of liquid grades. 500,000 of the 3,000,000 miles of roads in the U.S. are estimated to be of asphalt.

It is considered that there will be an increased tonnage in the form of asphalt roofing for the new houses planned, and the growing aviation industry will call for asphalt runways. Although it is estimated that about 160,000 miles of roads are due to be widened or rebuilt, no exact tonnage can be given for such a programme. It is concluded that there should be a very great and rapid rise in asphalt tonnage in the years ahead, although the rapidity of the rise will depend on the speed of the onset of post-war economy.  
T. M. B. M.

### Special Hydrocarbons Products.

**518. Gelled Fuel for Flame-Throwers.** C. M. Cawley. *Petroleum*, March 1946, 9 (3), 56.—Mechanized flame-throwers were used in over 500 actions, and achieved successes with very few casualties to the Allies.

This was due to the properties of the gelled petrol used as fuel. This "Fras Fuel" doubled the range of flame-throwers and gave tremendous "target effect." Fras Fuel was developed at the Fuel Research Station at Greenwich. The gelled fuel possesses the property of anomalous viscosity, behaving as a liquid of low viscosity when flowing through pipes and nozzles, but the jet leaving the nozzle behaves as a liquid of high viscosity resulting in long range. The flight characteristics of the fuel can be controlled by modifying the composition to adjust the viscosity. The gelled fuel is very stable, and can be stored for at least one year. Batches of 750 gal were eventually prepared, some 20,000 gal were prepared in experimental batches. Field trials were initially carried out by the Canadian Petroleum Warfare Experimental Unit, and later by the Petroleum Warfare Department. Production was afterwards undertaken by the "Shell" Refining and Marketing Co., Ltd.  
G. A. C.

**519. Synthesis of Toluene by Hydroforming and Recovery by Azeotropic Distillation.** F. E. Hartley. *Petrol. Engr.*, Dec. 1945, 17 (3), 156.—Prior to the war, toluene production in the U.S.A. was 28,000,000 gal/year and was manufactured exclusively from coke-oven operations. To cope with a demand for over 200,000,000 gal/year brought about by the war, the hydroforming process was made available for producing toluene from selected petroleum fractions. Dimethylcyclopentane, methylcyclohexane, and ethylcyclopentane are the chief compounds for synthesis, the two cyclopentanes being first isomerized to methylcyclohexane and then dehydrogenated to toluene. *n*-Heptane and dimethylhexane may also be present in the feed-stock, but pass through the process unchanged, being removed from the toluene by azeotropic distillation with methyl ethyl ketone-water.

The necessary synthesis compounds occurred to the extent of 1.5% in Los Angeles Basin crude, together with 0.5% of natural toluene, and were concentrated at Union's Los Angeles refinery by heart cutting.

Synthesis conditions in the hydroformer are as follows: (i) Reaction pressure of 150–300 lb/sq in; (ii) Reactor charge temperature 1000–1070° F; (iii) Wet gas recirculation (70% hydrogen) 6000 cu ft/brl of reactor charge; (iv) Catalyst consisting of 10% MoO<sub>2</sub> on alumina. The commercial hydroformer runs up to 9000 brl/stream day of charge stock.

Full details of the hydroforming process, the purification and azeotropic distillation of toluene and catalyst regeneration are given, together with numerous flow sheets and diagrams. T. M. B. M.

**520. Hexane Used as Solvent for Soybean Oil Extraction.** R. E. Greenfield. *Oil Gas J.*, 9.2.46, 44 (40), 101.—A new soybean-oil extraction plant in operation at Decatur, Ill., U.S.A., uses a hexane-type solvent and leaves less than 1% oil in the soybean meal, as compared with 4% left by the pressing method. The meal from the extraction process has a 44% protein content, 4% more than when the pressing operation is used.

Extraction takes place in a tower in which operates a large vertical bucket elevator, the buckets being in this case baskets with perforated bottoms. These are loaded with the flaked soybean which is extracted with solvent during their travel.

The solvent has an A.S.T.M. distillation range of 146–156° F and is maintained at 130° F in the extraction tower. The solution of oil in solvent is treated first in atmospheric evaporators, and then in a vacuum stripping tower, where the solvent is removed, separated from water, and returned to the extraction tower for re-use.

Solvent losses are kept below 0.7% of the weight of beans processed. D. L. S.

### Derived Chemical Products.

**521. "O.X.O" Process Made Higher Alcohols from Fischer-Tropsch Olefins.** Anon. *Nat. Petrol. News. (Tech. Sect.)*, 7.11.45, 37 (45), R926.—T.I.I.C. Report Index No. 3, *Report on Visit to Oil Trays in the Ruhr and Hanover Areas*, contains a description of an "OXO" (German code name) plant which was part of the operation of the Ruhr Chemie installation at Holten. This plant, which was about complete when the war ended, was intended to treat C<sub>11</sub>–C<sub>17</sub> olefins, converting them first into aldehydes by passing them, together with sulphur-free water gas, over ordinary Fischer-Tropsch catalyst. The aldehydes were then reduced to alcohols by passage with hydrogen over a nickel catalyst. These alcohols were destined for the manufacture of soap, and possibly edible fats.

The process as developed was to have used a C<sub>14</sub>–C<sub>18</sub> cut from the Fischer-Tropsch plant, which was dehydrogenated by passage over a mixed thorium/chromium catalyst. The olefins formed were separated into four cuts: C<sub>11</sub>–C<sub>12</sub>, C<sub>13</sub>–C<sub>14</sub>, C<sub>15</sub>–C<sub>16</sub>, and C<sub>17</sub>, which were treated separately. The mixture of olefins and water gas was then passed over the catalyst at 135° C and 150 atm. pressure, using an intermittent process with 20 min cycles.

The aldehydes removed by vacuum distillation were finally reduced using a Ni catalyst at a temperature of 180° C and pressure of 150 atm. D. L. S.

**522. British Made Synthetic Waxes.** Anon. *Chem. Tr. J.*, 8.3.46, 118 (3068), 306.—The Abril Corporation (Great Britain), Ltd., have obtained an extensive block of factories at Bridgend, South Wales, for the manufacture of a new range of synthetic

waxes. A £50,000 plant is being installed for the production of a new series of high-temperature waxes, but various other grades will be produced of interest to many industries.

