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OILFIELD EXPLORATION AND EXPLOITATION.

Geology.

1269. Fluorochemistry in Petroleum Science. J. de Ment. *Oil Gas J.*, 2.6.45, 44 (4), 75.—The slightest trace of oil will fluoresce even when greatly diluted with mud or water, or dispersed in small amounts through shales or cuttings or cores. Fluorescence has been used in detecting oil-water and gas-oil contacts in cores for setting casing. Very small amounts of oil can be detected by fluorescence.

Differences in fluorescence are easily noted and may be of correlative value. It may be possible to determine whether the production is from one or from several sands. Some details are given of the technique used in detecting oil or correlating sands and shales by ultra-violet light.

G. D. H.

1270. Marine Petroleum Possibilities. H. E. Gross. *Petrol. Eng.*, July, 1945, 16 (11), 76.—Offshore areas less than 600 ft below sea-level have an extent equal to the area of U.S.A., and it does not seem unreasonable to suppose that they may have oil reserves equal to the ultimate production of that country—i.e., about 50,000 million brl. The continental shelves are areas where much sediment has accumulated. The U.S.S.R. shows the greatest offshore possibilities, and Lake Erie the least.

In the Great Lakes area four localities appear attractive for oil prospecting: (1) west end of Lake Erie; (2) northwest half of Saginaw Bay; (3) east side of Lake Michigan between Benton Harbour and Ludington; (4) south end of Lake Huron. The Cincinnati Arch extends across Lake Erie. A Trenton oil-show has been found on Pelee Island. Much gas has been produced around Lake Erie, and gas may be obtained from the lake east of Pelee Island. The central part of the lake is 50-75 ft deep.

The trends of the Michigan Basin fields run into Saginaw Bay, and oil has been produced from fields near the Bay. Lake Huron has three submerged ridges, probably marking escarpments, over which the water is shallow. Trenton oil-wells have been completed on Manitoulin Island.

Although the eastern half of Lake Michigan may have numerous accumulations of Traverse oil, only a 3-mi. wide belt is sufficiently shallow to permit development by present techniques.

Maps show the continental shelf areas of the world, and the depth of water in the Great Lakes, together with nearby oilfields.

G. D. H.

1271. Heidelberg—a Major Mississippi Oilfield. K. M. Fagin. *Petrol. Eng.*, Aug. 1945, (16) (12), 66.—Heidelberg produces 8000 brl/day from 87 wells. The field is a faulted dome with a graben separating non-communicating east and west producing segments. There are four producing sands in the Eutaw. Water-drive exists, but its degree of effectiveness is problematical. There is little solution gas in the viscous oil and there are not many flowing wells. Reserve estimates range 50-105 million brl. Water production is increasing.

3500 acres produce and 500 more have been proved. The average sand thickness may be 130 ft, and the average porosity 27%. Permeabilities range 5-3500 mld, and gas/oil ratios 60-160 cu. ft./brl. 3,000,000 brl of oil have been produced, and the current production rate is 3,000,000 brl/year.

The wells are about 5000 ft deep and require 25-45 days to drill. About half the

wells are completed as weak flowing wells. The original flowing pressure was 2120 lb/sq in. The oil- and gas-fields of Mississippi are listed with pertinent data.

G. D. H.

1272. Hugoton Gas-field. E. G. Dahlgren. *Petrol. Eng.*, Aug. 1945, 16 (12), 178.—The Hugoton gas-field has 448 wells in Kansas, 229 in Oklahoma, and 64 in Texas. The developed area is 352,494 acres, but the total area has been estimated at 3,850,000 acres. About 850,000 acres are not considered to be suitable for commercial development at present. Reserve estimates range 20–26 million million cu ft. The largest well gave 52,980,000 cu ft/day initially, and has given 4,559,000,000 cu ft.

