ABSTRACTS.

AUTHOR INDEX.

The numbers refer to the Abstract Number.

Oilfield Exploration and Exploitation.

Geology.

322. **Alabama : its Geology and Oil Prospects.** W. B. Jones, *Oil Wkly*, 14.1.46, 120 (7), 51.—In Northern Alabama is a Palæozoic area with Cambrian to Carboniferous beds. The east-central area consists of crystalline rocks, mostly pre-Cambrian, while the Coastal Plain had Cretaceous and Tertiary beds resting on Palæozoic and crystalline rocks.

The southwestern terminus of the Appalachians plunges beneath the Coastal Plain beds as a series of deeply eroded, sharply folded anticlines, separated by broad synclines. This region does not seem likely to produce oil or gas. Flat or gently warped Palæozoics make up the Tennessee Valley, the Plateau region, and the Warrior coal-field. In the north are Mississippian asphaltic limestone (Gasper) and sandstone (Hartselle). The Bangor limestone has crude in cavities, and all three horizons are potential producers at depth. The Pennysylvanian holds possibilities. About 75 wells have been drilled in this area, all having had oil- or gas-showings. Small amounts of gas have been produced. Cretaceous beds lap on to the preceding area. They have oil and gas possibilities. Subsurface structure is masked; geophysics and core-drilling will be required to decipher it.

In the southeastern part of the State Tertiary beds occur, and these give adequate cover for potential oil and gas horizons, such as the Tuscaloosa and Eutaw. The Hatchetigbee anticline has provided an oilfield on its southwest flank. Piercement-type salt-domes are to be expected in the western part of the region, and salt-beds or plugs have been encountered in two deep wells. The Jackson and Bethel faults may be due to differential settling or to breaks along the steep margin of an old shoreline.

In southwestern Alabama there are Miocene and Quaternary beds.

The first producing well of the Gilbertown field was completed in 1944. A total of 24 producers yield about 1800 brl/day of 19-gravity oil. Production is along a fault-plane in the Selma chalk at about 2800 ft, or in the Eutaw sands at about 3400 ft. The Eutaw sand is rather tight. Ultimately the field may yield 4000–5000 brl/day.

G. D. H.

323. New Oil-field Apparently Assured in Venezuela Greater Oficina District. Anon. *Oil Wkly*, 17.12.45, **120** (3), 71.—The Nipa 1 wildcat 5¼ ml northwest of the West Guara field, and north of Oficina, was drilled to 9080 ft. On perforating at 7125–7135 ft it flowed 320 brl/day of 41·6-gravity oil, through a $\frac{5}{16}$-in choke. The G.O.R. was 10,500.

Tacata 1, in Monagas, 3 ml west of the Capacho discovery, has tested salt water at 7960–7970 ft. In the Tascabana 1 wildcat, 8 ml north of Oficina, a test at 7960–7970 ft is reported to have given 3,000,000 cu ft of gas/day, with some distillate and salt water.

The La Ceiba 1 wildcat, 19 ml northeast of the Santa Rosa field, is coring below 9250 ft. A number of interesting sands were found above 8500 ft.

The third well in the new Mara field of northwest Venezuela has flowed over 1000 brl/day, from the Cretaceous at about 6600 ft.

G. D. H.

324. West Guara (Venezuela) Field Development. G. O. Ives. *Oil Wkly*, 3.12.45, **120** (1), 16 (International Section).—West Guara is in the Greater Oficina area. It was discovered by slim-hole structure drilling, after seismic work had indicated the presence of an anomaly. The field was opened in June 1942. By October 1944 the production was 1,400,000 brl/month. The field is now fairly well defined by 97 producers and one dry hole. 29 wells are triple-zone producers, and many dual-zone producers will be converted to triple-zone wells. The output in these triple-zone completions is 450–500 brl/day/sand. The field covers 3500 acres. 39 separate sands have been tested, a good proportion of them extending over the whole field. Oil gravities range 8–57°, the 57° oil being black and flowing with G.O.R.'s of 450–800 on a ¼-in choke. The top oil is 20°-gravity; then down to 6250 ft the gravity is 43–53°; below 6250 ft there is a decrease down to 8–10° at 7900 ft. For oils lower than 30° the gravity may vary as much as 10° with structural position.

There is a major fault on the south running N.E.-S.W. The throw is about 450 ft, and downwards on the up-dip side. The field is 7½ km long and about 1½ km wide. The basement is about 8000 ft deep. There is natural flow from the Miocene producing sands. A 5400-ft well may penetrate 12–14 sands, with a combined effective thickness of 185–250 ft.

Drilling conditions are almost ideal. Rigs are skidded from location to location.

G. D. H.

325. Production Indicated for Northwestern Colombia. Anon. *Oil Wkly*, 14.1.46, **120** (7), 70.—After failing to produce from deeper horizons, Floresanto 1 is swabbing oil from 620–650 ft. Floresanto 4 is testing showings encountered in drilling to 1504 ft.
G. D. H.

326. Conflicting Reports Received about Shell's Wildcat in Eastern Ecuador. Anon. *Oil Wkly*, 10.12.45, **120** (2), 28.—Shell's Vuano 1 test is 80 ml southeast of Quito, near Arajuno. Some reports suggest that tests have given satisfactory amounts of oil, while others report oil-shows which are not very encouraging. The test is east of the Andes, 500 ml northwest of the Ganso Azul field of Peru. This produces from the Lower Cretaceous at 1174 ft on a structure 16 ml long and 7 ml wide, with 3600 ft of closure.
G. D. H.

327. Shell Abandons Test in Oriente of Ecuador. Anon. *Oil Gas J.*, 5.1.46, **44** (35), 44.—Shell has abandoned 1 Vuano at about 5300 ft. It lies southeast of Quito.

Ecaudor produced 668,051 brl of oil in the third quarter of 1945; the corresponding figure for 1944 was 749,943 brl.
G. D. H.

328. Chilean Test Well Points to End of Petroleum Imports. Anon. *Oil Gas J.*, 12.1.6, **44** (36), 60.—The Spring Hill test well, north of Tierra del Fuego, is reported to have a daily production of 2000 cu.m. Its depth is about 7400 ft.
G. D. H.

329. Province of Drenthe in Holland Holds Interest. Anon. *Oil Wkly*, 10.12.45, **120** (2), 65).—Prospecting is going on in the region of Schoonebek and Coe Vorden, Province of Drenthe, Holland, where the Germans drilled three tests. In June one well was producing 260 brl/day from a depth of 2500 ft.
G. D. H.

330. Oil Reported Discovered in Upper Part of Austria. Anon. *Oil Wkly*, 3.12.45, **120** (1), 50 (International Section).—Oil is reported to have been discovered at Pergern, 18 ml S.E. of Linz. It is near Wels Heath, which has yielded natural gas.
G. D. H.

331. Good Producer Reported on West Caspian Coast. Anon. *Oil Wkly*, 10.12.45, **120** (2), 65.—A 3750-brl well has been completed at Mahach-Kala on the west coast of the Caspian.
G. D. H.

332. Discovery of New Field in Russia is Indicated. Anon. *Oil Wkly*, 14.1.46, **120** (7), 70.—An oil well yielding 170 m. tons/day is reported in a new discovery in the general area of Krasnokamsk (Severokamsk field).
G. D. H.

333. Oil and China's Future. L. J. Logan. *Oil Wkly*, 3.12.45, **120** (1), 37 (International Section).—There is much prospective oil-bearing land in China, for there are large expanses of country with favourable sedimentary conditions, many anticlines and evidences of oil. Wu Su, in northwest Sinkiang Province, was the first commercial oil-field discovered in China, 25 producing wells were drilled, obtaining 49 to 52-gravity oil from about 4800 ft. This field is west of Tihwa.

The Yumen field of northwest Kansu Province lies between Yumen and Kiayukwan. The field was opened in 1939. There are 26 producing wells in a proved area of 3000 acres. Production is 21,000 brl/day. The 38-gravity oil comes from the Cretaceous at about 1350 ft. Oil seepages led to the discovery.

The Red Basin is favourable from the point of view of oil occurrence. There are many anticlines and many brine wells that have yielded small amounts of oil and gas from Cretaceous, Jurassic, and Triassic formations at shallow depths. The Permian and perhaps the Ordovician and Cambrian may have better oil possibilities. 4 ml southwest of Chungking a gas-producer was completed in a Lower Triassic limestone at 3300 ft. The pressure was 1200 lb/sq. in. 60 ml to the north another structure marked by oil- and gas-seeps has provided a high-pressure gas producer in the Triassic.

In Kweichow Province there are oil-impregnated Permo-Triassic beds 10 ml, southeast of Kweiyang. A Permian seepage has been found in Chekiang Province, below Shanghai.

Even in the most promising areas there has been little drilling.
G. D. H.

334. Australia's Deep Test Reported at 6765 ft. Anon. *Oil Wkly*, 24.12.45, **120** (4), 70.—Western Petroleum's test at Nelson, Victoria, is reported to have reached 6765 ft. New equipment is to be considered for Freney Kimberley Oil's test, which was suspended at 4271 ft in 1942. G. D. H.

335. Oil in the Arctic. A. R. McTee. *Oil Wkly*, 3.12.45, **120** (1), 3 (International Section).—At Umiat, Alaska, a well has been drilled to 1816 ft, and 4 separate sands have been met, each of which shows enough oil to encourage further drilling. It is hoped to continue the well to 7000 ft.

The problem of transport, housing, and drilling in the Arctic are described in fair detail. G. D. H.

Drilling.

336. New Mechanical Rotary Drilling Rig. Anon. *Petrol. Engr*, Dec. 1945, **17** (3), 130.—A new mechanical rig is described and illustrated with photographs and a layout plan. A few of the rig's specifications follows: (1) Depths of 10,000 ft with 4½-in drill pipe are recommended; (2) 3 engines with a combined input of 750 h.p. may be used; (3) the rig is rated at 750 h.p., 7500 ft-lb torque; (4) multiple-strand chain drives enclosed in dust-proof, oil-bath housings are supplied. V-belt drives are also enclosed; (5) the transmission unit has 3 forward and 1 reverse speed; (6) The rig has high- and low-speed drives from the lineshaft. These drives combined with the transmission speeds give a total of 6 forward and 2 reverse speeds to the drum, and 3 forward and 1 reverse to the rotary table; (7) the drumshaft is 7½-in diameter; the lineshaft is 6¾-in in diameter, and the rotary countershaft is 6½-in in diameter; (8) all clutches are controlled by compressed air, and are of internal expanding design. The low drum drive is equipped with a multi-jaw emergency clutch; (9) the hoist is equipped with a 24-in by 32-in special alloy steel drum with 10-in by 16-in brakes that are watercooled, torque equalized, micro-sensitized, and have an area of contact of 2170 sq. in. The coefficient of holding power is estimated to be 69 to 1. A few operating data are given. A. H. N.

337. Deep Sea Drilling. R. D. Shrewsbury. *Oil Wkly*, 10.12.45, **120** (2), 33–36.—A proposed design for building a " Shrewsbury Column " in the form of pressurized deep-sea chamber sealed against the sea and drilling deep wells from the bottom of the sea is described. Many of the ideas are still in the formulative stage, but diagrams and probable estimates and solutions for the various problems raised are presented. A. H. N.

338. Field Safety Programme Developed by American Association of Oilwell Drilling Contractors. Anon. *Petrol. Engr*, Dec. 1945, **17** (3), 88.—The American Association of Oilwell Drilling Contractors have called a conference on safety in drilling, and have launched a monthly bulletin, *Safety Hints on Drilling*, and published a book, *Safety Manual for Rotary Drilling and Procedure for Operating Field Safety Programme.*

Among the safety hints on drilling, the drilling contractors are advised to follow the rules listed: (1) provide safe drilling equipment and tools; (2) safeguard all machinery; (3) place no new machinery or equipment in operation unless full attention has been paid to its safety and crews trained to use it; (4) plan and arrange all drilling operations with careful attention to safety; (5) maintain a system of rig, equipment, and tool inspection to discover correctible hazards; (6) maintain safety-minded supervisors; (7) train, educate, and stimulate its employees to follow safe methods of work and to take a sincere interest in the safety of themselves and their fellow-workers; (8) investigate each and every accident to determine how best to prevent a recurrence; (9) make full and prompt report to the proper authorities of all cases of injury. A. H. N.

339. Cement Substitutes for Elimination of Water. C. E. Clason. *Oil Wkly*, 10.12.45, **120** (2), 54.—The need for a seal which is a true solution and not a suspensoid or colloidal dispersion in certain cases is explained. Certain patented materials called Resinite Seal have been used successfully. Resinite Seal of one type is particularly suitable for pure sandstone formations with a range in bottom-hole temperature of from 70° to 220° F. This product has been used in the East Texas Woodbine sand with marked success in plugging off bottom-hole water where the average formation temperature is 145° F. Other applications have been made in the Talco-Paluxy sand at 156° to 162° F. Many jobs have also been done in Pennsylvania, Oklahoma, Kansas, West Texas, and Illinois. The equipment in use consists of a dump bailer truck, a special dump bailer such as is used in gypsum cement work, and in some places, where needed, a winch line. Measuring lines, etc., and other devices common to bottom-hole work are also used. Rapid portable mixers and containers are part of the setup. This resin in its set condition has an ultimate compressive strength of from 12,000 to 15,000 lb/sq. in. The tensile strength is from 5000 to 9000 lb. These strengths are far greater than is actually necessary to accomplish the desired effect. In both fluid and solid phases, the sp. gr. is 1·201, which is 10·02 lb/gal. (U.S.). A. H. N.

340. Determining Minimum Cement Waiting Time. R. F. Farris. *Oil Wkly*, 7.1.46, **120** (6), 30. *Digest of Paper presented before American Institute of Mining and Metallurgical Engineers.*—To determine what strength the cement should have to support whatever amount of casing weight might be applied to it, laboratory determinations were made with pieces of 5½-in outside diameter casing, each set in cement inside of 9⅝-in outside diameter pipe. Five-foot lengths of pipe were used in each case, and standard cement slurry weighing 15·6 lb/gal was poured into the annulus of each unit to a height of 4 ft. The lengthwise bonding strength of the cement to the casing was determined at various time intervals by measuring the force which had to be applied to the end of the 5½-in pipe to move it with respect to the outside or 9⅝-in pipe. Each time the bonding strength of the cement in the annulus was tested, observations were also made of the strength of the cement briquettes and the progress towards the initial and final set. These data are shown graphically. When these data are used to calculate the vertical length of casing represented by a weight equal to a given bonding strength, it is found that a given length of cement, having reached a relatively low tensile strength at the beginning of its final set, can support the weight of 100 to 200 times that length of uncemented casing.

Two methods of predicting cement strengths are described in some detail.
A. H. N.

341. Special Diamond Coring Records Nearly 100 per cent in Lime Formations. K. B. Barnes. *Oil Gas J.*, 24.11.45, **44** (29), 98–101.—During the last few months experimental coring of oil-productive limestones and dolomites has been done with diamond-faced core bits at four wells, with the recoveries being 83·8% of 57 ft cored, 96·5% of 347·5 ft, 81·1% of 60 ft, and 97·5% of 40·5 ft. Furthermore, the wells all were in "hard to core" formations and territory. 400 to 500 diamonds totalling 60 to 100 carats make up the facing of the special core-heads. The diamonds are cast in place, rather than being individually inserted and set in the facing. A steel "blank" is made to comprise the upper part of the head and the joint. The blank is then suspended in a female mould in which the individual stones have been positioned by hand, and the matrix metal (an aluminium-bronze alloy) poured in. This casted bond forms the diamond crown. The tool is illustrated together with its characteristics. Concensus of those engaged in the four tests was that diamond coring is useful in special situations where the fragmental, vugular, or erratic porosity in limes has to be cored with a light weight scraping action to attain high recoveries, and where for special geological and reservoir study purposes the cost is warranted. The work also proved that diamond coring could be satisfactorily accomplished and high recoveries obtained without the use of hydraulic feeding equipment and with standard rotary tools, provided the equipment was in good mechanical condition and normal working ratings not exceeded. A. H. N.

Production.

342. Measuring Distribution of Liquids in Flowstring of a Gas-Condensate Well.—C. K. Eilerts, R. V. Smith, and V. L. Barr. *Oil Gas J.*, 15.12.45, **44** (32), 91.—The Bureau of Mines, in co-operation with the Natural Gasoline Association of America and the American Gas Association, is investigating means of preventing the serious corrosion to which some high-pressure, gas-condensate wells in the Gulf Coast area are subject. Samples in the fluid from these wells are being studied in the laboratory to ascertain the nature of the corrosion and to find inhibitors that will minimize its effects. Alloys

are being compared as to composition, fabrication, and resistance to corrosion for the purpose of finding economically feasible materials for making equipment to be used on the wells. Water has an important rôle in gas-condensate well corrosion, and portable equipment has been constructed and used in the field to measure the distribution of water in the tubing of a flowing well. The amount of water present at a given point in the flow-string is significant because it may control rates of corrosion and also determine the effectiveness of inhibitors. The sampling and analyzing of the analyses of hydrocarbon liquid/gas ratios and of water liquid/gas ratios are given graphically. Liquid water was found in a certain minimum ratio throughout the strings.
A. H. N

343. The Optimum Rate of Production. Part 13. P. J. Jones. *Oil Gas J.*, 24.11.45, **44** (29), 102.—Let the per-well rate of production be uniform during a period of development. Then the rate of development of a reservoir is equal to the rate of increase of the rate of production. Rates of development vary widely as between reservoirs from a slow initial rate up to a comparatively fast initial rate. A slow initial rate of development may be represented by rates of production proportional to cumulative recovery. A rapid initial rate of development may be represented by rates of development inversely proportional to the rate of production. The rates of development found in practice are likely to fall between these two limits. The characteristics of several types of development programmes as to rates of production and cumulative recovery are illustrated graphically. A fixed number of rigs and a uniform per-well rig time represents a uniform rate of development, uniformly increasing rates of production. The procedure for estimating the present value of the production accumulated during a period of development is illustrated by an example for uniformly increasing rates of production
A. H. N.

344. The Optimum Rate of Production. Part 14. P. J. Jones. *Oil Gas J.*, 1.12.45, **44** (30), 87.—The reserve recoverable before the rate of production from reservoirs starts declining depends on the initial well-producing capacity, the rate of decline of well-producing capacity, and on the rate of production. Other things equal, the initial well-producing capacity depends primarily on the number of wells drilled. The decline of well-producing capacity depends on producing and operating methods. The reserve recoverable before production starts declining with a fixed number of wells and given producing and operating methods varies with the rate of production from reservoirs. The slower the rate of production, the higher the reserve recoverable before production starts declining. These points are illustrated graphically, and by examples. In the case of oil reservoirs, the drilling of a comparatively large number of wells may cost more, as a rule, than injection of gas or water. The drilling of a comparatively large number of wells does not increase the barrels of ultimately recoverable oil. It increases well-producing capacity and the fraction of a fixed initial oil reserve, which is recoverable before the rate of production starts declining. The foregoing considerations may influence optimum rates of production through investments, operating expenses, or size of reserve.
A. H. N.