The new waxes, which have as their basis by-products of the margarine, soap, and other fat-splitting industries, are monomeric substances, and consist as a rule of practically pure chemical entities of long carbon-chain structure with various substituents. They are inert (hydrolysable only under very severe conditions), and to a very large extent resistant to oxidation. The range so far explored have melting points from 65° C to 280° C. Technical details of the process have so far not been divulged.

The corporation visualise a production of 10,000–15,000 tons a year by 1948.

T. M. B. M.

### Coal, Shale and Peat.

**523. Coal Extraction by Solvents (the Pott-Broche Process in Germany).** Anon. *Chem. Tr. J.*, 1.3.46, 118 (3067), 291.—A digest of C.I.O.S. Report XXXI-27 dealing with the coal-extraction plant of the Ruhrol G.m.b.H. at the Hugo Stinnes Werke of the Matthias Stinnes-Gewerkschaft at Welheim, Westphalia. This plant was the first and only one of its kind in Germany to operate the Pott-Broche process for the extraction of coal with organic solvents. The extraction process is not thought to be a commercial proposition without the availability of special oils derived from the hydrogenation of pitch for use as solvents.

Coals having more than 25% volatile matter are suitable, and the original solvent was 4 parts of tetrahydronaphthalene and 1 part of cresols (B.R. 190–210° C). This was used with half its weight of coal, but the solvent was later changed to middle oil from coal-tar pitch hydrogenation (B.R. 200–320° C), owing to the suitability of the recovered material for vapour-phase hydrogenation and the fact that the motor fuel produced contained a high percentage of aromatics.

The coal was powdered (for pumping purposes), dried by flue gas to 0.5% water content, and extracted in steam-heated kettles at 60–100° C. The extraction was a batch process. The mixture was then pumped to the preheating and extraction tubes, which were located in a flue-gas furnace maintained at 550° C. The total time from preheater to outlet was about 1 hr, 20% of the time being in the preheater. Filtration of the mixture was effected by porous ceramic candles of special design, which are described in detail. The filtrate was subjected to vacuum distillation, and the extract is said to be completely oil-free. The recovered oil was redistilled, and the small residue returned to the liquid phase hydrogenation plant.

The coal extract was coked for high-grade electrode carbon (0.1–0.15% ash).

T. M. B. M.

**524. Synthesis of (1) Glycerol and Propylene Glycol from Propylene, and (2) Ethylene Glycol from Ethylene.** D. M. Newitt and P. S. Mene. *J. chem. Soc.*, Feb. 1946, 97.—In the early stages of the slow combustion of an olefin at high pressures there is formed a mixture of the corresponding oxide and the isomeric aldehyde and alcohol. Under appropriate conditions of temperature and pressure the oxide is hydrolysed to glycol and the alcohol is further oxidised and hydrolysed to a polyhydric alcohol. For instance, propylene gives propylene glycol and glycerol, and ethylene gives ethylene glycol. The effect of temperature, pressure, and other factors on the course of the combustion is fully described.

T. M. B. M.

**525. Carbon Black.** W. L. Loving. *Petrol. Engr.*, Nov. 1945, 17 (2), 176.—The history and uses of carbon blacks are described. Approximately 90% of the production is used in the rubber industry, 5% in the printing ink and 2% by the paint and varnish, and 5% is divided over the uses for paper, plastics, battery, metallurgical and other industries. Carbon black was first made from natural gas in 1872 and the reciprocal channel process was patented by Melvill in that year. The channel process for carbon black is described. The material from the channel furnaces is "bolted" to remove any foreign matter such as sand or scale or hard carbon particles. This material is fluffy and has an apparent density of 5 lb/cu ft, an agitating process then removes entrained air and the density is increased to about 10 or 15 lb per cu ft at which density the blacks are used for inks or paints. For rubber compounding carbon blacks are

formed by various processes and have a density of from 20 to 25 lb/cu ft and are free-flowing granular dustless products. A thermal process was patented by Brownlee and Uhlinger in 1916, and is described. Briefly the gas is decomposed to carbon and hydrogen in the absence of air, by being brought in contact with highly heated refractory material. An improved method employs part of the hydrogen and produces a somewhat fine particle size black. Both grades have much larger size particles than channel blacks; 6 to 16 lb are produced per 1000 cu ft. Sometimes these thermal blacks are preferred to channel blacks where resistance to abrasion and wear are not important. Thermal blacks are less reinforcing than furnace or channel blacks. The furnace process blacks were first made in 1926; they are produced from natural gas and air in controlled proportions, using about 50% of the air as would be required for complete combustion. This general grade of furnace black is known as SRF (semi-reinforcing furnace) black and, as measured by reinforcing ability and particle size, falls between thermal and channel blacks. The yields range from 6 to 14 lb/1000 cu ft of gas. Approximately 492 million lb of channel black and 77 million lb of other blacks were produced in 1940. Natural rubber was only used then. Channel blacks are used satisfactorily as reinforcing pigments with natural rubber and adds greatly to the wear and abrasion resistance. Natural rubber has a tensile strength of about 3200 p.s.i.; when compounded with carbon black its strength is increased to 4000 p.s.i. Synthetic rubber, Buna-S, has a tensile strength of less than 200 p.s.i., the addition of carbon black raises it to around 3000 p.s.i. and increased quantities are required to compensate for the inherent differences between natural synthetic rubber. With synthetic rubber, furnace blacks provide easier compounding and low heat generating properties than channel blacks. The demand for furnace blacks has grown during the war years owing to the increased use of synthetic rubber and improved qualities have been developed in attempts to attain the good abrasive and high tear resistance properties that channel blacks impart to natural rubber. The natural gas industry is surveyed from the aspect of carbon black manufacture in relation to the location of the producing wells, *i.e.*, whether manufacture is near or remote from the producing centres, and cost of gas, *i.e.*, whether waste gas, which otherwise would be vented to the air, is used. Low cost gas is necessary for the industry. Sour gas can be used without sweetening, though it is better sweetened, cost of corrosion of plant must be considered against cost of sweetening. By using sour gas carbon black manufacturers have used a raw material that might have gone to waste. From 1000 cu ft of natural gas only 1.5 lb channel black and only about 10 lb of furnace black can be recovered. The economics of the industry are discussed. The future for carbon blacks is reviewed, production of types will depend upon the relative supplies of natural rubber available. Quality of furnace blacks will tend to approach channel black quality, but the yields of furnace blacks will then be lower than by the present furnace production.