The well considered to have been the discovery well was drilled in 1927, but some earlier wells had found gas. The gas reservoir rocks form part of the Big Blue series of the Permian, and are dolomites and sandstones. There is a general eastward-dipping monocline, a stratigraphic trap being formed by pinching out to the west and northwest. The initial pressure was about 440 lb/sq in.

The wells are drilled by rotary to the top of the Herington dolomite, where the first gas is usually found, and after running the producing string cable tools are generally used to complete the well. Nearly all recent wells have been acidized.

Numerous pipeline outlets exist. There are three natural gasoline plants. Except in a small area the gas is sweet. There is no oil production. Some details are given of the way in the allowable production of the gas-wells is determined. G. D. H.

1273. Brazil's Search for Oil. L. J. Logan. *Oil Wkly*, 11.6.45, 118 (2), 34.—Wildcatting in Brazil has been too limited to give more than general knowledge of the geology, and much geological, geophysical, and other work will be necessary before the country can be considered to have been explored. Four small fields have been developed in the Bahia area. In 1940 the average daily oil consumption was 26,000 bbl; in 1944 the daily oil production was only 160 bbl.

Government control without any enlistment of private industry seems to be a handicap.

Present production is in a long, narrow belt of Tertiary and Cretaceous sediments. The pools are Lobato, Candeias, Aratu, and Itaparica. There are about twenty wells, mostly pumpers. The paraffin-base oil causes trouble in pumping. The producing sands are 1600–3600 ft deep, and are probably Lower Cretaceous or possibly Jurassic in age.

Farther north, at Aracaju in the State of Sergipe, drilling has revealed a greenish oil in thin layers of shale interbedded with salt deposits. At Maceio, still farther north, good oil and gas indications have been obtained in deep tests, some as deep as 7000 ft.

In the southernmost Brazil is a large Permian basin underlain by Carboniferous and Devonian. There are local coal-basins within the larger basin. In some areas there are indications of oil in tar-sands, and it is hoped that production may be developed from the Permian and Devonian. Tests have been made, but not in good structural positions, so they are inconclusive.

A third major province with oil possibilities embraces most of the State of Maranhao and the western half of the State of Piaui. No drilling has been done, but it is believed that thick Mesozoic and Palaeozoic beds are present. In the Lower Amazon Basin is a fourth prospective oil province in the State of Para. Marine Silurian, Devonian, and Carboniferous beds are present. Near Santarin two wildcats about 1500 ft deep encountered gas. A fifth province with oil possibilities is in the Upper Amazon Basin in the Territory of Acre. Mesozoic and Tertiary beds are present. It may be related to the Cretaceous and Tertiary fields of Peru, extending to within 50 ml of the Pachitea field of Peru.

A map indicates the more favourable areas.

G. D. H.

Drilling.

1274. Modern Rotary Drilling Machinery and Practices. Part 6. W. S. Crake. *Oil Gas J.*, 11.6.45, 44 (14), 103.—Once a given rig, drill-pipe string, and hole size have been selected for the job, it becomes the task of the operating crews to make the hole with the minimum number of bits and in the shortest possible time consistent

with safety. While the original design of the rig fixes drilling efficiency to a major extent, the final results are largely determined by the intelligence and knowledge of the driller and the skill of his crew. It is the driller alone who is continually on the job to study rig performance and behaviour of the bits in the well. While the tool-pusher and engineers can advise the driller on general terms, facts, and figures, and give suggestions, the ultimate choice of proper rotary speeds, weights, bit types, and pumping rates is, as they should be, under the direct control of the driller, the advice of the tool-pusher being available on call.

