ABSTRACTS.

AUTHOR INDEX.

The numbers refer to the Abstract Number.

Oilfield Exploration and Exploitation.

Geology.

1323. Piercement Trap Reservoirs. O. Wilhelm. *Oil Gas J.*, 27.4.46, **44** (51), 147.—Piercing masses usually tilt and fault the beds penetrated. Piercement is commonly due to salt masses, igneous plugs, and the plastic cores of anticlines. Associated with salt masses there may be crescent, salt niche, peripheral wedge, peripheral segment, and composite reservoirs.

A diapiric anticline is one in which the plastic core has pierced the other beds. The structure may be complex. G. D. H.

1324. What is the Geological Fence? Anon. *Oil Gas J.*, 1.6.46, **45** (4), 113.—The geological fence defines the conditions which must be fulfilled by any acceptable theory of oil origin. The geological evidence in favour of *organic origin* is almost overwhelming. 99% of the oilfields are in marine sediments, and 1% in brackish sediments, indicating a *marine environment* of formation. The *temperature of formation* must not substantially exceed 212° F, and static *pressures* must not exceed 5000 p.s.i., thickness of sediments and other evidence pointing to these limits. Oil has not been found in sediments younger than the Pliocene, suggesting an age of about a million years for the youngest known oil. G. D. H.

1325. Calculation of the Petroliferous Reserves of a Geological Layer. A. Lugaresi. *Riv. Ital. Petrol.*, 1946, **14** (160), 9.—The quantity of petroleum which can be extracted from a given layer varies with the porosity and permeability of the stratum, with the degree of impregnation of the rock, with the viscosity of the oil, with the presence or absence of water and gas, and with the texture and structure of the formation. Some of these expressions are quantitatively defined. The work of Cutler, Bradford, and others in the U.S.A. (Bureau of Mines) is summarized and examined. It is concluded that displacement of oil by gas raises the yield to 50 to 65% when the field is nearing exhaustion, and to 70 to 80% if gas displacement is introduced when exploitation begins. D. H. McL.

1326. Two Promising Tests Revive Interest in Florida Wildcatting. H. David. *Oil Gas J.*, 1.6.46, **45** (4), 50.—O. D. Robinson State on Barnes Sound, Monroe County, first encountered oil-shows in the Lower Cretaceous at 10,162 ft, and had numerous saturated zones down to 10,365 ft. The upper part had the best saturation, the lower part consisting of tight limestones. After drilling to 12,050 ft the well was plugged back and perforated at 10,337–10,363 ft and acidized. Swabbing yielded a little heavy black oil.

1 Cory, also in Monroe County, found the top of the Lower Cretaceous at 8168 ft, while the Barnes Sound test met it at 6997 ft. The Key Vaca test stopped in the Eocene Oldsmar limestone, with the top of the Lower Cretaceous expected at about 8000 ft.

1 Hernasco Corp. had an oil show in cuttings at 5595–5600 ft, the Cretaceous having been entered at 3340 ft. A drillstem test at 5585–5605 ft recovered only salt water and mud.

The Upper Cretaceous beds overlap a thick wedge of Lower Cretaceous. 5000 ft or more of Lower Cretaceous occurs at Sunniland.

The main structural feature in Florida is a gentle doming. At the base of the Upper Eocene Ocala limestone is an unconformity. Hence the underlying structures may be stronger. 125 wells, mostly shallow, have been drilled in Florida. Until 1939 no well exceeded 6000 ft in depth, and few reached 3000 ft. Three oil wells have been completed in the Sunniland field which produces from a Lower Cretaceous limestone at 11,500–12,000 ft. The oil is 20–25° A.P.I. gravity.

A well 80 ml southwest of the Barnes Sound test has reached 7640 ft, and penetrated the Pliocene, Miocene and Oligocene in the first thousand feet. G. D. H.

1327. The Anadarko Basin—Will it Pay Off? C. N. Gould. *Oil Wkly*, 8.7.46, 122 (6), 61.—Oil and gas have been known in the Anadarko Basin for more than 40 years. In 1901 primitive wells were being operated a few miles northwest of Granite, Oklahoma. The Gotebo field was opened in 1908, the Cement field in 1916, and the Sayre field in 1922.

The Anadarko Basin was first officially labelled in 1924. Its structure is similar to that of the basins in Illinois, Michigan, Texas, and other states where important fields have been found. Its rock types appear to be favourable, and it is almost surrounded by producing areas.

Many believe that the Ardmore Basin south of the Arbuckles is continuous with the south end of the Anadarko Basin. The position of the west end of the Anadarko Basin is still undetermined, and the site of its northern margin is still not known with certainty. It may extend as far as the Kansas border in the north, and have western branches into Kansas and New Mexico. G. D. H.

1328. Industry Finds Many New Fields. Anon. *Oil Wkly*, 29.7.46, 122 (9), 71.—In the first half of 1946, 213 new fields were opened in U.S.A. This compares with an average of 171 per half year for the years 1937–1945. This year's discoveries included 146 oilfields, 16 distillate fields, and 51 gas-fields. The 1946 discoveries may have given over 1000 million barrels of reserves. The production in the first half of 1946 was less than this figure.

During the nine-year period 1937–1945 2423 new oilfields were found in U.S.A., and the average reserve provided per discovery was 8,493,029 brl. Using this figure as a yardstick, the discoveries in the first half of 1946 should provide 1,239,981,000 brl of new oil. Production in the first half of 1946 was 846,638,000 brl. Unless current discoveries are much poorer than in the past it is unlikely that reserves have suffered a net decline.

13·4% of all wells drilled in the first half of 1946 were wildcats; the figure for the 1937–1945 period was 11·4%. 11·7% of this year's wildcats were successful; the over-all success figure for the period 1937–1945 was 11·1%.

A table gives the ratio of wildcatting to all drilling and the proportion of all wildcats discovering new fields, by districts for the period 1937–1946. G. D. H.

1329. Wildcatting Keeps Pace with Record 1945 Total. Anon. *Oil Wkly*, 30.9.46, 123 (5), 31.—During the first eight months of 1946, 2904 exploratory wells have been completed in U.S.A. The corresponding figure for 1945 was 2905. 594 of the 1946 tests have been successful. 328 of them opened new oil-sources, 194 being new fields and 134 being new pay horizons. There were 44 new distillate discoveries and 113 new gas discoveries. 434 exploratory wells were completed during August. California had three oilfield discoveries during August, two being promising fields near Los Angeles. Colorado's Rangely field was extended. Five new oilfields were discovered in Illinois. Texas discoveries in August included 16 new oilfields, two distillate fields, two gas-fields, 10 new oil-pays, and two new distillate pays.

Tables summarize the results of exploratory completions during August and during the first eight months of 1946 by States and Districts. The August discoveries are listed with brief notes. G. D. H.

1330. Socony-Vacuum is Testing Wildcat Well in Colombia. Anon. *Oil Wkly*, 8.7.46, 122 (6), 30.—Yanacue 1 in the Magdalena valley is being tested. It lies west of the Cantagallo field. Pedro 1, across the river east of the Cantagallo field, is fishing at 9310 ft. La Salina 1 is drilling below 2888 ft. G. D. H.

1331. Texas Petroleum's Well in Colombia at 7923 ft. Anon. *Oil Wkly*, 8.7.46, 122 (6), 30.—Velasquez 1 in the Upper Magdalena valley has reached 7923 ft. Drill-stem tests have given oil shows, 35-gravity oil having been found at 7254–7274 ft, and there were shows at two higher levels. One section of 350 ft is reported to have had 162 ft of net oil-sand. G. D. H.

1332. Phillips' Wild Well in Venezuela under Control. Anon. *Oil Gas J.*, 18.5.46, **45** (2), 94.—Phillips' wild well is reported to have been flowing 50,000,000 cu. ft. of gas and several hundred barrels/day of oil. This well, in Monagas, is near and in the trend of the Jusepin-Santa Barbara fields. Gas was found at 4581 ft, and the first oil sand at 4706 ft. It is estimated that 375 ft of gas- and oil-saturated sands occur in a 600-ft section. The oil gravity ranges 25–35° A.P.I. G. D. H.

1333. Dual Completion from Eocene Sands Possible in Amana Area, Venezuela. Anon. *Oil Wkly*, 2.9.46, **123** (1), 48 (International Section).—Amana 3 has been drilled to 5300 ft. Tests through perforations have been made in the Eocene sands in the interval 3175–4000 ft. A sand at 3110–3255 ft, identified as the Mostrencas, has supplied 200 brl/day of 31-gravity crude. Perforations are expected to be made in the interval 3275–3955 ft, in order to give a dual producer. It is expected that a deep Cretaceous limestone test will be drilled. The structure is anticlinal with no apparent major faulting, and it lies 18 ml northwest of the Mara field and about 20 ml north of La Paz. G. D. H.

1334. Second Tierra del Fuego Well down to 8500 ft. Anon. *Oil Gas J.*, 15.6.46, **45** (6), 83.—A well 800 m. northeast of the Tierra de Fuego discovery well has reached 8500 ft. Oil was found at the 7500-ft level in the discovery well. G. D. H.

1335. French Research Emphasizes Oil Exploration and Utilization of Petroleum Gas. P. Guillaumat. *Oil Gas J.*, 27.4.46, **44** (51), 98.—The Saint-Marcet structure is being explored and developed, and tests are being undertaken on the nearby structures at Aurignac, Genesac, Proupiary, Plagne, and Saint-Martory. Ten gas-wells and two dry holes have been completed at Saint-Marcet. Two of the wells flowed some oil, and others had indications of light oil. To the beginning of 1946 the cumulative production of gas was 5,250,000,000 cu. ft, with 21,000 brl of oil and 2,860,000 lb of butane.

The first well at Plagne went to 6557 ft. It has gas shows in several shallow sands. A second test has reached 3960 ft, and had a gas-saturated sand at 328 ft. Three disappointing wells have been drilled at Genesac, the deepest being 10,197 ft. A 9818-ft test was drilled at Aurignac. Gas was encountered in a breccia in a 7597-ft well on the Proupiary structure, which is connected with Saint-Marcet. Seven shallow tests have been made at Saint-Martory, and a deep test is under way.

A well has been drilled on the structure at Dreuille, going to 6758 ft without success. A second well has reached 5280 ft. Two wells are being drilled at Tresiers, and are over 3500 ft deep. 15 shallow tests have been drilled around Tresiers, Cax and Auch.

At Gardiole a well is drilling at 2379 ft, and one at Vaunage has reached 1476 ft. Several shallow wells have been drilled at Gabian and Saint-Chinian.

The rock pressure at Saint-Marcet is about 2410 lb/sq. in. G. D. H.

1336. Oil Prospecting and Natural Gas Utilization in the South of France (1) Marceau. *Petroleum*, Aug. 1946, **8** (9), 180.—The utilization of natural gas and the exploration of more recently discovered oilfields in the South of France is discussed.
K. C. G. K.

1337. Oil Prospecting and Natural Gas Utilization in the South of France. (2) **Marceau.** *Petroleum*, 1946, **9** (9), 217.—Details are given of the treatment and utilization of natural gas by the Régie Autonome des Pétroles (R.A.P.). A number of experimental borings within recent years are mentioned. K. C. G. K.

1338. Kirkleatham Wildcatting Test in Yorkshire is Abandoned. Anon. *Oil Wkly*, 2.9.46, **123** (1), 48. (International Section).—Kirkleatham 2 has been abandoned in the Carboniferous at 3091 ft. Gas was encountered in the Upper Permian limestone as in Kirkleatham 1, but low porosity and permeability caused production to be smaller. G. D. H.

1339. **Hungary Gas Drilling in Vicinity of Karcag.** Anon. *Oil Wkly*, 15.7.46, **122** (7), 31.—Drilling for gas is proceeding at Karcag, east of the Tisza, where there are surface shows. G. D. H.

1340. **Hungary Reports New Oil and Gas Deposits.** Anon. *Oil Wkly*, 30.9.46, **123** (5), 15.—Several new oil and natural gas accumulations are reported to have been found east of the Danube. G. D. H.

1341. **Russia's Search for Petroleum.** Anon. *Riv. Ital. Petrol.*, 1946, **14** (160), 13.—A survey of Russia's actual and potential sources of petroleum. D. H. McL.

1342. **Search for Oil in Spain to be Greatly Accelerated.** Anon. *Oil Wkly*, 30.9.46, **123** (5), 15.—Current oil prospecting in Spain is centred around Burgos and Soria north of Madrid. During the past year a well has been cored to about 2000 ft, without having encountered encouraging oil-shows. G. D. H.

1343. **French Equatorial Africa Oil Possibilities said Good.** Anon. *Oil Wkly*, 15.7.46, **122** (7), 31.—Geological studies in the province of Gabon have been completed, and it is thought that oil exploitation in the region of Azinga might be successful. G. D. H.

1344. **Deep Tests being Planned for North Tunisia Section.** Anon. *Oil Wkly*, 22.7.46, **122** (8), 15.—A wildcat is being drilled at Zaouia, 5 ml southeast of Hadjebel-Aioun. Earlier tests, said to have had gas shows, southwest of Bizerta and south of Ferryville, were abandoned at 2500 ft and 7500 ft in 1936 and 1940, respectively. Further tests are projected north of Souk-el-arba (northern Tunisia) and near Tebaga (southern Tunisia). G. D. H.

1345. **Wildcat on Sinai Peninsula Shows for 275 brl Daily.** Anon. *Oil Gas J.*, 18.5.46, **45** (2), 97.—The S.U.D.R. wildcat on the east coast of the Sinai Peninsula is reported to have a potential of 275 brl/day of 22° A.P.I. oil from the interval 2680–2925 ft. G. D. H.

1346. **N.E.I. Oil Awaits Settlement of Post-war Political Problems.** Anon. *Oil Gas J.*, 18.5.46, **45** (2), 95.—108,000,000 brl of oil has been produced from some dozen fields in Java. The structures are mainly moderately steep asymmetrical anticlines, commonly intersected by faults. The oil comes from Upper Miocene sandstones at depths of 700–3000 ft.

The core of Java is geanticlinal, but has only small exposures of pre-Tertiary beds. In western Java there are 9500–10,500 ft of Tertiary beds which are mainly marine except near the top. Much of the area is covered unconformable by Plio-Pleistocene beds. There are surface oil shows. In eastern Java the known section amounts to 10,200–12,000 ft, but may be much thicker. There are very few porous beds. Sands are rare except high in the section. Limestones also are limited. Stratigraphic trap possibilities have not been examined.

The Balikpapan area of Borneo has produced about 240,000,000 brl of crude. Nearly all the producing structures are on a single anticlinal trend. They are moderately strong, with cross-faulting and steep western flanks. The oil is in Upper Miocene and Pliocene sands. About ten different sands produce down to 2500 ft. The oils are less asphaltic with depth.

The fields of the Tarakan area have given 144,000,000 brl of oil from Pliocene and Upper Miocene sands. The main field, Pamoesian, has 15 sands down to 3700 ft.

100,000,000 brl of oil has come from the Miri-Seria area. Miri is almost depleted, and is a rather complex highly faulted asymmetrical fold, with thrusting on the south-east flank. The axis of the east-west Seria fold lies off-shore. There are steep dips on the south flank. Production comes from the Upper Miocene. Eocene production is obtained from the structures in the Barito area.

In Eocene and Oligocene times thick deposits of sediments and volcanics were formed in west central and southeast Borneo, and marine shales, limestones and sandstones in central and east Borneo. In the Lower Miocene there are interbedded marine and freshwater beds, the latter increasing upwards to the Pliocene which is almost entirely terrestrial. Earth movements began in the late Miocene forming three embayments in which deposition continued. There was steep folding in the central parts of the basins.

The Vogelkop basin has a thick Tertiary section with numerous structures, and there are oil indications. Oil has been found on the Klamono, Wasian and Mogoi structures. Klamono has 8 producing wells proving 400 acres. It is a broad faulted anticline with oil in a limestone at 300 ft on the crest. The saturated sections are up to 400 ft thick. Wasian has two oil wells in a Miocene limestone. Mogoi has one well in the Miocene limestone. Both Wasian and Mogoi are gentle structures.

The Boela field of eastern Ceram gives oil from Plio-Pleistocene sands at 200–1000 ft. G. D. H.

1347. Says Delhi Field Biggest of Type Since East Texas. Anon. *Oil Wkly*, 15.7.46, **122** (7), 30.—The discovery well at Delhi was completed in December 1944, giving 108 brl/day of 41-gravity oil. 219 additional wells have been drilled, and the production is 16,000 brl/day. The reserves are estimated to total 175,000,000 brl. The field is a stratigraphic trap, and produces from the Tuscaloosa and Paluxy.
G. D. H.

Geophysics and Geochemical Prospecting.

1348. Validity of Data from Airborne Magnetometer. H. Jensen. *World Petrol.*, 1946, **17** (9), 45.—The conventional geological magnetometer was developed for mobile use in submarine work. The modified form has been used for aerial geological survey with the advantages, *inter alia*, of providing a continuous record and reducing errors due to local magnetic bodies. Position control has been carried out photographically and with the aid of electronic devices. F. S. A.

1349. The Electronic Principle Employed for the Discovery of Petroleum. Anon. *Riv. Ital. Petrol.*, 1946, **14** (160), 15.—The instrument devised by Craver of the Massachussets Institute of Technology for the discovery of petroleum is described. The instrument (known as the Petromer) is capable of defining several characteristics of a petroliferous layer, and its scope is defined in this description. D. H. McL.

1350. Application of Mud Analysis Logging. R. E. Souther. *Geophysics*, 1946, **10**, 76–90.—The mud analysis logging system, now widely used for exploratory and routine drilling, continuously analyses and records the oil and gas content of mud returns from wells being drilled by the rotary method. Oil and gas detected in the returning drilling fluid indicates oil or gas in the formation penetrated by the bit. Results of the continuous analyses are instrumentally correlated to the depths and formations from which the showings originated. A second useful phase of the system plots accurately and in detail rate of penetration or drilling speed on the log as a function of depth.

Trucks and trailers provide a mobile housing for all the mud analysis equipment so that it may be moved rapidly from well to well.

Applications of the method may be divided into two classes :

1. Routine drilling in proved areas where it eliminates unnecessary coring and locates gas caps and completion zones.
2. Exploratory drilling in which it minimizes coring by indicating for testing purposes porous zones containing oil and/or gas.

Mud analysis logging can be practised in areas where the electrical log cannot be used due to high salt content or other local conditions, where dangerous hole conditions make interruption of drilling operations for coring inadvisable, and for evaluating gas zones where cores are difficult to interpret.

In addition, each mud analysis logging unit contains equipment to obtain information useful in eliminating washouts, in predicting and preventing blowouts, and in controlling drilling mud characteristics. E. I. R.

1351. Exploring the Continental Shelf. C. J. Deegan. *Oil Gas J.*, 15.6.46, **45** (6), 98.—The commonest geophysical devices for underwater investigations are the gravity meter for reconnaissance and the seismograph for detail. The latter could be used in 600 ft of water, although the work would be expensive. Two general types of diving bells are in use for gravity meter work. One is suitable for depths up to 40 ft, the other up to 250 ft. In shallow water 25 stations/day and in deep water 10 stations/day can be covered with diving bells.

A series of diagrams and photographs show the construction and operation of the two types of diving bell. G. D. H.