W. H. C.

### Miscellaneous Products.

526. Corrosion-Resisting Plastic Material Applied to Oil-Field Equipment in Place. E. H. Short, Jr. *Oil Gas J.*, 22.12.45, 44 (33), 59.—A description of the use of air-drying thermoplastic synthetic resins as a means of preventing corrosion. It is possible to bake a material of this kind on pipe and other equipment at a central plant, thereby enabling the coating to withstand considerable heat, or a type of synthetic resin which is unaffected at 180° F may be applied directly in the field. Application of the latter type involves first the sandblasting of the surfaces to be coated or, in some cases, cleaning by wire brush or industrial cleaning compounds. The resin coating, usually vinyl acetate, is applied by means of a spray gun. Generally one prime coat and two finish coats are required on external surfaces, and a 30-minute drying period is necessary for each except the last one. A period of 48 hours should be allowed to elapse before the plastic surfaces are exposed to corrosive liquids. Data are given regarding the time taken for treatment, and also the physical properties of the film, the thickness of which is of the order of 0.003 inch per spray coat. The resistance of typical films to various reagents are tabulated, but it is pointed out that a period of several years (depending upon the type and severity of the corrosion) will be required completely to evaluate the protective value of plastics as applied to oil-field equipment.

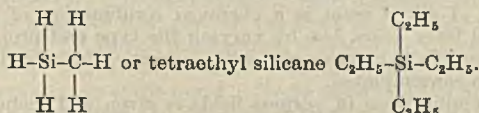
T. M. B. M.

527. **The Amazing New Chemical Family.** A. L. Foster. *Oil Gas J.*, 6.10.45, 44 (22), 86.—A survey of the history, application, chemistry, and properties of the silicones. These were first synthesized some 40 years ago, and considered to be chemical curiosities, but have since been put to a number of important commercial uses. One of their main applications to the petroleum industry is in lubricating greases, owing to their very high viscosity index, and operate satisfactorily at temperatures between 40° and 400° F. The greases are highly resistant to acids, alkalis, and oxidants, and are unaffected by steam and water. A coating of silicone grease is useful in preventing corrosion of metal surfaces, and can also be used for preventing contained materials from adhering to the surface of drums coated in this way.

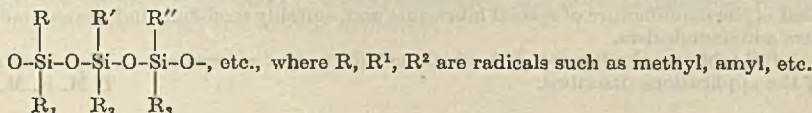
Silicone "rubber" is used for aircraft engine supercharger gaskets and similar applications, but owing to its low tensile strength cannot be applied for tyres. Remarkable results are also claimed for silicone resin varnishes for insulation of electrical goods, and for water-proofing.

Vapour-pressure curves are given for several typical silicones of Dow Corning production, and data are included on the viscosity of silicone liquids and oils to which these have been added.

The type component of a silicone is silicane,  $\text{SiH}_4$  (analogous to methane), and from which substituted silicanes are derived such as methyl silicane:



Silicones are probably formed by joining two or more silicanes containing one or two unattached valencies by means of oxygen atoms, when the general configuration becomes:—



The oldest and most common method of preparation is via the Grignard reaction when the latter reagent reacts with silicon tetrachloride to form dimethyl-silicon dichloride  $(\text{CH}_3)_2\text{SiCl}_2$ . This is hydrolysed to form the diol  $(\text{CH}_3)_2\text{Si}(\text{OH})_2$ , which decomposes rapidly, liberating 1 mol of water to form the silicone monomer  $(\text{CH}_3)_2\text{SiO}$ , which polymerizes rapidly. Other methods of preparation are also discussed in detail.

Some of the silicon polymers are liquids, with pour points as low as  $-85^\circ\text{C}$  and show no obvious signs of oxidation at  $150^\circ\text{C}$ . The elastomer type may be used to make a silicone rubber which hardens only at temperatures below  $-55^\circ\text{C}$ . The "bouncing putty" is one of the methyl silicone polymers which strongly resists quickly applied distortional forces, yet may be moulded like putty when the force is applied slowly. The degree of linkage in the polymer molecule is thought to have a great bearing on the properties of the product.

A list of references to the literature is appended.

T. M. B. M.

528. **Ultrasonic Naftalan Emulsions.** M. M. Nevyadomskii. *Nauka i Zhizn*, 1945, No. 4, 22-23.—By means of ultrasonic vibrations it has been found possible to prepare stable oil-in-water emulsions containing up to 12% of gas oil, the latter being obtained from crude from the Naftalan field. The emulsions have been found to possess curative properties with respect to cancerous tumours, both in animal and human subjects. Following successful animal (mouse) experiments, a series of 498 cases of severe internal human cancer were treated by injection of a 12% emulsion. A favourable response was obtained in 93% of the patients and in 27% of these the improvement was maintained for a period exceeding 9 months, and lasting in some cases up to 4 years. V. B.

529. **Colloid Chemistry of Clays.** E. A. Hauser. *Chem. Rev.*, Oct. 1945, 37 (2), 287.—The industrial applications of clays are discussed in the light of their colloidal nature. The significance of the colloidal state of matter is explained, emphasizing the import-

ance of the large surface/total volume ratio and the formation of diffuse electric double layers by colloidal micelles.