345. The Optimum Rate of Production. Part 15. P. J. Jones. *Oil Gas J.*, 8.12.45, **44** (31), 105.—Declining rates of production may be classified according to rates of depletion. The ratio of producing rate to reserve is the rate of depletion. This ratio, the rate of depletion, may be either uniform or variable. A declining rate of production proportional to reserve is a uniform rate of depletion. A declining rate of production not proportional to reserve is either an increasing, or a decreasing, rate of depletion. This article is limited to uniform rates of depletion. The following characteristics for uniform rates of depletion are illustrated graphically and by examples : (*a*) Rates of production ; (*b*) cumulative recovery ; (*c*) annual rate of decline ; (*d*) average annual rate of decline ; (*e*) average annual decline ; (*f*) reserve factors ; and (*g*) the number of years required to accumulate a reserve at various rates of depletion. Uniform rates of depletion will be used later to estimate the optimum rate of production for the reserve recoverable at declining rates of production.
A. H. N.

346. The Optimum Rate of Production. Part 16. P. J. Jones. *Oil Gas J.*, 15.12.45, **44** (32), 116.—Declining rates of production may be accompanied by increasing, uniform, or decreasing rates of depletion. Cycling operations and pressure maintenance projects are usually conducted at increasing rates of depletion. The rate of depletion, at the time the rate of production from a reservoir starts declining, is equal to the ratio of cumulative recovery and the product which results when reserve is multiplied by the number of years during which the recovery was accumulated. If the subsequent rates of depletion are uniform, this ratio is also equal to the prospective rate of production decline. But if the subsequent rates of depletion are not uniform, the prospective rates of production decline are variable. Variable rates of depletion are either increasing or decreasing rates of depletion. This article defines the limiting rates of production which represent increasing rates of depletion. The optimum rate of production for increasing rates of depletion is different from the optimum rate of production for increasing rates of depletion. For this reason, it is desirable to define the rates of production which represent increasing rates of depletion. A. H. N.

347. The Optimum Rate of Production. Part 19. P. J. Jones. *Oil Gas J.*, 5.1.46, **44** (35), 60.—Economic limits depend on producing and operating methods. The effect of economic limits on estimates of optimum rates of production from reservoirs to be developed may be neglected as a rule. However, estimates of optimum rates of gas, or water, injection into partly depleted oil reservoirs should be made in terms of economic limits as a rule. If an economic limit is of the order 1% or higher of the rate of production at a given time, estimates of reserves and of prospective rates or production are likely to be more accurate if made in terms of economic limits. These considerations are illustrated by examples. A. H. N.

348. The Behaviour of Water-Input Wells. Part III. P. A. Dickey and K. H. Andresen. *Oil Wkly.*, 3.12.45, **120** (1), 14. *Paper presented before American Petroleum Institute.*—In this part the plugging effects of suspended and dissolved matter and of organic growths on input well behaviour are detailed. In general it is found that materials of smallest diameters are of greatest plugging effect. Selective plugging is discussed, together with the results obtained with two patented methods. The use of fine suspended matter in a carrier fluid is found effective in certain selective plugging operations. A. H. N.

349. Behaviour of Water-Input Wells. Part IV. R. A. Dickey and K. H. Andresen. *Oil Wkly.* 10.12.45, **120** (2), 43. *Paper presented before American Petroleum Institute.*—In this part the phenomenon of formation rupture or " breakthrough " is discussed. The critical pressure at the sand face ranges between 1·0 and 1·7 psi/ft of depth in the northwestern Pennsylvania and eastern Illinois fields. Values for other fields also fall within this range, although there is insufficient information definitely to establish the range for each of them. The range of critical pressures cited applies to depths between 260 and 2075 ft. Critical pressures vary from well to well, and in one area (east of Rixford) in the Bradford field the critical pressures appear to be abnormally low, and of the order of 0·9 psi/ft of depth or less. Apparently the critical pressure is lower in the early life of a well than it is after a considerable volume of water has been injected into the surrounding sand. If, after a breakthrough has occurred, the pressure is reduced below the critical value, sometimes the well resumes its normal water-intake rate, but, if the critical pressure has been exceeded for several days or weeks, the wells usually do not resume their previous water-intake rates, but continue to take water at a high rate, which fluctuates in an irregular manner. Breakthroughs are almost always followed by the appearance of water in one or more neighbouring oil-producing wells within a few days, and the water passes quickly from one well to another. Breakthroughs are characterized by definite increases in injectivity indices. The increase in the value of the index is never gradual, and the graphs of the pressure-input points are straight lines with sharp discontinuities. The mechanism of rupture and its effects are detailed. A. H. N.

350. The Optimum Rate of Production. Part 17. P. J. Jones. *Oil Gas J.*, 22.12.45, **44** (33), 63.—The production characteristics for increasing rates of depletion are reviewed in this article. The rates of production and cumulative recovery corresponding to increasing rates of depletion are illustrated graphically and by examples. The rate of production decline increases for increasing rates of depletion. The average annual rate of production decline and the average annual decline of production increase for increasing rates of depletion. The significant characteristic of increasing rates of depletion is the increase of: (1) the rate of decline; (2) the average annual rate of decline; and (3) the average annual decline. The value of properties and the advisability of additional investment in reservoirs depend on the prospective rates of production decline. The rate of production decline may increase abruptly for increasing rates of depletion. A. H. N.

351. Lake Creek Cycling Project Example of Applied Engineering Technique. E. H. Short, Jr. *Oil Gas J.*, 1.12.45, **44** (30), 64.—The field is producing from seven zones by means of single, dual, and triple completion wells, some of which are used as injection wells. A diagram of a peg-model illustrates the complexity of the problem, and the paper discusses some engineering aspects of the production of the various zones. A. H. N.

352. Mobile Unit Provides Individual Well Data. H. A. Hess. *Oil Wkly*, 17.12.45, **120** (3), 66–67.—A portable unit incorporating a separator, oil meter, gas meter, and an automatic sampler for salt-water determination has been perfected and placed in mass production by a Houston concern. The unit is described. A. H. N.

353. Determining Weighted Average Bottom-Hole Pressure in East Texas Field. L. J. Meyer. *Oil Gas J.*, 1.12.45, **44** (30), 67.—Tread of reservoir pressure with production is a very important relationship in any pool. Because of the large area, number of wells, and reserve of the East Texas field, probably more bottom-hole-pressure tests and interpretative studies of pressure data have been made there than in any other single field. This paper presented the detailed procedure for the determination of the weighted average bottom-hole pressure of the East Texas field as conducted by the Engineering Department. Oil and Gas Division of the Railroad Commission of Texas. The formulæ used are derived, and typical tables of data and results are given. A. H. N.

354. Application of Laboratory Data on Phase Behaviour to Evaluation of Condensate Reserves. E. W. McAllister. *Petrol Engr*, Dec. 1945, **17** (3), 90.—Although the phenomenon of retrograde condensation has been recognized in laboratory work for many years, there is still considerable lack of the specific information required properly to re-estimate the petroleum products that would be recovered from a condensate pool produced by straight-pressure depletion. This is due to the lack of laboratory equipment suitable for running condensation or phase behaviour experiments on samples involving a change in composition with decrease in pressure. This experiment involves withdrawing portions of the sample in the gas phase, causing each increment of pressure decrease and determining the composition of the portions of samples withdrawn and remaining. At present, nearly all laboratories are equipped to run phase behaviour experiments involving no change in composition of the sample and showing only the indicated relative volume of liquid condensed with change in pressure and without determining the composition of the liquid so condensed. Such data are suitable only for determining the products to be recovered at the dew-point pressure or above, with an indication of the magnitude of the rate of liquid condensation that may occur in the reservoir with pressure drop in the retrograde region. Examples of experiments with constant composition are illustrated and their results are discussed. The discussion involves graphical studies, and the original paper should be consulted for more details. A. H. N.

355. West Edmond Salt-Water-Disposal Plant Initiates Service to Member Operators. W. J. Davis. *Petrol. Engr*, Dec. 1945, **17** (3), 106.—Details of an organization of companies for salt-water disposal from their respective fields are described. The design and operation of the plant are discussed. Amongst the hydrodynamical principles of the settling plant the following have been found to be valid rules for design: (1) that a particle 0·01 mm in diam. is the smallest particle that can be economically removed without the addition of a coagulant; (2) that the falling rate of such a particle in still water is 0·005 ft/sec; (3) that a continuous-flow settling basin, properly baffled, is as effective in removing suspended matter as a series of intermittent settling basins; (4) effective settling may be accomplished when the mean velocity through the basin does not exceed 3 times the falling velocity of the particle to be removed; (5) that the incoming and outgoing velocity of the fluid flowing through the basin can be as high as 25 times the mean permissible velocity; (6) that the detention time in a rectangular basin must be 3 times longer than in a circular basin in which radal flow is maintained, to allow for end currents; (7) that the working level of the fluid in a settling basin should not be less than 5 ft in order to insure quiet fluid, or more than 15 ft in depth, to insure maximum economical operation.

Mechanical and other operating details are given. A. H. N.

356. Oil Yield/Acre-Foot may Guide Well Spacing. K. M. Fagin. *Petrol. Engr.* Dec. 1945, **17** (3), 72.—Reasons for keeping ample records of field operations are detailed. Although the main purpose of developing these significant field-wide facts may be to enable the operator to forecast the probable future recovery from a new reservoir and the most effective and profitable well-spacing programme by comparison with the probable ultimate recovery per acre foot in older producing reservoirs with similar characteristics, the operator may use the facts in many other ways, such as: (1) to determine whether or not he is depleting the acre feet of producing formation under his leases as rapidly as the average acre foot in the field is being depleted; (2) to guide the preparation of estimates of recoverable oil reserves under his leases for tax or appraisal purposes; (3) to provide himself with a condensed history of the development and production progress of the field that will give clear and ample warning of impending operating difficulties that require budgeting, such as the need for installing pumps, the need for preparing for water encroachment, the need for remedial work on the wells, as well as the feasibility of pressure maintenance, repressuring, or water-flooding. A looseleaf ledger is described for these purposes. A typical field production data sheet is reproduced and many of the items included on the sheet are discussed.

A. H. N.

357. Annulus Method of Locating Water in Oil Well. J. S. Hagestad. *Petrol. Engr,* Dec. 1945, **17** (3), 198.—The determination of the entry of water into a well is usually done on a static well. The paper describes methods for determining water entry in a producing well without stopping it. In this method the tubing of a pumping well is raised and a bailer is used to place electrolytes at different points of the well, the bailer being lowered between the tubing and the casing. Detection of the electrolyte in the oil being pumped places the point of entry of the water. Typical cases are described.

A. H. N.

358. Selective Acidization Procedures at Carthage Field Result in Great Productivity—Larger Ultimate Recovery. N. Williams. *Oil Gas J.*, 22.12.45, **44** (33), 56–57.—Three of the four producing horizons of the Carthage gas-field in Panola County, Eastern Texas, consist of oolitic limestone formations in which acid treating of wells is a factor in developing maximum productive capacity. Since well potentials are a basis for allocations of allowable production, incentive is given for establishing the greatest productive capacity possible when completing wells. This has led to an acidization race among some operators in which relatively large volumes of acid have been utilized in many cases in attempts to increase the permeability of producing formations. Lately, however, the adoption of methods by which more effective placement of the acid can be attained, rather than increasing the volume, is receiving the consideration of operators. The general procedure, involving a squeeze cementation, is described, together with some interesting variants used when particular conditions requiring them are met in a well. Of interest in connection with squeezing practices in this field is the recent use of plastic in several wells. In one well this material was used exclusively, replacing cement not only for the initial "cementing" of the production casing string, but also for a succession of squeeze jobs. Its use is expected to prove especially advantageous in squeezing the interval between the Gloyd water sand and the Hill zone, as these upper formations are extremely unconsolidated and do not hold up, making it difficult to obtain a good cement job. With about 200 gal. of plastic squeezed into that interval satisfactory results have been realized. Packers are also used. A. H. N.

359. Engineering Approach to Oil Reservoir Controls. S. J. Pirson. *Oil Wkly,* 31.12.45, **120** (5), 22.—Scientific reservoir control presupposes the existence of reasonably accurate forecasting means of the expected performance of a field under existing or preassumed conditions. It is necessarily predicated upon the knowledge of natural as well as artificial recovery mechanism or " drives " which are fundamentally three in number—viz. water drive, segregation drive, and depletion drive. The various drives are the object of modifications resulting from pattern flow, dips, connate water saturation, viscosity variations, rates of formation flow, and sand heterogeneity. The various recovery mechanisms have their specific degree of ultimate recovery. Accordingly, it is pertinent to gauge the degree of effectiveness of each mechanism in a field in order to predict the ultimate recovery. To this end the concept of a " Drive Index " is introduced, and it is shown how such an index may be computed for each type of drive from the material balance equation for either a current production practice or any presumed rate of withdrawal. As a result, the recovery programme may be engineered so as to favour one or more types of drive in order to secure maximum recovery through the prescription of the most efficient rate of production. Formulæ are derived and presented for water-drive index (W.D.I.), segregation drive index (S.D.I.), and depletion-drive index (D.D.I.). Examples are given to illustrate the use of these indices. A. H. N.

360. Well Pulling Costs Cut by Time-saving Rack. Anon. *Oil Wkly*, 24.12.45, **120** (4), 49.—Details of a tubing rack and of another for rods used to minimize time of pulling are given. A. H. N.

Oilfield Development.

361. 25,800 Completions Probable for 1945. Anon. *Oil Wkly*, 17.12.45, **120** (3), 65.—The results of drilling in U.S.A. during the first 11 months of 1945 indicate that the year's total completions will number about 25,800 wells, including 400 old wells deepened.

In November the completion rate was 531 per week. The October figure was 501 per week. 23,711 wells were completed during the first 11 months of 1945. Texas completions were 20% above the 1944 level, Louisiana completions 38%, Oklahoma completions 29%, and Colorado completions 80%.

A table summarizes the U.S. completion results by States for November, 1945, and for the first 11 months of the year. G. D. H.

362. Venezuela. G. O. Ives. *Oil Wkly*, 3.12.45, **120** (1), 12 (International Section).—During the week ended October 13, Venezuela produced an average of 969,600 brl/day, thus exceeding the previous peak of 965,000 brl/day in the week ended August 13, 1945. The bulk of the output was from the Maracaibo Basin, where the flush production occurs 1–12 km offshore. A well is to be drilled in 90 ft of water on a concession in the centre of the lake.

Quiriquire produces 50,000 brl/day, and the single field extending westward from Jusepin through Mulata, Muri, and Santa Barbara to Travieso, gives 129,000 brl/day. In the Greater Oficina area are Oficina, Leona, East Guara, West Guara-Guico, and Yopales, all producing from sands of the same age, and of similar structural characteristics. The accumulation is due to normal faulting, and Oficina itself has at least a dozen blocks. The Greater Oficina area produces 100,000 brl/day, the bulk (2,000,000 brl/month) coming from West Guara's 3500 acres, while Oficina gives 1,250,000 brl/month from 12,275 acres.

A 16-in pipeline runs from Oficina to Puerto La Cruz, and a 16-in line from the Jusepin area to the same terminal. A 12-in line from the Santa Barbara field ends at Chaure. There is a 10-in line from Jusepin to Caripito, and 8-in and 10-in lines from Quiriquire to Caripito.

The San Joaquin, Guario, El Roble, Santa Ana, Rincon, and Santa Rosa fields are anticlinal or dome structures, whereas the Jusepin group is basically a series of stratigraphic traps with faulting, being formed by the wedge-out of the Miocene and other sands against the northern coast range of mountains. Production is largely from the Miocene in the San Joaquin area, while deep wells round Santa Rosa and El Roble have prospected the Eocene without yet establishing important production. This area produces 26,000 brl/day, San Joaquin providing about half the total. 225 km to the west is the Las Mercedes field, which lacks an outlet.

Lagunillas, Cabimas, Tia Juana, and Mene Grande are the principal producing areas of the Lake Maracaibo region. Their cumulative production to the beginning of

August 1945 was 2,346,141,340 brl. At the beginning of August Lagunillas was producing at the rate of 285,000 brl/day. Production is from the Miocene and Eocene, much of the offshore production being from the Eocene.

Until early 1945 the relatively unimportant fields of La Paz and La Concepcion produced from the Eocene. Early in 1944 Upper Cretaceous production was established at 4446 ft, about 1500 ft below the deepest Eocene pay. The initial well gave 800 brl/day, and a later well which reached 5397 ft, gave 4000 brl/day. It is hoped that this formation will produce elsewhere in the Maracaibo Basin below the Miocene and Eocene, although it may lie beyond the reach of present drilling techniques in most of the area. Cretaceous production has been found 33 km north of La Concepcion at 6011 ft.

Venezuela is capable of producing a million barrels of oil per day. G. D. H.

363. Argentina Production Declines 5·6 Per Cent. Anon. *Oil Gas J.*, 22.12.45, **44** (33), 46.—In the first six months of 1945 Argentina produced 11,569,832 brl of oil. G. D. H.

364. Production in Ecuador Drops in Third Quarter of 1945. Anon. *Oil Wkly*, 14.1.46, **120** (7), 70.—In the third quarter of 1945 Ecuador produced 668,051 brl of oil, 80,891 brl less than in the corresponding period of 1944, but 15,868 brl more than in the second quarter of 1945. G. D. H.

365. Iranian Oil Production Hit New Record in 1944. Anon. *Oil Gas J.*, 22.12.45, **44** (33), 46.—In 1944 the Iran oil production was 87,102,955 brl. Gach Saran produces about 15,120,000 brl/year. Agha Jari began producing in 1944. G. D. H.

Transport and Storage.

366. Pumping Various Products through the same Pipeline System. J. M. Williams. *Oil Gas J.*, 22.9.45, **44** (20), 197.—New operating problems were created in the early 1930's when the first products pipelines were constructed, since they naturally differed from a crude-oil system in operating details and in their use for several grades. As a result of experimental work carried out mainly by Keystone Pipeline engineers, it was possible in 1940 to pump 8 grades of gasoline, 2 grades of kerosine, 2 grades of furnace oil and 1 grade of gas-oil, with each grade individually delivered ready for use to the main terminal points on the line. This article discusses the theory involved and the results obtained in transporting a wide range of products through the same trunk-line system.

Fluid motion through pipes is shown to depend to a large extent on the value of the expression (known as the Reynolds number) $\frac{Dv\delta}{\mu}$ when $D =$ pipe diameter, $V =$ velocity of the fluid, $\delta =$ density of the fluid and $\mu =$ its viscosity. The change from streamline to turbulent flow takes place when this expression is equal to approx 2000, and the length of the contamination stream where one liquid follows another in a pipeline is proportional to this quantity.