1352. Early Reflection Seismograph Exploration in California. H. Salvatori. *Geophysics*, 1946, **10**, 17–33.—Following the success achieved in Oklahoma, a major attempt was made in 1931 to use the reflection method of seismic prospecting in California. The records obtained were exceedingly poor, and the results of this early work very disappointing. This was due to the fact that the area chosen was particularly unfavourable for reflection prospecting, and would give poor results even if modern technique and equipment were used. However, in 1932 a prospect near Merced was successfully mapped. The dip method of shooting became standard practice, as the correlation method so successful in Oklahoma was generally unsatisfactory in California. Wide spacing of lines and stations was the rule, as only structures having large amounts of closure were considered important. As a result of this early reflection work several important oilfields, including the Wilmington and Rio Bravo fields, were discovered. A brief history of the discovery of these two fields is given, and the seismic maps are compared with those compiled from well data. E. I. R.

1353. History of the Geophysical Exploration of the Cameron Meadows Dome, Cameron Parish, Louisiana. G. M. McGuckin. *Geophysics*, 1945, **10**, 1–16.—The development of the gravitational and seismic methods of geophysical prospecting since 1926 is discussed with reference to a typical Gulf Coast salt-dome. This dome lies entirely within the Cameron marsh area, and airplane photographs reveal no physiographic expression. The following methods were used: mechanical refraction seismograph (1926), torsion balance (1927), electrical refraction seismograph (1928–29), early correlation reflection seismograph (1929), dip reflection seismograph (1933), special salt profiling refraction seismograph (1942), continuous correlation reflection seismograph (1942), gravity meter (1943). The torsion balance revealed a significant gravity minimum indicating deep salt, and this was confirmed by subsequent drilling and later geophysical surveys. The additional structural details revealed by the later surveys is particularly striking. E. I. R.

1354. Gravimeter Prospecting for Chromite in Cuba. S. Hammer, L. L. Mettleton and W. K. Hastings. *Geophysics*, 1945, **10**, 34–49.—Early in 1942 the Gulf Research and Development Co. carried out a gravimeter survey in the chromite bearing Camaguey district of Cuba. As a result of this work one large chromite orebody was located. This paper is of general interest owing to the fact that gravity anomalies as small as 0·05 milligal were considered to be of economic importance, thus taxing the limiting performance of modern gravimeters. E. I. R.

1355. German War-time Developments in Geophysical Instruments. Anon. *Petrol. Times*, 31.8.46, **50** (1281), 908.—A summary of the BIOS Report No. 334 by Professor A. O. Rankine. The most important developments were in the field of gravity surveying (with the invention by Dr. Graf of a new gravimeter) and in methods of recording the results of geophysical work. The new Graf gravimeter is a better instrument than the Thyssen, which was used in Germany before the war, but it is inferior to the best of the American gravimeters, such as the Gulf and the La Coste. No great progress has been made in the fields of seismic, electrical, and magnetic prospecting, and in no case are the new German instruments greatly, if at all, superior to the British or American types. R. B. S.

Drilling.

1356. Deeper Drilling Necessitates that Greater Emphasis be Placed on Drill-Pipe Testing. G. Weber. *Oil Gas J.*, 31.8.46, **45** (17), 72.—A general study of drill-pipe inspection is presented. Magnetic particle inspection and the fluorescent penetrant method are cited as aids to visual inspection, together with automatic testing methods which would indicate defects to be further inspected by skilled personnel. The latter methods involve techniques based on a number of principles, including surface magnetic field measurement, diffraction or back reflection of gamma rays and X-rays, hysteresis and eddy current losses, and conduction of heat, electric currents, vibrations, supersonic waves, X-rays, and other radiations. The different grades of pipes are described and some of present-day and prospective field inspection methods are discussed.

A. H. N.

1357. Mud Engineering in Modern Drilling Practice. Anon. *World Petrol.*, 1946, **17** (9), 46–49.—The paper consists of a review of the desirable properties of drilling muds and methods by which such properties can be most nearly obtained. Special reference is made to the sodium salt of carboxymethylcellulose as a mud component. A non-critical comparison between water base and oil base muds is drawn. F. S. A.

Production.

1358. Gas Recovery Systems. D. Rogers. *Producers' Monthly*, June 1946, **10** (8), 54.—(*Paper presented at annual meeting Eastern District Division of Production, A.P.I.*, Pittsburg, June 1946.)—In this paper gas recovery refers to the salvage of solution gas escaping from produced crude oil either at low pressure or under vacuum. The amount of gas which can be recovered from a barrel of produced crude oil depends on the gravity and temperature of the oil and the pressures under which it is handled. Gas recovery in the Bradford field is effected at the gas–oil–water separators and stock-tanks. The gas-recovery line takes gas from the separator dome and from the top of the stock-tanks, and delivers it either directly to a vacuum pump or to a vacuum gathering system. Some companies use separators in which the oil and water levels automatically adjust the outlet flow by float-operated valves. " Slop " tanks are often used to perform a secondary oil-water separation, and thus reduce losses caused by emulsions, stuck-valves, freeze-ups, and excessive fluctuations in fluid flow. Another type of installation uses a gasometer to regulate the pressure.

The economics of gas recovery is briefly studied: it appears that by carefully analyzing all pertinent factors an oil-producer can determine whether gas recovery will be profitable on his properties, how much initial investment will be required, and how soon a pay-out can be expected.

The paper is well illustrated by diagrams and seven references are appended.

R. B. S.

1359. Control of Gas-Cap Expansion. W. J. Travers, Jr. *Oil Gas J.*, 20.7.46, **45** (11), 91.—*Paper presented before A.P.I.*—The field structure and conditions in a deep California field are discussed. A study of the history of production of the field reveals an expanding gas-cap resulting in increasing gas–oil ratios. The first method of gas–oil ratio control consisted of shutting in wells where ratios had climbed above 2000 cu. ft./brl. By April 1942 six wells were shut in for this reason. It was then apparent that some means of gas–oil ratio control which would avoid the loss of producing wells would be necessary efficiently to carry out the objectives of pressure maintenance. A plan was worked out for a remedial programme so that by cementing sections of the well the gas–oil ratio could be reduced. This plan is described in detail, together with the improvements attendant on its execution. A. H. N.

1360. Plastic Plugging Reduces Gas–Oil Ratios. E. S. Bauer. *Oil Gas J.*, 31.8.46, **45** (17), 88–89.—Plastic plugging is an effective and at the same time economical method of sealing off unwanted water and gas intrusion into oil-pays. Extensive work done in the west Texas oilfields, using Resinox (a phenolic, low-temperature curing resin), has proved that effective control of gas–oil and water–oil ratios can be gained within a price range economically practical to oil producers. The highly acid gases prevalent in the oilfields will not dissolve the plastics to cause new fissures. Plastic plugging is less expensive than tamping lead filaments and turnings into wells and, unlike this method, a well that has been plugged with plastics, be it a gas-shut-off, a bottom-hole-water shut-off, or a mid-section water shut-off, can be easily drilled deeper at a later date. A method of plugging used is described which can be used to reduce either water or gas produced with the oil. A. H. N.

1361. Operators in Hull and Silk Field Study Repressuring Programme. C. H. Keplinger and J. M. Wanenmacher. *Oil Gas J.*, 31.8.46, **45** (17), 76.—A detailed report on the geology, structure, and past development of the Hull and Silk Field is presented as an introduction to the necessity of instituting a re-pressuring programme for the field. The field is under the control of several operators, and the project calls for a unitized repressuring scheme. Estimates of reserves and profits are given.

A. H. N.

1362. East Texas Field Has Record of Outstanding Results from Its Four Year Programme of Salt Water Disposal. Part 4. W. S. Morris. *Oil Gas J.*, 31.8.46, **45** (17), 92.—Effects of injection of salt water into East Texas Field on the production economics of the field by maintaining the reservoir pressure are studied with the aid of a tabular and graphical representation of the results so far achieved. A. H. N.

1363. Source and Purification of Water Supply. G. W. Holbrook and A. R. Ellenferger. *Producers' Monthly*, June 1946, **10** (8), 57. (*Paper presented at annual meeting Eastern District Division of Production, A.P.I.*, Pittsburgh, June 1946.)—The importance of adequate quantities of water of proper quality for water-flooding operations is stressed. The selection of the most suitable source and the methods to obtain the required amounts is one problem, and the determination of the proper treatment to make the water most suitable for use is another.

The better the quality of the raw water to start with, the less treatment is required. Surface waters from lakes and rivers often vary in quantity and quality with changes of season. They usually contain substantial quantities of mechanical impurities such as mud, sand, suspended clay, and organic matter, and frequently require extensive settling basins with adequate clean-out provisions, in addition to filters. The changing quality is an even greater disadvantage, for it calls for continuous close supervision of the treatment process, and changes in the treatment to match changes in the quality. Springs provide water relatively free from mechanical impurities and less likely to be affected by changes of season, and they eliminate the necessity of underground equipment to make the supply available. Unfortunately the quantity available is seldom adequate for water-flooding work. For these reasons the majority of water-floods in operation at the present time are supplied by sub-surface waters obtained through wells from porous formations. The available quantity of such a water supply is in most cases limited only by the number of wells drilled, and the quality will ordinarily change only very slowly with time.

The primary purpose of water treatment is to maintain the highest rate of recovery and to get the greatest economic recovery of crude from the development, by preventing any unintentional plugging of the sand at the input well which would cause a decrease in the input water rate. A second purpose is to prevent corrosion, not only to save maintenance expenses, but also because the products of corrosion themselves cause plugging of the sand face. A third purpose is to increase the efficiency of displacement of oil by water. Among the various impurities the most important are suspended matter, microscopic organisms, dissolved gases, and various dissolved solids; the acidity (pH valve) also has an important effect. There is no standard water treatment which will remove all the impurities which may be present, and proper treatment must be devised in each individual case on the basis of water analyses. Improper treatment can result in a water much more harmful than the original raw water, particularly insofar as chemical plugging may occur.

The various treatments commonly used are aeration, chemical treatment, settling, algae treatment, filtering, and de-aeration. Aeration increases the oxygen content, but causes precipitation of iron and manganese as oxidized products, and also removes carbon dioxide and hydrogen sulphide. Alkalis are used to raise the pH value and remove carbon dioxide. Chlorine controls algae and assists in the oxidation of iron and manganese. Polyphosphates are used to stabilize water by holding in solution the carbonates present and also for preventing corrosion by the deposition of a thin protective coating. Sodium sulphite can be used for oxygen removal and alum is sometimes used as a coagulent to improve the efficiency of filters. Ample time and capacity for settling must be allowed for and adequate provisions must be provided for cleaning out settling-tanks. Hypochlorites, copper sulphate, and phenol derivatives are effective in removing algae. Vacuum treatment can be used for de-aeration. Finally, the various types of filtering treatments are discussed. R. B. S.

1364. Water Meters (to measure input of water intake wells). F. Milne. *Producers' Monthly*, June 1946, **10** (8), 51.—The measurement and control of water intake in water-flooding are essential for the scientific control of these operations. The basic rules governing the installation of a high-pressure water-meter on an intake well are: (1) after the meter is installed turn the water on slowly and allow the water line, the well, and the meter to be thoroughly filled; (2) open the air-vent screw on the meter about three turns to allow any air to escape that might be in the meter; and (3) open the valve on the water-line gradually after the pressure is built up in the well. The motor cannot then race at an excessive rate, because the pressure will be nearer equal on both the inlet and the outlet of the meter.

Care must be used that silt, rust or scale are not allowed to enter the meter, and the water used must be free from chemicals or acids which would have a damaging effect on the finely machined surfaces of bronze and hard rubber parts within the meter. These things not only result in inaccurate registration, but eventually cause premature wear and damage. Many producers use a 1-inch-high pressure-strainer ahead of the meter and installed so that it can be removed for cleaning. In view of the rate of water-flow through a meter the possibility of freezing up is remote, however; enclosed oil-gear trains are to be preferred to open wash-gear trains in this respect.

The various types of water-meters suitable for oilfield use are briefly described. R. B. S.

Oilfield Development.

1365. Exploratory Drilling Rate Down, Success Ratio Up. Anon. *Oil Wkly*, 29.7.46, **122** (9), 75.—2097 exploratory tests were completed in U.S.A. during the first half of 1946. 21·7% of them were successful. In the corresponding period of 1945 18·8% of the exploratory wells were successful. This year there have been 347 discoveries and 109 extensions.

California, New Mexico, and the Rocky Mountain States have had fewer exploratory completions than in 1945. Illinois had five new oilfields, five new pays, and five extensions in June; Kansas had four new oilfields, a gas-field and two extensions; Oklahoma had six new oilfields, one gas-field, a new oil-pay, three oilfield extensions, and a gas extension; and Texas had eight new oilfields, four gas-fields, five new oil-pays, two new gas-pays, one distillate pay, and three oilfield extensions.

Tables give a summary of the exploratory drilling results, and details, by States, of the exploratory drilling results for June and for the first half of 1946. The June discoveries are listed with a brief statement of the salient points. G. D. H.

1366. Completions May top 1945 Total. Anon. *Oil Wkly*, 29.7.46, **122** (9), 58.—13,568 wells were completed in U.S.A. during the first half of 1946, compared with 12,172 in the corresponding period of 1945. Increases over 1945 were shown in Texas, Colorado, Oklahoma, Kansas, Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and New York.

2392 wells were completed in June, 1946, 1297 finding oil and 211 finding gas.

A table summarizes the U.S.A. well completion results for June and for the first half of 1946, by States and districts. G. D. H.

1367. Footage Being Drilled at Pre-War Rates. Anon. *Oil Wkly*, 29.7.46, **122** (9), 86.—In the first half of 1946 a total of 45,848,047 ft of hole was drilled in the 13,568 U.S. completions. The corresponding figures for 1945 were 43,249,271 ft and 11,911 new wells.

On the Louisiana Gulf Coast the average depth of completions in the first half of 1946 was 9064 ft. Florida's 11 completions averaged 7083 ft per well.

Tables give the numbers of completions, total footage, and average footage per well yearly from 1925, and similar data, by States, for the first halves of 1941, 1945, and 1946. G. D. H.

1368. Independants Drill Three-Fourths of Wells. Anon. *Oil Wkly*, 29.7.46, **122** (9), 59.—During the first half of 1946 10,125 wells in U.S.A. were completed by the smaller companies and independents. 3163 wells were completed by the remaining companies. The former groups completed 1631 of the exploratory wells, and the remaining 466 wells were completed by 36 companies, including most of the " major " companies and several of the more active independent companies. Of the total of 1815 strict wildcats, 1463 were drilled by the small operators. The small operators completed 64·3% of the successful exploratory wells, and had 70% of the new field discoveries.

During 1946 the small companies have been more active than in 1945, while the reverse is true of the remaining group, including the major companies.

A table summarizes the completion results for the first half of 1946 by companies for the larger operators, together with totals for the rest of the industry. G. D. H.

1369. Gas Reserves of the U.S. E. DeGolyer. *Oil Wkly*, 29.7.46, **122** (9), 62; *Oil Gas J.*, 4.5.46, **44** (52), 80.—At the beginning of 1946 the U.S.A. proved recoverable gas reserve was estimated to be 144,000,000,000,000 cu. ft., including only fields with reserves exceeding 20,000,000,000 cu. ft., except in the Appalachian area, Illinois, Indiana, and Michigan. The pressure base employed was 16·4 lb/sq. in, and the temperature 60° F. In the Appalachian area, Indiana, and Illinois, the reserves are comparatively unimportant in terms of volume and were estimated from analyses of decline curves and pressure data. Elsewhere the reserves were estimated horizon by horizon and field by field. Where possible the pressure-production decline method was employed, and in other cases the volumetric method was used.

The figure given for the total is believed to be conservative, and there may actually be reserves of 200,000,000,000 cu. ft.

Five fields or areas have 43% of the total reserves, 20 account for 61·6%, and 100 for 81·6% of the total reserves.

Except in the Appalachian area, California, and a few northern States, little effort has been made to prospect for gas. Most of it has been found while searching for oil, and in the past many gas-shows were plugged and abandoned or neglected because of low prices or lack of markets. In future such finds are likely to be exploited.

Within the past ten years drilling to greater depths has resulted in the discovery of increasingly greater proportions of hydrocarbons in the gaseous than in the liquid phase than in the earlier search for shallower fields.

The limits of the Hugoton gas-field are not yet known. The productive limits of other gas-fields are also incompletely defined.

Tables give the recoverable reserves by States for the beginning of 1946, with a breakdown according as whether the gas is free or dissolved. There is also a list of reserve estimates (totals) at different dates since 1919. G. D. H.

1370. Permian Basin to Lead Expanded Operations. Anon. *Oil Wkly*, 29.7.46, **122** (9), 66.—The Permian Basin sector of West Texas has over 1000 proved locations waiting to be drilled. Pipe-line outlets are operating to capacity, and the construction of new pipe-lines is being considered. Few of the older producing areas have exhausted their drilling locations, and Keystone, TXL, Dean, Slaughter, and Estes-North Ward each has over 100 locations to be drilled.

At Wilmington the prolific " 237 " schist zone may underlie a substantial part of the field. Many shallow wells will be deepened to this zone. ½ ml west of the Poso Creek field, Kern County, heavy oil has been found in the Santa Margarita. The Cymric field is small in area, but prolific.

Much exploration in West Central Texas will be for Mississippian and Ellenburger production. In South Texas the most important recent developments are the discovery of the North Albercas field, Webb County, and the extension of the Piedras

Pintas field, Duval County. In East Texas there has been substantial development at Hawkins, and at the Opelika gas-distillate field oil has been found on the north flank.

A new deep production record has been established at Weeks Island, Iberia Parish, Louisiana, where production comes fróm 13,763–13,778 ft.

The Antioch Southwest pool of Garvin County, Oklahoma, was opened in the Pennsylvanian. The Blue Hill field of McClain County had a big strike in the Chimney Hill section of the Hunton.

Mississippi obtained a new field in Adams County. Of 13 completions in Florida during the first half of 1946, only one was a producer. This lay 1 ml west of production at Sunniland. Notable shows were reported in a test in Monroe County, and in one in Hernando County. Georgia had two dry wildcats. G. D. H.

1371. Design for Petroleum Expansion Outside the United States. R. G. Greene. *Oil Gas J.*, 15.6.46, **45** (6), 84.—U.S.A.'s first production abroad was obtained in Mexico in 1900, and in 1914 America's foreign production was limited to Mexico and Rumania. Since 1919 about $3,200,000,000 has been expended on U.S. foreign oil operations, 41% having been spent on exploration and development, and 59% on transportation, refining, and marketing. Since 1919 some 25,300,000,000 brl of foreign reserves (excluding Russia) has been found, and U.S. controls about 45% of this total.

Foreign operations involve a risk of expropriation. Nationalized development has been adopted in many South American countries, but foreign entry is still possible in Venezuela, Colombia, Ecuador, and Peru without undue complications. National development may also be adopted in Czechoslovakia, Yugoslavia, and possibly in Rumania.

Big U.S. investment losses were sustained in Europe and Asia during the recent war.

In the Middle East reserves may total 27,000,000,000 brl, 53·15% being held by British companies and 40·47% by American companies. Estimates of Russia's reserves range 6000–50,000 million barrels. G. D. H.

1372. Canada Vigorously Pushing Oil Search, Concentrating on Western Plains. W. W. Burns. *Oil Gas J.*, 25.5.46, **45** (3), 94.—Investigations are claimed to have established Alberta as having a tremendous gas reserve. It is possible that one company may erect plant for converting gas to gasoline.

77,000 acres east of the Viking–Kinsella reserve have been proved up.