In order to explain the properties of clays, a clear picture of the shape and actual dimensions of colloidal clay particles is necessary, as well as the chemical composition. This has been obtained by X-ray diffraction, and electron-microscope studies. An explanation is also given of the fact that a clay particle when dispersed in water must be regarded as a colloidal micelle. This concept is used to explain many of the phenomena typical of clay minerals, such as ion exchange reactions, plasticity, thixotropy, dilatancy, rheopexy, dispersion, and stream double refraction.

These phenomena form the basis of the industrial application of the clays, and those fields of science and technology in which the importance of the colloidal chemistry of clay minerals has been proved are discussed. They include the use in ceramics, agriculture, soil engineering, oil-well drilling, films and plastics, thixotropic pastes, and water-softening. The use of clays in the production of emulsions, in the bonding of foundry sands, in insecticide and fungicide or bactericide sprays, and in lubricants is mentioned, as well as the many new applications which are likely to arise. V. Bu.

**530. The Versatile Alkyds find New Uses.** G. Leffingwell and M. A. Lesser. *Chem. Ind.*, 1946, 58 (1), 60.—The many and varied application of alkyd resins are described. The normal type of alkyd resin is a chemical combination of glycerine, phthalic anhydrides and oil fatty acids, but by varying the type and proportion of the basic ingredients it is possible to create resins with properties desirable in or essential to the specific application contemplated.

A list of their applications in various fields is given and includes: coatings and finishes of various kinds, sheets and films, flexible abrasive belts, safety glass, linoleum, brake lining, and electric insulating materials. Their use as insecticides is also described; a 2% glyceryl phthalate alkyd resin in water was applied to plants heavily infested with red spiders, and these pests quickly disappeared. They have also been used in the manufacture of special lubricants and, suitably modified, find use as emulsifiers and demulsifiers.

A full bibliography is appended, which includes patent references to a large number of the applications described. T. M. B. M.

**531. Styrene Copolymers in Surface Coatings.** D. H. Hewitt and F. Armitage. *Paint Mfr.*, March 1946, 16 (3), 91.—An account is given of the use of copolymers of styrene with drying oils in the production of surface coatings, and copolymerization techniques are discussed. Copolymerization with butadiene gave polymers in which cross-linking could be effected by vulcanization. Styrene polymerized with dehydrated castor oil over a wide range of proportions and viscosities to form homogeneous products. The standard formulation was 50 parts drying oil, 50 parts styrene monomer and 100 parts solvent, which yielded a varnish with a clear, quick-drying film hardening by oxidation after addition of usual driers. Useful products could be obtained within the range of from 40 parts of styrene to 60 parts of oil, to 60 parts of styrene to 40 parts of oil, with 100 parts of solvent. Clear films were yielded; at 40% oil length rather brittle, and at 60% oil length flexible, durable, but slow drying.

If polymerization was carried out in the absence of solvent with 50 parts styrene and 50 parts D.C.O. a heterogeneous mass resulted; the solventless type of product was permanently thermoplastic, thus differing from the solvent type. Replacement of the xylene solvent by white spirit gave opalescent solutions, with a rather quicker rate of viscosity increase. The styrene copolymers have good paint-making properties, including rapid air-drying, with subsequent after-hardening, good stability towards pigments, are water resistant, and have good electrical properties.

The mechanism of copolymerization was as yet little understood. It was thought that styrene polymerization with non-conjugated unsaturated fatty acid radicals was a chain transfer process, and with conjugated radicals propagation of the styrene chain across the conjugated system was involved.

In the discussion, the authors stated that a number of inconclusive experiments had been made with oil of the Bis-Oil type. Work had been done on the precipitation of copolymers, and the material was found to have satisfactory adhesion characteristics. G. A. C.

## MISCELLANEOUS.

532. Wilson, Coleman say Industry can meet predicted increase in Oil Demands; urge freedom of Technological Research. Anon. *Nat. Petrol. News*, 10.10.45, 57 (41), 19.—The full texts are given of the reports on world petroleum resources presented by S. P. Coleman and Dr. R. E. Wilson, on behalf of their investigating committees, to the United States Senate Committee on petroleum resources. Mr. Coleman's report covers the world distribution and the United States, supplies and potential production of crude oil, and the products therefrom are shown, as forecast estimates for the years 1947 and every five years up to 1965, in comparison with statistics for prewar years. It is considered there is a more than adequate supply to meet the world's needs, since actual and potential production in foreign areas greatly exceed the future consumption estimates. The forecast of trends of petroleum requirements for the periods 1921-1944, 1947-1965 are given. The estimated consumption of petroleum products in the United States are given, and discussed under individual products: motor fuel, aviation gasoline; gasoline for other purposes; kerosine; distillate fuels; residual fuel oils and lubricants. Data are also given for the same periods as to the increase in fuel burnt in and the increase in number of domestic burners, the increase in numbers of passenger cars and the decrease in fuels consumption per year per burner, and the decrease in motor fuel, per car, per year, due to improvements that will eventuate in the future. Dr. Wilson in his report, which covers rather the technological aspects of the industry, states that America's capital consumption of petroleum is 30 times the average of the rest of the world. He declared that the American petroleum industry has never failed to meet the demands, despite the upward trend in consumption estimated, and will continue to do so, provided the National policy is broad and non-restrictive. He gives warning that heavy importation from foreign sources, where low discovery costs and high production per well characteristics prevail, which at little or no duty could result in a price depression, and so cause disastrous results on America's producing and refining industries.

W. H. C.

## BOOKS RECEIVED.

*Teoriya Avtomobilya. (The Theory of the Motor Car.) Pt. I. The Stability of the Motor Car with Respect to Skidding.* By E. A. Chudakov. Moscow-Leningrad, 1944. 291 Pp.

This work is published by the Academy of Sciences of the U.S.S.R. The present portion, Part I, is exclusively concerned with a study of the movement of a car in the horizontal plane. The subject of movement in an inclined plane, and also when skidding has already started, will form the subject of subsequent parts. As may be expected in a subject of this nature, the treatment is largely mathematical, the forces acting on a car and on its various components under different conditions being analyzed. The effect of the various types of differential construction is discussed, and the work concludes with an examination of the skidding tendency when the vehicle is proceeding in reverse.