Much of the experimental work described was carried out using a 400-ft system of ½-in glass tubing where the liquid boundaries were always under inspection and their behaviour could be correlated with that expected from theoretical considerations. Samples could also be taken from various points on the line and examined for their extent of contamination. Contamination curves are given showing interface characteristics obtained with various mixtures of grades using both the miniature rig and 8-in pipe some 500 miles in length. T. M. B. M.

367. Pipeline Coatings Tested for Dielectric Strength. E. A. Koenig. *Oil Gas J.*, 22.9.45, **44** (20), 303.—A description is given of the application of protective coatings to pipelines, the best coatings to apply, and their testing by means of measurements of dielectric strength.

The necessity of coating pipelines is stressed, and the advantages of carrying out the coating process by machine is discussed. Good bonding with many primers is limited by slight traces of moisture, dust, grease, and light rust films, and therefore too much stress cannot be put on clean pipe. Pin holes and air bubbles are often formed in a hot coating application, and may be sealed over in the pipe coating which will appear satisfactory. The use of a porous type wrapping such as Fiberglass assists in removing some of these defects, and samples prepared in the laboratory by dipping sheets of this material in the molten coating showed an increase in breakdown voltage (in volts per mil) as the thickness of the sample decreased indicating uniformity of the dielectric materials, and the high compatibility of the coating and the Fiberglass. Field tests subsequently showed the superiority of this material, and a 10-mile length of this coating on a pipe inspected after 6 years was found to be in excellent condition. Fiberglass has since been used for the protection of new and reconditioned lines varying in diameter from 4 to 24 in and of total length 120 miles. T. M. B. M.

368. Rustless Pipe for War and Peace. F. Squires. *Oil Gas J.*, 4.8.45, **44** (13), 70.—Details are given of investigations made by the Illinois Geological Suvey to find superior corrosion-resistant pipe materials. The most satisfactory materials were found to be: (1) coal-tar pitch with a binder of macerated paper and wood fibre; (2) cement with binder of asbestos fibres; and (3) both plain and reinforced plastics. Fibre pipes made of 75% coal-tar pitch and 25% macerated paper and wood fibres are manufactured in three grades for electric conduit work; the second-grade pipes, having a bursting pressure of 220 p.s.i., were joined together in different ways and subjected to mechanical and corrosion tests. Tapered ends driven into oppositely tapered couplings provide lines suitable for surface gravity lines; threaded pipes in threaded stainless steel or plastic couplings give non-corrodible lines suitable for surface lines and cemented-in casings for shallow wells. These lines, however, sag under their own weight and are susceptible to shocks from different sources which cause crazing and subsequent weakening. These faults can be corrected by either cement lining or inside reinforcement with coiled wire and cement lining. These methods increase the resistance to bursting and make them suitable for surface pressure lines.

The method of manufacture of asbestos-cement pipes of 200 p.s.i. bursting pressure is described; they are used for electric conduits, vent-pipes, and water-mains. Sections of these pipes were coupled up with seven kinds of joints, which are described and discussed. Their testing is described and the results are given and discussed. Threads of the asbestos-cement pipes are best cut by means of a grinding wheel; 4 threads on each pipe end are recommended. Rubber of fabric-graphite gaskets can be used.

Pipes made of highly compressed cement reinforced with glass fibres (termed "glasscrete"), on testing would not withstand shock and suddenly applied loads.

Asbestos-cement pipes may be threaded by grinding, and joined by stainless steel or plastic couplings to form a line strong enough to provide practical pressure surface lines, and may be cemented in a casing in wells of considerable depth for salt-water disposal. Trials with asbestos-cement pipes joined by plastic couplings either alone or reinforced by glass fibres or metal are described. The results show that the former were very successful, and that metal reinforcing of plastics has given very promising results. It is anticipated that great improvements may arise from further work in these directions. W. H. C.

369. Alaskan Highway Oil Pipeline. Anon. *Engineering*, 5.1.45, **159**, 1.—The pipeline was constructed to permit the direct distribution of fuel oil and gasoline to the Alaskan Highway and to airfields along the route. The previous route necessitated a long sea passage for tankers which, apart from curtailments due to bad weather, was vulnerable to submarine attack by the Japanese, who succeeded in destroying many ships.

The scheme was designed to relieve the supply position by running a pipeline from the existing oilfields at Norman Wells to Whitehorse, 600 miles away, and the nearest accessible point on the Highway. This necessitated crossing the Mackenzie Mountains, 5000 ft high. Climatic conditions were severe, ranging from 70° F below zero in winter, to 90° F in summer.

The Norman Wells crude is paraffinic, and of such quality that it may be used without refining as a diesel fuel. A small refinery at Norman Wells supplied the gasoline necessary for the construction work. Subsequently a new refinery was established at Whitehorse with a capacity of 3000 brl/day, crude being delivered via the pipeline from Norman Wells.

The pipeline from the refinery followed the Highway westward to Fairbanks (600 miles) and eastward to Watson Lake (300 miles). There was also a branch line to

Skagway, which could be used to supply tankers from Whitehorse or in reverse to supply gasoline shipped from other sources to Fairbanks, Whitehorse, and Watson Lake.

Pumping-stations are provided at approximately 50-ml intervals throughout the system of 1600 mls total length. The pipe varied in diameter according to the section and service from 2 to 6 in diameter. Lengths of from 30 to 40 ft are electrically welded together.

Work on the pipeline was started in 1942 and completed in 1944. The contractors had to overcome many natural and climatic obstacles, the supply of materials and equipment presenting many difficulties. A full description of the construction of this pipeline appeared in "Engineering News Record" dated May 18, 1944.

C. D. B.

370. High-Pressure Gasoline Cable-type Pipelines under the English Channel. V. A. Sheals. *Oil Gas J.*, 22.9.45, **44** (20), 205.—The historical events leading up to the construction of the pipelines under the channel are discussed, as well as the methods employed for its manufacture.

The idea was conceived by A. C. Hartley of the Anglo-Iranian Oil Co., and an experimental 2-in line designed and built by Siemens was installed for test in the Bristol Channel in December 1942. As a result of these tests, and in anticipation of D day, several British manufacturers started to build 3 in pipe in 1943, and in 1944 four American manufacturers were selected to assist in its manufacture. The design of the cable is given, and details as to the alloys used noted. The pipe was extruded in 2300-ft lengths on special large-diameter reels; photographs of the plant used are reproduced. The splicing process used for joining the lengths together is described, which operation took about 2 hours for each joint.

The first complete pipelines were laid from the Isle of Wight to Cherbourg, and later from Dungeness to Boulogne, distances of 66 and 29 miles respectively, the pipe being shipped in lengths of 35 and 70 nautical miles. The transport and shipping arrangements of the cable from the United States are given, and photographs of the gondola cars used are included.

Details of the results of endurance tests are listed, and in operation the lines had a very ample factor of safety. A total of 12 lines of HAIS cable pipe and 8 lines of 3-in welded steel (Hamel type) were installed, and approximately 1,000,000 gal of gasoline were pumped through the lines daily.

T. M. B. M.

371. Technique for Determining Installation of Cathodic Units. O. C. Mudd. *Oil Gas J.*, 22.9.45, **44** (20), 201.—The article discusses the method used for placing correctly the direct-current cathodic corrosion-preventing devices on pipelines as well as the correct location of insulating flanges.

Two gasoline-driven 2·5-kw, 50-amp, 50-volt generators (to develop up to 75 amp with corresponding voltage decrease) mounted on pneumatic-tyred trailers are used. An anode is inserted in the soil 300 to 400 ft from the pipeline, to a depth of 4 to 5 ft with electrolyte solution. The positive terminal of the generator is connected to this and the negative to the pipeline, operating the unit at the desired current output for 4–5 hr to polarize the adjacent pipe surface. Pipe to soil potential measurements are then made along the line by a copper sulphate half-cell electrode, progressing away from the unit connection and continuing beyond the point of minimum requirement to make sure that the limit of effective protection has been passed. The second unit is connected up similarly at a distance from the first of approximately three times the length of line found under effective protection (0·25 v min). Both units are then operated simultaneously for 4–5 hr, while pipe-to-soil potentials are taken from generator to generator to find if protection is complete. Insufficient protection between units requires moving the second nearer the first and repeating the test, while over-protection is not only uneconomical but may cause damage; 2·5 volts is the maximum allowable pipe to soil potential. After an intervening section is found to be satisfactorily protected, measurements are continued beyond the second unit by transferring the first generator to a new position.

The spacing between these locations has been found to vary greatly with the nature of the soil.

The distribution of galvanic anodes, protecting only isolated corrosive sections, must be such that two copper-sulphate half-cell electrodes (one placed directly above the pipe, and the other approx. 5 ft away at right angles to the line) indicate a definite current flow from soil to pipe along the section to be protected.

Pipelines can be sectionalized electrically to control current flows of either galvanic or external origin by the insertion of insulating flanges, the line being insulated from the soil for at least 50 pipe diameters.

The insulation of pumping-stations from main pipelines is also necessary and means for carrying this out are described. T. M. B. M.

372. The "Pluto" Pipeline. Anon. *Engineering*, 1.6.45, **159**, 425; 8.6.45, **159**, 444; 15.6.45, **159**, 464; 22.6.45, **159**, 483; 29.6.45, **159**, 504.—Operation "Pluto" (Pipelines Under The Ocean) was the undertaking by means of which, in conjunction with the 1000 miles strategic line laid across England, the Allied Forces on the Continent were supplied with petrol.

Originally suggested by Lord Louis Mountbatten to Mr. Lloyd, then Minister of Defence, the first experimental length of "Hais" 2 in pipe was in the form of an extruded lead pipe devised by A. C. Hartley, C.B.E., of the Anglo-Iranian Oil Co.

The first trial length was laid across the Thames by a Post Office cable ship. From the experience gained a second experiment followed in which two lengths of 3 in pipe strong enough to stand a pressure of 1200 lb/sq. in. were laid across the Bristol Channel from Swansea to Watermouth, near Ilfracombe. The tidal conditions in the Bristol Channel were judged to resemble sufficiently those of the English Channel. It provided useful training in the laying of the pipe and operations of all ancillary equipment for the various branches of the services concerned. It was found necessary to make and lay both sizes of pipe under internal pressure, to avoid deformation. Eventually both diameter pipes were laid across the Channel to France.

The "Hamel" pipe developed while these experiments were proceeding was the outcome of a suggestion made by B. J. Ellis, O.B.E., and H. Hammick. It consisted of short solid drawn lengths of steel pipes, butt-welded end to end, and coiled on a drum.

It was proved that 20-ft lengths of 3-in steel pipes could be wound and unwound on a drum having a diameter not less than 30 ft.

In the meantime the Admiralty designed a pipe-laying craft converted from a hopper barge with a drum mounted in trunnions on deck. Later the floating drum was developed capable of carrying a length sufficient to cross the Channel. A factory was also constructed with an output of 10 miles a day and storage facilities of 350 miles of pipe.

In co-ordination with the "Hais" and "Hamel" schemes, shore pumping-stations were provided by the Petroleum Warfare Department. The laying of the pipes was in charge of the Navy. The main bases were at Southampton and Tilbury. Laying of the pipes began soon after D-Day, 4 being laid from the Isle of Wight to a point near Cherbourg and 16 lines from Dungeness to Boulogne. Shore lines operated by the R.A.S.C. extended to Antwerp, Eindhoven, Emmerich, and Frankfurt.

The "Hais" pipe or "cable" was manufactured in the same way, and was indistinguishable from large electric cables. Quayside storage was arranged prior to loading into the ships tanks.

Special handling gear had to be designed and erected at these storage points.

The "Hais" cable was made up of an extruded lead pipe 3·08 in internal diameter with walls 0·195 in thick. It was covered by successive protective layers of 2 thicknesses of paper tape, 1 layer of bitumen-impregnated cotton tape, 4 layers of planished mild steel strip, a serving of gas-tarred jute yarn, armouring of 57 galvanized steel wire, and finally 2 servings of gas-tarred yarn. The finished cable had an outside diameter of 4·488 in, and weighed 67 tons per nautical mile. Designed to stand a pressure of 1500 lb/sq in bursting pressure was found to exceed 3500 lb/sq in.

Internal pressure of 25 lb/sq in was used during armouring, but none during extruding. After extruding, sections were tested to 70 lb/sq in for 25 hours. During laying the cable was filled with water at 200 lb/sq in. A special coupling was evolved to enable jointing to be made without loss of pressure.

Four ships were specially fitted out for laying the "cable," the 2 larger ships having two machines each for picking up and paying out cable, which were arranged fore and aft. These machines were developed, and differed only in minor respects from the normal marine cable gear. The ships were fitted also with roller-type bow and stern gear to avoid kinking the pipe. Special portable electric hauling gear for handling the cable on board was also provided.

Converted Thames barges fitted with brake and clamping gear were used for landing the shore ends.

Experiments on the Hamel pipe started in 1942. Lengths were hand welded together and not annealed. Coiling tests on a 30-ft-diameter drum were successful.

The tubes used for the pipeline were 3 in bore and 5 S.W.G., and made up from lengths of 20 to 40 ft joined by flash butt-welding. The external and internal flash were removed. The finished pipe failed under hydraulic test at 8100 lb/sq in.

The erection of the production plant at Tilbury started in October 1942, and consisted of welding and handling plant. The 2 parallel sets of conveyors and storage racks had a capacity of 338 sea-miles in 4000-ft lengths, which are joined together in 70-mile lengths for winding on to the drums. The welding flashes were not removed at the 4000-ft joints. 17,120 tons of tube, 845 sea-miles long, was made up at Tilbury in 1338-foot lengths, at an output of 8·3 sea-miles per day.

Winding of the pipe on to the drum was carried out in daylight only. Drums holding 80 miles of pipe were wound in 6 days at the rate of 2½ miles per hour, and a total of 6 drums were made and wound.

The drums which were constructed at Tilbury had barrels 40 ft diameter and 60 ft long, to which were welded flanges 5 ft deep. Conical ends extending 15 ft from each end, on which carried the trunnions prevented the towing bridle from fouling the flanges.

During winding two hinged arms were provided on the jetty which engaged with the trunnions. The drums were revolved by winches.

The pumping plant installed in connection with the scheme consisted of seven 12-stage centrifugal pumps driven by 550-h.p. motors with a capacity of 310,000 gal of petrol per day each at a pressure of 1500 lb/sq in, and 54 reciprocating pumps belt-driven by 60-h.p. diesel engines.

The main pumping-station at Dungeness linked three delivery mains with the 16 cross-Channel pipes starting from that point, and took its power from Hastings to Folkestone. Other pumping-stations were erected at Sandown and Shanklin.

C. D. B.

373. Reconditioning Storage-Tank Surfaces. V. M. Coulson. *Oil Gas J.* 5.1.46, 44 (35), 80.—Proper protection of storage-tank surfaces may be obtained with suitable coating materials when the areas to be protected are efficiently prepared.

Where a protective coating has failed, the coating, rust, and scale must be removed from the vessel surface and the bare metal primed. Simple equipment is required for this cold chemical process, an air compressor as used in paint spraying, two 55-gal steel drums, a 5-cu ft capacity pressure tank operating at 35 p.s.i., spray nozzles and hoses.

22 tanks totalling about 38,500 sq ft, which had been covered with 1 coat of red-lead primer and 4 coats of white paint, were stripped, descaled, derusted, and conditioned by this method by 2 men at a cost of $0·03 per sq ft. 1 gal of paint removing solution was required for 17½ sq ft of surface. Rust- and scale-removing material cleaned 62½ sq ft of metal surface. Paint-stripping materials used were standard products which remove all types of paints except certain baked synthetic finishes. The solution is sprayed over the entire surface of the tank, followed by an air-water rinse, the operation being repeated until surface is clean.

For surface conditioning the vessel is spray-coated with the conditioning solution and allowed to dry before coating with protective material.

The ageing of tank surfaces before painting may soon be superseded by this method.

G. A. C.

Refinery Operations.

Refineries and Auxiliary Refinery Plant.

374. Corrosion Problems in the Petroleum Industry. 5 (1) Some Unfamiliar Causes. A. H. Stuart. *Petroleum*, Dec., 1945. 8 (12), 243.—When any piece of mechanism operating under fatigue stresses, as in that of a repeatedly applied stress ranging from zero to maximum, and exposed to corrosive conditions such as a damp atmosphere, the corrosion rate increases. An example in the petroleum industry is the case of the sucker-rods employed in pumping mechanisms, and much work has been done on selecting suitable steels. Repeated strains will cause rupture in a protective film, and danger of corrosion is increased.

Corrosive effects are produced by drops of liquid falling on metal from a height. Corrosion occurs between two metal surfaces in contact under pressure, the extent depending on nature of metals and lubricant employed.

Cavitation erosion occurs in pump impellors and other hydraulic equipment. The pitting of the propellers of the Mauretania was studied in 1912; as a result of this and other studies the selection of metals has been found to be important.

This type of corrosion is akin to fatigue corrosion, but another theory postulates electrolytic action. Fretting or contact corrosion is possible in pivot bearings, since, even though load is very light, the stress may reach considerable values. G. A. C.

375. Corrosion Problems in the Petroleum Industry. A. H. Stuart. *Petroleum*, Feb., 1946, 9 (2), 42.—Successful application of corrosion-prevention methods is limited to the conditions for which provision is made. Aluminium and its alloys provide an example of the formation of a protective film of the metallic oxide. This film can be thickened by anodizing, the metal being the anode, graphite the cathode, and in one process a 3% solution of chromic acid is the electrolyte.

The process is worked at 40° C, the voltage being raised in easy stages to 50. An alternative process uses sulphuric acid as the electrolyte at about 20° C, with a lead cathode, for about 10 to 50 minutes.

The anodized films provide a good bond for further protectives—for instance, paint.

The Bower–Barff process employs the same principle, chiefly for sanitary fittings.

Parkerizing is the best-known of processes which develop a film of ferrous phosphate on iron or steel, and metal so treated offers a bond for paints.

Sherardizing is a process in which iron, packed in zinc dust, is heated to 250° C, the zinc entering the iron by a form of diffusion.

To guard against pitting of gear wheels, zinc oxide is incorporated in the lubricant and after running some time, the metal surface of the gears is found to contain an appreciable amount of zinc.

Other methods include hot-dipping, as in the making of tin-plate; a tin-pickling process, by which the ferrous article to be descaled is made the cathode, silicon iron the anode, in a hot dilute solution of sulphuric acid containing about 1 gm. of tin sulphate per litre. The profuse evolution of hydrogen helps to remove the scale.

The salt-spray test, designed to examine articles for corrosion-resistance, tests specimens for corrosion in a mist of salt water, is being developed under specified conditions. G. A. C.

376. Lighting for Oil Refineries. D. M. Tuck. *Petrol Engr*, Aug., 1945, **16** (12), 113.—The lighting of the services section of a refinery, viz., the offices, laboratories, boiler and power plants, and the various engineering workshops, drawing offices, stores, etc., is discussed.