Only some 12 out of 1600 wells drilled in Western Canada can be considered to have been deep enough to test the whole sedimentary section. The proven reserves are estimated at over 51,000,000 brl, 21,000,000 brl being at Turner Valley and the rest at Norman Wells. Turner Valley's output has fallen since February 1942. Canada produces only 15% of her oil requirements.

1 Brazeau is testing the Madison at 12,000 ft. A flowing well has been completed at Lloydminster, but this will be put on the pump to reduce water-coning and sand movement. Production at Lloydminster comes from the Cretaceous at 1800–1900 ft. The oil is 14·7° A.P.I. gravity. Efforts are being made to get oil at Jumping Pound, where gas and condensate have been found on the crest of the structure. Other foothill anticlines are being drilled.

In the plains Upper Cretaceous to Devonian beds occur. Small oilfields have been found. 1 Redstone in the Norman Wells area was junked at 4874 ft, because of mechanical troubles. No favourable indications had been met. The well was bottomed in Silurian. G. D. H.

1373. Production in South America Continues Expansion. Anon. *Oil Gas J.*, 27.4.46, **44** (51), 100.—26 wells are being drilled in Colombia. The production in 1945 averaged 62,534 brl/day. Venezuela has 80 rigs active. Nine wells are under way in Ecuador. No. 1 Bajada was abandoned at 13,206 ft; 2 Rodeo is drilling at 10,500 ft. The 1945 output in Ecuador averaged 6850 brl/day. In Peru a well is to be drilled east of the Andes and 300 ml northwest of the Ganzo Azul field. 46 wells are being drilled in Peru. Slight shows have been reported in a well on the Titicaca national reserve. During 1945 Peru's production averaged 37,500 brl/day. Bolivia has five wells under way. Its 1945 production was 1160 brl/day. Chile's Punta Arenas area well was drilled to 7500 ft. It is said to have a potential of 8000 brl/day of 39° A.P.I. oil. 51 rigs are active in Argentina, where the 1945 production averaged 62,000 brl/day. Four wells are being drilled in Brazil. G. D. H.

1374. Creole to Exploit New Concessions Promptly. Anon. *Oil Gas J.*, 25.5.46, **45** (3), 92.—Creole is carrying out geophysical work in Guarico, Monagas, and in Lake Maracaibo.

The eastern extension of the deeper sands at Maracaibo seems to be cut off by a fault. G. D. H.

1375. Production in Venezuela Registers Big Increase. Anon. *Oil Wkly*, 15.7.46, **122** (7), 31.—During the first five months of 1946 Venezuela produced 170,000,000 brl of oil. The output of western Venezuela was 61,296,764 brl in the first quarter of 1946, an increase of 31% over the figure for the same period of 1945. G. D. H.

1376. Venezuelan Output Still Exceeding 1945 Figures. Anon. *Oil Gas J.*, 15.6.46, **45** (6), 82.—During the first quarter of 1946 Venezuela produced 90,574,145 brl of oil; the 1945 total was 323,440,191 brl. Tables give the production for these two periods by fields and by companies. G. D. H.

1377. Western Venezuela's Output up 19·3% in 1945. Anon. *Oil Gas J.*, 1.6.46, **45** (4), 44.—Western Venezuela produced 218,538,657 brl of oil in 1945; the 1944 figure was 183,199,288 brl. G. D. H.

1378. British Zone of Germany Producing 12,900 brl Daily. Anon. *Oil Gas J.*, 15.6.46, **45** (6), 83.—Production in the British zone of Germany has risen from 3920 brl/day when the Allies took over to about 12,900 brl/day. The 24 oilfields and one gas-field of this zone are around Celle and Hamburg, near the Dutch border. Most of the wells are pumpers, but some at Wesendorf flow. Near Bentheim a gas-field produces 10,000,000 cu. ft./day from a limestone.

Before the war Germany's oil reserves were estimated at 85,000,000 brl, and the daily production at 20,000 brl. G. D. H.

1379. Continuing Search for Oil in Britain. A. H. Day. *World Petrol.*, 1946, **17** (10), 47–49.—A short historical survey of exploration in Britain is given, together with the present position. 735,000 ft have been drilled in 380 wells by the D'Arcy Exploration Co., 250 of which have been productive. Over 400,000 tons have been produced, mainly from the Eakring district. Output has recently declined. It is stated that prospecting in Britain is uneconomic but the production obtained was valuable in time of war. F. S. A.

1380. War Oilwells of England. R. K. Dickie. *Times Trade and Engineering*, 1946, **60** (993), 8–9.—A brief illustrated account of the oilfields in Lancashire and Nottinghamshire. The extent of the latter is indicated on a sketch-map, and the geological structure is shown on simple diagrams. It is considered probable that other oilfields, of a similar size, may be discovered. V. B.

1381. Cradle of Galician Oil in Midst of Revival. Anon. *Oil Wkly*, 15.7.46, **122** (7), 31.—The Bitkov field is being revived, 16 wells being in operation. 100 new wells have been drilled in the Devonian oil horizons at Tuimazy which has an output of 29,000 brl per day. G. D. H.

1382. Roumanian Production Still Short of Pre-War Total. Anon. *Oil Gas J.*, 1.6.46, **45** (4), 44.—During 1945 Roumania produced 32,480,000 brl of crude, compared with 24,584,000 brl in 1944. The 1938 production was 64,970,000 brl. About 21,700,000 brl of the 1945 production went to Russia. G. D. H.

Transport and Storage.

1383. Steady Turbulent-Flow Equations of Continuity, Momentum, and Energy for Finite Systems. E. R. Van Driest. *J. Appl. Mech.*, 1946, **13** (3), A-231–A-238.—The steady turbulent-flow equations for continuity, momentum, and energy were derived for certain finite systems. It was found that for an incompressible fluid the continuity relation contained neither non-uniform velocity-distribution correction terms nor turbulence terms, that the momentum equation involved velocity-distribution corrections and mean-square velocity fluctuations, and that the energy relation contained not only velocity-distribution corrections and mean-square terms, but in addition mean-cube and double- and triple-correlation terms. The correction factors for non-uniform velocity distribution were evaluated for fully developed open channel and pipe flow. Through the momentum law the effect of turbulence was shown quantitatively in the case of the hydraulic jump in open channels and the sudden expansion in closed conduits. A. H. N.

1384. Fuel Oil Storage. Anon. *Gas Oil Pwr*, 1946, **41**, 351–355.—Layouts suitable for barrel, tank, and bulk storage are described, and recommendations are laid down as to the construction of tanks. The draw-off connection should be so placed that dead space is available for the settlement of water and solid matter, and to this end the tank should slope towards the back so that sludge can be drawn off through a drain-cock. Additional fittings include dipsticks and filters, of which two in parallel should be used. H. C. E.

1385. Gasoline Loss Control and Molecular Weight Determinations. H. G. Koefoed. *J. Inst. Petrol.*, 1946, **32**, 529–574.—The causes of loss of products are systematically analyzed. Loss by evaporation is the main type studied in detail. After reviewing briefly a previous method, a new scheme is described. The errors of analyses are discussed and the probable overall error evaluated. The system uses an absorbing oil in an Orsat apparatus to determine the quantity of hydrocarbon vapour in air. The method can also be used to estimate the molecular weight of the vapours. The results of testing the methods on laboratory and large-scale are discussed. The possible methods of combating evaporation losses are finally described. A. H. N.

1386. Effects and Corrections of Gas-Pulsation Problems. F. M. Stephens. *Oil Gas J.*, 14.9.46, **45** (19), 78.—The effects of vibration on equipment when gas, air, or steam is compressed is discussed.

Besides effects on lines and equipment, pulsation flow is a chief cause of inaccurate orifice metering as high as 20%, regardless of location of meter. It is frequently impossible to read pressure-gauges.

Loss of horsepower due to high instantaneous peaks and to the extra pressure drop required to drive a pulsative flow through a transmission line is another effect.

Attempts to tie down the points of excessive vibration displacements structurally often result in the necessity for additional supports elsewhere, owing to shift of the point of displacement. Recently mechanical vibrational dampeners have been installed at certain points in the system. They consist of weights with springs or rubbers, or springs alone. Exact location is necessary, and a partial cure only is usually achieved. Meter readings errors are reduced by installing pinching valves in the lead lines. Volume bottles, having five to 15 times the compressor displacement, fitted to both discharge and suction side of a compressor, minimize the effects of reflections and reduce horsepower loss to a minimum. Pulsation dampeners on the filter principle, smooth out the flow, and reduce necessity for hold-down systems, and when fitted to discharge and suction side of compressors result in conditions which eliminate instantaneous pressure conditions within the cylinder when the valve is open on the discharge side, and in a uniform pressure condition at the time the suction valve is open. G. A. C.

Refinery Operations.

Refineries and Auxiliary Refinery Plant.

1387. Design Plan of United's New Carthage Plant. G. Weber. *Oil Gas J.*, 20.7.46, **45** (11), 86.—A plant producing daily 170,000 gal of liquid products is described.

The new United Gas Pipe Line Co.'s condensate-natural gasoline-recovery plant in the Carthage, Texas, gas-field processes 150,000,000 cu. ft. of raw gas daily to extract a total of 170,000 gal of liquid products.

The gathering system involves more than 100 miles of lines serving 81 wells from three formations.

Products made include kerosine, motor fuel, naphthas, butanes, natural gasoline, and liquefied petroleum gases.

The raw gas is taken into the scrubbers at 1050 p.s.i.g. when condensate is removed, the stripped gas going to the absorbers and low-pressure gas lines. Condensate is dehydrated, flashed, and fractionated to produce light motor fuel, naphtha, and kerosine; fuel oil being taken off as side streams. Absorption oil make-up is supplied by kerosine. The absorption oil, after contacting the gas, is stripped to remove hydrocarbons, and finally returned to cycle; the stripped gas being dehydrated in four towers packed with specially treated bauxite containing 60–70% of alumina, the cooled gas being mixed with the gas entering the high-pressure pipe-line. The desiccant is re-activated by passing hot dry gas at 400° F through the towers for 8 hours. G. A. C.

1388. Design and Cost Factors for Steam and Power Generation in the American Refinery. W. F. Ryan. *Oil Gas J.*, 20.7.46, **45** (11), 97.—A review is given of American refinery power practice and costs, and a hypothetical plant discussed.

The commercially developed maximum operating pressure is 2200 p.s.i. with a throttle temperature of 950° F for high-pressure steam. In the hypothetical plant this steam is passed through a high-back-pressure turbine exhausting at 450 p.s.i. and generating approximately 40 kWh per 1000 lb steam. The 450 p.s.i. steam is reheated to 850° F for use with low-pressure turbine generators and auxiliary drive turbines.

These generators would be designed with controlled extraction at 300, 125, and 15 p.s.i. Heat exchangers are used for extraction of heat from the boiler blowdown, the equipment being located between stages of the boiler feed-pumps. Condensate is returned to the power plant from all closed heat exchangers in the refinery. A double-circulating system is designed to reduce the handicap of high blowdown, which is costly due to loss of heat and cost of treating replacement water. Future designs should yield more than 100 kWh per 1000 lb of process steam at a heat consumption of not more than 4500 B.Th.U. per kWh and at a capital cost of less than $125 per kW above the cost of a low-pressure boiler plant supplying only process steam. High pressures of 3000–3200 p.s.i. are envisaged.

A survey of 85 plants has shown that the pre-war capital cost of power generating equipment was about $105 per kW, the unit investment decreasing with increasing steam pressure. In contrast, the American public utility has an investment of more than $300 per kW in electric plant above. G. A. C.

1389. Dividends from Furnace Draft. R. Reed. *Oil Gas J.*, 14.9.46, **45** (19), 80.—Results both of use and misuse of furnace draft conditions are discussed.

High maintenance and fuel costs, danger of injury to personnel, and impairment of process conditions result from neglect of draft conditions. A curve illustrates the amount of vacuum which must be maintained to avoid a condition of pressure at any place in the furnace, and an example is worked out.

Draft gauges manifolded to allow for furnace conditions in a number of places with a single instrument are very advantageous. With an indication of 0·02-in H_2O at the arch sufficient draft will exist at the burner levels for all practical purposes.

Factors involved in furnace-draft design include the radiant and convection sections, a breeching, a damper, and a stack. A table shows the amount of draft which can be obtained from stacks of various heights and diameters; the stack is the key to furnace draft conditions. An inadequate stack cannot give good draft conditions. Maintenance costs will increase with pressure on the furnace, since the hot gases overheat the steel supporting arch and walls, and outward flow of hot gases from peep holes may injure personnel. In high wind conditions accurate draft indications are hard to obtain. Differences of 0·15-in H_2O between windward and leeward sides occur in moderate winds. A figure shows a suggested correction measure, consisting of 1/16-in holes drilled 10 ft apart in a ½-in manifold encircling the furnace, to permit balancing pressures on each side of the furnace. The atmospheric connection into the manifold is made half-way between any two 1/16-in holes in the pipe. Furnace pressures can be controlled by regulation of damper or of the secondary air control.

Too great a draft will waste fuel, owing to excessive infiltration of air into the furnace, too little draft causes a flow of hot gases from the furnace. Secondary air-entry area should be such as to maintain the required excess air with increased furnace draft.
G. A. C.

1390. An Echanger Design. W. L. Nelson. *Oil Gas J.*, 20.7.46, **45** (11), 117.—No. 102 in the *Refiner's Notebook* series serves as a summary of many previous issues on heat exchange.

The design of an exchanger for a particular purpose is considered through a series of steps, including economical approach, heat duty, routing, number of passes, tube transfer rate, diameter of shell, shell velocity, overall transfer rate, and pressure drop. An example is given and worked out. G. A. C.

Cracking.

1391. Modern Catalytic Processing in Summary. S. S. Allender. *World Petrol.*, 1946, **17** (8), 60–62.—This is an introduction to the following papers and reviews the types of catalytic processes now in use. **Catalytic Cracking for the Small Refinery.** O. W. Willcox. *Ibid*, **17** (8), 63.—Some figures are given to support the view that the smaller refinery should change to catalytic cracking. It is stated that 70% of the refineries in U.S. are not thus equipped. **The Small Kellogg Fluid Cat-Cracker.** Anon. *Ibid*, **17** (8), 64, 65.—A 4000-brl/day unit is described. It occupies an area of 1650 sq. ft. The reactor, regenerator, and precipitator are all supported at the same elevation, 69 ft above ground. Gas velocities are reduced, and the plant has been generally simplified as a result of experience. A flow diagram and tables showing the relative economics of 4500 brl/day unit operating on 39° A.P.I. mixed base crude and a 9500 brl/day unit using 36° A.P.I. paraffinic crude as stock are presented. Before depreciation charges the costs are 5·29 and 5·57 cents per gallon respectively. Optimum yield is 45–55%. Plants designed for 1700 and 2250 brl/day are mentioned. **Small Thermofor Cat-Cracker.** Anon. *Ibid*, **17** (8), 66–67.—Newer designs are tending towards moving catalyst yet retaining the inherent safety features. Small units in capacity range of 1000–5000 brl/day are available. A flow sheet and cost data are given. **Small U.O.P. Cat-Cracker.** Anon. *Ibid*, **17** (8), 68–69.—A flow diagram is given, together with explanatory outline. Some degree of automatic control is indicated on a 2600 brl/day unit. Improvements over the large units are listed. Tables are presented showing the improved performance obtained by recycling (31° A.P.I. gas oil as feed) over once through operation and the effect of reactor temperature on the octane number of the product. Some economic data are included. The unit is self-supporting as regards steam. Other power requirements are discussed. **Cycloversion for the Small Refinery.** Anon. *Ibid*, **17** (8), 70.—This paper takes the same form as those above. Low maintenance costs are claimed owing to the fixed bed. The plant is self-supporting for steam. F. S. A.

1392. Indiana Standard's Three Cat Cracking Units. Anon. *World Petrol.*, 1946, **17** (8), 82, 83.—Standard Oil Company (Indiana) is to have three new fluid catalytic cracking units. Each will be capable of processing 25,000 brl/day of gas oil. A vapour-recovery plant is to work in conjunction with each. F. S. A.

Chemical and Physical Refining.

1393. Removal of Chlorine and Gum Formers from Alkylates. R. G. Haldeman and W. A. Pardee. *Industr. Engng Chem.*, 1946, **38**, 242–246.—The alkylates produced by the reaction of *iso*butane and ethylene using an aluminium chloride catalyst possess very high potential gum values, and organic chlorides may be present to the extent of 0·10% by weight. The removal of these chlorides is necessary because of their detrimental effect on the tetraethyl lead susceptibility of the gasolines into which the alkylates are blended. A detailed study has therefore been made of the treatment of chlorine-containing alkylate in the vapour phase over the bauxite catalyst, Porocel. It is shown that the gum-forming constituents of the alkylates can be removed under conditions similar to those for chlorine removal, but that the severity of this treatment is critical, since by over-treatment the gum-forming properties of the gasoline are increased. A. W.

Special Processes.

1394. **Reactions of Aliphatic Hydrocarbons with Sulphur.** H. E. Rasmussen, R. C. Hansford, and A. N. Sachanon. *Industr. Engng Chem.*, 1946, **38**, 376–382.—A process is described for reacting aliphatic hydrocarbons, containing at least four carbon atoms in a straight chain, with sulphur to give the corresponding olefin, diolefin, and thiophene or thiophene homologue. If the charge-stock is commercial (95%) *n*-butane, the following variations of the process are possible: (*a*) an 80% conversion to a product consisting of 35% thiophene, 35% butadiene, and 30% *n*-butylene by weight by recycling unreacted butane; (*b*) a 75% conversion to equal weights of thiophene and butadiene by recycling unreacted butane and butylene; or (*c*) a 50% conversion to thiophene alone by recycling unreacted butane, butylene, and butadiene. A. W.

1395. **Production of Gasoline from Natural Gas.** Anon. *World Petrol.*, 1946, **17** (8), 52–54.—A brief outline is given of the development of the Hydrocol process (Hydrocarbon Research, Inc.) which is said to be of special value for gas deposits not supplied with long-distance transportation facilities. Gasoline production cost is comparable with that from crude, in the Gulf Coast area. Initially only gasoline, gas oil, and alcohols will be produced. The process is stated to consist of three stages, representing advances over former practice: oxygen separation, production of synthesis gas under high temperature and pressure, and catalytic reduction of the gas to desired products. No details are given. F. S. A.

1396. **Hydrolysis and Isomerization of Chlorotoluenes to *m*-Cresol.** R. N. Shreve and C. J. Marsel. *Industr. Engng Chem.*, 1946, **38**, 254–261.—The simultaneous hydrolysis and isomerization of *o*-chlorotoluene and *p*-chlorotoluene have been investigated. The optimum operating conditions are 350° C, 2·5 moles of sodium hydroxide per mol of chlorotoluene, and a 2-hour reaction time. Cresol mixtures of 60% *m*-cresol content are obtained. A. W.

1397. **Lubricating Oils from Fischer–Tropsch Olefins, Using Water-Gas as Raw Material.** G. M. Dazeley and D. Gall. *Petroleum*, 1946, **9** (9), 208–210.—Because of their higher olefin content, products from the Fischer–Tropsch process using water-gas ($CO : H_2 = 1 : 1$) are more promising raw materials for polymerization to lubricating oils than products in the same boiling-range using synthesis gas ($CO : H_2 = 1 : 2$).

With a given olefin chain-length experimental results showed that the absolute viscosity of the lubricating oil is inversely proportional to reaction temperature, while the V.I. remains approximately constant. With a given reaction temperature, the absolute viscosity is inversely proportional to olefin chain-length. Oxidation-stability is little influenced by reaction temperature and chain length. Generally, the oils were superior to those from the product of synthesis-gas. K. C. G. K.