Drilling efficiency, defined as the ratio of the time on bottom drilling, coring, or reaming on the overall time, is analyzed. Bit performance is studied as a function of four variables: (1) characteristics of the drilling mud; (2) volume of circulation; (3) rotary r.p.m.; (4) weight on the bit. The above list assumes that the important variable of having the best possible type of bit in the hole for the formation being drilled has been solved, and that only the best quality of materials and knowledge have been built into the bit. Drillpipe torque, which is a secondary variable induced by a combination of the last of listed variables and wall friction caused by crooked holes, is left out of this discussion. When considering the above main variables, it is seen that there can be a very large number of reasonable combinations thereof applied against the bit. This is true, because any significant change of one of the variables required compensatory change of one or more of the others. In addition, formations in the earth are extremely changeable in drillable characteristics within short intervals of depth. Fortunately for operators, manufacturers of bits, particularly the more expensive hard-formation bits, make broad recommendations as to circulating values, weights, and revolutions/minute most suitable for their products under ordinary conditions. These recommendations are usually based on the soundest of platforms, which is long-term experience, and operators who neglect this advice are generally inviting poor bit performances and high drilling costs. Each of the four variables is studied separately. Automatic controls, instrumentation and records, drilling costs, and safety precautions are detailed. A. H. N.

1275. Modern Rotary Drilling Machinery and Practices. Part 7. W. S. Crake. *Oil Gas J.*, 18.8.45, 44 (15), 128.—In this, the last of the series, future trends and suggested improvements are discussed. It is concluded that: (1) the development and improvement of surface equipment for oil-well drilling have proceeded at a far more rapid pace than the development of subsurface technique and equipment; (2) low hydraulic efficiencies and consequent high operating costs are due, in many instances, to the use of too small drill-pipe sizes, and in some instances to too high and wasteful circulation rates; (3) the bit and its use being the key to drilling costs, more concentration on its proper use in the field, and subsequent improvements in its design in the manufacturing plant, will reduce drilling costs; (4) study and control of drilling variables are necessary to know what affects bit performance—automatic control of the weight or feed rates of the bit is a necessary step in this direction; (5) the most important energy and effort of the drilling industry should be concentrated on improved control methods, drilling methods, and bit design. Surface machinery sizes needed, and operating costs, depend entirely on these factors. A. H. N.

1276. Horizontal Drilling. Anon. *Oil Wkly*, 1.10.45, 119 (5), 35-39.—Horizontal tributary holes may be drilled from a central vertical hole by the method described. The lower part of the drill-pipe carries a flexible stationary section, at the end of which is a curved section of a drill-pipe to start the deviation. The bit used for drilling horizontal holes is a rotary turbine bit which attains a high rotational speed by means of power derived from the energy of the fluid pumped down the drill-string to the bit. The construction is shown in a cross-sectional view. The cutting action of the bit depends in part on the tendency of the cutter teeth to lift and drop the bit. A highly efficient bearing mechanism is therefore provided to resist the axial loads imposed by the tendency of the bit to rise and fall and the resistance to such movement by the turbine and the drilling string above. Since turbine parts will eventually be cut away by abrasive action of the power fluid, the construction of the bit provides ready disassembling and reassembling for replacement of the parts of the turbine. The entire bit, including housing, turbine, and cutting member, is made as short as possible

to provide for drilling the curved hole with which the horizontal hole takes off from the vertical. The overall length is only 20 in. The fluid is discharged as close to the cutting teeth as possible, in order to remove cuttings from the bottom and to keep the bit and well-bore clean. The turbine bit assembly consists of three main parts: a casing or housing made with a pin for connection to the drill-string and carrying the nozzles of the turbine; a shank member, rotatively mounted in the housing, carrying the turbine runner; and the cutter element, which is mounted to rotate on the shank about an axis that is inclined with respect to the axis of rotation of the shank. The procedure of drilling horizontal wells is described. A rathole was continued, in one instance, with constant deviation until the bit reappeared at the surface near its predicted position.