Illuminating calculations are discussed, and the effect of factors which reduce the lighting power is described. The in-service factor, used in the calculations, is the product of the following: (lamp depreciation × dust and dirt × voltage drop × lamps out (defective and broken) × interception, (of light by machine parts, tools, worker's body, etc.) × atmosphere absorption). This in-service factor when multiplied by the calculated illumination gives the foot-candle value that the maintenance engineer should be able to read with a light meter. The fundamentals of correct and economical lighting are discussed and explained.

In the sections mentioned, practical suggestions for the design of new construction and maintenance of the performance are given, and photographs of certain sections are included. Diagrams show the position of lamps with respect to the kind of work being done, and are annotated with the types and power of the lamps installed, lenses, reflectors, lateral-spread refractors, etc. W. H. C.

377. Probolog Spots Corrosion, Cracks, Holes in Exchanger Tubes. Anon. *Oil Gas J.*, 15.12.45, **44** (32), 121.—Shell Development Co., engineers have perfected an instrument known as the "Probolog," which determines irregularities electrically in exchanger and other non-ferrous tubes, and registers them on a moving paper ribbon. Pits, holes, cracks, thin spots, and other damaged conditions can therefore be logged throughout the tubes length, often before these can be discovered by the naked eye.

The electronic recorder is essentially a Wheatstone bridge, of which the tube under inspection becomes part; in addition to the mechanism for passing the paper strip, a neon light flashes with varying degrees of intensity as irregularities in the tube wall are passed. The instrument is available for sale to the industry. T. M. B. M.

378. Mixing Liquids in Shallow Tanks Aided by Design Analysis. E. S. Bissel, H. J. Everett, and J. H. Rushton. *Chem. Met. Eng.*, 1946, **53** (1), 118.—The problem of mixing is discussed in relation to the proportions of the tank; number and size of tanks; shape of tank bottoms and corners; rate of liquid draw-off; type, size, and number of impellers, and variable speed of impellers. It is recommended that: (1) the depth of liquid over the impeller to prevent vortexing should be not less than 1½ times the diameter of the propeller; (2) the maximum ratio of tank diameter to liquid depth should vary proportionately from 2 : 1 for a liquid depth of 1 ft to 7 : 1 for a liquid depth of 15–20 ft; (3) no tank should be considered for suspension of solids where the slurry is to be drawn off, unless the depth of liquid is at least equal to the diameter of the tank and preferably 1½–2 times the diameter; (4) tank bottoms should be dished or conical; (5) the propeller diameter should be ⅓ to ¼ of the tank diameter, or of the diameter of the cone at the position of the propeller. L. B.

379. Chemical Requirements of the Petroleum Refining Industry. Anon. *Chem. Met. Eng.*, 1946, **53** (1), 139.—The enormous quantities of chemicals consumed in petroleum refineries are discussed. Figures which are tabulated show that the major usages are of H_2SO_4, clay, NaOH, and tetraethyl lead. The functions of the large variety of the chemicals in the industry are reviewed. L. B.

380. Mexico Slated to have One of World's Largest Refineries. C. Vinson. *Oil Gas J.*, 5.1.46, **44** (35), 42.—The Atzcapotzalco refinery near Mexico City has been expanded and it is now one of the largest modern refineries in the world, with a daily capacity of 40,000 brl of crude. Six new units have been built at this refinery, and a 65,000-brl crude-stabilization and 70,000,000 cu. ft. daily capacity gas-absorption plants erected at Poza Rica, and improvements made to pipelines, at an expenditure of $20,000,000. Mexican engineers are being trained in U.S. refineries for operation of these plants.

$6,000,000 is to be spent on a 25,000-brl refinery at Salamanca, Guanajuato, and a like amount on a 282 mile, 12-in pipeline from Poza Rica. The Salamanca refinery is to be partly built from plants at Tampico which are being dismantled. Plant expected to be in operation by 1947.

The cracking unit at Atzcapotzalco will handle 11,500 brl of residue from crude. The power-plant will have two generators of 5000 kva. each. Tank storage has been extended to 2,000,000 brl. Electrical pumps are being installed at the 6 stations along the Poza Rica—Mexico City pipeline.

The total Pemex refinery capacity will exceed 160,00 brl day. G. A. C.

381. Haifa Refinery Played Important Part in Supporting Allied Operations in Mediterranean Theatre. E. Aschner. *World Petrol.*, Dec., 1945, **16** (13), 44.—Haifa refinery, second largest in Middle East, originally designed for capacity of 2,000,000 tons/year, has been considerably expanded, and had an input of 3,292,000 tons in 1944, producing butane, narrow-cut naphthas, gasoline, kerosine, gas oil, diesel and fuel oils, and asphalt. Refinery production began Nov. 1939, one year ahead of schedule, employing 1 crude topping unit and 2 treating plants. Additional units for crude topping and asphalt production were erected during the war, and the cracking sections of 2 crude units not in service were converted into additional crude distillation units.

Total refinery throughput during the war was 12,000,000 tons, and about 6,000,000 tons of fuel oil and 2,500,000 tons of benzine produced went to the fighting services, a valuable contribution to the war in Africa and the Mediterranean. Products were also supplied to Palestine. G. A. C.

Distillation.

382. Tray Details—Bubble Caps. The Refiner's Notebook. No. 54. W. L. Nelson. *Oil Gas J.*, 11.8.45, **44** (14), 125.—Many designs of bubble caps are in use, but usually they are of bell or cup shape, as shown by a sketch of a cast-iron bubble cap and yoked upriser held together by a bolt. They are designed so that a minimum pressure drop exists from plate to plate. To provide this the area of the annular space should be equal to the area of the vapour uptake, chimney, or riser. Therefore the outer diameter of the riser should be about 65% and 61% of the diameter of the cast-iron cap or steel cap respectively, and the space between the top of the bell and top of the riser should be greater than one-fourth of the inside diameter of the riser. Total area of the slots and the area of the open space between the cap bottom and the tray should be greater than the area of the vapour riser. A tabulation shows details of commercial bubble caps from 2½ in to 6 in diameter in terms of slot area; vapour uptake area, uptake area over column area. The pressure drop per plate in pounds per square inch may be approximated by: $P = k.s.u.^2 + 0{\cdot}022\ C$, in which k is constant ranging from 0·01 to 0·015, s is specific gravity, u is velocity through riser in feet per second and C is the height in inches of liquid over the centre of the slots. W. H. C.

383. Refiner's Notebook. Bringing a Tower on Stream. *Oil Gas J.*, 22.9.45, **44** (20), 325.—Water is present in a tower that has been off stream because steam is normally used to clear it of oil vapour. The operations necessary to allow normal operations to recommence are described, and these are shown diagrammatically with a sketch of a typical fractionation set-up. T. M. B. M.

Absorption and Adsorption.

384. Application of Diethylene Glycol-Water Solution for Dehydration of Natural Gas. N. K. Senatoroff. *Oil Gas J.*, 15.12.45, **44** (32), 98.—Diethylene glycol has proved to be a very satisfactory substitute for the calcium chloride previously employed for dehydration of natural gas, and has the advantage of being less corrosive than the latter.

The paper presents some of the process engineers' basic computations pertaining to the design of suitable equipment.

The application of diethylene glycol solution to dehydration of natural gas at operating pressures in excess of 1000 lb/sq in was recently tried on the Pacific coast in connexion with the Goleta-Ventura natural gas transmission line, but rigorous engineering design of absorption equipment was impossible owing to complete lack of data on the properties of glycol solution at this high pressure. Pilot-plant experiments were impossible owing to shortage of time. It was therefore decided to limit design computations to purely theoretical studies of the effect of increased operating pressure on the important phases of the absorption process, taking as a basis some data obtained from a similar plant working at 400 lb/sq in.

Examples of the calculations are given, with detailed information as to the properties of ethylene glycol in solution and the saturated water-vapour content of natural gas.

Drawings of the absorbers and bubble caps employed are included, and consideration given to factors such as absorber diameter, effect of pressure on absorption rate, plate spacing, and number of plates used.

A bibliography is included. T. M. B. M.

Cracking.

385. Thermal Cracking of Petroleum. H. C. Sung, G. G. Brown, and R. R. White. *Industr. Engng. Chem.*, **37** (12), 1153–1161.—Using apparatus and procedure giving results within the range of accuracy required for the design and operation of thermal cracking units, experimental data on the thermal cracking of industrial combined-feed and virgin close-cut fractions have been obtained. The effect of time, temperature, pressure, and type of charging stock on the distribution and type of product, and on the rates of the reactions involved, has been evaluated from these results. Specific rates of reaction for the decomposition of the close-cut fractions for the production of gas and light distillate oils of certain end-points, have been calculated. The specific polymerization rates have been determined, as well as qualitative information on the rate of formation of coke. A. W.

386. Olefin Production by Thermal Cracking of *iso*Butane. P. M. Arnold. *Oil Gas J.*, 7.7.45, **44** (9), 87.—When *iso*butane is thermally cracked, about 60% is dehydrogenated, forming *iso*butylene and hydrogen, and 40% is demethanized, giving propylene and methane. Secondary reactions also occur; (1) in which the products are further cracked giving hydrogen, methane ethylene, tars and coke to a limited extent; and (2) polymerization of the olefins, which is more critical as high-molecular-weight compounds are formed, which in turn break down to tars and coke. As polymerization is affected by pressure and the concentration of the olefins, the operation must be conducted at low pressures to limit the extent of cracking. The *iso*butane used for olefin production should be pure, but 10% or less of *n*-butane and higher hydrocarbons will not seriously affect the results. Pentanes and higher hydrocarbons should be less than 1–2%, as these compounds more easily crack, to products which tend to degrade to tars and coke. Sulphur should be removed. Because of polymerization, butylenes should be limited to 2%.

The original Phillips' plant is described; it was designed to process 75,000 gal/day. Yield data and pilot-plant work indicated that 20–30% *iso*butane cracked per pass through the coil would give the best results.

The reaction temperature chosen was about 1200° F and heat input was limited to about 7000 and 6000 B.Th.U. per hour/per sq ft of outside tube area, respectively, for convection and radiant tubes. The *iso*butane feed was vaporized by exchange of heat from the reaction products. The furnace coil outlet is set at 30 p.s.i. to avoid the use of blowers, and the pressure drop was limited to 100 p.s.i. Modifications and arrangements to the plant are described by which means the capacity was increased to 125,000 gal/day. To avoid excessive drop through the tubes the serial-flow furnace tubes were rearranged for flow in 2 streams, and the final 7 tubes in each radiant section were replaced by tubes ½ in larger than the preceding ones of 4-in outside diameter with ½-in walls. Larger burners were installed. A flow controller regulates the feed-stream, and the reaction is regulated by varying the feed supply by the use of automatic gas-density controllers on the furnace outlet lines. The "Cycloil" gas-cleaner used to remove fine coke particles is described. In the 2 flow-furnace coils the temperature was increased to 1350° F, with a pressure drop of 71 p.s.i. through the coils, compared with 100 p.spi. for half the flow rate. One coil is decoked by steam and air, whilst the other continues in operation. Test data are given for different flow rates. The yield of *iso*butylene decreases as the percentage conversion and flow rate increase. The mechanism by which coke builds up in crevices and ruptures the tubes is described; for this reason the tube welds must be perfect, and conventional return bend fittings avoided. A properly designed unit can be kept on stream 95% of the time. W. H. C.

387. T.C.C. Catalytic Cracking Process for Motor Gasoline Production. R. H. Newton, G. S. Dunham and T. P. Simpson. *Petrol Engr*, Oct. 1945, **17** (1), 210.—In the Houdry and T.C.C. catalytic cracking processes a stream of vaporized oil is passed through a bed of cracking catalyst consisting of pellets of activated natural clay or of the synthetic silica-alumina type.

The products are light gases, a B-B fraction mainly *iso*butane and butylene, a gasoline cut consisting of *iso*paraffins, aromatics, olefins, and naphthenes, a gas oil richer in aromatics than the virgin gas oil.

Following the commercialization of the Houdry fixed-bed method, 34 units employing the moving-catalyst principle are successfully operating in the T.C.C. cracked process for production of aviation gasoline.

The T.C.C. unit consists of a reactor and a regenerator. In the reactor the oil passes through a bed of catalyst from 8 to 35 ft in depth, which is moving downwards at a uniform rate. At the bottom the catalyst is removed and transported to the regenerator, where it is passed downwards through a series of burning and cooling zones, the counter-flow principle being employed.

Careful laboratory studies in establishing the process were made. For example, catalyst particle size eventually chosen was 0·1 to 0·2 in; elevators of about 200-ft lift were found necessary; and a catalyst bed depth at least 1·5 times the spacing of the distributor holes are required above the flow-control plate to ensure vertical movement.

Alternate burning and cooling zones in the regeneration phase ensure initiation of combustion, limit maximum temperature to 1150° F, and prevent too rapid deterioration of catalyst.

Rate of combustion of the carbon deposit on catalyst pellets was found to depend on limits of inlet and outlet temperature for each zone. Latest kilns have from 7 to 10 burning sections.

It is important to isolate the oil system from the air by means of pressure seals of inert gas; and formula are developed to calculate the required pressure drop.

Heat transfer from gas to pellet catalyst has been studied, and found to be extremely rapid, but precise mathematical use of the data is difficult. The coefficient for heat transfer from gas to catalyst was found to vary from 0·003 to 0·013 cal/sec/°C/cc. A typical heat balance is tabulated.

The cracking plant is of conventional and simple design. The reactor vessel has unique distribution of oil vapours, sealing, catalyst-flow control, and purge system. Flue gas provides the seal, and inverted relatively narrow channels connected to an inlet duct passing along the diameter distribute the oil. The catalyst passes over the feed-grid, and is coated with a deposit of higher-boiling constituents of oil, some already coked.

Purging is accomplished in 2 steps in a relatively short time, and equal distribution of the purge steam to each of the 400 odd holes is ensured.

The temperature conditions in the reactor are such that a simple cylindrical steel vessel can be used, and insulation placed outside the steel. For corrosive stocks the reactor is lined with the proper alloy steel.

The kiln is of improved and simplified design, angle packing has been eliminated, and salt-cooling system replaced with direct steam-generating coils. Distribution and control of catalyst flow are as arranged in the reactor. No sealing of top of kiln is required. Two separate air systems are provided, one can be used for cold, the other for hot air.

The elevator links are of low-alloy steel, designed to operate at temperatures up to 900° F. The upper sprockets and head-shafts are also designed for high-temperature operation. The sprocket teeth are lubricated by a layer of fine graphite, main bearings are water-cooled and oil lubricated.

Thus the T.C.C. reactor system is flexible, with a wide variety of oil and catalyst contact times, and regeneration can be controlled in a separate vessel. G. A. C.

388. New Pellet Dryer for T.C.C. Catalyst Offers Diverse Post-war Uses. J. W. Payne and C. H. Lechthaler. *Chem. Met. Eng.*, 1945, **52** (12), 105.—An efficient pellet dryer for T.C.C. catalyst, developed by the Socony-Vacuum Oil Co., is described. Successful pilot plant studies enabled a large-scale dryer to be constructed in the minimum time. The unit is described with illustrations, and a graph is given showing the relationship between pressure drop, particle size, and air-flow rate through granular materials. It is considered that the apparatus may be applied to the drying of grain, dehydrating foodstuffs, and drying granular materials for chemical and related industries.

L. B.

389. The Design and Operating Features of Houdry Fixed Bed Catalyst Cracking Units. R. H. Newton and H. A. Shimp. *Petrol Engr*, Oct. 1945, **17** (1), 240.—In the fixed-bed plant the catalyst is contained in specially designed cases. Several gas-streams are passed through each bed in sequence, obtaining the steps of cracking, purging, regeneration, and purging. By the use of a number of catalyst cases the flow of all major streams is continuous.

This process demands that heat is supplied when and where required and is removed during regeneration, the catalyst must be purged, and excessive build-up of catalyst deposit prevented.

A yield of gasoline obtained at about 4% wt of carbon deposit is near economic maximum, and units should be designed to handle about 4 to 5% of the charging stock as carbonaceous deposit to be removed from catalyst. Conversion at space rates of 1 liquid vol of oil per vol of catalyst per hour, and higher, makes it necessary to burn 7·8 lb carbon per hr for each 100 lb catalyst on stream. Combination with the heat capacity of the catalyst and heat-transfer elements gave a carbon burning rate of 1·1% wt of the catalyst in 10 minutes, thus ensuring no damage to the catalyst.

To avoid catalyst poisoning, the design allowed for a carbon deposit of 1·1% wt, and a regeneration period of 10 minutes.

A second type of cycle, involving 4 catalyst cases, employs on-stream periods as short as 7½ min.

Two general types of cycle timer are used, differing principally in the type of contactor. Motor-operated forged steel-body gate valves suitable for frequent operation at about 850° F are employed. Steam is used to seal the gate and prevent leakage.

The catalyst cases contains cooling, oil, and air tubes ; outlet and collecting ports are arranged so that the vapour path is about 30 in, thus allowing the use of the limiting orifice principle for ensuring good flow distribution.

The bottom of the case is complicated, arrangements for salt flow in and out and air introduction having to be made. Analysis of the factors affecting heat transfers are difficult, but cooling fins are so designed that an average overall heat transfer coefficient of 6·4 B.T.U./hr/sq ft/°F is obtained. This involves conduction and radiation from pellets to fins and convection between gas and fins. Temperature control at the border of the tube pattern has been arranged, and cooling coils are provided to give further protection against damage to the case shell.

A molten eutectic mixture of KNO_3 and $NaNO_3$ is used to control temperatures in the catalyst bed, and the salt circulating through the case is maintained under a vacuum to prevent oxidation and minimize hazards.

Air is excluded from storage tanks by a steam blanket.

The salt system also provides a source of high-temperature heating fluid, producing 450 lb/sq in steam, etc.

An axial type turbo-compressor unit is used for power recovery, the average net electrical power output being 120 kw.

The units produce 40–48% of gasoline with a clear octane number of 80 C.F.R. Motor method.

In the Houdry process the equipment permits catalyst temperatures from 650° to 875° F, and pressures from 5 in mercury absolute to over 200 lb/sq in, and the wide choice of operating cycle permits almost any degree of severity required.

G. A. C.

Isomerization.

390. 60 Per Cent Yield in Liquid-Phase Isomerization of Pentane. L. S. Galstaun. *Oil Gas J.*, 5.1.46, 45 (35), 56.—At Avon, California, a liquid phase pentane isomerization plant of the Shell type has been in operation since 1944. The plant is essentially similar to the liquid phase butane isomerizers using antimony trichloride as a catalyst carrier. The catalyst is anhydrous aluminum chloride, together with 5 mol % of anhydrous hydrogen chloride. Some mechanical changes in design and operating technique have been made.

Normal pentane, after drying, is fed to the preheater, thence to the bottom of the catalyst scrubber, where antimony trichloride and free aluminium chloride are countercurrently extracted from reject catalyst stream entering at top of column. The pentane stream flows to the contactor, where it is subjected to isomerization conditions after injection of HCl and antimony trichloride. Reaction temperature is 200° F, pressure 300 p.s.i. Means are provided by which recycle streams are separated and returned to the process.