1398. **Monomercuration of Aromatic Hydrocarbons. Paracymene.** T. F. Doumani and K. A. Kobe. *Industr. Engng Chem.*, 1946, **38**, 248–250.—Monomercurated products can be obtained from *p*-cymene in high yield. A new method of separating the 2- and 3-isomers is given. The bactericidal properties of some cymyl derivations are compared with basic phenylmercuric nitrate. A. W.

1399. **Monomercuration of Aromatic Hydrocarbons. Toluene.** A. J. Barduhn and K. A. Kobe. *Industr. Engng Chem.*, 1946, **38**, 247–248.—Process conditions have been developed whereby toluene is exclusively monomercurated with a yield of 98%. The orientation is approximately in the ratio *ortho* : *meta* : *para* = 43 : 13 : 44. A. W.

1400. **Synthetic Fuels in Germany. 3(3)-Fischer–Tropsch Process, Lubricating Oils and Acetylene.** Anon. *Petroleum*, Sept. 1946, **9** (9), 215.—The production both of synthetic rubber, and the chemicals used—*e.g.*, acetylene, butadiene, and styrene—are discussed.

An I.G. plant at Huls had a rated capacity of 4000 tons of Buna S per month and was ¾ sq. mile in area.

Buna S is made by polymerizing butadiene and styrene. The former was made as follows :

aldol → butylene glycol
↑ ↓
hydrocarbon gases → acetylene → acetaldehyde → butadiene

The styrene was made from benzene from coal-tar plants in the Ruhr and ethylene produced at Huls.

Details of acetylene production and subsequent manufacture of butadiene are given. K. C. G. K.

1401. Synthetic Fuels in Germany. 3(2)-Fischer–Tropsch Process, Lubricating Oils and Acetylene. *Petroleum*, Aug. 1946, 8 (9), 191.—During the war the Germans made considerable quantities of synthetic lubricating oils. The Kuhlmann plant at Lestaque near Marseilles produces 25 tons of product per day.

In order to produce 1 ton of lubricant, this plant requires as raw materials 600 kg of Fischer–Tropsch gas oil, 600 kg of benzole, and 160 kg of dichlorethane. The oils formed consist of polybenzenes with long paraffinic chains attached, giving a high V.I. and a low pour-point.

The second German process is that of the Kuhlmann Co. A pilot plant is in operation at Harnes, near Lille. The starting material is Fischer–Tropsch spirit, which is as olefinic as possible (unlike the gas oil used in the first process, which should be as low in olefins as possible). The spirit is mixed with 3% of aluminium chloride, and remains in contact with it for 5 hours at room temperature. Two layers form, the lower containing a heavy polymer bound chemically with the aluminium chloride, which is removed by treatment with caustic soda and washing with water. The upper layer contains paraffinic spirit and free polymer. The spirit is removed by steam-stripping. The properties of these oils are given in tabular form.

During the war four underground lubrication-oil plants were constructed by the Germans. None of these was used, however. K. C. G. K.

1402. Vapour-Phase Nitration of Neopentane and Neohexane. A. P. Howe and H. B. Hass. *Industr. Engng Chem.*, 1946, 38, 251–253.—A study of the vapour-phase nitration of *neo*pentane and *neo*hexane at approximately 410°C has been made. Contact times vary from 1 to 1·5 sec and the molal ratio, hydrocarbon : nitric acid from 0·9 to 3·5 : 1·0. In particular, *neo*hexane appears to give good yields of nitroparaffins, the figure being well above 40% of theoretical, although no attempt was made to discover optimum conditions. 2 : 2-Dimethyl-1-nitrobutane, 3 : 3-dimethyl-1-nitrobutane, and 2 : 2-dimethyl-1-nitropropane are new compounds identified. A. W.

Patents.

1403. Patents on Refining Processes and Products. C. E. Hemminger, assr to S.O. Dev. Co. U.S.P. 2,397,485, 2.4.46. A process of catalytic cracking in which the oil vapours are preheated in a suspension of a powdered inert material prior to the conversion stage.

A. P. Lien and B. H. Shoemaker, assrs to S.O.C. Indiana. U.S.P. 2,397,495, 2.4.46. Ethylbenzene is produced from an alkylbenzene containing at least 3 carbon atoms in the alkyl group by catalytic treatment with hydrogen fluoride and boron fluoride.

R. L. May, assr to Sinclair Refining Co. U.S.P. 2,397,498, 2.4.46. Salicylic acid is esterified with a cut of refinery olefins using boron trifluoride as catalyst under conditions minimizing alkylation.

R. W. Richardson, assr. to S.O. Dev. Co. U.S.P. 2,397,505, 2.4.46. A bentonite clay activated by acid treatment then impregnated with an active metallic oxide is used as a cracking catalyst. Its activity is maintained by regular acid treatment.

A. W. Francis and E. E. Reid, assrs to Socony Vacuum Oil Co. U.S.P. 2,397,542, 2.4.46. Ethylbenzene is prepared by contacting benzene with $AlCl_3$ at 100–150° C in an atmosphere of ethylene at around 100 lb pressure.

A. H. Schutte, assr to The Lummus Co. U.S.P. 2,397,566, 2.4.46. An apparatus is described for the preferential adsorption of a gas in a mixture of gases by means of a finely divided adsorbent material. Equipment for the recovery of the gas and the adsorbent is also described.

R. T. Bell, H. O. Folkens, and C. M. Thacker, assrs to The Pure Oil Co. U.S.P. 2,397,638, 2.4.46. Hydrocarbon oils are cracked at between 375° and 750° C in the presence of a small amount of hydrogen bromide and oxygen.

L. Berg, G. L. Sumner, Jr., and C. W. Montgomery, assrs to Gulf Research & Dev. Co. U.S.P. 2,397,639, 2.4.46. Olefins are isomerized by passage at 300–600° C over alumina impregnated with anhydrous hydrogen chloride.

L. M. Henderson and W. G. Annable, assrs to The Pure Oil Co. U.S.P. 2,397,662, 2.4.46. Penna. cylinder stock is distilled under light cracking conditions in the presence of steam and light hydrocarbon vapours until about 91% distillate is obtained. After the addition of 15% petroleum and removal of the light fractions boiling within and below the gas oil range the stock is centrifugally dewaxed with naphtha at −35° F.

H. G. Smith and T. L. Cantrell, assrs to Gulf Oil Corpn. U.S.P. 2,397,702, 2.4.46. A mineral oil additive which is the metal salt of a sulphurized derivative of the reaction product of ricinoleic acid and diaryl chlorophosphite.

J. W. Teter, assr to Sinclair Refining Co. U.S.P. 2,397,705, 2.4.46. In using a finely divided catalyst to react olefins and ammonia a slurry is made of the catalyst in liquid ammonia before it is passed to the reaction zone.

C. Weizmann. U.S.P. 2,397,715, 2.4.46. Aromatic hydrocarbons are produced from aliphatic and hydroaromatic oils by contact with a copper-iron mixture at 600–700° C and around atmospheric pressure at a space velocity of 0·16–0·19 litres per litre of catalyst per hour.

A. J. Shmidl, assr to S.O. Dev. Co. U.S.P. 2,397,760, 2.4.46; E. F. Wadley, assr to S.O. Dev. Co. U.S.P. 2,397,768–9, 2.4.46. Processes for the recovery of hydrogen halides from their mixtures with other gases.

B. T. Anderson and M. T. Flaxman, assr to Union Oil Co. U.S.P. 2,397,771, 2.4.46. 0·01–0·5% of a high mol. wt. acidic material obtained by the caustic treatment of petroleum fractions is added to diesel fuel oil.

R. B. Thompson and J. A. Chenicek, assrs to U.O.P. Co. U.S.P. 2,397,820, 2.4.46. Normal butane is isomerized employing a Friedel–Crafts type catalyst, then alkylated with ethylene and hydrogen chloride in the presence of the same type catalyst.

C. R. Clark, assr to Allied Chemical and Dye Corpn. U.S.P. 2,397,839, 2.4.46. Toluene is recovered from its mixture with non-aromatics of the same boiling range by distillation under suitable conditions with *p*-dioxane.

A. B. Hersberger and K. M. Thompson, assrs to Atlantic Refining Co. U.S.P. 2,397,859, 2.4.46. A liquid fuel is produced by the suspension of a finely divided bituminous fuel in oil stabilized with an acid such as hydrocarbon sulphonic acid or phosphoric acid.

V. N. Jenkins, assr to Union Oil Co. U.S.P. 2,397,868, 2.4.46. Lub. oil is dewaxed to give a high-m.-p. wax and a low-m.-p. wax by varying the concentration of methyl ethyl ketone in the dewaxing solvent. The ketone poor solvent is distilled with sufficient water to recover a benzene free cut of methyl ethyl ketone.

J. E. Shields, assr to Alox Corpn. U.S.P. 2,397,904, 2.4.46. A gun oil composition made up of 5 parts wool grease, 0·4 part lecithin, 4·35 parts methyl esters of high mol. wt. saturated aliphatic acids (derived from lub. oil oxidation), and 90·25 parts (by wt.) of a highly refined low pour point lub. oil.

P. L. Cramer and C. R. Begeman, assrs to General Motors Corpn. U.S.P. 2,397,925, 9.4.46. Paraffin hydrocarbons are isomerized, using an aluminium halide in the presence of a nitroparaffin as a promoter.

D. E. Burney, E. L. d'Ouville and C. M. Hull, assrs to S. O. C. Indiana. U.S.P. 2,397,945, 9.4.46. Propylene is polymerized to synthetic lub. oils by means of $AlCl_3$ under suitable conditions.

H. M. Fraser, assr to International Lubricant Corpn. U.S.P. 2,397,956, 9.4.46. A grease is manufactured from a lub. base and the lithium soap of a 12-hydroxy-stearic acid.

R. A. Macke and H. J. Zoeller, assrs to S.O. Dev. Co. U.S.P. 2,397,969, 9.4.46. Paraffin scale is sweated then acid treated, distilled over excess NaOH solution, then sweated further. The refined wax is improved in stability to heat and light.

S. W. Wilson, assr to S.O. Dev. Co. U.S.P. 2,397,996, 9.4.46. Improvements in the process of extracting butadiene from a mixture of saturated and unsaturated hydrocarbons by means of ammoniacal cuprous acetate.

D. G. Brandt, assr. to Cities Service Oil Co. U.S.P. 2,398,074, 9.4.46. A two-stage thermal cracking process operated under conditions to produce a maximum yield of toluene.

L. C. Brunstrum and H. J. Liehe, assrs to S.O.C. Indiana. U.S.P. 2,398,075, 9.4.46. An improved lime grease is obtained when hydrating a lime soap in the presence of a preferentially water-soluble surface-active substance capable of appreciably reducing the interfacial tension between water and a hydrophobic phase.

M. R. Lipkin, assr to Sun Oil Co. U.S.P. 2,398,101, 9.4.46. Aromatic hydrocarbons are extracted from gasoline and kerosine by adsorption on silica gel and recovered from the gel by means of a liquid desorbing agent in a cyclic process.

H. Schindler, assr to The Pure Oil Co. U.S.P. 2,398,120, 9.4.46. A rust inhibitor for turbine oil is produced by suitable treatment of the soda extract obtained in removing phenols from petroleum distillates with caustic soda.

C. M. Thacker and R. T. Bell, assr to The Pure Oil Co. U.S.P. 2,398,126, 9.4.46. Mercury vapour is mixed with hydrocarbons prior to dehydrogenation over a solid porous catalyst acting as a carrier for suitable metals and oxides.

L. C. Brunstrum and K. J. Liehe, assr to S.O.C. Indiana. U.S.P. 2,398,173, 9.4.46. A grease is made up with 5% lithium soap, a major proportion of lub. oil, and 0·2–2% of an unsulphurized ester of a polyhydric alcohol and an acid.

R. M. Cole, assr to Shell Dev. Co. U.S.P. 2,398,175, 9.4.46. Sulphide catalysts are reactivated by stage treatment involving steam, free oxygen, hydrogen sulphide, then hydrogen.

J. W. Loy, assr to Phillips Petroleum Co. U.S.P. 2,398,186, 9.4.46. Regeneration of the catalyst employed in catalytic cracking under fixed bed conditions.

T. E. Sharp, assr to S.O.C. Indiana. U.S.P. 2,398,193, 9.4.46. A rust preventive oil is composed of lub. oil, an ester of anhydroalkitol and a carboxylic acid, and an aliphatic soap of an oil soluble petroleum sulphonic acid.

E. W. Zublin, E. R. White and E. R. Barnum, assr to Shell Dev. Co. U.S.P. 2,398,202, 9.4.46. A corrosion preventive composition consisting of a lub. oil containing in fine dispersion a small amount of a dicarboxylic acid containing at least 16 C atoms, the two acid radicals being linked by an element from the sulphur group.

K. J. F. Dutson, Jr. and D. A. Smith, assr to S.O. Dev. Co. U.S.P. 2,398,213, 9.4.46. A surge device for reducing thermal decomposition of oil in high-temperature accumulators such as the bottom of a tower.

E. W. Hunt, assr to S.O. Dev. Co. U.S.P. 2,398,228, 9.4.46. A method of starting up a fluid catalytic cracking unit.

J. D. Morgan and R. E. Lowe, assrs to Cities Service Oil Co. U.S.P. 2,398,242, 9.4.46. A paint and varnish remover, which consists of a paste of water, kerosine, monoethanolamine, its oleate, nitropropane, and *iso*propyl alcohol.

D. T. Rogers and H. Feldhusen Jr., assrs to S.O. Dev. Co. U.S.P. 2,398,253, 9.4.46. An olefin is used in the presence of a boron halide catalyst to alkylate a phenol prior to the preparation of the sulphide.

J. C. Zimmer and A. J. Morway, assrs to S.O. Dev. Co. U.S.P. 2,398,271, 9.4.46. A lube oil additive is obtained by sulphurizing the polymer produced in the vapour-phase clay treatment of a steam-cracked petroleum distillate.

J. M. Barron, assr to The Texas Co. U.S.P. 2,398,280, 9.4.46. A combination process of catalytic and thermal cracking.

E. Bartholomew, assr to Ethyl Corpn. U.S.P. 2,398,281–2, 9.4.46. Lead tetraethyl and lead tetraethyl-iron carbonyl compositions based on graphical relations between the quantities of the components.

G. H. Denison Jr. and P. C. Condit, assrs to California Research Corpn. U.S.P. 2,398,414–16, 16.4.46. Organic selenides are employed as lub. oil additives.

A. F. Garvin. U.S.P. 2,398,424, 16.4.46. Process for manufacture of ceresin from a paraffin-base residuum involving dilution with naphtha, filter pressing, distillation, and further oil extraction.

E. C. Hughes, assr to S.O.C. Ohio. U.S.P. 2,398,429, 16.4.46. A water-free cutting oil is obtained by the reaction between phosphorus pentasulphide and a mineral oil and is made non-corrosive by inclusion of an unsaturated fat and the dioctyl ester of sodium sulpho-succinic acid.

O. Roelen and W. Feisst, vested in the Alien Property Custodian. U.S.P. 2,398,462, 16.4.46. A process for preparing the iron-group-type catalysts used in the hydrogen–carbon monoxide synthesis of gasoline hydrocarbons.

W. A. Schulze and G. H. Short, assrs to Phillips Petroleum Co. U.S.P. 2,398,468, 16.4.46. Ammonia (0·001–1·0% by wt) is used to inhibit polymerization of butadiene during transport and storage.

W. E. Vaughan and F. F. Rust, assrs to Shell Dev. Co. U.S.P. 2,398,479–81, 16.4.46. Ultra-violet rays are employed in the preparation of organic sulphur compounds, halogenated mercaptans, and thioethers, and in catalysed abnormal addition reactions.

E. L. d'Ouville and B. H. Shoemaker, assrs to S.O.C. Indiana. U.S.P. 2,398,495, 16.4.46. A syntholube is obtained by alkylating the viscous polymer of a normal olefin with *iso*butane in the presence of $AlCl_3$ catalyst at normal temperatures.

R. B. Greenburg, assr to Allied Chemical and Dye Corpn. U.S.P. 2,398,526, 16.4.46. Paraxylene is recovered from a hydrocarbon oil by fractional melting of a mixture of the oil with an alkanol containing not more than two carbon atoms.

H. E. Messmore, assr to Phillips Petroleum Co. U.S.P. 2,398,546, 16.4.46. Design of a thermally insulated catalyst chamber.

G. R. Reading, assr to Phillips Petroleum Co. U.S.P. 2,398,557, 16.4.46. Aluminium chloride catalyst by heat and pressure treatment is formed into a soft plastic coherent mass, formed into a desired shape and hardened.

W. R. Smith and A. R. Goldsby, assrs to The Texas Co. U.S.P. 2,398,563, 16.4.46. Straight-chain hydrocarbons +1% by wt. aromatics are isomerized by means of an aluminium halide-hydrocarbon complex. The latter containing the aromatics is reacted with an olefin under alkylating conditions, the alkylated aromatics are removed and the complex is recycled to the isomerization stage.

W. A. Bailey Jr. and C. W. Bittner, assrs to Shell Dev. Co. U.S.P. 2,398,610, 16.4.46. Preparation of stabilized alumina for catalysis.

J. D. Morgan and R. E. Lowe, assrs to Cities Service Oil Co. U.S.P. 2,398,662, 16.4.46. A compass fluid which flows at −80° F and has a small viscosity–temperature change under working conditions is comprised of 1-nitropropane, ethyl silicate, and pseudo-cumene.

W. A. Schulze, assr to Phillips Petroleum Co. U.S.P. 2,398,674, 16.4.46. A highly aromatic gasoline is obtained when a gasoline consisting of approximately equal proportions of olefins, paraffins, naphthenes, and aromatics is contacted with a bauxite catalyst at 1000–1300° F.

H. L. Yale and G. W. Hearne, assrs to Shell Dev. Co. U.S.P. 2,398,685, 16.4.46. Acyclic monoketones are obtained from normal butylene by treatment with an oxygen containing mercury salt in aqueous sulphuric acid.

W. J. Bloomer, assr to The Lummus Co. U.S.P. 2,398,689, 16.4.46. Ethylene glycol lower alkyl ether is used as an entrainer in the azeotropic distillation of styrene associated with close-boiling aromatics.

B. S. Greensfelder and S. Z. Perry, assrs to Shell Dev. Co. U.S.P. 2,398,739, 16.4.46. A catalytic cracking process employed silica–alumina–zirconia diluted with a non-adsorptive and non-combustible mineral.

C. H. Angell, assr. to U.O.P. Co. U.S.P. 2,398,759, 23.4.46. A fluid catalytic process.

G. C. Connolly, assr to S.O. Dev. Co. U.S.P. 2,398,773, 23.4.46. Alumina plus a salt containing boron and fluorine is used as a cracking catalyst.

L. W. Cook, assr to The Texas Co. U.S.P. 2,398,819, 23.4.46. A catalytic cracking process in which two catalysts are used, aluminium fluoride to crack naphthenes, and boron oxide to crack paraffin hydrocarbons.

S. R. Funsten, assr to Filtrol Corpn. U.S.P. 2,398,825, 23.4.46. An acid-activated clay.

J. C. Munday, assr to S.O. Dev. Co. U.S.P. 2,398,846, 23.4.46. The products of catalytically cracked gas oil are refined by mild catalytic hydrogenation to saturate the olefins and convert the high-boiling aromatics into naphthenes. A saturated aviation gasoline is separated and the hydro gas oil is returned to the cracking process.