V. B.

*Proceedings of the Institution of Automobile Engineers. Vol. XXXVIII, 1943-44.* London: The Institution of Automobile Engineers, 1946. Pp. 403 + xxxix.

Included in the papers read before the Institution of Automobile Engineers during the Session 1943-44 are "Heavy-Duty Motor Oils," by K. Arter, and "Petrol: Its Development, Past, Present, and Future, with Some Notes on the Potentialities of High-Octane Fuels for Road Vehicles," by H. Fossett. Reports of the discussions of these papers are given.

**Transactions of the Institute of Marine Engineers.** Vol. LVI, 1944-45. London : The Institute of Marine Engineers, 1946. Pp. 264 + xi.

Among the papers in this volume are "The Design and Construction of Diesel-engined Tankers," by H. S. Humphreys, and "Heavy-Oil Engine Progress," by J. W. Armstrong. Papers on diesel machinery for cargo vessels of low power are also included.

**1945 Supplement to A.S.T.M. Standards including Tentatives. Part I. Metals.** Philadelphia, Pa. : American Society for Testing Materials, 1946. Pp. 395 + xiii.

This supplement contains the newly adopted and revised standards and tentatives in the metals field accepted since the appearance of the 1944 book of standards.

**Quarterly Journal of the Geological Society of London, Vol. CI, Parts 3 and 4.** London : Longmans, Green & Co., 1946.

Contains the paper on "The Geological Results of the Search for Oilfields in Great Britain," by G. M. Lees and A. H. Taitt, read before the Geological Society on December 6, 1944.



## INSTITUTE NOTES.

MAY, 1946.

### FORTHCOMING MEETINGS.

Wednesday, June 12, 1946, at Manson House, 26 Portland Place, London, W.1 :—"The Application of Variance Analysis to Some Problems of Petroleum Technology," by H. M. Davies, Ph.D., A.R.I.C.

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### APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

The following have applied for admission or transfer to the Institute. In accordance with the By-Laws, the proposals will not be considered until the lapse of at least one month after the publication of this *Journal*, during which time any Fellow, Member, or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of the candidate.

The object of this information is to assist the Council in grading the candidate according to the class of membership.

The names of candidates' proposers and seconders are given in parentheses.

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#### *Applications for Membership.*

BOON, Cyril Bertrand, Works Chemist/Supervisor, Germ Lubricants Ltd.  
(*J. E. Southcombe ; J. S. Parker.*)

COURTAN, Maurice Marcel, Engineer-in-Chief, S. A. des Petroles Jupiter, Paris.

FIRMINGER, John, Laboratory Chemist, Esso European Laboratories. (*C. S. Windebank ; A. Osborn.*)

FOTHERGILL, Hugh Cyril Stanislaus, Regional Manager, Petroleum Board.  
(*F. H. Garner ; H. C. Tett.*)

- JENNISON, John Anthony, Chemist, Manchester Oil Refinery Ltd. (*E. J. Dunstan ; G. H. Harries.*)
- LANGSTON, Robert Pembruge, Chemist, Burt, Boulton & Haywood Ltd. (*T. Kennedy ; C. E. J. Langdon.*)
- MEAD, Brian, Refining Representative, Standard Oil Co. (New Jersey). (*H. C. Tett ; F. H. Garner.*)
- PAUL, Peter Ferguson MacLachlan, Chemist, J. O. Buchanan & Co. Ltd.
- SMITH, Clement Greville, Deputy Chief Chemist, Limmer & Trinidad Lake Asphalt Co. Ltd. (*A. W. Attwooll ; D. C. Broome.*)
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*Applications for Transfer.*

- BOWKER, Thomas Dennis, Assistant Works Manager, London Oil Refining Co. Ltd. (*J. E. Haslam ; H. S. Kiernan.*) (*Student to Associate Member.*)
- DENNIS, Cyril Frederiek, Director, British Oilfield Equipment Co. Ltd. (*N. Matheson ; C. R. Sams.*) (*Member to Fellow.*)
- PARR, Ronald Walter, Chemist, "Shell" Central Laboratories. (*W. R. P. Hodgson ; P. G. Higgs.*) (*Student to Associate Member.*)
- PERKS, John Gilbert, Captain, R.E.M.E. (*T. G. Hunter ; A. H. Nissan.*) (*Student to Associate Member.*)
- THORPE, Thomas Charles Gordon, Sectional Head, Chemical Laboratories, Anglo-American Oil Co. Ltd. and Petroleum Board. (*C. Chilvers ; E. B. Evans.*) (*Associate Member to Fellow.*)