In the catalyst removal column, mixed pentanes, hydrogen, and HCl are distilled off as overheads, while antimony trichloride containing a small proportion of aluminium chloride is separated as bottoms. The catalyst column is equipped with a reboiler containing a surge-chamber. The overhead portion is partly condensed, and condensate used as reflux. The bulk of gas is recycled to the contactor ; from the remainder hydrogen and light hydrocarbons are removed, HCl and heavier hydrocarbons being retained. In the HCl stripper the accumulator liquid yields HCl overhead and isomerized plant product as bottoms, which latter is cooled and caustic washed. Chemical analyses constitute process-controls, important variables being temperature of contactor, concentration of aluminium chloride in catalyst, concentration of HCl, volume of hydrogen recycled to contactor, and concentration of inert hydrocarbon–aluminium complex in the catalyst.

No corrosion protection is required in vessels and lines in pentane service ; carbon steel is used elsewhere except where turbulent conditions exist or no corrosion is tolerable—an example being the contactor, where the steel is nickel clad.

Special precautions in handling the catalyst are necessary. All catalyst lines and vessels must be kept heated, since the catalyst melts above normal atmospheric temperature.

Experience has shown that the process is sound, but control more critical for pentane than for butane. G. A. C.

Special Processes.

391. German Plants Extract Gasoline from Coal. L. C. Halfpenny. *Petrol. Engr*, Aug. 1945, **16** (12), 188.—A brief description is given of two plants for producing and processing brown coal which are situated at Böhlen and Espenhain near Leipzig, Saxony. Thirteen photographs are shown of the field and plant. The lignite appears to be of Miocene age, is a mealy peaty substance, containing about 53% water, and is found in beds 2 to 20 ft thick, interspersed by silt and overlain by about 50 ft of recent glacial deposits, sands, and gravels. The mining and transport to bunkers at the top of a four-storey building are described. From the bunkers, half is transported by belt conveyors to power plants for drying and burning to provide electric power, the other half is similarly transported to the pulverizing plant to be pounded through 1-in mesh sieves and then passed to the drying-ovens, in which the water content is reduced to 13%. This material is then compressed into bricks about 4 × 6 in, and the briquettes transported to 30 drying ovens each of 300 ton/day capacity, and by a continuous passage taking 24 hours, become bone dry. They are then burned at 600° C in an absence of oxygen and produce coke, gases, and tars (" Teerantar ").

The coke is burned for auxiliary heat and power. Some of the gas is cooled at 300 atm from 280° to 25° C at this stage. As some of the tar is in the form of collodial particles suspended in the remainder of the gas, the mixture is separated at 110° C by 50–60,000 v. This gas is then cooled from 110° C to 25° C at 300 atm. This condenses most of the liquids which are added to the tar. All the gas is then passed to absorbers which remove the last 5% of the benzine. The dry gas is desulphurized with an alkaline solution in a vacuum. The sulphur removed is a most important by-product. The purified gas is marketed in nearby towns. The moisture from the ovens is extracted for phenols, and the water is used for cooling. Two-thirds of the tar is piped to the Böhlen works, 3 miles away. The remainder is converted at the producing centre. The Espanhain works (built in 1938–39, at a cost of $100,000,000) can deal with 9,000-metric tons/day of lignite, and yield about 11% of benzine (350,000 gal)—*i.e.*, about 5% of the mined lignite. The tar is subjected to a hydrogenation and selective distillation process, the end-products being benzine (about 60–65 octane number), diesel oil, and paraffin. The benzine is blended with benzol to give a motor fuel of 75 octane value. The diesel oil is used without further treatment, the paraffin is used for cracking operations. W. H. C.

392. The Process of Sulphation. S. Glicher. *Petroleum*, Dec. 1945, **8** (12), 232.—The first general procedure in the sulphation of fatty oils is to add slowly 98% sulphuric acid, preferably as a spray, whilst stirring, and then to wash the sulphate produced.

Oils of the vegetable group, especially the non-drying type such as castor peanut and almond oils, are easiest to sulphate.

Practical tests should be made during sulphation, washing, and neutralization. With Turkey red oil, the turbidity of the solution is a criterion in the first two processes; whilst neutralization should take place in the cold and stop when the product clarifies.

Fish oils such as cod and whale are more difficult to sulphate. The presence of water is harmful; 20 to 23% of sulphuric acid will cause a high degree of sulphation; and degree of mobility of product is important. Washing and neutralization are effected, cold, and carefully controlled by solubility tests.

Terrestrial animal oils—for example, neat's foot and lard oils—have to be carefully sulphated, the temperature not being allowed to rise above 30° C, and solubility tests made as with the other groups. G. A. C

Products.

Chemistry and Physics.

393. The Depolarization of Light Scattered from Polymer Solutions. P. Doty and H. S. Kaufman. *Journ. Phys. Chem.*, Nov. 1945, **49** (6), 583–594.—The theory of depolarization of scattered light is developed with particular reference to the study of polymer molecules in solution. A simple apparatus, based on the Cornu method, is described. This permits the measurement of the depolarization of the transversely scattered light, using unpolarized and vertically and horizontally polarized incident light. Measurements on fractions of cellulose acetate, polyvinyl chloride, and polystyrene as a function of molecular weight, concentration, and solvent are reported. The data are interpreted in terms of the changes in anisotropy and size as a function of the above-mentioned variables. A. H. N.

394. Correlation of Viscosities of Liquids with Temperature. M. S. Telang. *J. Phys. Chem.*, 1945, **49**, 579.—The variation with temperature of viscosities of non-associated liquids can be represented by the empirical equation :—

$$\frac{1}{\eta} = \frac{m}{(1 - T_r)^{\frac{1}{10}}} - k$$

where η = viscosity in centipoises at $T°K$, T_r = reduced temperature = T/critical temperature, and m and k are constants. Associated liquids, like water and alcohol, show deviations at lower temperatures. For 7 other organic liquids the maximum deviation from the equation is about 1%. H. C. E.

395. The Methods of Specifying the Properties of Viscoelastic Materials. T. Alfrey and P. Doty. *J. Appl. Phys.*, 1945, **16** (11), 700–713.—Seven methods (Voigt model, Maxwell model, operator equation, mechanical impedence function, creep curve, relaxation curve, and dynamic modulus function) of specifying viscoelastic behaviour are discussed. A number of exact relations between these methods of specification are worked out in detail. The majority of these relations are simple enough to be of practical value, although a few are too cumbersome. Approximate relationships between the creep curve, the relaxation curve, Maxwell model, and Voigt model are discussed ; and numerical examples show the magnitude of errors introduced by the approximation to be small even in quite unfavourable cases. A consideration of the practical utility and physical meaning of the various methods of specification distinguishes between (1) those of general descriptive value and those of direct experimental value and (2) those useful in a phenomenological study of mechanical behaviour and those more suited to a formulation of molecular theory. A summary of the present molecular theories is presented, together with their interpretation in terms of the Voigt and Maxwell specifications. A. H. N.

396. Polymerization of Alpha-Methylstyrene. A. B. Hersberger, J. C. Reid, and R. G. Heiligmann. *Industr. Engng. Chem.*, 1945, **37** (11), 1073–1078.—α-Methylstyrene has been homopolymerized by solutions of Friedel-Crafts catalysts in organic solvents at temperatures as low as −130° C to molecular weights as high as 84,000. The highly-polymerized product includes a wide range of molecular weights as shown by distribution curves based on fractional precipitation. This polymer is not distorted in boiling water, and has a higher fusion point than polystyrene, but is inferior in strength to the latter.

A copolymer of *iso*butylene and α-methylstyrene, which can be formed into thin, strong, flexible sheets, has been made by the same polymerization technique. The emulsion copolymerization of butadiene and α-methylstyrene yields an elastomer comparable to that now obtained from butadiene and styrene ; the optimum ratio of butadiene to α-methylstyrene contains a greater proportion of butadiene than is used with styrene. In this copolymerization, α-methylstyrene has advantages of stability and ease of handling when compared to styrene. A. W.

397. Catalyst Cracking of Pure Hydrocarbons. B. S. Greensfelder, H. H. Vige, and E. M. Good. *Industr. Engng. Chem.*, 1945, **37** (12), 1168–1176.—The cracking of 22 aromatic hydrocarbons over a silica-zirconia-alumina catalyst is reported. A wide range of behaviour is observed from nearly inert compounds like toluene or biphenyl, to highly reactive ones such as aromatics with substituent alkyl or *cyclo*alkyl groups containing 3 or more carbon atoms, for which the removal of the whole substituent group is the chief cracking reaction. Results from catalytic of the various hydrocarbon classes are reviewed. The stability of compounds of a given carbon number in processing over the cracking catalyst, increases in the order : olefines, aromatics, with C_3 or larger substituent groups, naphthenes, polymethyl aromatics, paraffins, and unsubstituted aromatics. This order differs substantially from that found in thermal cracking. A. W.

Analysis and Testing.

398. Determination of Water Content in Oils. M. M. Acker and H. A. Frediani. *Industr. Engng. Chem. Anal.*, 1945, **17** (12), 793–794.—A technique is presented for the determination of moisture in insulating and lubricating oils, using the Karl Fischer reagent. A. W.

399. Lamp Method for Determination of Hydrogen in Liquid Organic Compounds. S. G. Hindin and A. V. Grosse. *Industr. Engng. Chem. Anal.*, 1945, **17** (12), 767–769.—Detailed experimental procedure is given for the determination of hydrogen in liquid organic compounds by a lamp method. The analysis of a series of pure compounds, ranging in volatility from diethyl ether to cetane, and containing from 10 to 16% hydrogen, indicated an average accuracy of 0·03% hydrogen and an average precision of 0·02% hydrogen. Analysis of known mixtures gave results of similar reliability. The technique possesses several advantages over the Leibig-type combustion; the modifications for the analyses of aromatic and unsaturated hydrocarbons have yet to be described. A. W.

400. Determination of Butadiene Dimer in Recycle Styrene. H. A. Laitinen, A. S. O'Brien, and S. Wawzonek. *Industr. Engng. Chem. Anal.*, 1945, **17** (12), 769–772.—Butadiene dimer (4-vinyl-1-*cyclo*hexene) is determined in recycle styrene by the iodine chloride method after first quantitatively polymerizing the styrene present, using sodium as catalyst and dioxan as solvent. The method is sensitive to 0·2% vinyl *cyclo*hexene and is accurate to about ±0·2% (absolute) over a range 1 to 20% vinyl *cyclo*hexene. A. W.

401. Determination of the Purity of Hydrocarbons by Measurement of Freezing Points. A. R. Glasgow, Jr., A. J. Streiff and F. D. Rossini. *Bur. Stand. J. Res. Wash.*, Nov. 1945, **35** (5), 355.—An improved and simplified procedure for determining the freezing points of hydrocarbons from time-temperature freezing and melting curves, and for calculating the purity when the freezing point for zero impurity is: (*a*) known; and (*b*) not previously known, is described as well as the procedure for determining the cryoscopic constant. Full details as to apparatus employed is given. Reproducibility in freezing point determinations is considered to be 0·01–0·02° C.
T. M. B. M.

402. The Rapid Determination of Tar and Bitumen in Road Material. E. H. Green and E. A. Cox. *J. Soc. Chem. Ind.*, 1946, **65**, 1.—A rapid method, suitable for routine plant control, is described for the determination of bitumen or tar content of bituminous surfacing materials. Soluble binder is extracted from the mixture by shaking with methylene chloride and filtering. The solvent is evaporated from an aliquot portion of the filtrate, under reduced pressure. Time for a complete analysis, according to type of mix, is ½–1½ hours. Results agree well with those of methods previously employed, the latter being reviewed. F. S. A.

Crude Oils.

403. Petroleum in Kansu Province, China. H. J. Gavin. *Petrol. Engr*, Oct. 1945, **17** (1), 181.—The first field of considerable importance in China, the Laochunmiao, was established in 1941 in the Kansu "Corridor" at about 8000 ft above sea level.

Despite great difficulties, particularly in transport, development has progressed steadily as experience was gained. By March 1945 all producing wells were flowing under control through flow beans.

Wells were drilled by the rotary method, using diesel-powered equipment. The crude oil is of intermediate base, approximately 32·5° A.P.I., 50° F. pour point and 0·15% sulphur. Gas is separated in brick tanks, and the high pour point of the oil coupled with low atmospheric temperature necessitate steam heating of tanks and lines.

The crude oil is refined in a pipe-still unit; many of the pumps, shell stills, and boilers are of Chinese manufacture.

Straight gasoline (21% yield), kerosine, gas oil, and wax are produced, but residual fuel oil and heavier fractions are discarded to waste. Very good facilities for the welfare of the employees have been established.

The Chinese engineers have ingeniously improvised; for example, smoke-stacks were made from oil-drums, insulated inside when necessary; copper and brass coins were used to cast globe valves.

Except for bulk paraffin and finished candles all products are shipped in drums by trucks or animal-drawn carts. Truck transportation to Chunking is augmented by large rafts, buoyed by some 300 goatskins, on which drums of gasoline are floated down the Chialing River.

The production of the Laochunmiao oilfield is still small, but was of great importance during the war: in the northern regions the gasoline from this field has been of considerable value, as also were the kerosine and candles.

It is likely that this field and others yet to be discovered will be of prime importance in China's future economy. G. A. C.

Gas.

404. Synthetic Ammonia Produced from Natural Gas. J. A. Lee. *Chem. Met. Eng.*, 1945, 52 (12), 94.—The plant operated by Mathieson Alkali Works at Lake Charles, La., is described. Natural gas arrives at the plant by pipeline at a pressure of 300 p.s.i. The pressure is reduced to 50–75 p.s.i., and the gas purified from sulphur by passage through towers containing bauxite. The issuing material is then mixed with steam and fed through a furnace packed with a suitable catalyst, in which decomposition to H_2, CO, and CO_2 is effected at 1300° F. The mixture still contains unreacted hydrocarbon, and is next burnt in a " combustion furnace " with an amount of air calculated to yield the correct H_2/N_2 ratio in the feed to the ammonia plant. The product leaving the furnace at 2000° F is cooled by a water-spray quench to 800° F, and, at this point, consists of 40% H_2, 11% CO, 4% CO_2, and 28% steam. In the next stage the CO is converted to CO_2 catalytically. The latter is extracted by means of monoethanolamine at 200 p.s.i. and 100° F, and residual CO by a cupric/cuprous formate solution at 2100 p.s.i. The pumped gas is then compressed to 4000 p.s.i., passed into the ammonia converters, where promoted iron catalysts effect the synthesis at 923° F. The reaction product exchanges heat with incoming recycle gas, and leaves the converters at 375° F, containing 16% ammonia. The latter is condensed by further cooling and chilling, and separated. Recycle gas carrying some 2½% NH_3 is returned to the ammonia convertors. L. B.

Engine Fuels.

405. New Safety 100-Octane Aviation Fuel. J. H. Kunkel. *Petrol Engr*, Aug. 1945, 16 (12), 172.—The activities of the Standard Oil Development Co. in the production of a safety 100-octane aviation fuel are reviewed from 1932. The new fuel is for use in ignition-ignited fuel-injection aircraft engines, and is briefly described as having a flash point of 105° F., and as having all the power characteristics of the ordinary 100-octane aviation gasoline. It is produced by a hydrogenation process. A practical demonstration of its safety is described and illustrated, which shows its slow evaporation compared to 100-octane avaition gasoline, and their respective inflammabilities.

W. H. C.

Lubricants.

406. Anomalous Viscosity of Lubricants at Low Temperatures. P. A. Rebinder, N.A., Boguslavskaya, and V. B. Mokievskii. *Petroleum*, Dec. 1945, 8 (12), 233.—Study of viscosity at low temperatures is complicated by difficulty of interpreting the results obtained, the viscosity values being made indefinite due to formation of colloidal and crystalline structures.

The process of flow in semi-solid lubricants consists of a succession of fissures followed by a renewal of the structure, thus leading to a infinite number of individual mechanisms and behaviours.

The static yield value corresponds to the pressure required to transfer from slow Newtonian flow to structural flow. The value for this can be tens of thousands of times more than.that for structural flow.

The yield value characterizes properties such as setting point, flow over surfaces, creep, etc.

The limiting pressure is constant within extremely wide limits, and a table shows measurement of the yield value θ in G/cm^2 in capillaries of varying width, both the capillary-tube method and that based on the longitudinal displacement of a cylinder giving satisfactory results. G. A. C.

407. Lubrication Vade Mecum Addendum (2). E. W. Steinitz. *Petroleum*, Feb. 1946, **9** (2), 31.—In this addendum to the Lubrication Vade Mecum notes are given on lubricants for general technical equipment comprising air compressors, ball-bearings, gear boxes, worm gears, and vacuum pumps; for rotary coal driers, ore-roasting kilns and winding engines in mining and related industries, and on calendars, conical mills, and other machines used in the pulp, paper, and stationery manufacture and printing. G. A. C.

Asphalt, Bitumen and Tar.

408. Bitumen and the Bitumen Industry with Special Reference to Asphaltic Bitumen. 5 (2). Industrial Applications of Asphaltic Bitumen. J. S. Jackson. *Petroleum*, Dec. 1945, **8** (12), 234.—Outside coatings have to withstand wear and tear of handling and laying, formulas based on blown bitumen and fibrous fillers being successful. Pipes are primed with bitumen before coating, and for maximum protection finally wrapped with bitumen—impregnated coir fabric after thickness of the coating has been measured by an apparatus designed for the purpose.

Bitumen is extensively used for lining and water-proofing tanks, being strongly adhesive to concrete, brick, metal, or wood; and for many hydraulic works, such as canal banks, dams, and reservoirs.

Bituminous joint-filling compounds, containing a fibrous filler to increase shock-resistance, are used for a variety of purposes. Laboratory tests designed to test the accommodation of the composition to movements of concrete masses due to changes in temperature or ground subsidence, and its adhesivity to maintain a waterproof joint, are applied.

Such joints are of special importance in construction of protective revetments on coasts, canals, and reservoirs.

Resistance to flow on sloping surfaces is important; two types of mixtures, one containing a high, the other a low percentage of bitumen have been evolved.

The Shelperm process is one in which a fine emulsion is pumped through injection tubes into suitable porous sands, where it breaks up on reaching the desired location, or predetermined time, due to the addition of suitable coagulants.

It is essential that particle size of the dispersed bitumen phase is adjusted to the porosity depending on required depth of penetration.

The process was used in connection with the extension to the Assiut barrage on the Nile, practically complete impermeability of the subsoil being achieved.

Bitumen is also used in the manufacture of brattice-cloth, dampcoursing, special lubricants, adhesive and numerous minor applications. G. A. C.

Special Hydrocarbon Products.

409. Petroleum to Supply all Butadiene Next Year. H. D. Ralph. *Oil Gas J.*, 15.2.45, **44** (32), 70.—The use of alcohol for synthetic rubber production has been discontinued in America from the end of 1945, and all butadiene scheduled for 1946 rubber production will be produced from petroleum.