E. W. Thiele, assr to S.O.C. Indiana. U.S.P. 2,398,869, 23.4.46. A continuous process of alkylation of *iso*paraffins by gaseous olefins to produce an aviation safety fuel.

J. W. Teter, assr to Sinclair Refining Co. U.S.P. 2,398,899, 23.4.46. A catalyst for amination of olefins by ammonia comprising a metal such as cobalt or nickel in suspension on acid-treated bentonite.

C. B. Linn, assr to U.O.P. Co. U.S.P. 2,398,905, 23.4.46. Acids of phosphorus, their anhydrides or esters are added to liquid hydrogen fluoride used as the catalyst in the alkylation process.

P. Miller, assr to Standard Catalytic Co. U.S.P. 2,398,908, 23.4.46. The C_4 cut of refinery gases and C_2–C_3 olefins are converted into aviation gasoline by a series of steps involving hot acid polymerization, hydrogenation, distillation, and alkylation.

A. C. Byrns, assr to Union Oil Co. U.S.P. 2,398,919, 23.4.46. A complex salt of two metals from the groups iron cobalt nickel and chromium molybdenum is used with hydrogen to desulphurize sulphur-contaminated oils.

W. W. Gary, assr to Filtrol Corpn. U.S.P. 2,398,930, 23.4.46. Butadiene is separated from other low-boiling hydrocarbons by steps involving catalytic polymerization, distillation, and de-polymerization.

M. H. Kollen, assr to Union Oil Co. U.S.P. 2,398,943, 23.4.46. A blend of a high boiling *iso*paraffin and a small proportion of a high mol. wt polymer of a low boiling olefin is used as a hydraulic fluid.

A. H. Schutte. U.S.P. 2,398,967, 23.4.46. A design of a centrifugal filter apparatus to separate a mixture of a liquid and a lighter solid.

J. M. Schantz, assr to Hercules Powder Co. U.S.P. 2,399,063, 23.4.46. A grease is obtained by the addition to a mineral oil of an oil-soluble soap of a rosin having at least 50% of the double bonds saturated with hydrogen.

W. S. Bonnell and W. W. Weinrich, assrs to Gulf Research & Dev. Co. U.S.P. 2,399,093, 23.4.46. A process for isomerizing paraffin hydrocarbons and for alkylating branched paraffin isomers for the production of alkylate using aluminium halide catalyst.

A. P. Lien, assr to S.O.C. Indiana. U.S.P. 2,399,126, 23.4.46. Ethers are produced by the interaction of olefins and alcohols using hydrogen fluoride and boron fluoride as catalyst. G. R. N.

Safety Precautions.

1404. Tetra-Ethyl Lead Poisoning. D. A. K. Cassels and E. C. Dodds. *Brit. Med. J.*, 1946, ii, 681–685.—T.E.L. has sufficient v.p. to be absorbed in appreciable amounts through the lungs. At ordinary temperature air saturated with T.E.L. contains 5 mg Pb/litre; the maximum safe concentration is $1{\cdot}5 \times 10^{-4}$ mg Pb/litre. The toxicity of T.E.L. is solely due to its Pb content, but is accentuated by its fat solubility causing selective concentration in nervous tissue. T.E.L. poisoning is thus an intoxication of the central nervous system. Exposure to vapours of leaded fuel in can filling and pumping installations during the war gave rise to conditions of potential hazard, whilst the post-war cleaning of storage tanks (especially those underground) gave rise to 25 cases (two fatal) of poisoning. These are reviewed, six case histories being given. Initial symptoms are disturbances of sleep and of the alimentary tract. The classical signs of Pb poisoning either do not occur or are subsidiary. In diagnosis a history of exposure to T.E.L. is of great value. Determination of the Pb content of urine of exposed personnel is a valuable guide to possible intoxication, concentrations of below 0·10 mg Pb/litre are not of significance, 0·15 mg may indicate mild poisoning, and values above 0·20 show danger. Corrections for urine gravity may be necessary. If prescribed safety regulations are observed, T.E.L. poisoning will be obviated, since the dangers are well understood, continuous supervision is, however, essential. Treatment of mild poisoning cases is by removal from exposure and sedatives. Severe cases require expert nursing, in view of the acute mental symptoms present. If recovery occurs it is complete, with no permanent after-effects. V. B.

Products.

Chemistry and Physics.

1405. Boiling Points of Three Isomeric Heptanes. F. S. Fawcett. *Industr. Engng Chem.*, 1946, **38**, 338–340.—Boiling points of 2 : 2-dimethylpentane, 2 : 4-dimethylpentane, and 2 : 2 : 3-trimethylbutane have been determined by the comparative dynamic method over the range 1–15 atm, using *n*-heptane as the reference liquid. A. W.

1406. Energy Levels and Thermodynamic Functions for Molecules with Internal Rotation. II. Unsymmetrical Tops Attached to a Rigid Frame. K. S. Pitzer. *J. Chem. phys.*, 1946, **14**, 239.—The formulas derived in this paper make the equations and the tables given in the first paper of this series (*J. Chem. phys.*, 1942, **10**, 428) applicable to this more general class of molecules. Additional approximations are involved and carefully examined. J. T.

1407. Statistical Mechanics of Multimolecular Adsorption. I. T. L. Hill. *J. Chem. phys.*, 1946, **14**, 263.—Cassie's statistical treatment of multimolecular adsorption on a free surface, leading to the BET equation, is criticized and corrected. The method is generalized to include adsorption when the maximum number of layers of adsorbate is restricted. The isotherm equation obtained is the same as that found by Brunauer, Emmett, and Teller for this case, rather than the equation proposed by Pickett. The BET equation, though not completely satisfactory, is apparently the correct equation for the particular model used. Real improvements in the theory should follow from refinements in the model rather than from modification in the treatment of the BET model. A more refined model is proposed, and the general method of using it is discussed. The BET model is shown to be a crude special case of the model suggested here, but it has the advantage of presenting no mathematical difficulties. Preliminary results, based on improved models, indicate that a somewhat refined multimolecular adsorption theory is capable of predicting capillary condensation for suitable values of parameters, thus suggesting that the ideas of multimolecular adsorption and capillary condensation are not really in conflict, as is generally assumed. J. T.

1408. Theory of Multimolecular Adsorption from a Mixture of Gases. T. L. Hill. *J. Chem. phys.*, 1946, **14**, 268.—The Brunauer–Emmett–Teller Theory of multimolecular adsorption is extended to mixtures of gases. This is achieved by making use of the evaporation–condensation properties of liquid mixtures. At the present time there are no satisfactory experimental data available with which to test the theory. J. T.

1409. The Diffusion of Vapours Through Polymers. P. Doty. *J. Chem. phys.*, 1946, **14**, 244.—The rate of permeation of a gas through a polymer expressed as a function of temperature may be represented as $P = P_0e^{-E/RT}$. All data on the permeability of gases through polymers show that for a given gas log P_0 is linear with E (the energy of activation for permeation). An explanation is given for this relationship. The effect of plasticization on permeation of water vapour is studied experimentally, and it is shown that the lowering of the heat of solution is the predominant effect. From the data the entropy of solution may be calculated and interpreted, showing that water molecules dissolved in the unplasticized polymer exhibit much less freedom than when they are dissolved in plasticized polymer. Calculations also show that a large number of degrees of freedom are simultaneously operative in the process of the diffusion of a gas molecule through a polymer. J. T.

1410. Researches on Asphaltenes. Part II. Radical Reactions. F. J. Nellensteyn and J. Dorleyn. *J. Inst. Petrol.*, 1946, **32**, 582–586.—The theory that asphaltic bitumen consists of a core of carbon of colloidal dimensions protected by a sheath of hydrocarbons, advanced in 1923 by Nellensteyn, is further discussed in the light of researches on the chlorination of asphaltenes. The apparatus and procedure are described. The radicles : ⁝CH_1 ; :CH_2 and ·CH_3 play an important part apparently as chlorination produces C_6Cl_6 and C_2Cl_4 and other chlorinated carbon compounds. A. H. N.

1411. Hydrocarbon Azeotropes of Benzene. R. F. Marschner and W. P. Cropper. *Industr. Engng Chem.*, 1946, **38**, 262–268.—The azeotropic behaviour of benzene in admixture with ten non-aromatic hydrocarbons has been investigated and the entire boiling range of the hydrocarbons with which benzene forms azeotropes at atmospheric pressure has been established. Collectively, the data argue that the azeotropic behaviour of benzene is more pronounced the higher the hydrogen–carbon ratio of the second hydrocarbon component. Benzene is a much weaker azeotrope-forming substance than is ethanol, with which saturated hydrocarbons of nearly four times the boiling point spread form azeotropes. Fractionation data are presented to indicate the limitations imposed by the presence of benzene on analytical hydrocarbon fractionation, but the usefulness in certain cases of benzene as an azeotropic agent is also demonstrated. Correlations are developed by means of which the compositions and boiling points of uninvestigated benzene–non-aromatic hydrocarbon azeotropes may be estimated. A. W.

1412. The Thermal Conductivities of Eight Common Gases between 80° and 380° K. H. L. Johnston and E. R. Grilly. *J. Chem. phys.*, 1946, **14**, 233.—Thermal conductivities of O_2, N_2, CO, NO, H_2, He, N_2O, CO_2, and CH_4 have been measured between 80° and 380° K with a hot wire cell of potential lead type developed by Taylor and Johnston. The results generally have a precision of better than 0·1% and are believed to be accurate to ±0·5%. These are tabulated for the eight gases and are compared with the results of other investigators. J. T.

1413. Temperature-Density Relation for Gasoline-Range Hydrocarbons. J. Griswold and J. N. Chew. *Industr. Engng Chem.*, 1946, **38**, 364–367.—The temperature coefficient of density (a) in the equation, $d^t_4 = d^{20}_4 + a(t - 20)$, for pure hydrocarbons from C_5 to C_{12} is correlated with hydrocarbon type and molecular weight (M) at temperatures near 20° C by the formula, $- a = m(1/M - 0{\cdot}002) + 6 \times 10^{-4}$, where m is a constant depending only on hydrocarbon type. This permits an exact conversion of d^{20}_4 to A.P.I. gravity whenever the type of compound is known. For application to wider temperature ranges, values of β in the equation, $d^t_4 = d^{20}_4 + a(t-20) + \beta(t-20)^2$, are calculated for a few compounds on which data of sufficient accuracy and range are available. The values of β vary with structure in an unknown manner. A. W.

1414. The Knowledge of Carbon Rings (Part 40). The Melting Points of the Polymethylene Series of Hydrocarbons from *cyclo*-Propane to *cyclo*-Octadecane. L. Ruzicka, Pl. A. Plattner, and H. Wild. *Helv. Chim. Acta*, 1946, **29**, 1611–1615.—In the *n*-paraffin series the m.p.'s increase rapidly for the lower members, approaching a limiting value (*ca* + 30° C) for the higher members. There are two curves (one for the hydrocarbons having an odd number of C atoms, and the other for the even-numbered chains), uniting at approximately C_{16}–C_{18}. The curve for the odd-numbered paraffins is the lower, because these hydrocarbons are less symmetrical, the only exception being methane, which has a relatively high m. p. by virtue of its symmetry.

For the *cyclo*paraffins the m. p./C atoms curve is less regular. Rings having an odd number of C atoms do not always have relatively low m. p., and only compounds with seven-, eleven-, and thirteen-membered rings (*i.e.*, prime numbers) melt noticeably lower than their neighbours. *cyclo*Pentadecane (5 × 3) is at a maximum on the curve and *cyclo*nonane (3 × 3) has also a relatively high m. p. The most marked maxima occur with *cyclo*hexane (2 × 3), *cyclo*-octane (2 × 2 × 2) and *cyclo*dodecane (2 × 2 × 3), exemplifying the known fact that the m. p. of organic compounds are greatly dependent on symmetry.

On the basis of the m.-p. curve the *cyclo*paraffins can be divided into three groups : (i) small rings (C_3 — C_5), a special case, perhaps, since there is abnormal bond strain, (ii) medium rings (C_6 — C_{11}), rigid, three-dimensional systems with similar bond-lengths and crystallizing in spherical aggregates, and (iii) large rings (C_{12} upwards), less rigid, elongated systems, which crystallize in long needles and approach the *n*-paraffins with increasing molecular weight. C. N. T.

1415. Vapour-Liquid Equilibria in Three Hydrogen-Paraffin Systems. M. R. Dean and J. W. Tooke. *Industr. Engng Chem.*, 1946, **38**, 389–393.—The solubilities of hydrogen in *iso*butane were determined for temperatures from 100° to 250° F and pressures from 500 to 3000 psi. Solubilities in 2 : 2 : 4-trimethylpentane were found for temperatures from 100° to 302·5° F and in a mixture of isomeric dodecanes for 200° and 300° F with pressures ranging from 500 to 5000 psi. The compositions of the equilibrium vapour phases were also determined. The solubility of hydrogen increases with temperature and pressure, but decreases as the solvent molecular weight increases. In *iso*butane the solubility of hydrogen follows Henry's law only at 150° F and lower. The hydrogen solubilities in the two heavier hydrocarbons increase more rapidly with pressure at low pressures than at high pressures. Correlation with literature data shows that hydrogen is more soluble in paraffins than in aromatics of similar molecular weight. Vaporization equilibrium constants are computed from the data for both solvent and solute. The constants vary widely with pressure and to a lesser degree with temperature. The constant for hydrogen increases with an increase in solvent molecular weight. A. W.

Analysis and Testing.

1416. Cracking of Heavy Fractions on Hot Metal. Anon. *Riv. Ital. Petrol.*, 1946, **14** (160), 15.—Experiments carried out on cracking petroleum distillates on electrically heated metal spirals have established that a gas is produced identical to that from paraffin wax. The yield of gas per unit of consumed energy is low. D. H. McL.

1417. Viscosity Characteristics of Greases. V. P. Varentzov. *Petroleum*, Aug. 1946, **8** (9), 184.—See Abstract No. 1054 of 1945.

1418. Viscosity Characteristics of Greases. 2. Nature of Grease Flow. V. P. Varentzov. *Petroleum*, Sept. 1946, **9** (9), 206.—See Abstract No. 1054 of 1945. K. C. G. K.

1419. An Improved Hot Wire Cell for Accurate Measurements of Thermal Conductivities of Gases over a Wide Temperature Range. Results with Air between 87° and 375° K. W. J. Taylor and H. L. Johnston. *J. Chem. phys.*, 1946, **14**, 219.—Description of an improved hot wire cell of the potential lead type is given together with theoretical treatments for radiation, end conduction, potential lead conduction, and the " temperature jump " effect. The latter can be eliminated by linear extrapolation of reciprocal plots of " apparent conductivities " as a function of pressure. At pressures below about 20 cm of mercury the convection effects are absent. The emissivity from bright platinum was measured. The thermal conductivity of air was measured at seventeen temperatures between 87° and 375° K, and the results, which are believed to be accurate to within $\pm 0{\cdot}5\%$, are generally lower than those reported in recent years, for air. A tabulation of results together with a critical analysis of possible sources of error is given. The advantage of this method over either the " thick wire " or " compensating lead " type of cells is pointed out. J. T.

Engine Fuels.

1420. British Aviation Fuel Manufacture—Middle East—III. Anon. *Industr. Chem.*, 1946, **22**, 586–600.—This paper lists the extensions to existing plant, and new plant which was installed when availability of shipping made this possible. The extensions were mainly in the field of alkylation, superfractionation, and solvent extraction, but auxiliary plant, such as acid washing, recovery and production, and tankage, had to be increased. Some indication is given of the factors taken into account in planning. In less than six years production increased from 29,000 tons/annum of medium quality fuel to the finally attained rate of 1,160,000 tons of 100–130 grade (plus 90 grade) aviation gasolines. An expenditure of $50 millions in the U.S.A. was involved. F. S. A.

Gas Oil and Fuel Oil.

1421. Fuel-Oil and Oil Firing. G. J. Gollin. *Heating and Ventilating Engr*, 1946, **19**, 276.—This is the first of a series of articles dealing with the industrial application of fuel oil.

As an introduction, a general description is given of the chemical composition of the three main families of hydrocarbons in petroleum oil. Diagrams of the molecular structure of the aliphatic, aromatic, and naphthenic hydrocarbons are shown.

Refinery processes in broad principle are illustrated showing how gasoline, kerosine, diesel, and fuel oils are obtained from the crude oil. J. N.

1422. Fuel-Oil and Oil Firing. G. J. Gollin. *Heating and Ventilating Engr*, 1946, **19**, 324.—A brief explanation of the process of combustion of fuel oil is given.

There are three main ways in which fuel may be wasted by burning it inefficiently. They may be due to poor oil-burning equipment, incorrect operation of the equipment, or a combination of both. Sources of waste are : (*a*) Unburnt carbon in products of combustion ; (*b*) Carbon incompletely burnt, *i.e.*, combining with oxygen to form carbon monoxide ; (*c*) Too much excess air. Efficient oil-burning equipment should operate with excess air only 10–20% above theoretical.

Tables and graphs are given showing typical analyses of flue gases as they vary with percentage of excess air. Flame temperature, thermal dissociation, and radiation losses are also discussed. J. N.

1423. Fuel-Oil and Oil Firing. G. J. Gollin. *Heating and Ventilating Engr*, 1946, **19**, 386.—This is the third article of the series, and in it the author discusses the significance to the purchaser of certain physical characteristics of fuel oil.

Methods of measurement of viscosity, gravity, and calorific value are outlined, and conversion tables for viscosity and gravity are illustrated.

Ash content is of lesser importance. Fuel oil ash contents vary from 0·01 to 0·15% compared with 2% to over 10% for solid fuels. Provided oil-burning equipment is correctly adjusted and refractory linings installed in the right manner, there should be no appreciable fouling of boiler-heating surfaces. J. N.

1424. Fuel-Oil and Oil Firing. G. J. Gollin. *Heating and Ventilating Engr*, 1946, **19**, 422.—This article describes various designs of oil-burners used in boilers and industrial furnaces.

The function of an oil-burner is to deliver the fuel into the combustion chamber in a finely divided state, the process commonly being referred to as atomization.

Burners used for such purposes are known as blast-burners, and may be divided into three main types, according to the pressure of the atomizing medium. These are low-pressure, 6–30 in water-gauge; medium-pressure, from 3 lb/sq. in. to 15 lb/sq. in., and high-pressure, from 15 lb/sq. in. upwards.

For low- and medium-pressure blast atomizers air is usually employed as the atomizing medium, while in the case of high-pressure, steam is normally used.

Different methods used by different manufacturers are described with illustrations of each type. J. N.

1425. Fuel-Oil and Oil Firing. G. J. Gollin. *Heating and Ventilating Engr*, 1946, **19**, 461.—In the fifth article of this series the author continues the description given in the fourth article on burners. Additional type of blast-burners are described, and details of the principle of pressure jet atomizers are given.

This latter type is used in nearly all ships' boilers and is widely employed in large power-station work.

The advantages and disadvantages of each type and the factors governing the selection of burners are discussed. J. N.

1426. Fuel-Oil and Oil Firing. G. J. Gollin. *Heating and Ventilating Engr*, 1946, **19**, 507.—Types of vaporizing burners and principle of operation are discussed and illustrated in this article.

Vaporizing burners are so called because there is no attempt to atomize the oil before burning. The oil is heated, vaporizing the greater part of it, the vapour being subsequently mixed with the correct amount of air and burnt.