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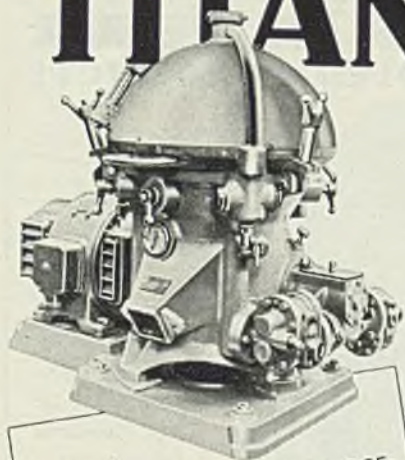
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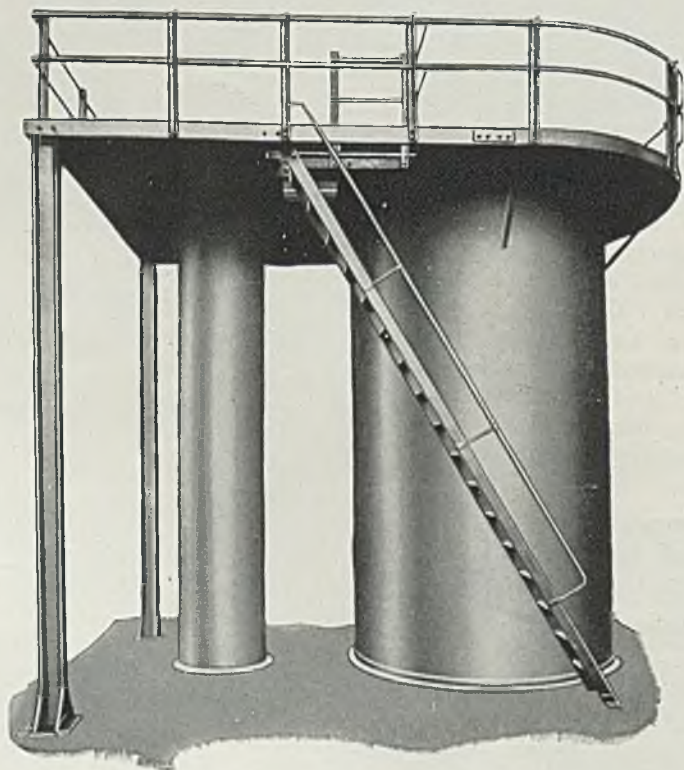
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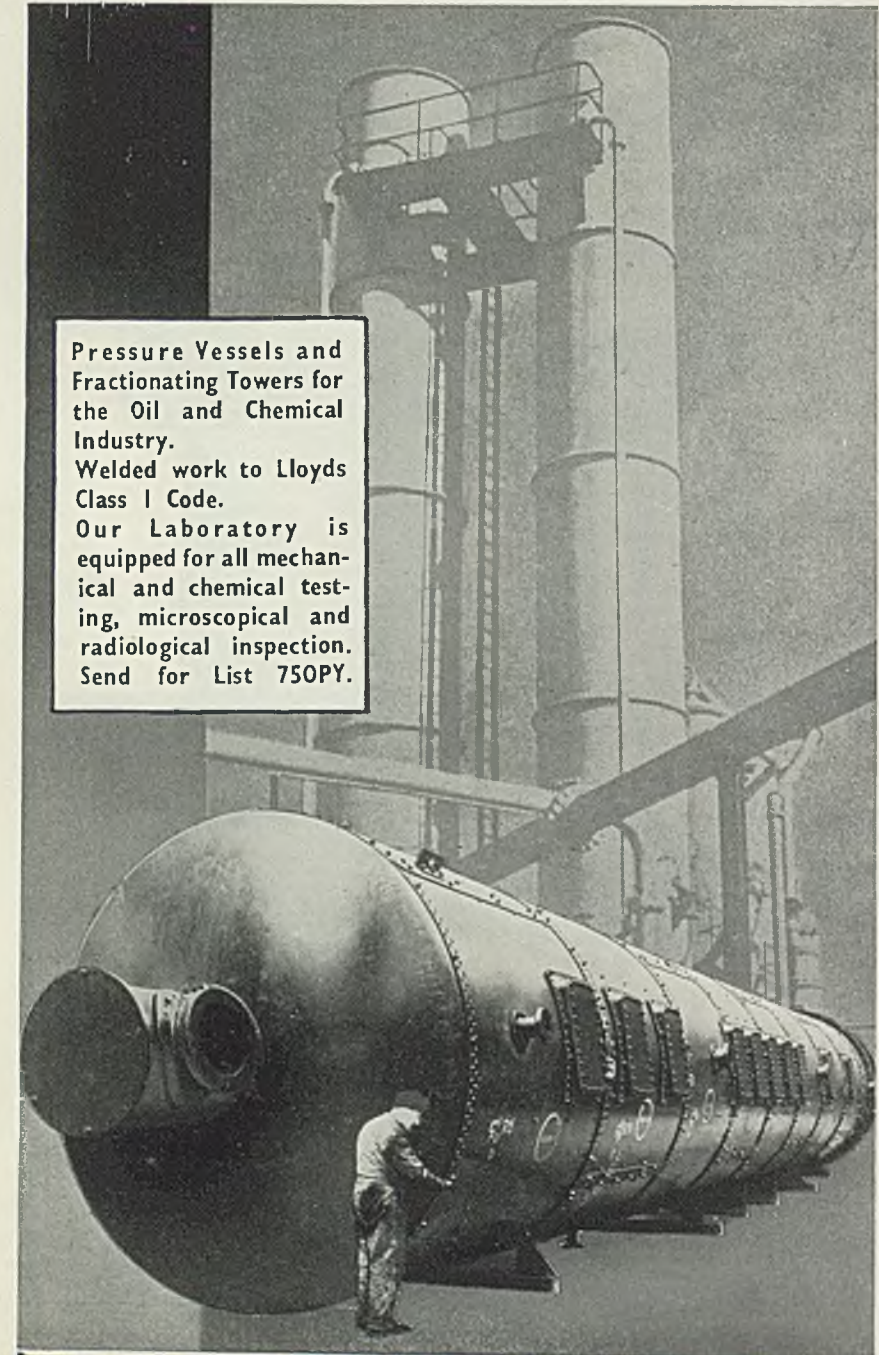
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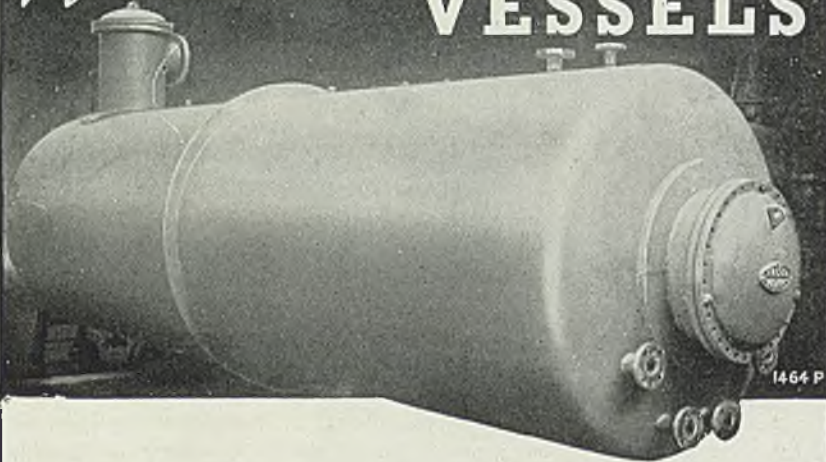