Production of 413,000 tons of butadiene is called for in 1946, which is expected to yield 600,000 tons of synthetic rubber. This amount, together with the 300,000 tons of natural crude rubber which will be imported, is expected to meet all demands, although butadiene manufacture can be increased if necessary. The contribution to be made by each of the producing petroleum butadiene plants is given.

The 11 alcohol butadiene plants to be closed down (which produced 360,000 tons of butadiene in 1944) are also listed, but it is thought that they will be retained by the Government in standby condition. Butadiene from alcohol cost 40 c/lb compared with that of 8–10 c/lb for petroleum.

Three petroleum butadiene plants are also being closed down; these all used the naphtha-cracking process, which is more expensive than the other petroleum butadiene processes in use. All the present copolymer plants will remain in operation, and are expected to operate on about 580,000 tons which will just balance the butadiene output of the petroleum process plants.

Although the cost of producing synthetic rubber on a peace-time basis has not yet been determined, estimates based on various prices of raw materials and several processes are given.

Locations of the Government synthetic rubber plants are given and U.S. rubber consumption (1941–4, 1945–6 estimated) and production (1942–4, 1945–6 estimated) are shown in graphical form. T. M. B. M.

410. Many New uses Found for Petroleum Waxes. R. B. Killingsworth. *World Petr.*, Oct. 1945, **16** (11), 55.—War-time demand for microcrystalline wax, mainly for packaging, has increased production from 20 million lbs in 1939 to 120 million lbs in 1944. Solvent deoiling of slack waxes is increasing in importance, the total production of crude scale and refined paraffin waxes produced by this method and by normal sweating having passed the 500 million lb mark in 1940. Solvent dewaxing of residual lubricating stocks is replacing cold settling for the manufacture of petrolatum, and this product has now become an important source of microcrystalline wax by controlled fractional crystallation with solvents or solvent deoiling. 80% of the paraffin wax production is used in moisture-proof packaging material. It is also used in milk containers, cereal boxes, drinking-straws, and in the form of emulsions used in beater sizing or top sizing of paper. The main advantage of microcrystalline waxes is their flexibility at low temperatures, so that the most important use is in the packaging of military equipment, a satisfactory series of coatings for metal parts consisting of: (1) a rust preventative; (2) greaseproof paper wrapping; (3) molten microcrystalline wax laminated and coated paper wrappings; and (4) molten microcrystalline wax dip-coat. Other uses are in food packaging, particularly in the form of laminated papers, in water-repellent fabrics, electrical insulation, as substitute for beeswax in inks, polishes, cosmetics, etc., in acidproof linings, and in the printing, rubber, and ceramic industries. C. L. G.

411. Domestic Fly Sprays (1) Introduction. C. L. Gilbert. *Petroleum*, Feb. 1946, **9** (2), 34.—The use of fly-sprays dates only from 1919, but by 1939 over 5,000,000 gals of domestic fly-sprays were sold annually in the U.S.

A fly-spray consists of a solution of a toxic agent in a petroleum distillate. Originally pyrethrum and rotenone were the toxic agents, but synthetic products, chiefly D.D.T. are replacing these. A recent development is the aerosol type of spray, whereby a persistent mist of very fine particle size is produced.

In the U.S. specifications for household sprays have been drawn up, grading of the sprays being based on the percentage kill on flies by the Peet-Grady method.

Spraying equipment varies from the domestic to the large power-operated sprays of factories, warehouses, etc.; and small bombs containing kerosine solutions of insecticides under air or CO_2 pressure have also been used in the field.

Freon 12 (dichlorodifluormethane) is widely used as carrier in aerosol bombs.

Specification recommendations have been made on quality of carrier, including distillation range, flash point, colour, viscosity, and odour; and the effect of viscosity on the kill has been studied.

Of the toxic materials, pyrethrum, extracted from the flowers of *Chrysanthemum cinerariæfolium*, and cultivated in Dalmatia, Japan, Kenya, Brazil, etc., was most widely used.

The dried flowers are solvent-extracted with kerosine or ethylene dichloride. The toxic principle of the pyrethrum is pyrethrins I and II, and the extract is toxic to a wide variety of household and horticultural pests. Toxic action is believed to be due to destruction of cells of the nervous system associated with paralysis.

Rotenone is extracted from roots of plants of the Derris genus, growing in the East Indies.

The ground root, and extract, is used against some horticultural and agricultural pests, but use is limited owing to relative insolubility in kerosine. It is more stable than pyrethrum, and effect on insects is due to interference with oxygen adsorption rather than nerve poisoning. G. A. C.

Derived Chemical Products.

412. Utilization of Natural Gas in the United States. G. G. Oberfell. *Oil Gas J.*, 15.12.45, **44** (32), 76.—This article reviews the past, present, and future uses of natural gas in the United States. While considerable quantities are employed in carbon-black manufacture, the use of natural gas as fuel is likely to increase greatly. As a raw material in the manufacture of chemicals it is of considerable importance, but the quantity used is, and probably will be, relatively small compared with its other uses.

It is considered to be a more economical raw material than coal for conversion to liquid hydrocarbons by the Fischer-Tropsch process, especially where modifications of this can be combined with other processes—to manufacture, for example, gasoline and various chemicals. It is thought, however, that the Fischer-Tropsch process would not be competitive with present refinery operations using crude oil as a raw material, under present prices. Also, the peak of gasoline production from natural gas by Fischer-Tropsch would undoubtedly amount only to a small proportion of the nation's total gasoline supply.

A table showing the efficiencies of gasoline production from both coal and methane (the latter by two processes) is given, together with a graph showing the energy supplied annually by coal, petroleum, natural gas, and water power. T. M. B. M.

413. Petroleum By-products. A Big Factor in Organic Chemical Industry. Anon. *Chem. Met. Eng.*, 1945, **52** (12), 121.—The great variety of products which may be derived from methane, ethylene, propylene, butane, butylenes, and pentane is discussed. The relationships between starting materials and products are illustrated diagrammatically. L. B.

414. German Carbide Chemicals. Plant and Processes at the Knapsack Works. Anon. *Chem. Tr. J.*, 1.2.46, **118** (3063), 137.—A digest of C.I.O.S. Report No 22-XXVII-83, which relates to the plant at Knapsack of the A.G. Gesellschaft für Stickstoffdünger owned by the I.G., believed to be the largest single carbide manufacturing unit in Germany. Of outstanding interest are a continuous cyanamide manufacturing process and batch processes for the simultaneous production of acetic acid and acetic anhydride from acetaldehyde.

Calcium carbide was produced in 11 furnaces, 7 of the old type (1921–1931) and 4 of the new type (1931–1938). The former operated at 10,000 kw producing 60–70 tons of carbide in 24 hrs. Power characteristics were: 3-phase, 50 cycles, 86% power factor, primary voltage 600, voltage across electrodes 118–151. 4·4 kwh were required per kilo carbide. The new furnaces operated at 23,000 kw, producing 150 tons carbide per day with power characteristics: 3-phase, 50 cycles, 92% power factor, voltage across electrodes 125–181. 3·2 kwh required per kilo of carbide.

Calcium carbide was converted into cyanamide by passing nitrogen over the carbide in presence of a calcium chloride/fluoride catalyst at 700° C in 6 tunnel furnaces, each having a capacity of 25-30 tons per 24 hrs. Acetylene prepared by a wet or dry process from the carbide was used for the production of acetaldehyde by passing it through suitable towers filled with a 10% solution of a 50% mixture of ferrous and ferric sulphates. The exit gas was purified and distilled to 99·2% acetaldehyde.

Two processes were used for acetic acid manufacture from the acetaldehyde, the older feeding the aldehyde mixed with oxygen over magnesium acetate catalyst. The newer process produced acetic acid and acetic anhydride, using cobalt or copper acetate as catalyst at 40° C in presence of oxygen. The reaction products were separated by fractionation.

For acetone manufacture 95% acid was vaporized and heated to 400° C, being subsequently converted at 400–420° C by means of a cerium acetate catalyst. Purification was effected by distillation. T. M. B. M.

415. Propylene in Chemical Industry. Anon. *Petroleum*, Feb. 1946, **9** (2), 30.—Propylene can be derived either from coal or petroleum, about 100,000 tons being present in the town and coke-oven gas produced annually, and an estimated potential of 2,000,000 tons from refinery gases throughout the world.

In the U.S. and to a small extent in this country, the C_3 and C_4 fraction is bottled and sold under trade names, *e.g.*, calor gas; some 460 million gal being produced in 1941.

A diagram shows the more important chemical derivatives including glycerol and acetone which may be obtained from proplyene.. G. A. C.

Coal, Shale and Peat.

416. Shale Oil. Anon. *Engineer*, 21.12.45, **180**, 498; 28.12.45, **180**, 520.—The history of shale oil is briefly outlined, together with a description of the various forms of shale and localities in which it is found, together with some production figures in various parts of the world.

Like coal, shale differs in quality with the different districts in which it is found, and occurs in seams usually near the surface. Processing plant is usually situated near the source of the shale, and yields products of the paraffinic and olefin series, together with ammonia liquor and sometimes phenol, when subjected to destructive distillations. In addition, gas is liberated which can be used for heating the retorts and for illumination, etc.

Improvements in production technique have resulted in a higher proportion of motor fuel and diesel oil being produced. Figures for the yields of typical shales on treatment in a Salerno plant are given.

Details of operation of various treating plants are described, including the Pumpherston, Pintoch and Davidson retorts.

The modern Salerno retorts is dealt with in some detail, and its operating cycle explained.

In Part II of the article the modern Davidson retort, which operates on an entirely different system, is described. Originally designed to handle Estonian shale, it consists essentially of a drum 75 ft long and 4 ft diameter, having a slight fall towards the discharge end and rotating at about one revolution in 2½ min.

An internal stationary tube of D section, with suitable inlets, collects the products of carbonization. The bulk of the dust which is deposited in this tube is finally eliminated in a centrifugal collector. Reciprocating scrapers mounted on the outside of the stationary tube and in contact with the moving inner surfaces of the retort remove depositions. Accumulation of dust is prevented by the provision of reciprocating push-plate cleaners worked in conjunction with the scrapers. The stationary drum is supported on roller bearings surrounding reduced necks made on the tube.

The rate of feed to the retort is controlled automatically. Depth of shale in the retort is important, and the cross-sectional area of the bed should be more than one-third that of the retort, to prevent sliding and to give maximum carbonizing efficiency. Heat for carbonizing is supplied by spent shale containing about 15% combustible material, and may be supplemented by gas from carbonization if necessary. The hot spent shale is conveyed to the special furnace without appreciable heat loss.

With a working temperature of 500° C the retort described can handle 1 ton of shale per hour in fragments not less than 3 in cube.

Shale oil may be hydrogenated to increase the yield of motor spirit, and this may be done simultaneously with the carbonizing process by the decomposition of the water in the shale or by added steam. Various British and American patents for hydrogenation are described. C. D. B.

417. Thermal Solution. M. K. D'Yakova. *Petroleum*, Dec. 1945, **8** (12), 227.—A new method of thermal processing of solid fuel for its conversion into liquid employs conditions in which the organic portion of the solid fuel undergoes appreciable decomposition. Essentially it is a process of disaggregation of the colloidal complex by the solvent. The solid fuel is ground to 0·2–5 mm, mixed with equal weight of solvent, heated to 380–430° C for 10–30 min at 30–40 atm. After the reaction the mixture is distilled. The process has wide applicability, and a much higher proportion of organic matter is converted to liquid form than by other processes.

A wide variety of substances may be used as solvents, including petroleum, fuel oil, tar distillates, and compounds such as tetralin.

Tables are given showing yields from shale, wood, peat, cellulose, and coals.

G. A. C.

418. Alternative Sources of Liquid Fuel. W. D. Spencer. *Petroleum*, Dec. 1945, 8 (12), 228.—The rapid depletion of wood reserves, with the slow rate of regeneration, resulted in replacement by more suitable materials in industrial countries. After the exhaustion of other forms of carbonaceous matter it may be necessary to rely on plants for energy requirements.

In the Berl two-stage process, involving the application of heat and pressure, the raw material is plant and waste agricultural material such as molasses, sawdust, and potatoes.

A conversion efficiency of nearly 50% was obtained on Louisiana dry sugar-cane, yielding a mixture of light hydrocarbons and raw sugar; but the process, like others producing liquid fuels and chemicals from coal, is uneconomic.

In Britain the best accessible coal seams are being worked out, but peat, lignite, oil shale, and other bituminous matter reserves are greater than commonly thought. One quarter of the total reserve of 200,000 million tons of peat occur in the British Empire, including about 12,000 million tons in the British Isles.

Tar sands in Canada could produce 250,000 million brl of oil, comparing with a total probable reserve of 20,000 million brl of oil in the U.S.A. G. A. C.

Miscellaneous Products.

419. Some Novel British Patents on Fuel and Power. C. Ridley. *Petrol. Times*, 5.1.46, **50**, 20.—Abstracts are given of various recent patents relating to fuel and allied matters.

Bugatti has been granted a patent (No. 11,840) for a hydraulic coupling which differs from the normal fluid flywheel which has its own self-contained oil supply, by specifying that engine oil is to be supplied from the engine pump.

Patent 571,814 of the Telegraph Construction and Manufacturing Co. specifies a process for the manufacture of polyethylene by dissolving the substance in a hot solvent in which it is insoluble at a lower temperature. The precipitated powder can be sprayed by a metal gun in the well-known manner.

Patented by an American, British Patents 572,091–92 deal with non-metallic submerged bearings suitable for boat propellers, along which grooves are cut allowing the water to flow along the bearing forming a lubricating film. The Rover Co. have been granted a patent (572,080) for the application of the exhaust gases from the engine to disperse the liquid fuel and convert it to a fine spray on its discharge from the injection nozzle.

British patent No. 572,012, recently granted to the Shell Development Co., provides for a special lubricating-oil composition for turbines and for dielectric use. The additive which renders the oil highly resistant to oxidation and gum or sludge formation is 2 : 4-dimethyl-6-tertiary octyl phenol in proportions of 0·05–2% wt.

British Patent 571,539, granted to the Cincinatti Milling Machine Co., relates to the salvaging of the power expended in the machining of metals. The process is a chemical one, and uses the waste heat to initiate certain chemical reactions which, while not being possible at ordinary room temperature and pressure, are started and continued under the influence of high temperatures and pressures. The process described includes the supply of a fluid to a chamber enclosing the operation of a tool cutting chips from a metal rod, which continuously imposes fresh nascent surfaces sensitive to chemical reaction with the fluid supplied. Aluminium is one of the metals used, and the fluid supplied for the reaction is carbon tetrachloride, the product being hexachlorethane. T. M. B. M.

420. Wood-Preservatives Standardization. An Interim Classification Scheme. Anon. *Chem. Tr. J.*, 1.2.46, **118** (3063), 160.—A committee of the Wood Preservative Section of the British Standards Institution have considered the preparation of a specification for wood preservatives based on laboratory performance tests. The efficiency of a wood preservative depends mainly on: (i) Toxicity towards wood-destroying fungi; (ii) Penetrating power; (iii) Resistance to leaching, evaporation and decomposition. B.S. 838, "Method of Test for Toxicity of Wood Preservatives to Fungi," is not thought to be a complete method of assessing toxicity under practical conditions, and at the present juncture it has not been found possible to devise acceptable tests for (ii) and (iii).

As an interim measure for the guidance of users, the B.S.I. has issued BS 1282;

1945 "Classification of Wood-Preservatives." All wood preservatives which should comply with the B.S. method of test for toxicity as described in Appendix A to the specification are classified into: (*a*) Tar oil; (*b*) Organic solvent; and (*c*) Water solution types. The normal properties of each type are described and methods of application and impregnation are discussed. T. M. B. M.

421. Artificial Waxes from Lignite. (The German Montan-Products Industry.) Anon. *Chem. Tr. J.*, 8.2.46, **118** (3064), 171.—The report compiled by the British Intelligence Objective Sub-Committee on information obtained on the technology of the German montan-wax industry from chemists employed by the I.G. at Oppau is discussed.

The only lignite deposits in Germany suitable for montan-wax production are those at Halle Riebeck, which have a wax content of 15%. The raw material and crude wax extraction plant are in the Russian zone, and the further refining facilities are in the American zone.

At Halle Riebeck the lignite is powdered, dried, and extracted in a Soxhlet-type plant with a boiling mixture of 80% benzene and 20% ethyl alcohol. The crude wax, which is obtained by evaporation, consists of 70% wax, 15% resin, and 15% bituminous material, is similar to carnauba wax having an acid number of 35–40, and consisting mainly of approximately 25% of montanic acid and 75% of montanic acid esters and a small amount of free alcohols.

Before further processing, the crude wax is powdered and treated in the cold with the same solvent mixture as above in order to remove resin, the wax then melts at 83–85° C. The various brands of I.G. waxes were obtained from this material by further treatment; thus I.G. Wax S was prepared by oxidation with a mixture of chromic and sulphuric acids at 110–120° C, and consisted mainly of C_{26} to C_{30} fatty acids with 15% of unreacted esters, having a melting point of 83° C and an acid number of 145–150. Wax S did not find wide use, but was employed as a starting material for others. Wax E was the glycol ester of Wax S, and was used for aqueous emulsions and creams. Wax O consisted of 60% Wax E and 40% of the calcium salt of Wax S, and is considered to be the best substitute for carnauba wax. Wax BJ (beeswax substitute) was a mixture of Wax S and palmitic or stearic acids all esterified with ethylene glycol and modified with 15% 50° C m.pt. paraffin wax. Wax Z with its high m.pt. (100° C) and water resistance was used for electrical work, and was prepared by ketonizing the Wax S fatty acids by heating at 300° C in presence of 1–2% of iron powder. T. M. B. M.

422. Statistics on Production of Plastics. Anon. *Modern Plastics*, Dec. 1945, **23** (4), 134.—Data on the production of plastics in the U.S. from 1940 to 1944 reveal that expansion is continuing, but at a reduced rate. The 1944 total production of synthetic resins amounted to 784 million lb, compared with under 277 million lb for 1940, while for the same years production of cellulose plastics increased from under 36 million lb to nearly 81 million lb. Of the synthetic resins, the cyclic type represented slightly more than half, the phthalic anhydride-glycerol products being in largest production, followed by the phenol formaldehyde type. The protective coatings industry absorbed the largest proportion of synthetic resins (293 million lb), mainly phthalic anhydride-maleic anhydride—and abietic acid—alkyd resins. Mouldings and castings absorbed 120 million lb, the remainder being used in adhesives, laminations, treatment of textiles, paper, leather, in glazing, sheeting, films, etc. Of the acyclic type, the polyvinyl products were of the most importance.

Data are included for the 1944 production of plasticizers (179,376,000 lb) and of elastomers (1,763,227,000 lb). The production of elastomers included the following: Polybutadiene-styrene (GR-S) 1,500,993,000 lb; Polybutadiene-acrylonitrile (GR-A) 37,731,000 lb; Polychloroprene (GR-M) 105,957,000 lb; Polyisobutylene-diolefin (GR-I) 42,315,000 lb; and Polyisoprene 370,000 lb. C. L. G.