There are very definite limits to the grades of oil which may be used on burners of this type, the most important characteristics being distillation range and the Conradson carbon value.

The significance of each of these characteristics is explained.

General arrangements of oil-burning installations are illustrated and filling and storage systems described. J. N.

Lubricants.

1427. Developments in Lubrication (1). S. J. M. Auld. *Petroleum*, Aug. 1946, **8** (9), 190.—The first part of a lecture discussing the principles of lubrication, the use of additives, and the manufacture of synthetic lubricants. K. C. G. K.

1428. Developments in Lubrication (2). S. J. M. Auld. *Petroleum*, Sept. 1946, **9** (9), 211–212.—The second part of a lecture on the principles of lubrication, the use of additives and the manufacture of synthetic lubricants. K. C. G. K.

1429. Lubrication Vade Mecum Addendum (c). E. W. Steinitz. *Petroleum*, Aug. 1946, **8** (9), 195.—The lubrication of passenger motor cars, motor lorries, motor cycles and tramway cars is dealt with. K. C. G. K.

1430. Lubrication Vade Mecum Addendum (7). E. W. Steinitz. *Petroleum*, Sept. 1946, **9** (9), 219.—Section XI deals with the lubrication of Agricultural and Building Contractors Machinery, including: Agricultural Trailers, Farm Carts; Asphalt and Tar Mixers; Bucket Dredgers; Wheel Tractors, Caterpillar Tractors; Steam Ploughs. K. C. G. K.

1431. Notes on New Lubricants. C. Ridley. *Gas Oil Pwr*, 1946, **41**, 358–359.—The U.S.A. now makes and markets two types of synthetic oils. One, made from hydrocarbon gases, is said to have a negligible increase in viscosity when used in an engine, since its oxidation products are volatile. The other has a molecular structure similar to that of conventional lubricants, except that many of the carbon atoms are replaced by silicon atoms. The advantage of this synthetic are: negligible change of viscosity with temperature, good heat stability, and general chemical inertness.

It is stated that German chemists, starting from coal, can match practically every lubricant made in the U.S.A. from natural petroleum. H. C. E.

1432. Some Observations on the Development of Extreme Pressure (E.P.) Properties by Chlorine and Sulphur Additives in Mineral Oil, as Assessed by the Four-Ball Machine. W. Davey. *J. Inst. Petrol.*, 1946, **32**, 575–581.—The Four-Ball Machine has been used to assess the development of E.P. properties by chlorine and sulphur additives in mineral oil, and the use of these additives together for high load conditions justified. The formation of ferrous chloride films by chlorine additives has been confirmed and the effect of sulphide films and hydrogen chloride studied. A. H. N.

1433. Role of Inertia in Hydrodynamic Lubrication. M. C. Shaw and C. D. Strong, Jr.; Reply by A. Fogg. *Nature*, 1946, **158**, 452.—Fogg's experiments on lubrication of parallel thrust surfaces operated at high speeds give results comparable with those obtained with conventional Michell or Kingsbury type thrust-bearings. These results are explained on the basis of a temperature gradient along the film in the direction of relative motion.

A mechanical analysis of the system shows that this theory is in qualitative, but not quantitative, agreement with Fogg's experiments in that the load capacity of parallel surfaces is of the order 1/5 to 1/10 of that for an equivalent tilting-pad. The inertia of the lubricant is negligible at low, but not at high, rotative speeds. The inclusion of inertia terms in hydrodynamic equations accounts qualitatively for the observed load capacity of plane rotating discs which, in accord with the inertia theory of lubrication, can carry loads only at relatively high speeds.

A bearing designed to take advantage of inertia at all speeds gives at different speeds different curves, in agreement with the inertia theory, when coefficient of friction is plotted against ZN/P, where Z is the viscosity of lubricant in centipoises, N is the speed in R.P.M., and P is the unit load on the projected area of the bearing.

(Reply by A. Fogg.) If the load capacities for parallel and tilted surfaces are compared on the basis of mean film thicknesses of lubricant the comparison is not valid, for a fixed taper surface will fail by contact at the trailing edge when the mean film thickness is comparatively large. For parallel surface thrust-bearings the curves of coefficient of friction against ZN/P are substantially the same over the range 1000 to 20,000 r.p.m., and inertia has only a secondary effect. The possibility of inertia effects was examined, and rejected, before the thermal expansion theory was put forward. H. C. E.

1434. The Influence of Oil-Film Journal Bearings on the Stability of Rotating Machines. A. C. Hagg. *J. Appl. Mech.*, 1946, **13** (3), A-211–A-220.—The self-excited vibration caused by the lubricating films of journal bearings, and commonly called oil film whirl or oil whip, is discussed. The upper limit of whirling frequency has been found to be one-half rotational frequency in the general case; actually the phenomenon will manifest itself at a frequency which is invariably below this limit. Stability criteria have been developed for certain common systems in terms of bearing and rotor parameters. The tilting-pad bearing of Michell has been established as a so-called "stable" or "non-whirling" bearing. This bearing and related types are probably the only oil-film journal bearings which are incapable of exciting oil-whip, regardless of the system to which they are applied. Qualitatively the results of the paper appear to be in agreement with observations. In certain cases, results have been substantiated experimentally. A. H. N.

1435. The Pressures against which Oils will Spread on Solids. E. R. Washburn and E. A. Anderson. *J. Phys. Chem.*, 1946, **50** (5), 401–406.—The spreading tendencies of oils on steel were measured directly by utilizing the spreading pressures of monomolecular films. Lubricating oils in different degrees of oxidation were studied and, in general, the spreading pressures were found to increase—approximately being doubled on oxidation at 200° C in 4–6 hours. A. H. N.

1436. Principles of Filtration. 1. Introduction. A. H. Stuart. *Petroleum*, Aug. 1946, **8** (9), 193.—The rapid growth of mechanical transport has resulted in the use of many types of oil filters. This article reviews some of the general principles on which filters operate and comments on the results obtained from laboratory tests.

K. C. G. K.

1437. Principles of Filtration. 2. Oil Cleaners. A. H. Stuart. *Petroleum*, Sept. 1946, **9** (9), 213.—In connection with the filtration of used lubricating oil, it is important to consider the nature of the impurities found. From external sources come gases, such as oxygen and carbon dioxide, liquids, such as unburnt fuel and water or other coolant, and solids, such as iron dust, white metal particles, road dust, sand, carbon, etc. Decomposition products from the oil itself may be at least as objectionable as foreign contaminants.

The simplest type of oil-cleaning is settling under gravity. This process, however, is usually very slow. It can be accelerated by heating the oil to reduce its viscosity, by the addition of a coagulant, or by centrifuging. Filtration is the common mode of treatment. As the mesh of the sieve becomes finer, resistance to flow increases very rapidly. Thus if it is desired to remove very fine particles, the pressure drop through the filter will be considerable. Adsorbent material such as fullers' earth is employed as a filtering septum in an attempt to overcome this drawback. This latter process is not, however, a mechanical one, since certain oil-soluble resins may be retained in this way. K. C. G. K.

1438. Machinery of Plain Bearings with Single-Point Tools. P. Grodzinski. *Petroleum*, Aug. 1946, **8** (9), 188. 1. Lubrication Theory. The bearing theory is discussed and the difference explained between high-speed rotating diamond and tungsten carbide tools. The methods of scraping and reaming hitherto used do not yield a good bearing surface, so that long running-in periods become necessary. A short survey of modern bearing materials and their customary clearance and capacity limits is given in tabular form.

In a bearing with perfect fluid lubrication, the minimum oil-film thickness must be sufficient to prevent contact between the peaks of the journal and the bearing surfaces. Hence, the safety film thickness must be at least equal to the sum of the peaks of both journal and bearing surfaces. In 1942, B. Sacks stated that the minimum thickness of an oil film must be at least equal to $2 \times 2 \times 5\ h_{rms} = 20\ h_{rms}$, where $h_{rms} =$ average roughness is root mean square micro. in, as indicated by tracer point instruments. Surfaces of h_{rms} average height of 1·4 micro. in can be produced commercially at the present time, so that it may be possible to go down to a minimum oil-film thickness of between 40 and 80 micro. in, *i.e.*, 1/10 to 1/5 of the values in use about 12 years ago. K. C. G. K.

1439. Machining of Plain Bearings with Single-Point Tools 2. Bearing Theory. P. Grodzinski. *Petroleum*, Sept. 1946, **9** (9), 214.—Bearing theory is discussed in relation to surface structure. The merits and uses of diamond and tungsten carbide tools are examined. K. C. G. K.

1440. Steam-Turbine Lubrication Problems and their Solutions. A. Wolf. *Petroleum*, Aug. 1946, **8** (9), 183.—Former literature on turbine lubrication indicated that faulty lubrication, excessive oil deterioration, formation of obstructive deposits, etc., was invariably shown, particularly in the early stages, by increase in the bearing temperatures, oil-cooler outlet, water temperature, etc. Rusting or corrosion of ferrous surfaces, or increasing sluggishness, and even sticking of oil-operated relay mechanisms in large turbines, was neglected, although this may cause the speed governor to stick when the load is removed, with consequent danger of the rotor flying apart. In practice, such serious defects may not be shown up by any marked rise in oil-bearing or cooler outlet water tenperatures. This applies particularly to uninhibited, highly solvent refined turbine oils derived from naphthenic crudes.

Any corrosion of ferrous surfaces is not seen on ordinary visual inspection. Corrosion of non-ferrous surfaces does not as a rule occur until the oil has reached a very advanced stage of oxidation. In moderate and high-temperature turbines, while the temperature of the return oil from each bearing may be of the order of, say, 140° F, the temperature of the oil-skin in immediate contact with the rotor journal must be far higher when the unit is operated by steam, superheated perhaps to any temperature up to 1000° F or over. This skin temperature is one of the main factors determining the rate of oxidation of the oil. To diminish its effects, it is very important to ensure that the flow of cool oil through the bearings and over the portions of the rotor shaft also within the bearing housings, but projecting from the bearings shall be as uniform as possible, to avoid all risk of the development of local "hot spots." Bearing return temperatures are also of great importance, and should be logged at least daily. The engine-room temperature should be taken and recorded at the same time, and the difference carefully observed. It should be constant for each bearing (making allowance for any variations in the temperature of the oil leaving the cooler). Any increase in the case of individual bearings indicates an abnormal condition.

There is undoubtedly a general trend for uninhibited oil life to be shortened by abnormally high oil temperatures. This tendency is little if at all evident with efficiently inhibited oils. It must be emphasized, however, that uninhibited turbine oils, especially of the highly solvent-refined type derived from naphthenic base stocks, may deteriorate very rapidly, even if the oil temperatures in every portion of the lubricating system are perfectly normal and have remained constant over a long period. K. C. G. K.

1441. Steam Turbine Lubrication Problems and their Solutions. 2 (2) Effect of Steam Temperature on Oil Oxidation. A. Wolf. *Petroleum*, Sept. 1946, **9** (9), 203.—A portable mercury thermometer of range, say, 20–220° F is very useful in carrying out turbine lubrication surveys. Details are given of the positioning of the thermometer bulb so as to ensure reliable readings.

The view that turbines should present no lubrication difficulties, even when driven by highly superheated steam at high pressures, is based on the moderate level of bulk oil temperatures and the assumption that steam does not come into direct contact with the oil, because the turbine casing is separated by an open space from the bearing housing, and both are provided with glands and seals. However, present high steam pressures and high-speed rotors make it difficult to design steam-tight glands, and have brought about a reduction in the distance between the rotor bearing centres. Leaking superheated steam is invisible, but may be detected by its charring effect on paper. Any such superheated steam-jet contacting the oil-sealing rings of the bearing housing will enter and form an emulsion as soon as the steam temperature falls below 212° F.

It is probable that most oil-oxidation occurs in the bearing-housings, particularly at the high-temperature end of the turbine. Due to aeration of the oil and a possible vacuum ejecter effect produced by the escape of oil from the bearing housing via the vertical oil return pipes, the oxygen supply is continuous, so that oxidation does not slow down as might be expected.

In addition to lubrication and providing fluid pressure, the oil plays an important function in removing heat from the bearings. K. C. G. K.

1442. Phenomena in the Oil Insulation of Pressurized Electric Cables. C. F. Proos. *Ingenieur*, 1946, **58** E, 65–70.—Continuing the previous study (see Abstract No. 987), measurements were carried out on the effect of overloading a pressurized cable. Overloading at room temperature did not effect the insulation. Measurements after a heat treatment (1000–3000 hours at 60–75° C) indicated larger dielectric losses ($tg. \delta$) at low loads than at high loads.

It would appear that the method of testing could be used for evaluating the properties of various oils and methods of cable construction.

The general conclusion is that the insulating properties of the oil should preferably be independent of electric load at high temperatures. In addition, the oil and the other insulating materials should have a good oxidation stability. M. B.

Bitumen, Asphalt and Tar.

1443. Base Design for Bituminous Roads. L. D. Hicks. *Roads and Streets*, Aug. 1946, **89** (8), 103.—Recommended base and sub-base thicknesses beneath 1-inch bituminous surface treatment for various wheel loads in North Carolina are given. A series of tables list various types of loads, and thicknesses for subgrade bearing values of 30, 20, 15, and 10 p.s.i. serving under maximum axle loads of 8000 to 20,000 lb. G. A. C.

1444. A Study of Bituminous-Coated Corrugated Sheet-Metal Culverts. J. Y. Welborn and P. J. Serafin. *Public Roads*, 1946, 22 (9), 227.—The field inspection of culvert pipe installed for the drainage of surface water and laboratory analyses of the samples taken are described.

The metal pipe had been in service from 4 to 9 years. Three general types of bituminous-coated sheet metal pipe are used. Galvanized metal pipe coated with asphalt and with an asphalt pavement consists of corrugated sheet-metal piping uniformly coated with asphalt inside and out, and the section of the inside circumference which forms the bottom of the pipe when installed is coated with an additional thickness of asphalt such that the corrugations are filled and a smooth pavement formed. A second type is asbestos-bonded metal pipe coated with asphalt and with an asphalt pavement, a layer of asbestos felt being rolled into the molten spelter coating on one side of the sheet, and after the surface is primed with a bituminous material the sheets are fabricated into corrugated pipe. The asphalt pavement is formed as for the plain pipe. The third type is a galvanized corrugated pipe coated on the outside and three-fourths of the inside with asphalt; the remaining fourth, which forms the bottom of the pipe, is paved with asphalt reinforced with metal.

The data from the inspection report for each culvert were tabulated, and an explanation of the terms good, checked, cracked, broken, loss, adhesion, and flow are given in the article.

From the data obtained it was concluded that in general the most severe deterioration of the asphalt coating and pavement was found at the outlet ends of the pipes, and the amount of flow of water did not bear any consistent relation to the degree of deterioration, nor had the slope of the pipe much influence. The outside asphalt coating was usually checked, and had very little adhesion to the metal. Metal-reinforced asphalt-paved inverts showed the greatest amount of deterioration, and asbestos-bonded metal had the greatest resistance to deterioration. The durability of the coating depends largely on the type of asphalt used. G. A. C.

1445. Soil Compaction, Moisture and Bearing Value. A. H. Gawith. *J. Inst. Engrs Australia*, 1946, 18, 109.—Recent advances in the knowledge of the influence of seasonal changes and variations in height of ground-water table on the stability of the soil are dealt with, and results are given of an investigation of roads in a particular locality.

The degree of compaction of the soil being produced by some compacting process which breaks down the larger secondary particles can be defined either in absolute or relative terms. Two methods exist to determine the compaction, the Practor and the Modified A.A.S.H.O. Compaction tests, which obtain the percentage of the dry weight per cubic foot which can be obtained by ramming at the most favourable moisture content under the conditions specified for the particular test.

Compaction to high densities will reduce the moisture content attained by the material under saturation conditions, and swelling is influenced by the moisture content and surcharge of sand or other granular material.

The moisture content of a soil is modified by several factors, including non-uniformity of temperature and texture, rain falling on the surface soil, and cracks in the soil column.

Darcy's law for the movenent of water and for unsaturated flow is stated, and from Russian experiments some indication of the possible rates of upward movement of water has been deduced. Three cases are discussed on the behaviour of water in the soil under a pavement for varying water-tables, and the moisture content for four individual soils are tabulated. Field tests included observations of moisture conditions under light sealed pavements in Victoria, where the average annual rainfall is 17 inches. Values of liquid limit varying from 43 to 66% and of Plastic Limit 15 to 21·2% were encountered with soil-moisture contents from 6 to 29·5%.

The California Bearing Ratio test was applied to a limited number of large samples, and a chart shows the relation between this ratio and the resistance to penetration of a Proctor needle.

From the data obtained it is considered that it is only on account of the low rainfall and high rate of evaporation in these semi-arid areas that it has been possible to use the very thin pavements with some degree of success.

Failures and longitudinal cracks generally nearer the pavement edges occurred, probably caused by lower bearing value of the soil at the edges. G. A. C.

Special Hydrocarbon Products.

1446. Crystallography of Waxes and Related Substances. 3(2). Photomicrographs. L. Ivanovsky and J. H. Wredden. *Petroleum*, Sept. 1946, **9** (9), 218.—Six further micrographs are shown of crude, yellow, and white Russian ozokerites. K. C. G. K.

1447. Plastics from Petroleum. 3(2). Production. W. S. Penn. *Petroleum*, Aug. 1946, **8** (9), 186.—All thermosetting plastics requiring the use of formaldehyde can have the latter component derived from petroleum. Allyl plastics are obtainable from petroleum via propylene.

The synthetic elastomers probably absorb the largest quantity of petroleum products used for making chemicals. There is no doubt that fairly large quantities of some synthetic rubbers will continue to be made even when natural rubber once more becomes freely available.

At present the most important is undoubtedly GR–S, the butadiene–styrene copolymer. The manufacture of styrene has already been described. Butadiene may be obtained by several alternative routes. Perbunan types are obtained from butadiene and acrylonitrile. Butyl rubber is produced by copolymerization of *iso*butylene and *iso*prene on butadiene. Neoprene is made by polymerizing chloroprene, which is made from acetylene.

Thiokols are made by heating sodium polysulphides with ethylene halides.

Various solvents and plasticizers can also be made from petroleum. If certain chemicals could also be produced from petroleum in large quantities, the use of petroleum in the field of plastics would be even more important. One such chemical is butadiene, the roundabout production of which from aldol is awkward and costly. It is also important to produce more benzene and other aromatics from petroleum.

As regards the post-war demand for synthetic rubbers, the question of GR–S, the general purpose synthetic rubber, is the most prominent. GR–S is not as good, in its present form, as natural rubber, and will be almost completely replaced. Later, of course, improved polymers may be developed. The demand for other synthetic rubbers (perbunan, neoprene, thiokol) is not likely to diminish to any extent, and may even increase because of their ozone and oil-resistance. The situation for P.V.C. is similar, where it has been used for special purposes. K. C. G. K.

Derived Chemical Products.

1448. Synthesis of the Base $C_{16}H_{25}N$ of California Petroleum. V. Prelog and U. Geyer. *Helv. Chim. Acta*, 1946, **29**, 1587–1603.—Three nitrogen bases of similar constitution have been synthesized and examined. One of these, 2 : 4-dimethyl-6-(*trans*-2 : 2 : 6-trimethyl*cyclo*hexyl)-pyridine, has been shown, from a consideration of the ultraviolet absorption spectra, densities, refractive indices, molecular refractions, and properties of the picrates and picrolonates, to be identical with the nitrogen base, $C_{16}H_{25}N$, isolated from California petroleum by W. C. Thompson and J. R. Bailey (*J. Amer. Chem. Soc.*, 1931, **53**, 1002–1011). The structure of this base was previously shown by B. Shive, S. M. Roberts, R. I. Mahan, and J. R. Bailey (*ibid.*, 1942, **64**, 909–912) to be 2-(2 : 2 : 6-trimethyl*cyclo*hexyl)-4 : 6-dimethylpyridine. C. N. T.