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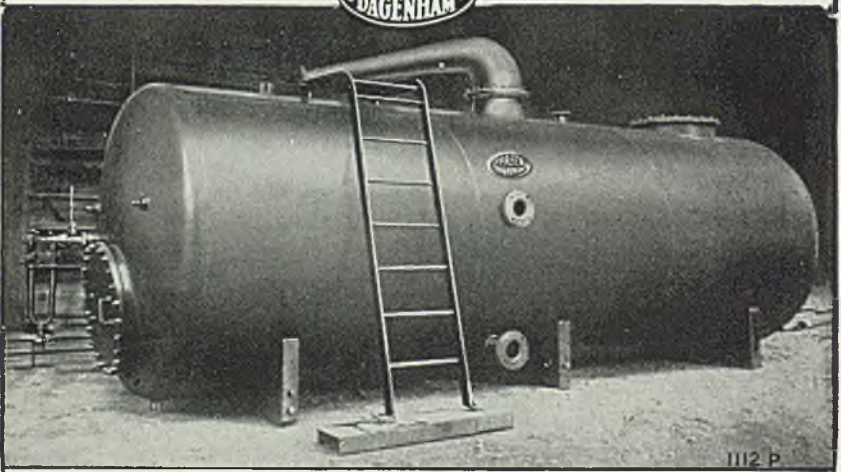
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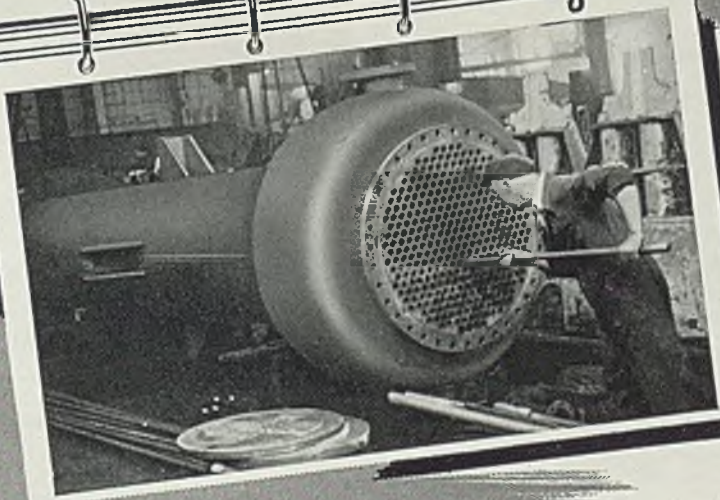
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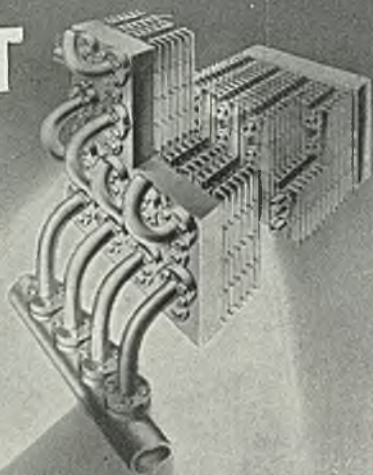
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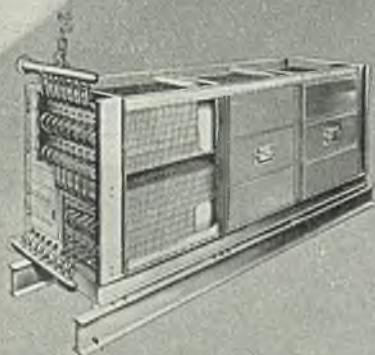
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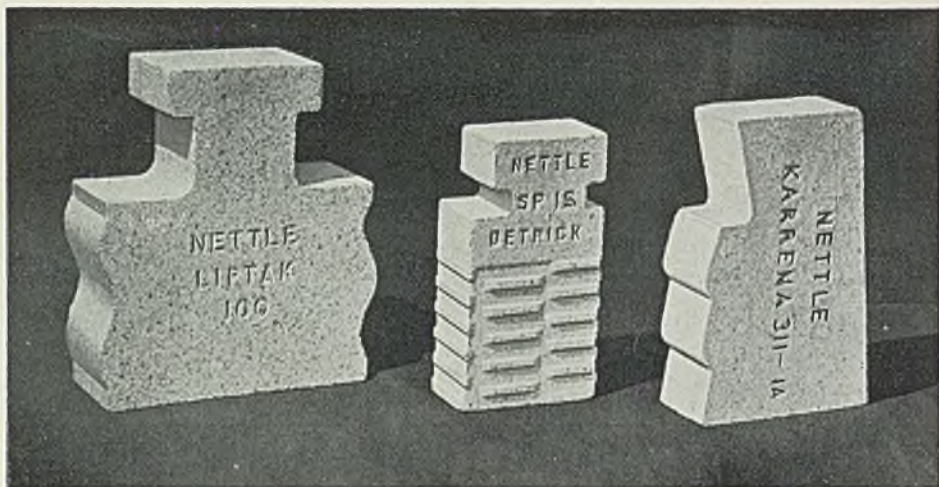
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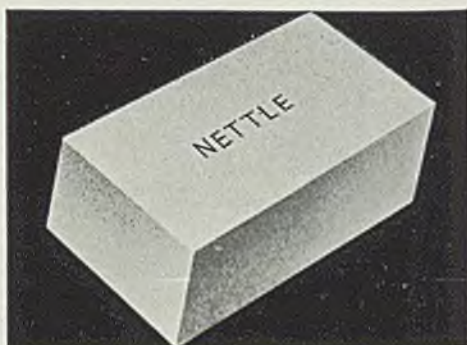
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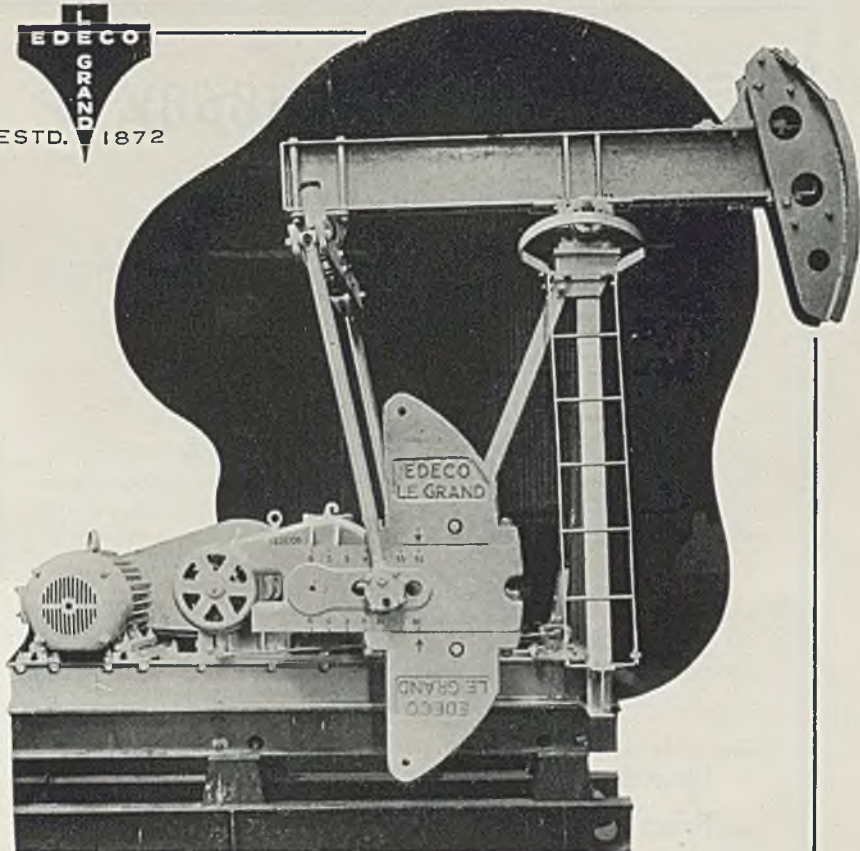
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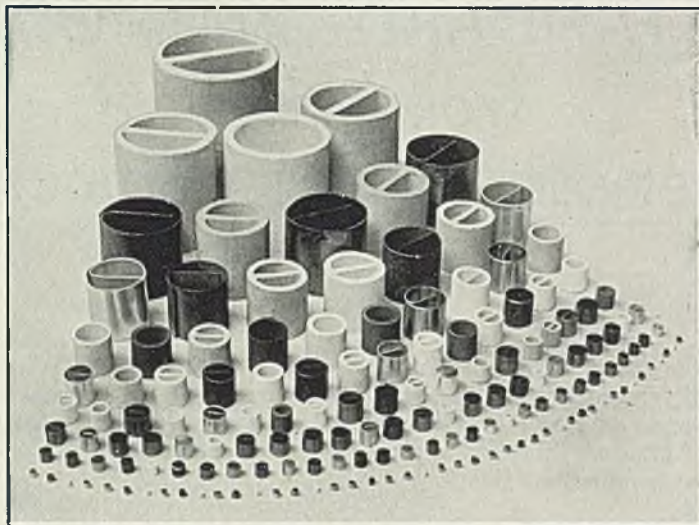
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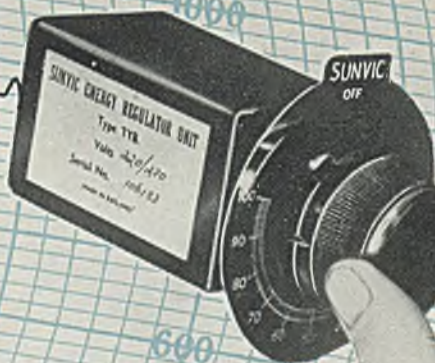