Engines and Automotive Equipment.

423. Piston Ring Problems. J. S. Courtney-Pratt and G. R. Tudor. *Engineer*, 7.12.45, **180**, 469.—The authors outline a method of investigating the breakdown of the lubricant film between the piston ring and cylinder liners of an I.C. engine as a factor effecting wear.

The equipment used consisted of a small gasoline engine in which the piston was fitted with an insulated piston in the second groove. Connection was made by leads attached to the back of the ring, and led down the con-rod and through the case by means of a link motion. The electrical circuit was completed through the cylinder liner. The potential drop across the oil film was measured and recorded continuously throughout the cycle by means of a cathode-ray oscillograph and camera, and was taken as a measure of the film thickness. From results obtained the following observations were made :

The piston and cylinder wall were never separated by a continuous oil film, and lubrication improved with speed. The breakdown of the film was most marked near the ends of the stroke, where sliding velocities were low and the greatest wear occurred.

Only slight deterioration was observed with increase in gas pressure, but an increase in oil viscosity showed a marked improvement. With oils of any viscosity increase in temperature greatly reduced the thickness of the lubrication film.

For minimum wear the engine should be operated as cool as possible, the lower limit being the dew-point of the combustion products. The warming-up period should be as short as possible.

Since for high efficiency high operating temperatures are necessary, the authors suggest the use of " addition agents " to maintain effective lubrication at high temperatures.

The method outlined is said to be sensitive, and conditions of lubrication throughout the cycle and changes due to operating conditions that were likely to effect the rate of wear could be analysed. C. D. B.

424. Piston Ring Problems. An Improved Method of Measuring Piston-Ring Wall Thrust. B. Pugh. *Engineer*, 7.12.45, **180**, 471.—Considerable care must be exercised in the selection of piston rings if reasonable repeatability of tests and of oil consumption is to be obtained. Examination of rings after test may also give useful information of what has happened during the test.

An apparatus developed by the author for the accurate measurement of the polar-ring thrust pattern is described.

It consists essentially of a ring-holder bored to the cylinder size, recessed, and screwed in the rear portion to take an adjusting ring. A crossbar carrying a micrometer screw and dial is attached to, but insulated from, the ring-holder. Load is applied to the ring by a plunger operated by one end of a balance arm mounted below the base plate.

When load is applied, the deflection of the ring is measured by the micrometer making electrical contact with the inside of the ring, indicated by a voltmeter. Deflections of one-half of one-ten-thousandths can be measured.

Extrapolation to zero deflection of the linear portion of a graph obtained by plotting deflection against load for various positions of the ring gaps gives the ring wall thrust at each point of its circumference. C. D. B.

425. Piston Ring Problems. An Improved Method of Measuring Piston-Ring Wall Thrust. B. Pugh. *Engineer*, 14.12.45, **180**, 491.—Piston-ring " sticking " in petrol engines is caused by the deposition in the ring grooves of oil deterioration products, wear and corrosion products and lead from the fuel, and the degree of sticking under given conditions is effected by the properties of the oil. It is the chief criterion of most tests to rate oils according to their deterioration characteristics in an engine cylinder. The notes are based on experience of the author of running 50, 50-hr tests to develop a specification test for aero oils in a single-cylinder poppet-valve air-cooled unit, and in assessing the mechanical factors which may effect ring-sticking, with special reference to ring and ring-groove wear, and oil consumption.

The effect of " shut down " on the mechanics of ring deposits and direct and indirect methods of indicating ring-gumming are discussed.

Piston-crown temperature is considered to constitute the best method of control for oil tests, with temperature measurement behind the rings to give evidence of the commencement of sticking. A method of measuring piston temperatures is described with some typical figures obtained on a 500-cc single-cylinder unit. Anything which prevents or restricts ring rotation or movement will accelerate gumming.

Mechanical factors will effect, and may reverse, the relative rating of oils, and those which cannot be controlled must be considered in assessing engine data, or when formulating a laboratory test simulating engine conditions. Correlation between engine and laboratory tests is best based on the time to give incipient ring-sticking rather than the degree of sticking produced after a definite time. C. D. B.

426. Operating Report on Gas-Turbine Use in Sun Oil Company Refineries. A. E. Pew. *Oil Gas J.*, 11.8.45, **44** (14), 118.—Regeneration of spent catalyst in large cracking units requires vast quantities of air. The Houdry Corpn. in collaboration with the Sun Oil Co., have since 1936 adopted gas turbines and axial compressors for the purpose. For plants of 10,000 brl/day air requirements for the regeneration are about 40,000 cu ft/min. at 45 p.s.i. Normally turbine inlet gas temperatures vary from 875° to 950° F at 40 p.s.i., the outlet pressure of the compressor being about 50 p.s.i. A table is given of turbo-compressors in service on static bed Houdry units, 12 supplying 23,000 cu ft/min; 13, rated at 40,000 cu ft/min and one giving 60,000 cu ft/min; the types being Brown-Boveri and Allis-Chalmers, with speeds of 5180 r.p.m. The equipment of the 40,000 cu ft/min, their constructural materials and method of operation are described. Diagrams are given of the pressure burners and of the hook-up of the starting motor, asynchronous generator, turbine, blower and pressure burners with the salt heat exchanger, cracking chambers, and combustion case for the regeneration process. The angular contact ball thrust bearings of the turbo-compressors have been replaced by the Kingsbury-type bearings, which will be employed in all new installations. A summary of the turbo-compressor operations up to May 1945 shows the number of operating days, the number of days lost through breakdowns, and the percentage of time lost due to turbo-compressor troubles, and an analysis is given of the causes of breakdown due to bearings, lubrication, blades, air-seals, explosions, and miscellaneous troubles. These are fully discussed. Under normal operating conditions the amount of excess power supplied to, or developed by the unit depends on the type of catalytic cracking reaction being practised—*i.e.*, with increase in carbon deposition, power will increase. In general, with air at 60° F to the compressor, and with a gas temperature to the turbine at 950° F, the 40,000 cu ft/min unit will generate up to 900 Kw excess power than that required for driving the compressor. The quantity of air delivered by the compressors described fluctuates less than 1% for 20% variation in discharge pressure, compared with a 20% fluctuation, or more, for similar changes when centrifugal compressors are employed. W. H. C.

427. Oil-Burning Locomotives on the G.W.R. Anon. *Petrol. Times*, 5.1.46, **50**, 16.—Eighteen heavy freight locomotives are being converted experimentally by the G.W.R. at Swindon to burn heavy fuel oil instead of coal. The oil-burning equipment consists essentially of a Weir-type burner, an oil-regulating cock and heater, and a steam manifold carrying the necessary control valves. The fuel-tank, which is lagged, and the front compartment of which is steam heated, has a total capacity of 1800 gal. A standpipe from the tank has a filter fitted, and then passes through an auxiliary heater to the burner.

The burner is of the type in which oil flows over a weir on to a ribbon of steam, by which it is caught up, atomized, and projected toward the back of the firebox.

All the converted engines will be used in South Wales for coal and freight traffic, and it is anticipated that runs of about 250 miles will be possible between refuellings. Two refuelling depots are under construction, one at Llanelly and the other at Severn Tunnel Junction, which will each have a storage capacity of 36,000 gal.

The annual saving of coal effected by the conversion of these 18 engines will be approximately 13,000 tons. T. M. B. M.

Miscellaneous.

428. Control Occupational Hazards through Industrial Hygiene. N. V. Hendricks. *Chem. Met. Eng.*, 1946, **53** (1), 124.—The purpose of the article is to emphasize the importance of the hazards of atmospheric contamination. The safe atmospheric concentrations and the physiological effects of a large number of toxic materials are listed in a table, and methods of protecting personnel discussed. L. B.

429. British War Devices in 1945. I. Anon. *Engineer*, 1946, **181**, 31–33.—Information concerning "Pluto" was released on 24th May, 1945, (see Abstract No. 1028/1945).

Details of "Operation Fido" were made public on 1st June, 1945. "F.I.D.O." (Fog, Intensive, Dispersal Of) was in effective use from the winter of 1943 onwards. The method consisted of evaporating fog locally by direct air heating, using burning petrol vapour as the source of heat. The "Haigill" burner (Hartley, Anglo-Iranian, Gill) was installed in 13 operational airfields. One of the last types of burner to be developed, the "Slot" burner, consisted of a hairpin-shaped tube in which flames from petrol vapour, issuing from orifices in the lower limb, impinged upon the upper limb and vaporized the petrol flowing through it. The whole installation was below ground level, so as not to interfere with traffic, and was operated from a switchboard in a central control room. Plans were made to instal fully automatic equipment at Heathrow airfield, the chief airport for London. There were to have been 12,000 yd of burners, capable of burning petrol, when in full use, at the rate of 100 tons per hour. Owing to the high cost of operation, estimated at £450 to land a large transport aircraft, the Fido installation at Heathrow has been abandoned. A. C.

430. British War Devices in 1945, II. Anon. *Engineer*, 1946, **181**, 54–55.—Among the exhibits of sea-flame barrage, fougasses, and mobile flame-throwers shown at the Petroleum Warfare Department exhibition in London in October 1945, was a small-size flame-thrower, built for research purposes, with a nozzle diameter of a few millimetres, compared with about 1 inch in the full size. It was found that to increase the range of the flame either the nozzle diameter or the viscosity of the fuel had to be increased. The first alternative was impracticable for fuel consumption reasons using mobile apparatus, and the second gave rise to high-pressure drops in fuel ducts and nozzle. The difficulty was overcome by using a petrol "gel," which acted as though its viscosity were low in the ducts and nozzle and high in the jet. Reasons are also given for the fact that the ignited jet has an effective range of about twice that of the cold unignited jet. A. C.

431. German Petroleum Industry in the Hamburg District. Anon. *Petrol. Times*, 19.1.46, **50**, 73.—A review is given of C.I.O.S. report XXXII–94, which consists of 15 reports on the petroleum refining industry in the Hamburg area, including Bremen and Kiel, and includes the performance, utilization, testing of products, and research.

Report No. 1. *Interrogation of Technical Staff at Shell Haus, Rhenania-Ossag.* (a) *Aircraft Engine Oils.* At the beginning of the war two main oils (approx 100 sec Saybolt at 210° F) were available: Aeroshell Mittel, a blend of 15% Endvoltol with 85% Edeleanized oil of the Venezuelan type; and Intava or Rotring 100, a Duosol residue from American or German paraffinic crudes. The use of the Voltol blend decreased as the War progressed, and blends of synthetic oil with Edeleanized indigenous oil were later adopted. No V.I. raisers were incorporated in aero-oils, but non-metallic additives claimed to inhibit oxidation and ring sticking were added where necessary.

(b) *Voltol.* No Voltol was made by chemical catalysis (*e.g.*, BF_3) and in general the main product was Endvoltol made from 33⅓% rape oil and 66⅔% mineral-oil distillate.

(c) *Basic Oils and Additives.* The quality of the oils for the services was maintained to the end, but oils for civilian use underwent marked deterioration. The steam cylinder oil position became difficult owing to shortage of dewaxing equipment for treating residual oils. Among the substitutes developed were "emulsion lubricants." Shortage of bright stocks for engine oils was relieved by the manufacture of high viscosity synthetic oils.

(d) *Motor Oils.* Oppanol (P.I.B) was used to some extent to obtain flat viscosity/temperature curves, but fear of gummy piston deposits limited its use for Army vehicles. No H.D.-type additives appear to have been developed for use in high-speed diesels or other I.C. engines.

(e) *Gear Oils.* Shortage of fats led to the use of lead naphthenate plus free sulphur in these oils in 1942. Other E.P. compounds used by the Wehrmacht were: (i) a sulphur compound made by treating a cracked wax olefin with sulphur monochloride; (ii) "Etrol"—apparently a nitro-compound plus free sulphur and some fatty oil.

(f) *Greases.* Shortage of fatty oils led to the use of tallow, oxidized paraffins, and Montan wax. Two lithium stearate greases were developed.

(g) *Cutting Oils and Rust Preventives.* Economy was effected by using weaker slurries and increasing slightly the amount of emulsifier used. A soluble cutting oil made by treating a synthetic gas oil with sulphur monochloride was developed.

(h) *Hydraulic Oils.* A low-pour-point Edeleanized asphaltic base oil blended with 3% Voltol was supplied to the Luftwaffe.

(j) *Marine Engine and Torpedo Oils.* Blown-fatty oils in blends were substituted by montan-wax soaps.

(k) *Emulsion Lubricants.* A mineral oil containing an emulsifier was supplied to the user, who stirred in an equal volume of water, and used the resulting water in oil emulsion as a lubricant. As emulsifiers, montan wax, an oxidized synthetic wax, and Voltolized unrefined ozokerite were supplied.

(m) *Extracts.* Endeleanu extracts were used as rubber extenders, printing-ink components, putty substitutes, and for many other purposes.

(n) *Asphaltic Bitumen.* Crudes available for production of asphalt were Roumanian, and certain indigenous oils. Colophony and related wood products were widely used for emulsification of bitumen.

(o) *Research.* A number of research projects were instigated. Two items of particular interest were : (i) the use of vapour $AlCl_3$ to prepare lubricating oils from olefins ; (ii) the development of silica gel-oil grease made by compounding 9% specially prepared gel with an oil free of polar substances.

Reports Nos. 2 *and* 3. *Harburg and Grasbrook Refineries of Rhenania-Ossag.* A description is given of refinery operations during the war using for the most part indigenous crudes.

Report No. 4, *Deutsche Vacuum Oel A.G.* A description of the refineries at Schulau and Oslebshausen. The first-named refinery was old and of little technical interest, but the latter possessed a Duosol plant with some novel operating details. Emulsion oils as well as cutting and soluble oils were made at Schulau, and were of the same type as described in Report No. 1. Intava research and engine-test laboratories operated in this district.

Reports 5, 7, 8, 9, 10. These deal with refineries operated by the various companies and making a variety of products.

Report No. 6. A brief report outlining the type of equipment used for engine-testing fuels and lubricants at Rhenania-Ossag laboratory at Tiessau.

Report No. 11, *Chemisch-Physikalische Versuch Anstalt der Marine at Dänisch-Nieuhof.* Here was concentrated all German Naval research, except radar. The most interesting section is that referring to the work on spontaneous ignition temperatures leading to the definition of a characteristic quantity—the " priming value " of oils.

Report No. 12. Interrogation of Dr. Kurt Wissel of the Stettin Hydrogenation works.

Report No. 13. *Reichinstitut fur Erdolforschung der Technische Hochschule at Hannover.* A considerable amount of fundamental research was carried out which has not yet been properly assessed. Some valuable work on solvent dewaxing included determinations of the solubility of pure hydrocarbons in a wide variety of solvents. A colour reaction for the detection of hydrocarbons containing tertiary carbon atoms sensitive to 0·01% was developed.

Report No. 14. *Interrogation of Dr. Hans Hartmann Director of Norddeutsche Mineraloelwerke Pölitz.*

Report No. 15. *Description of German Underground Plants.* A description of the various types of underground plants based on interrogations in the Hamburg area, includes details of 15 different kinds of unit, some of which were completed, and some only projected.

D. L. S.

BOOKS RECEIVED.

1945 Supplement to A.S.T.M. Standards including Tentatives. Part II. Nonmetallic Materials—Constructional. Philadelphia, Pa.: American Society for Testing Materials, 1945. Pp. 229 + x.

This supplement to Part II of the 1944 Book of A.S.T.M. Standards contains the newly adopted and revised standards and tentatives in the nonmetallic constructional materials field accepted since the publication of the 1944 book.

Journal of the Iron and Steel Institute, Vol. CL, 1944. London: Iron & Steel Institute, 1945. Pp. 683 + x.

This volume contains the twelve papers presented at the autumn, 1944, meeting of the Institute and includes "The Bonding Properties of Mixtures of Petroleum Extracts and Linseed Oil and of the Extracts Themselves," by W. Davies and W. J. Rees. It also contains abstracts of articles on the manufacture and properties of iron and steel.

Transactions of the Institution of Chemical Engineers. Vol. 20, 1942. London: Institution of Chemical Engineers, 1946.

This volume of the Proceedings of the Institution of Chemical Engineers during 1942 contains papers on "The Evaporation of Liquids in Currents of Air," by S. H. Wade, and "The Representation of Vapour–Liquid Equilibrium by Means of a New Graphical Method," by A. L. Bloomfield.

Journal of the Junior Institution of Engineers. Vol. LV, 1944–45. London: The Junior Institution of Engineers, 1945. Pp. 364 + viii.

Among the papers read before the Junior Institution of Engineers and included in the present volume were "The Rudiments and Industrial Applications of Distillation Processes," by C. Hunnikin, and "The History and Present Practice of the Tar Distillation Industry," by W. G. Adam.

Manual of Firemanship. Part 6B. Practical Firemanship—II. London: H.M. Stationery Office, 1945. Pp. 169 + iv. 2*s*. 6*d*. (*Post free: 2s. 10d.*)

Issued under the authority of the British Home Office (Fire Service Department), this part of the *Manual of Firemanship* deals with the practical side of firefighting and contains a useful chapter on fires in oil installations and tank farms. It contains excellent illustrations of equipment and of actual firefighting operations.

1945 Supplement to A.S.T.M. Standards including Tentatives. Part III. Nonmetallic Materials—General. Philadelphia, Pa.: American Society for Testing Materials, 1945. Pp. 505 + xiii.

This supplement to Part III of the 1944 Book of A.S.T.M. Standards contains the survey adopted and revised standards and tentatives in the nonmetallic general field. It includes petroleum products and lubricants and industrial aromatic hydrocarbons.

INSTITUTE NOTES.

April, 1946.

FORTHCOMING MEETINGS.

Wednesday, May 8, 1946, at Manson House, 26 Portland Place, London, W. 1. :—"**The Geology of the Guayaquil Estuary, Ecuador,**" by Dr. G. Sheppard.

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

Dr. A. E. Dunstan.

At the end of last year Dr. A. E. Dunstan, who for the past twenty-five years has been the Institute's Honorary Editor, signified his desire to resign from that position. His resignation was accepted with much regret by the Council.

It was in 1920 when Dr. Dunstan first became closely associated with the *Journal* as Honorary Associate Editor and in the following year he succeeded the late W. H. Dalton as Honorary Editor. Under his wise guidance the *Journal* and other publications of the Institute have gained a high reputation in the literature of the petroleum industry and the high standard set by him in the earlier years has been maintained in spite of the vicissitudes of war.

As some indication of the progress of the *Journal* under Dr. Dunstan's supervision it may be mentioned that for the year 1921 it was published in five parts only with a total of 471 pages. Ten years later, in 1931, it had become a regular monthly publication and contained 1330 pages, including 570 pages of abstracts of current literature. Last year (1945), even though restricted by paper shortage, there were 494 pages of original papers and 414 pages of abstracts.