Miscellaneous Products.

1449. Colloidal Carbon. W. H. Cadman. *Petrol. Times*, 31.8.46, **50** (1281), 898.—An abridged form of an extensive paper by the author presented before the Royal Society of Arts. It deals with many aspects of colloidal carbon production, properties, and uses. Natural gas is the raw material which is by far the most extensively used in the production of colloidal carbon. Other raw materials include waste refinery gases and various coal products. R. B. S.

1450. Liquid Methane as a Motor Fuel. 1. Supplies and Properties. R. M. Bridgwater. *Petroleum*, Aug. 1946, **8** (9), 194.—The possibility of using methane as a motor fuel is of interest to the petroleum industry for two reasons. Firstly, it affords a means of which Britain can make use of an efficient substitute for imported fuel.

Secondly, in countries amply endowed with petroleum there is usually a large quantity of natural gas available which may be used to conserve petroleum supplies.

Supplies which could be used without affecting other existing processes are : natural gas, mines gas, sewage gas and surplus coke-oven gas. These supplies are not large and are not always in places convenient for use. Sources of natural gas in this country are small.

The difficulty with the use of coke-oven gas as a source of liquid methane is that it contains only 25–30%. Conversion of the carbon monoxide and hydrogen in the gas into methane catalytically has not yet reached the stage of being a commercial proposition.

Potential sources of methane oil : as a by-product in petroleum refining, the hydrogenation of coal and oil and the Fischer–Tropsch and related syntheses. Little is available in Great Britain at present from such sources, however.

The properties of methane make it very suitable for use in internal-combustion engines. It is best transported in liquid form. One pound of methane has a calorific value 14% higher than the same weight of gasoline. Because of density considerations, however, its calorific value on a volume basis is 34% less than that of gasoline. Methane has excellent anti-knock properties as well as various other advantages.

K. C. G. K.

1451. Phase Relations in the System : Sodium Stearate-Cetane. T. M. Doscher and R. D. Vold. *J. Colloid Sci.*, 1946, 1, 299–312.—The binary system sodium stearate–cetane is examined between crossed Nicols at temperatures between 20° C and T_i, the temperature at which an isotropic liquid is formed. The following observations were made :—

20–110° C. Curd fibres (dark irregular strings) and waxy phases (dark stippled areas) are first seen. With increase in temperature the former vanish, and subsequently liquid separates out.

110–120° C. The appearance of the material at this stage is a function of soap content :

Above 75% soap, the liquid is reabsorbed immediately. As the soap concentration decreases the waxy phase is transformed to a brilliant uniform "superwaxy" phase.

Between 75% and 57% soap, free liquid is reabsorbed on holding the temperature constant for up to 2 hours. Transitory structured areas appear in the isotropic phase, but are not seen if the rate of heating is rapid.

Between 57% and 40% soap, free liquid is reabsorbed as above, but the structured areas are more permanent.

Below 40% soap, free liquid is never completely reabsorbed. With decreasing soap content the structured areas eventually appear as an isotropic material which below 20% soap forms irregularly outlined rods of a palisadic type of structure.

120° C to T_i. At high soap content a coarsening of the field is suggestive of the formation of crystallites. As the soap content decreases this effect is missing, T_i falls, and the superwaxy phase predominates. A phase diagram of the system is given.

In discussing these changes, the authors suggest that the curd fibre phase is a disordered array of crystallites of sodium stearate bound by intermolecular forces, a weakening of which results in the formation of waxy phases. It is deduced that cetane dissolves between the soap chains, with eventual formation of superwaxy soap. This hypothesis accounts for the non-smectic character of the superwaxy phase, since the inclusion of cetane molecules between the chains of the soap lattice when the attractive forces of the polar heads is still high will deform the parallel character of the lattice and prevent the formation of a smectic phase. The appearance of a smectic phase at lower temperatures and high cetane concentration is explained by the assumption that still more cetane molecules overcome the polar forces to give a loose structure in which the tails of the soap molecules are again parallel.

H. C. E.

1452. Secrets of German Fuel Technology Unearthed. Anon. *Petrol. Times*, 14.9.46, 50 (1282), 966.—The following C.I.O.S., B.I.O.S., and F.I.A.T. Final Reports are briefly reviewed :

B.I.O.S. Final Report No. 513. Notes on the Organization of the German Petroleum Industry during the War (14 pages).

B.I.O.S. Final Report No. 507. Coal Tar Distillation, Chlorinated Phenols, Phenol Formaldehyde Resins, and Synthetic Phenols (24 pages). H.M.S.O. 3*s.* (post 2*d.*).

B.I.O.S. Final Report No. 510. Samples of Petroleum Products Collected from the Hamburg, Hannover, Bremen, and Kiel Area (38 pages). H.M.S.O. 3*s.* 6*d.* (post 2*d.*).

B.I.O.S. Final Report No. 511. Ruhr Chemie A.G. Sterkrade-Holten: Interrogation of Dr. O. Roelen (25 pages). H.M.S.O. 2*s.* 6*d.* (post 2*d.*)—Contains reports on translations of three documents prepared by Dr. Roelen of Ruhr Chemie A.G., viz.:—

I.—The Fischer–Tropsch Process and its Products.

II.—Synthetic lubricants made by the Ruhr Chemie A.G.

III.—Town Gas and Methanised Air for Automotive Propulsion.

B.I.O.S. Final Report No. 512. Schlafhorst Chemische Werke G.m.b.H., Hamburg, Germany: Lubricants (15 pages). H.M.S.O. 1*s.* 6*d.* (post 1*d.*).

F.I.A.T. Final Report No. 90. Interrogation of Professor Franz Fischer (3 pages)—Contains reports on information given from memory by Professor Fischer on *iso*-synthesis, iron synthesis, nickel catalysts, suspended catalysts, and isomerization.

F.I.A.T. Final Report No. 239. Textile Auxiliary Products Manufactured by I.G. Farbenindustrie, Mainkur Works (12 pages). H.M.S.O. 6*d.* (post 1*d.*).

F.I.A.T. Final Report No. 273. Interview with Dr. J. W. Reppe, I.G. Farbenindustrie A.G. (21 pages)—Contains reports on Dr. Reppe's principal contributions to the war in the form of newly developed processes involving novel reactions of acetylenes and of metallic carbonyls.

F.I.A.T. Final Report No. 447. Study of Production of Shale Oil from Shale in Wurtemberg (99 pages).

F.I.A.T. Final Report No. 737. Economic Study of German Synthetic Waxes (32 pages). R. B. S.

Engines and Automotive Equipment.

1453. Use of Ether as Ignition Agent. R. J. Bender. *Auto. Aviation Ind.*, 1.9.46, **95**, 40.—The Ring process, which the article describes, is an invention for the elimination of the sparking-plugs in an aero-engine, which are the weakest part of the engine, especially for high-altitude work. Ignition is produced by spraying into the combustion chamber at the right moment of the gasoline-air compression stroke a liquid which will ignite spontaneously at the temperature of the cylinder, thus igniting the combustible charge. The ignition liquid used, called "R-Fluid," is an ether such as butadiol diethyl ether or diethyl diglycol ether. The cetane rating of this fluid can be as high as 185. R-Fluid can be used as a starting fluid for diesel engines. The Ring process has proved to reduce the knocking tendency of a fuel, apparently due to the fact that the particles of R-Fluid penetrate the mass of air and fuel thoroughly before igniting, so that ignition is thereafter uniform throughout the cylinder charge. A saving of fuel of approximately 5% may be expected as a result of the more knock-free performance and in the lean mixture condition. Two problems in connection with the Ring Process are the problem of starting the engine, especially at low temperatures, which involves auxiliary spark-ignition equipment, and the problem of reducing the cost of installation of the necessary injection equipment. R. B. G.

1454. Fuel Sensitivity and Engine Severity in Aircraft Engines. S. D. Heron. *J. Soc. aut. Engrs*, 1946, **54**, 511–512.—The relation of engine severity and fuel sensitivity is discussed; recent research on hydrocarbons within the aviation gasoline boiling range reveals that there are no possible super fuels for severe engines which have high cylinder and mixture temperatures. With mild engines, performance numbers of 200–300 employing 4 cc of TEL are possible. It is suggested that a decision should be made between adopting the severe or mild engine to guide fuel producers in the production of the appropriate gasoline. G. P. K.

1455. Airscrew Turbine Progress. Anon. *Flight*, 31.10.46, **50** (1975), 466.—Describes development of Armstrong Siddeley Python and Mamba airscrew gas turbines. The Python has completed 25 hours running with Rotol airscrews and favoured aircraft for use as flying-test beds are the Avro Lancaster and Lincoln. The two engines are respectively the highest-powered and smallest airscrew turbines so far announced. Development of the Mamba is not so far advanced. The gas-flow is straightened by clustering the combustion chambers between the axial-flow compressor and the turbine instead of packing them round the compressor casing, as on the Python. Total weight with airscrew is about 1000 lb, and diameter over cowling, 27 in.

The A.S.X. is being used in the development of a starter for the Python. The starter works on compressed air or a slow-burning cartridge. The intention is to use it in conjunction with a mobile ground compressor, but to carry cartridges for "unscheduled" starting. The A.S.X. runs up to 1500 r.p.m. in 30 sec using an air-pressure of 100–140 lb/sq. in. I. G. B.

1456. Filtration for Oil Engines. C. G. Vokes. *Gas Oil Pwr*, 1946, **41**, 347–350.—The effect of dust particles of given size on piston wear is described. For air filtration the viscous filter, the oil-bath filter, and the centrifugal cleaner are all discussed, and their advantages and disadvantages are compared. A new type of air-filter utilizes the blast from the exhaust to create an injector effect for the air-stream, from which a layer of clean air can be drawn off.

The three principal methods of oil filtration—full flow, byepass, and periodic removal of oil for external filtration—are analyzed, and faults commonly encountered in practice are pointed out. Three stages in the filtration of fuels are described.

A list of desirable characteristics of air and oil filters is given. H. C. E.

1457. Combustion in a Precombustion-Type Diesel Engine. H. F. Bryan. *J. Soc. aut. Engrs*, 1946, **54** (9), 449–457.—Diesel-engine combustion has been studied using a high-speed camera to photograph spray form, spray penetration, and combustion in a pressure chamber in which engine conditions could be simulated and in a single-cylinder engine with a window set in the precombustion chamber. Apparatus and results achieved are discussed. Present indications are that for best diesel performance the maximum rate of burning of fuel should occur in the last half of the combustion period, and that the position of top centre in relation to maximum rate of burning is of prime importance. G. P. K.

1458. Theseus I. Anon. *Flight*, 10.10.46, **50** (1972), 386.—Further details of the Bristol turbine-airscrew unit are given.

The compressor comprises nine stages of axial blading and a final centrifugal impellor giving an overall compression ratio of 5 : 1 at 300 m.p.h. at 20,000 ft. At full throttle the compressor runs at 8200 r.p.m. and delivers 30 lb/sec of air at sea-level static conditions—equivalent power input is 3500 h.p. The heat-exchanger is a matrix type unit the tubes of which are arranged in 16 sets, eight inlet and eight outlet separated by suitable headers. To mitigate differential expansion the exchanger is situated on the main engine mounting structure and located at the forward end. The first turbine (two-stage) powers the compressor and auxiliaries, and the single-stage second turbine drives the airscrew. The latter runs at 9000 r.p.m. As the speeds of the two turbines must be kept in nearly constant ratio, a governor mechanism is incorporated whereby the airscrew blade pitch is automatically controlled. The reduction gear incorporates four sets of compound planet wheels and the ratio is 8·4 : 1. I. G. B.

1459. Reliability of Gas Turbines. Anon. *Flight*, 17.10.46, **50** (1793), 426.—Rolls Royce give details of performance testing of a Series I Derwent engine. Originally assembled in June 1944, it has run a total of 1005 hours, 920 hours of this being at full type test conditions. After 500 hours replacements needed were a set of flame tubes, one air-casing, some turbine blades, and a fuel-pump. Major components still in use are the wheel-case with accessory drives, the compressor impellor and shafts; the compressor casing, diffuser, and combustion chambers.

In R.A.F. service the running period of 180 hours has recently been increased to 270 hours. Present practice is to increase the overhaul period in stages of 90 hours and a further extension of 90 hours is expected to be granted for the Derwent I.

I. G. B.

1460. Hydraulic Power a Growing Avenue for Petroleum. C. Ridley. *Petrol. Times*, 31.8.46, **50** (1281), 920.—The use of hydrocarbon fluids in hydraulic controls and transmissions, hydraulic lifts, fluid flywheels, and torque converters, hydraulic springing, and as hydraulic fluids for other purposes, is discussed. The advantages of these drives over mechanical units, especially in reducing the complexity of design, are also outlined. R. B. S.

Miscellaneous.

1461. Liquid Methane as a Motor Fuel 2. Carriage of Methane. R. M. Bridgwater. *Petroleum*, Sept. 1946, **9** (9), 216.—The best way of carrying gaseous methane is compressed in cylinders. Data are given for the weight of equipment and the possible mileage in the case of a 5-ton lorry operating on various alternative fuels. It is seen that liquid methane comes next to petrol as regards general performance. Its disadvantage is that it so readily evaporates, necessitating careful design of equipment. Various ways of delivering liquid methane to the engine are also discussed.
K. C. G. K.

1462. World Refinery Construction Enters New Stage of Expansion. Anon. *World Petrol.*, 1946, **17** (8), 78–81.—The expected post-war decline in refining and production equipment has been much less severe than was anticipated. This fact, together with the improvization effected as a war-time measure, has led to many new installations. The major projects of the world are reviewed, together with the measures to reconstruct those plants which have suffered through war, especially in the Far East and Europe. F. S. A.

1463. Reconstruction of the East Indies. Anon. *Riv. Ital. Petrol.*, 1946, **14** (160), 14.—A summary of the present position of the petroleum industry in the East Indies.
D. H. McL.

1464. German Production and Refining in the British Zone. Anon. *Petrol. Times*, 31.8.46, **50** (1281), 912.—Statistical data are presented on the production of north German oilfields for the last six months of 1945 and the first six months of 1946. The monthly output of refineries and products for the same period are also tabulated.
R. B. S.

1465. A British Refinery in War-time. Anon. *World Petrol.*, 1946, **17** (8), 71–73.—An account is given of the war-time activities of Manchester Oil Refineries, Ltd. The paper includes a list of their products. F. S. A.

1466. British Refining Adjusted to Peace-Time Demands. A. H. Day. *World Petrol.*, 1946, **17** (9), 41–43.—In order to economize on shipping space and labour, import of crude fell by 75% during 1938–43, but total petroleum imports increased by 25% due to import of refined products. Some details are given of the changes made to effect reduction in home refining. Brief argument is advanced concerning the relative merits of continuing this policy or of expanding domestic refinery activities. It is stated that Britain is reverting to pre-war industrial production and that her oil requirements are the same as previously, except that the Government is the sole purchaser.
F. S. A.

1467. United Kingdom Petroleum Imports in July and the Seven Months. Anon. *Petrol. Times*, 31.8.46, **50** (1281), 923.—Statistical data on imports and exports (including oil fuel bunkering of shipping) of crude oil and refined products for July and the first seven months of 1946 are presented, together with comparative figures for 1945 and 1938. R. B. S.

1468. U.K. Import Trade of Solid Petroleum Products in War-time. Anon. *Petrol. Times*, 14.9.46, **50** (1282), 952.—The war-time decline in the imports of solid petroleum

products into the U.K. is illustrated by statistical data on these imports, both by imported products and by countries of consignment, for the years 1938–1945 inclusive.
R. B. S.

1469. Hungarian Oil. M. Freund. *Petroleum*, 1946, **9** (9), 204.—A survey of oil production and refining in Hungary. Tables indicate crude oil and natural gas production for the years 1937–1945 and also show the capacities of Hungarian refineries (before war damage) and analytical data for Hungarian crudes. K. C. G. K.

1470. Dictionary of Italian Technical Terms relating to the Petroleum Industry. Anon. *Riv. Ital. Petrol.*, 1946, **14** (160), 18.—Continued from the June 1946 issue of this journal, the dictionary gives English, French, and German equivalents of technical terms relating to petroleum technology. D. H. McL.

1471. Palestine Petroleum Imports and Exports in 1945. Anon. *Petrol. Times*, 31.8.46, **50** (1281), 914.—Statistical data are presented on the imports and exports of crude oil and refined products for 1945 with comparative figures for 1944, 1943, and 1938. R. B. S.

1472. Deficiency of Combustible Liquids in Roumania. Anon. *Riv. Ital. Petrol.*, 1946, **14** (160), 13.—Roumania is suffering from a grave deficiency of heavy oils for internal industry. The government has authorized the sale of a mixture of 60% kerosine, 10% gas oil and 30% residual asphalts, whilst the manufacture of asphalts has been prohibited to encourage the production of this mixture. The actual deficiency, which amounts to at least 30,000 metric tons per month, is the result of reparations and sales to U.S.S.R. D. H. McL.

ERRATUM.

Abstract No. 1026. The maximum fluid pressure of the slush-pump referred to should read 2000 lb/sq. in.

BOOKS RECEIVED.

Gas Turbines and Jet Propulsion for Aircraft. G. Geoffrey Smith. London: Flight, 1946. 4th Edn. Pp. 246. 12*s*. 6*d*.

First published in 1942, the fourth edition has been brought up-to-date by the inclusion of additional matter and comment on various phases of modern gas turbine practice.

Heat Engine Calculations. A. E. Talbot. London: Sir Isaac Pitman & Sons Ltd., 1945. Pp. 89 + vi. 3*s*. 6*d*.

Based on the author's experience in teaching the principles involved and the calculations necessary for those engaged in the running and maintenance of diesel, petrol, steam and marine engines, this book should be particularly helpful to students.

Our Oil Resources. Edited by Leonard M. Fanning. New York: McGraw-Hill Book Co., 1945. Pp. 331 + viii. $4.

Eighteen authorities and oil company executives have contributed to this symposium on the development of U.S. oil resources. Questions of conservation, technology, reserves, and capital employed are discussed.

Petroleum Production. Vol. I. Mechanics of Production: Oil, Condensate, Natural Gas. Park J. Jones. New York: Reinhold Publishing Corpn., 1946. Pp. 228 + vii. $4.50.

The purpose of this volume is to set out for consideration a system of mechanics of producing oil and condensate prior to the breakthrough of displacing fluids into producing wells.

Physical Constants of Hydrocarbons. Vol. III. Mononuclear Aromatic Hydrocarbons. Gustav Egloff. New York: Reinhard Publishing Corpn., 1946. Pp. 661 + xiii. $15.

This volume follows the style of the previous two volumes in the series and is a collation of all melting point, boiling point, density, and refractive index data available before May, 1944, for the mononuclear aromatic hydrocarbons found in the world's resources.

The Wild Catters. Samuel W. Tait, Jr. Princetown, New Jersey: University Press, 1945. Pp. 218 + xvi. $3.

An informal history of the pioneers of the oil industry, including an account of early drilling in Ontario, the story of Salt Creek and a chapter on life in the boom oil towns.