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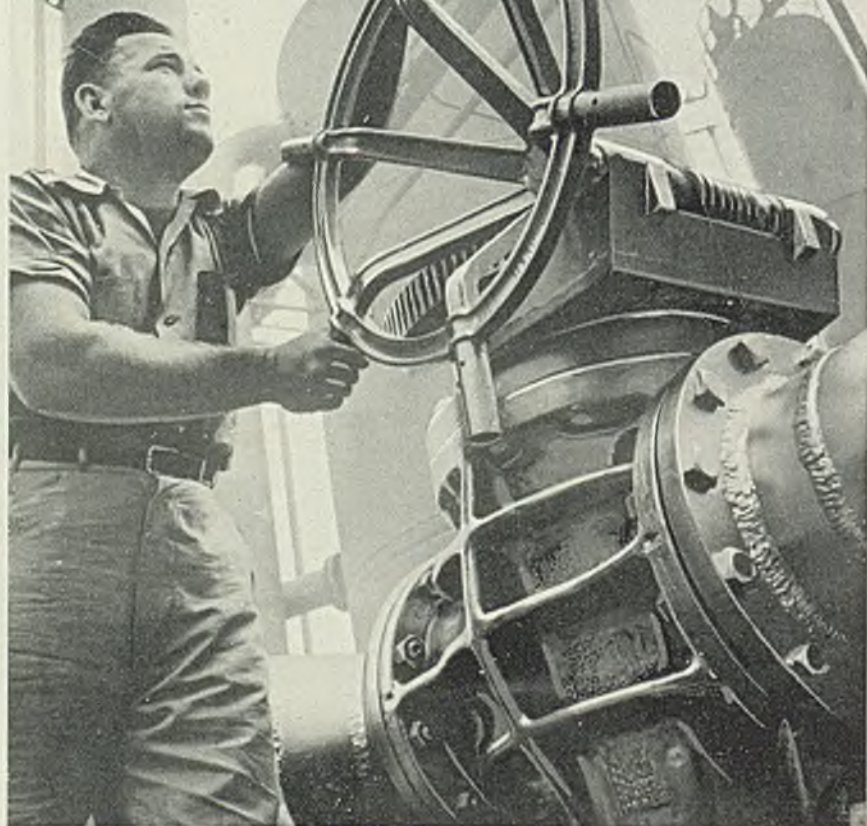
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