An important feature of the *Journal* which owes its inception to Dr. Dunstan is the Abstract Section, which he started in 1921. Similarly, the Annual Reviews of Petroleum Technology were initiated by him in 1924 as part of the *Journal*, and a few years later became a separate publication, only being suspended after 1940 on account of war conditions. The gap is to be filled this year by a volume covering progress in the intervening years.

Apart from the *Journal*, Dr. Dunstan has also been editorially responsible for all publications of the Institute, including *Proceedings of the First World Petroleum Congress*, *Petroleum—25 Years Retrospect*, *Oil-Shale and Cannel Coal*, *Dangerous Gases in the Petroleum Industry* and *Standard Methods for Testing Petroleum and Its Products*. These publications in themselves will act as a record for all time of the outstanding part which Dr. Dunstan has played in the affairs of the Institute.

In succession to Dr. Dunstan the Council have appointed Prof. F. H. Garner, O.B.E., as Honorary Editor. He has been Honorary Associate Editor since 1936.

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.

Ault, William Sinclair, Assistant Refinery Manager, "Shell" Refining & Marketing Co., Ltd. (*E. LeQ. Herbert ; H. E. F. Pracy.*)

Bedford, Douglas Ernest, Manager's Assistant, Stocks & Terminals Dept., Petroleum Board. (*F. H. Garner ; A. Osborn.*)

Courtney, James, Chief Executive (Engineering), Northern Ireland Road Transport Board. (*R. R. Dunn ; H. E. Brown.*)

Donaldson, James, Assistant Operator, Anglo-Iranian Oil Co., Ltd., Abadan.

Ellis, Eric George, Chemist, Vacuum Oil Co., Ltd. (*S. J. M. Auld ; E. R. Blane.*)

King-Farlow, Denys, Trade Relations Dept., Shell Petroleum Co., Ltd. (*C. L. Gilbert ; H. Hyams.*)

Fleming, Howard William, Chemist, "Shell" Refining & Marketing Co., Ltd. (*H. E. F. Pracy ; J. L. Black.*)

Fraser, John Alexander, Student, Glasgow University. (*W. M. Cumming.*)

Gibson, David Stuart, Assistant Mechanical Engineer, Trinidad Petroleum Development Co., Ltd. (*R. R. Tweed ; F. G. Rappoport.*)

Hutt, Eric Tom, Senior Research Engineer, Shell Lubricating Oil Laboratory. (*C. H. Johnson ; J. Cantor.*)

Irvine, Douglas, Laboratory Assistant, Anglo-American Oil Co., Ltd. (*C. Chilvers ; T. C. G. Thorpe.*)

Meadows, Henry Thompson, Technical Representative, Silvertown Lubricants, Ltd. (*L. O. Maskell ; A. F. Goodwin.*)

Montgomery, Edmund Charles, Electrical Oils Technologist, Silvertown Lubricants, Ltd. (*L. O. Maskell ; A. F. Goodwin.*)

Neppe, Max Leonard, Chemist, South African Torbanite Mining & Refining Co., Ltd. (*W. T. Jarrett ; E. C. Schiffman.*)

O'Connor, Michael Anthony, General Manager & Director, Shamrock Petrol Ltd. (*R. R. Dunn ; J. S. Parker.*)

Ogilvie, Ronald, Production Engineer, Anglo-Ecuadorian Oilfields, Ltd. (*W. W. Connor ; C. Barrington Brown.*)

Regan, Joseph William, Consulting Lubricating Engineer, Caltex (Africa) Ltd. (*W. H. Scharges ; J. W. Weitz.*)

Rigden, David Thomas, Assistant Chemist, Anglo-Iranian Oil Co., Ltd. (*W. A. Partridge ; F. J. Patman.*)

Thompson, Oliver Frederic, Administrative Position, Shell Petroleum Co., Ltd. (*J. A. Oriel ; E. LeQ. Herbert.*)

Tremaine, John Frederick, Senior Analytical Chemist, Esso European Laboratories. (*W. E. J. Broom ; A. Osborn.*)

Wardill, Thomas Edwin Mandall, Medical & Welfare Officer, Trinidad Petroleum Development Co., Ltd., Trinidad. (*C. C. Wilson ; A. H. Richard.*)

Applications for Transfers.

Baskin, Leon, Petroleum Technologist, Haifa. (*Student to Associate Member.*)

Black, John Linton, Refinery Manager, "Shell" Refining & Marketing Co., Ltd. (*H. E. F. Pracy ; J. G. Hancock.*) (*Associate Member to Member.*)

Down, Arthur Lewis, Chemical Engineer, Trinidad Leaseholds, Ltd. (*A. R. Richards ; A. G. V. Berry.*) (*Student to Member.*)

McEwen, George Charles, Technical Civil Servant, Ministry of Aircraft Production. (*J. Mason ; S. R. Hills.*) (*Associate Member to Member.*)

McGrath, Leonard, Chemist, Lobitos Oilfields, Ltd. (*V. Biske ; J. C. Wood-Mallock.*) (*Student to Associate Member.*)

Martin, Rex Ingram, Geologist, Trinidad Leaseholds, Ltd. (*K. W. Barr ; H. H. Suter.*) (*Student to Member.*)

Moore, Philip Harold, Petroleum Technologist, Moore & Barrett. (*J. Barrett ; Harold Moore.*) (*Member to Fellow.*)

Rowntree, Walter Beveridge, Chemical Dept., Petroleum Board. (*F. N. Harrap ; T. C. R. Baker.*) (*Associate Member to Member.*)

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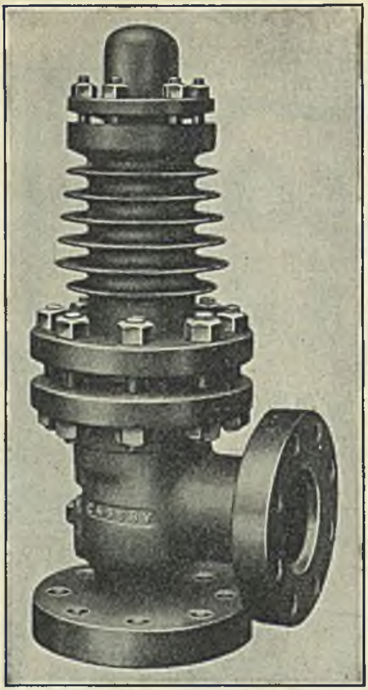

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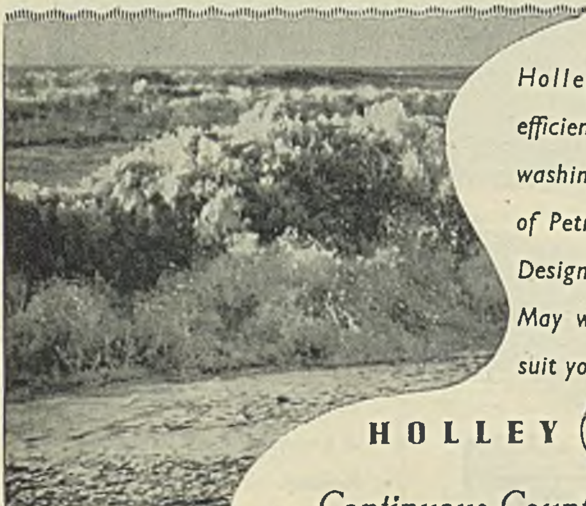

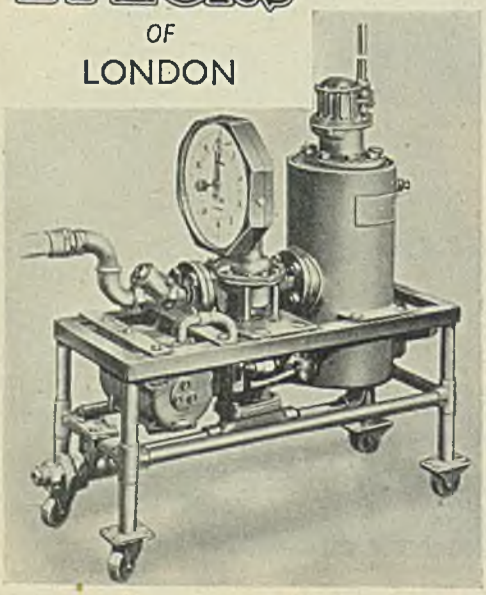

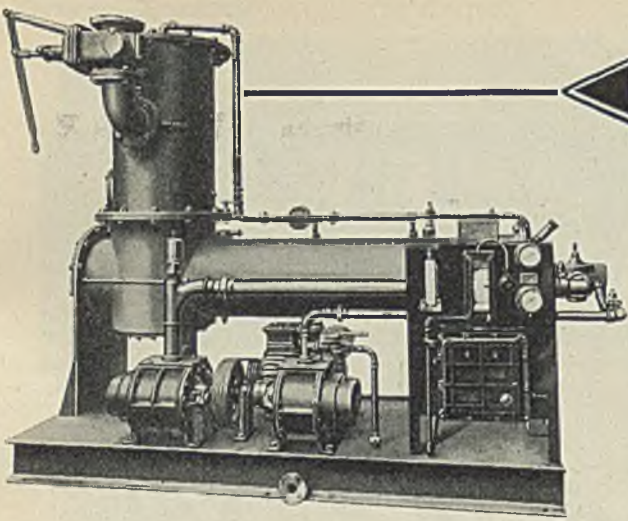

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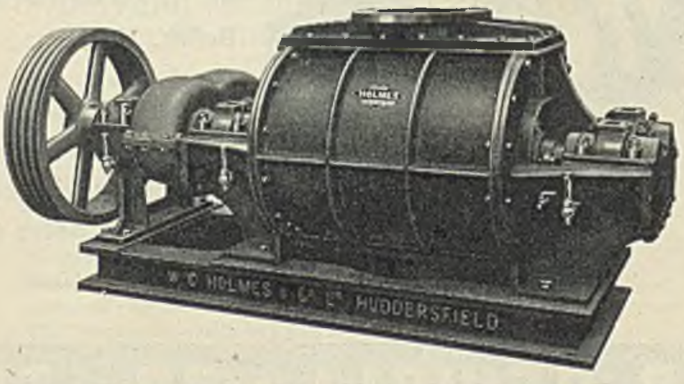

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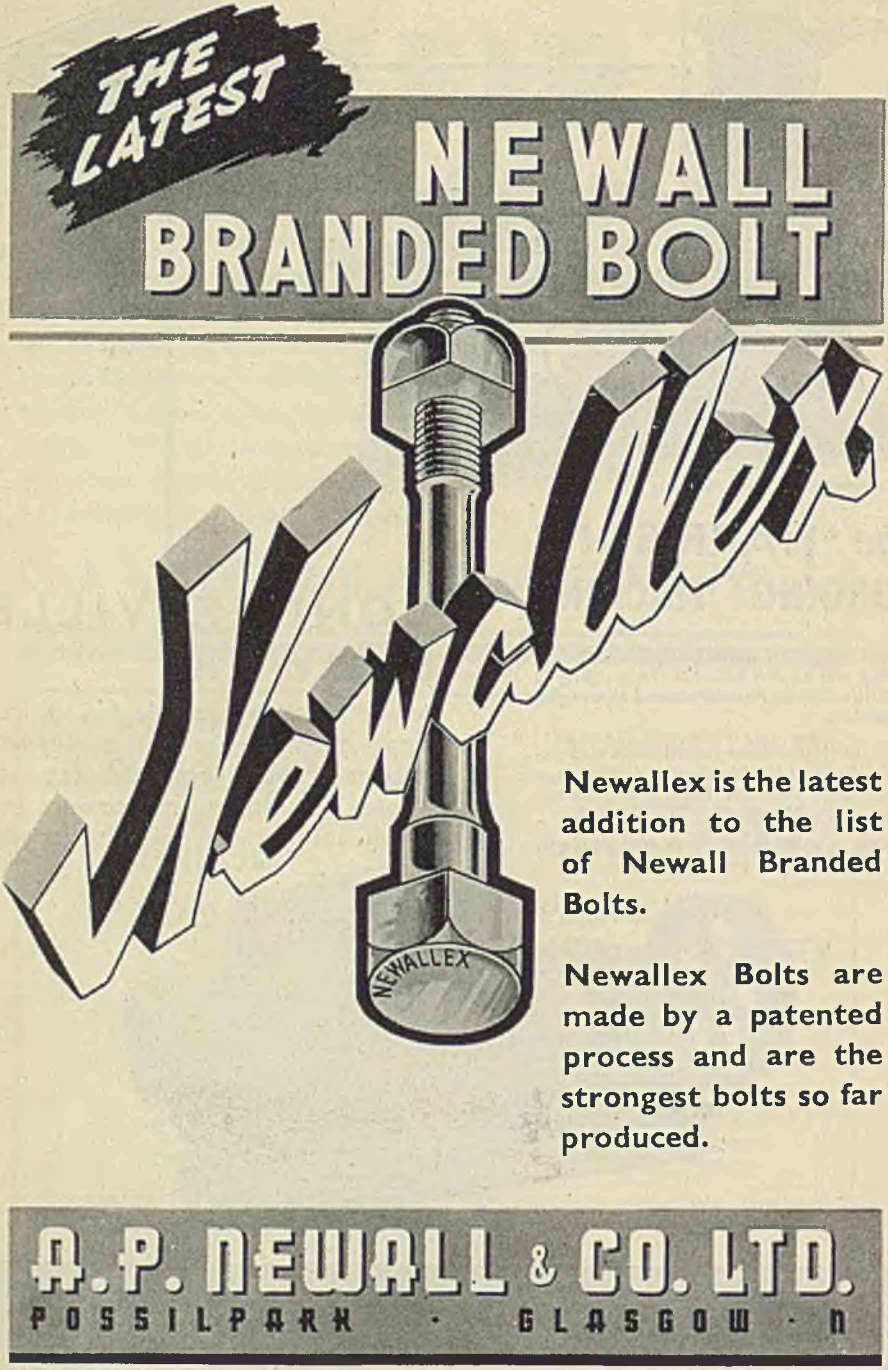

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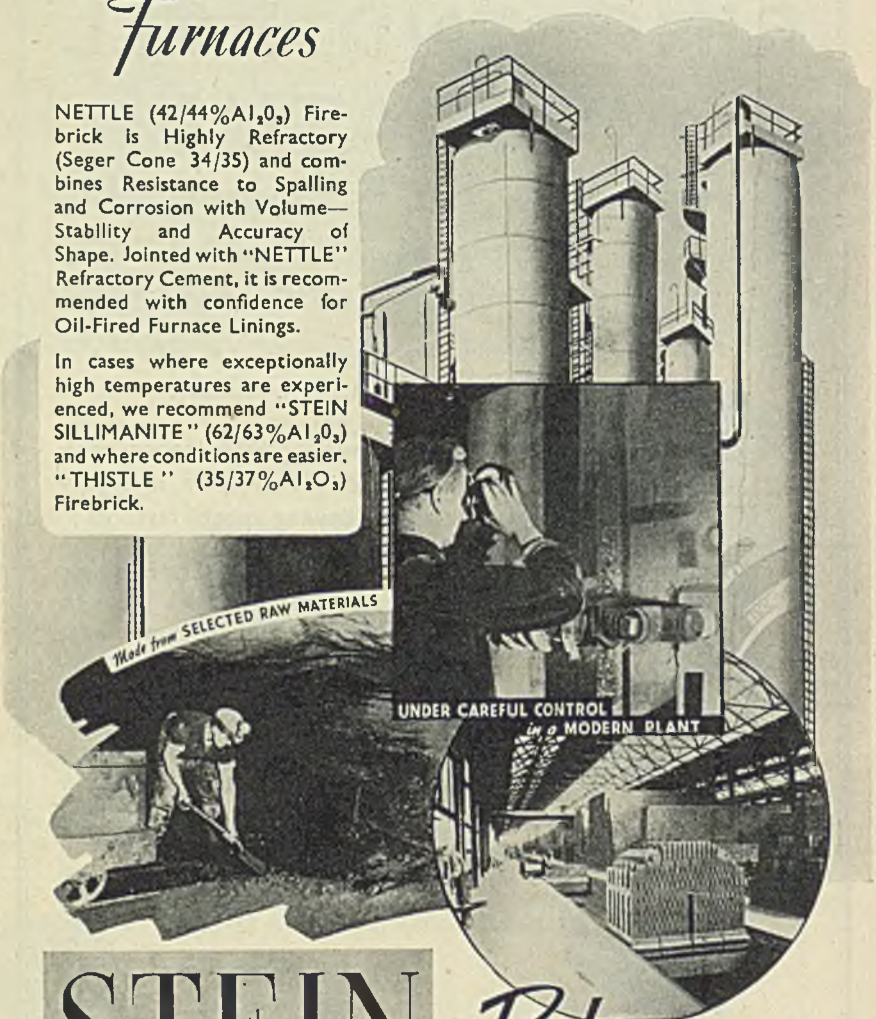

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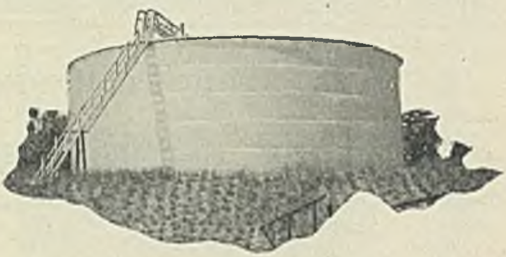

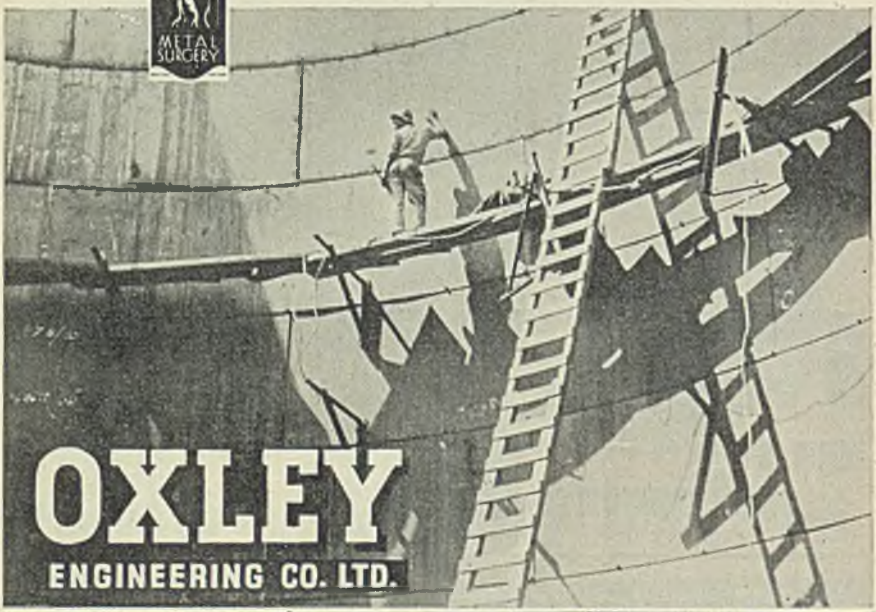

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