O Neftenosnosti Kizelovskogo Raiona (Petroleum Occurrence in the Kizel District). N. A. Gedroitz and P. A. Sofronitzkii. Moscow-Leningrad, 1941. Pp. 40. Price 75 kopeks.

Short summary of previous work; significance of the Kizel region from the petroleum standpoint; stratigraphy and general geology of the area; oil-shows and bitumen deposits; results of chemical and geological investigations.

Geologicheskoe Stroenie i Neftenosnost' Poluostrova Manguishlak (The Geological Structure of and Petroleum Occurrence in the Manguishlak Peninsula). S. N. Alekseichik. Moscow-Leningrad, 1941. Pp. 96. Price 2 rubles 50 kopeks.

Geomorphology; stratigraphy; tectonics; signs indicating petroleum; other useful minerals.

Issledovaniya po Khimii Prirodnuikh Asfal'tov (Investigations on the Chemistry of Natural Asphalts). V. A. Uspenskii and A. I. Gorskaya. Moscow-Leningrad, 1941. Pp. 72. Price 2 rubles 25 kopeks.

This publication is divided into two parts, the first deals with the experimental chemical examination of solid bitumens from the pre-Ural region, whilst the second is devoted to a discussion of the acidic components of solid bitumens.

Fauna Tretichnuikh Otlozhenii Yugo-vostochnoi Chasti Sovetskogo Sakhalina (Fauna of the Tertiary Deposits of the South-eastern Part of Soviet Sakhalin). A. A. Simonova. Moscow-Leningrad, 1941. Pp. 80 + 25 plates. Price 4 rubles.

Stratigraphy; palaeontology; description of fauna belonging to the Pelecypoda, Scaphopoda, Gastropoda. A brief English summary is appended.

Verkhnii Paleozoi Bashkirskoi A.S.S.R. (The Upper Palaeozoic of the Bashkir Autonomous Soviet Socialist Republic). D. L. Stepanov. Moscow-Leningrad, 1941. Pp. 100 + 2 plates. Price 3 rubles 50 kopeks.

Stratigraphy; main features of the geological history of Bashkiria in the upper palaeozoic; the formation of limestone massives of the Ishimbaev type; petroleum deposits in the upper palaeozoic strata of Bashkiria.

The above five publications are Nos. 15, 16, 17, 18 and 20 respectively in a new series issued by the Petroleum Geological-Investigational Institute.

Geologicheskoe Stroenie Severo-zapadnoi Chasti Zapadno-sibirskoi Nizmennosti i ee Neftenosnost'. (The Geological Structure of the North-western Part of the Western Siberian Depression and Petroleum Occurrence therein). V. G. Vasil'ev. Moscow-Leningrad, 1946. Pp. 152. Price 10 rubles.

Cartographic sources; history of explorations; geology of the region; petroleum deposits.

Problema Neftenosnosti Donetzkogo Basseina (The Problem of Petroleum Occurrence in the Donetz Basin). V. V. Veber. Moscow-Leningrad, 1945. Pp. 88. Price 6 rubles.

The region in question is the northern border of the Don basin. Profile; tectonics; oil-shows; oil-bearing problems of the zone.

Nauchnuie Osnovui Poiskov Nefti (The Scientific Principles of the Search for Petroleum). K. P. Kalitzkii. Moscow-Leningrad, 1944. Pp. 244. Price 35 rubles.

Signs indicating large-scale oil deposits; oil migration; formation of oil deposits; the origin of petroleum; determination of oil-bearing geological structures.

All the publications described above are published by the State publishing organization dealing with literature on petroleum and mined fuels.

V. B.

INSTITUTE NOTES.

December, 1946.

MEMBERSHIP.

The Institute of Petroleum is anxious to contact members whose association with the Institute has been interrupted during the war years. The Council request that those members, whose association with the Institute has lapsed, communicate with the Institute as soon as possible. In view of the many difficulties experienced in connection with the payment of subscriptions the Council will do all possible to assist as regards the arrears accumulated under war-time conditions.

SCOTTISH BRANCH.

A meeting of the Scottish Branch of the Institute was held at the Royal Technical College, Glasgow, on November 15, the Chair being taken by Mr. Robert Crichton, Branch Chairman.

A paper on "A Brief Survey of Recent Developments in Mechanized Coal Mining," was read by Mr. G. R. Buchanan, of The Fife Coal Company. The paper dealt particularly with what had been done and was being done in the Company's collieries and attracted many members from the shale fields, who made up a large proportion of the attendance of over 100.

A vote of thanks to the lecturer was proposed by Mr. John M. Caldwell and to the chairman by Prof. W. M. Cumming.

The Branch Committee is indebted to Dr. William Reid, a member of the Committee, General Manager of The Fife Coal Co. Ltd., and recently appointed Production Director of the Coal Board in Scotland, for arranging the meeting.

STANLOW BRANCH.

The Stanlow Branch of the Institute held its first meeting of the current session on October 16, when the following films were shown :

"*Through the Mills.*" (Stewarts & Lloyds, Ltd.) This illustrated the manufacture of steel tubes.

"*An English Oilfield.*" Depicting developments at Eakring.

"*Production of High Quality Steel.*" (Hadfields, Ltd.). Questions on the subject of this film were answered by Mr. W. H. Salmon, of Hadfields, Ltd.

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.

Applications for Membership.

Bowkett, Terence John, Student, Royal School of Mines. (*S. E. Coomber; G. D. Hobson.*)

Clarke, Arthur Henry, Senior Chemist, Geochemical Laboratories. (*H. B. Milner; L. J. Chalk.*)

Cooke, Percy Frederick, Research Chemist, "Shell" Central Laboratories. (*W. R. P. Hodgson; J. Parrish.*)

Gadsby, Gordon Neville, Principal Lecturer, Applied Chemistry Branch, Military College of Science. (*J. R. H. Whiston; J. B. Robinson.*)

Greenway, John Henry, Installation Supervisor, Petroleum Board. (*A. H. Stephenson; J. Parrish.*)

Haniff, Mohamed, Junior Engineers' Assistant, Lago Oil & Transport Co. Ltd., Aruba.

Jenner, Peter, Chemical Assistant, "Shell" Refining & Marketing Co. Ltd. (*W. R. P. Hodgson; P. G. Higgs.*)

Larson, Clifford M., Chief Consulting Engineer, Sinclair Refining Co., New York. (*A. E. Miller; K. G. Mackenzie.*)

McFadyen, Robert William, Assistant to Sales Manager, Lobitos Oilfields Ltd. (*J. S. Parker; D. M. Glendinning.*)

McGuinness, Thomas Frederick, Mechanical Engineer, Texas Oil Co. Ltd. (*H. Weiser; W. H. Goodhind.*)

Oswald, Roman Kazimierz, Member of the Institute of Technical Research, General Staff, Polish Army. (*S. Sulimirski; A. L. Wachal.*)

Payne, Henry Fernie, Secretary, Liverpool Storage Co. Ltd. (*T. A Hallam; H. Grosvenor.*)

Potter, Kenneth, Sales Engineer, The Texas Oil Co. Ltd. (*H. Weiser; W. H. Goodhind.*)

Smith, Barry Dudley, Petroleum Laboratory Technician, R.A.F. (*W. Johnson; G. C. McEwen.*)

Watson, Bernard William James, Managing Chemist, Hampshire County Council. (*A. W. Attwooll; D. C. Broome.*)

Whitchurch, Ronald, Office Engineer, "Shell" Refining & Marketing Co. Ltd. (*E. LeQ. Herbert; P. M. Griffiths.*)

Applications for Student Membership.

(Proposed by F. H. Garner.)

CHARLES, Eric John,	Student, University of Birmingham.
EDGHILL, Charles Murray,	,, ,, ,,
FORSTER, Archibald William,	,, ,, ,,
FOSBURY, David William,	,, ,, ,,
GRAFTON, Raymond William,	,, ,, ,,
HAMMERTON, Denis,	,, ,, ,,
HINDE, Peter,	,, ,, ,,
HIXON, Fred Ernest,	,, ,, ,,
HORNIBROOK, John Nevill,	,, ,, ,,
LINDNER, James Neville Donovan,	,, ,, ,,
MORRIS, Dennis Michael,	,, ,, ,,
WEBB, Charles Gerald,	,, ,, ,,

Transfer.

ANDREWS, Basil George, Field Chemist, Caribbean Petroleum Co. Ltd. Venezuela. (*W. R. P. Hodgson; J. Parrish.*) (*Student to Associate Member.*)

BARBER, Bernard Thomas, Trainee Exploitation Engineer, Anglo-Saxon Petroleum Co. Ltd. (*F. H. Garner; A. H. Nissan.*) (*Student to Associate Member.*)

MARTYN, John Robert, Geologist, British Controlled Oilfields, Ltd., Ecuador. (*Student to Associate Member.*)

MIMA, Heshmat, Maintenance Engineer, Anglo-Iranian Oil Co. Ltd., Tehran. (*Student to Member.*)

PALMER, Edward Reginald, Senior Scientific Officer, Ministry of Supply. (*W. H. Thomas; A. R. Ogston.*) (*Student to Fellow.*)

STARK, Allan Ramsay, Chemist, Anglo-Iranian Oil Co. Ltd. (*G. H. Coxon; F. E. Smith.*) (*Associate Member to Fellow.*)

WRIGHT, William Roy, Chemical Department, Shell-Mex & B.P. Ltd. (*F. N. Harrap; C. Chilvers.*) (*Student to Member.*)

PERSONAL NOTES.

The Council of the Royal Society of Arts has awarded Silver Medals for the Session 1945–46 for " works of high merit and national value " to the following for the papers referred to :

Major W. H. Cadman, M.B.E., F.Inst.Pet., " Colloidal Carbon."

Percy Evans, M.A., M.Inst.Pet., " The Oilfields of India and Burma."

A. Clifford Hartley, C.B.E., F.Inst.Pet., " Operation Pluto."

RETIREMENT OF MR. F. C. STARLING.

Mr. F. C. Starling, who retired at the end of September last from his post as Under-Secretary in charge of the Petroleum Division of the Ministry of Fuel and Power, first became associated with the petroleum industry in 1929, when the then Petroleum Department was transferred from the Board of Trade to the Mines Department. He was appointed Director of the Department in 1931 and for several years was also in charge of the Fuel Treatment Branch of the Mines Department.

In 1934 he was promoted to Assistant Secretary and it was in that year that the Hydrocarbon Oils Production Act, which led to the building of the hydrogenation plant at Billingham, and the Petroleum (Production) Act, which sought to promote the wider search for petroleum in Great Britain, were passed.

When the Falmouth Committee was set up in 1937 to investigate the question of oil from coal with particular reference to Britain's needs for oil supplies under emergency conditions, Mr. Starling was appointed a Joint Secretary. He was also a member of a Sub-Committee of the Oil Board investigating British Empire oil supplies, and of a Technical Sub-Committee examining storage questions.

During 1938 and 1939 Mr. Starling was closely associated with the preparation of emergency schemes should war materialize, and in 1941 was made Director of Petroleum Supplies, a post which he retained for the remainder of the war. For his work as Director of the Petroleum Department he was awarded the C.B.E. in January 1939.

When the United States entered the war, Mr. Starling became intimately concerned with the British and American organizations set up to ensure that the greatly expanded needs for petroleum products for the war effort were maintained. This was a major war problem and involved him in several visits to the U.S.A. and in many discussions with American representatives who visited Britain. His work in this connexion was recently recognized by the U.S. Government in the award of the Medal of Freedom with Silver Palm, generous tribute being paid to his efforts in the official citation.

During the war Mr. Starling was a member of the Oil Control Board, the committee of the War Cabinet responsible for oil policy, of its Executive Committee, and of the Tanker Advisory Committee appointed by the Minister of War Transport. In 1944 he was a member of the mission to Washington to explore at official level proposals for an Anglo-American Oil Agreement. He also accompanied the Ministerial Delegation headed by Lord Beaverbook in July of that year and, in September 1945, took part in the negotiations with the U.S. Delegation to Britain led by Mr. Harold Ickes which resulted in an Agreement being signed on behalf of both Governments.

An Honorary Member of the Institute, Mr. Starling served on the Executive Committee of the First World Petroleum Congress and was a member of the British Delegation to the Second World Petroleum Congress in Paris in 1937.

REPORTS ON GERMAN INDUSTRY.
B.I.O.S. INFORMATION SERVICE.

Although the B.I.O.S., C.I.O.S., F.I.A.T., and J.I.O.A. Reports on German Industry are available, either by purchase from H.M. Stationery Office or by reference in the principal public libraries, it is recognized that many firms have not the research staff available to examine the whole range relating to a particular industry or subject. Already nearly 1400 reports have been published and that number may well be doubled.

An Information Section has therefore been set up to deal with scientific enquiries arising out of these reports and will also have access to much additional information and documents not suitable for reproduction in publications.

It is important that prompt use be made of these facilities if the full value of the intelligence available is to be realized and enquiries should be addressed to B.I.O.S Information Section, 37, Bryanston Square, London, W.1.

An exhibition illustrating the methods of gathering the information on German wartime developments was held in London during December and will be repeated in Bristol, Cardiff, Birmingham, Manchester, Nottingham, Leeds, Newcastle, Glasgow, and Belfast.

Kindly mention this Journal when communicating with Advertisers.

more than 300 . . .

100,000 pounds of ethylene per day is the capacity of this plant, designed and built by Lummus.

Lummus has designed and built over 300 plants for manufacturing ethylene, butadiene, phenol, alcohols, solvents, and other chemicals from petroleum and other source materials.

Petroleum is the low-cost source of these chemicals, and the market for them is expansive. It is estimated that chemical, pharmaceutical, and cosmetics manufacturers will invest a billion dollars in expanded facilities during the next five years.

With complete research and construction facilities and with broad experience in petroleum refining as well as chemical production, Lummus is prepared to design and build for you a plant which will produce petroleum chemicals most economically.

Lummus engineers will gladly discuss with you the practical considerations of building or expanding your petroleum-chemical facilities.

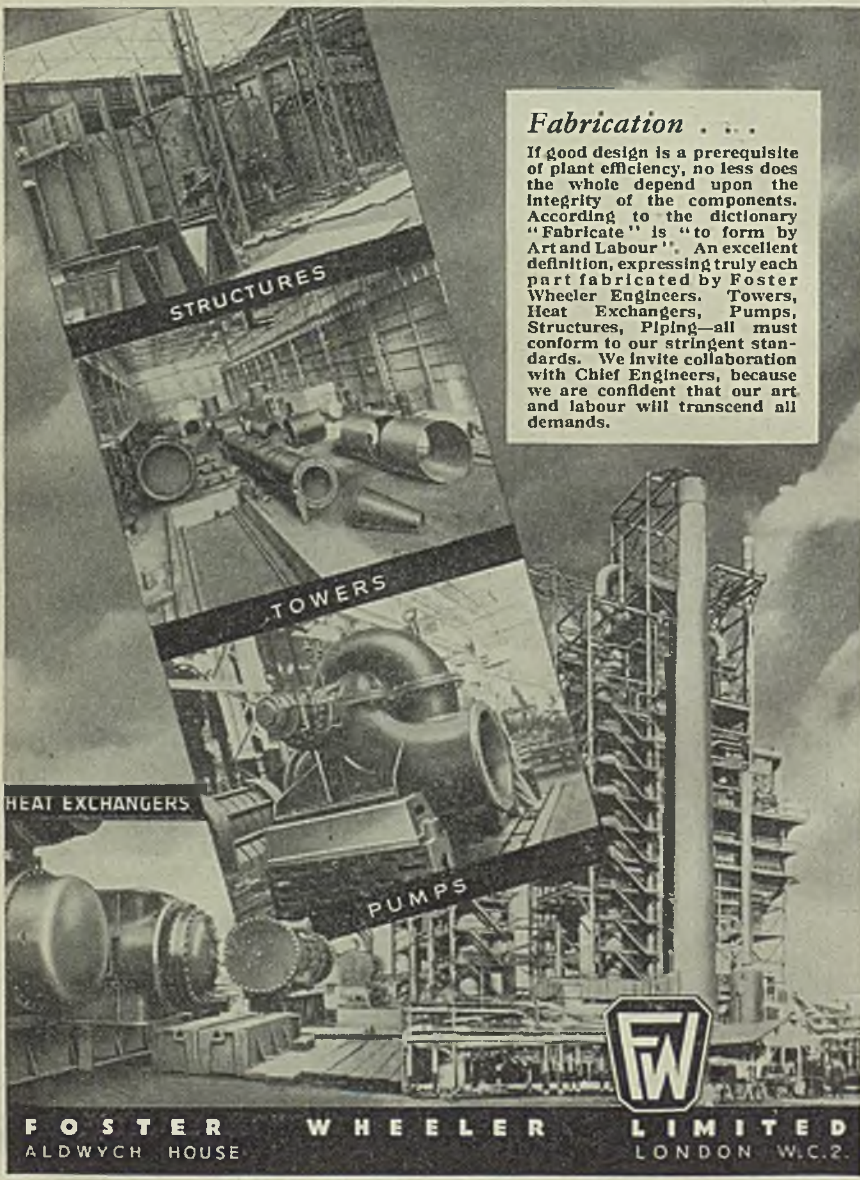
R. H. DODD
Representing The Lummus Company
78 Mount Street, London, W.1,
England.

Lummus
PETROLEUM REFINING PLANTS

Kindly mention this Journal when communicating with Advertisers.

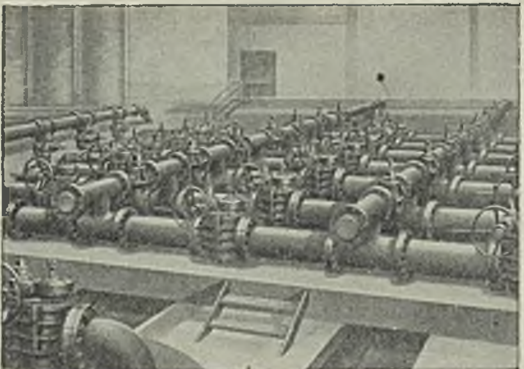
Kindly mention this Journal when communicating with Advertisers.

TO THE CHIEF ENGINEER



Kindly mention this Journal when communicating with Advertisers.

NEWMAN-MILLIKEN GLANDLESS LUBRICATED PLUG VALVES ON AN OIL DISTRIBUTION MANIFOLD



Newman-Milliken Valves are deservedly popular with oil field engineers because, unlike all other valves of this type, the Newman-Milliken employs a parallel plug which is never raised from its seating during operation. Consequently no grit or foreign matter can enter between the valve seating surfaces and cause jamming or "freezing." Newman-Milliken Valves are made in a variety of patterns and metals suitable for all oil field services, particularly for "Christmas trees" and mud lines up to 5,000 lbs. working pressure per square inch. Full details gladly sent on request.

Sole Makers under licence, excluding the U.S.A.

Newman, Hender & Co. Ltd.

WOODCHESTER · GLOS. ENGLAND

"Klingerit"

One Jointing for all purposes

"Klingerit" Compressed Asbestos Jointing is the universal jointing for all purposes no matter how severe the pressure or temperature. The high quality and dependability of "Klingerit," the first compressed asbestos jointing ever made, is determined by 60 years of experience and skill in manufacture; improved methods of production make it unsurpassed for superheated and saturated steam—acids and other chemicals—oils, petrol, solvents. Technical advice is freely available on request.

RICHARD KLINGER LTD

KLINGERIT WORKS · SIDCUP · KENT · TEL: FOOTS CRAY 3022

Kindly mention this Journal when communicating with Advertisers.