A. H. N.

1277. Diesel-Electric Rig Employs New Features. H. A. Hess. *Oil Wkly*, 1.10.45, 119 (5), 40-42.—This rig is drilling below 6500 ft on a wildcat for Quintana Petroleum Co near Gonzales, Texas. By manipulation of three switches on the derrick floor, the driller is able to direct the power output of three 650-hp diesel engines. Two of these engines are connected directly to a 400-kw generator, and the third is connected directly to a 300-kw generator, and is also connected to a 135-kw generator by means of V-belts. This arrangement allows for maximum power output for a round trip, and also allows distribution of power during drilling operations. In this manner 300 kw can be connected to the rotary table, 135 to the mud-mixing pump, while the two 400-kw generators can be used to operate each of the other two slush-pumps. In the general layout the engines are 150-ft from well centre, with power-lines leading through the control equipment to each of the driving motors. The control building, located directly in front of the engine-house, contains the switches by which the driller is able to direct from the derrick floor the output of each of the generators. Next in line between the derrick floor and the engine-house are the slush-pumps. Two 400-hp motors and one 600-hp motor are used on each of the slush-pumps. The other lines from the control-room lead to the 800-hp motor on the draw-works and the 300-hp power motor which turns the rotary table. Several innovations are described and illustrated.

A. H. N.

1278. New 2100-Horsepower Diesel-Electric Drilling Rig is Compact and Portable. K. M. Fagin. *Petrol. Engr*, Aug. 1945, 16 (12), 194.—The rig is scheduled to drill a 14,000-ft wild-cat test, and is one of the largest rigs in the world. Three turbo-charged 8-cyl diesel engines that can develop a total of more than 2100-hp serve as prime movers. These are direct-connected through flexible couplings to the main 395-v d.-c. generators. Smaller auxiliary generators driven by V-belts from the main generator shafts are mounted on top of the main generators. These auxiliaries in turn are surmounted by 4-kw variable voltage exciters. Each of the three diesel engines, complete with its generator and instrument panel, is mounted on heavy steel skids for easy handling by large winch-trucks from one location to another. The three engine-generator units are situated side by side and covered with specially designed metal roofing units to form a compact engine generating-house. Electric current from the generators is fed through overhead cables to the central switch and control-house for distribution to the hoisting, rotary table, mud pump, auxiliary motors, and lighting system. The switch and control-house is likewise mounted on skids for easy transfer from location to location. A utility house is situated beside the engine-generator house. This contains diesel utility engine direct-connected to a 30-kw 125-v 1200-r.p.m. constant-voltage auxiliary generator; an arc-welding current transformer, and a two-stage air-compressor driven directly by a 15-hp electric motor. The compressed air is piped through the utility house wall into three 72-gal storage tanks mounted on the outside. The diesel utility engine is started by a 6-cell storage battery.

Details of the rig are given.

A. H. N.

1279. Laying Down Drill-Pipe. E. Sterrett. *Oil Wkly*, 17.9.45, 119 (3), 58.—Use of a tail-out line in place of the older method of supporting the lower end of a joint of drill-pipe on a buggy not only relieves one man of a heavy and at times extra-hazardous job as he tries to keep ahead of the pipe as it slides down the ramp-plate, but it also speeds up the work, except actually latching the stand on the support

and the eventual placing of the last-pulled joint against those already racked. One company has gone farther in the development and adaptation of the tailout line method than some others. It uses a section of sand line as the supporting member, with turn-buckle attachments at both ends to permit accurate spotting, and the maintenance of the tension, which eliminates undesirable sag in the line as the "go-devil" rolls down the slope of the wire line as it carries the lower end of the joint of drill-pipe. Wherever possible the line is attached to trees or other natural anchorage at the lower end, or to a bridle on a dead-man in open country. The upper end, adjacent to the rotary table, passes over a braced post which carries a pulley to permit line direction change without overloading a single strand or a few wires. The end is anchored, through turnbuckle, to a member of the substructure close up to the rotary mounting. On the derrick floor, facing and about a foot from the steel armour on the ramp, is placed a roller unit which prevents drag of the upper end as the tail-out line carries the lower end. This unit is designed so that it may be spiked to the floor, but carries little side or end thrust, even when the end of the pipe nears the point where it leaves the roller for the short travel across the planking before the end of the box contacts the chute on its descent to ground level. The fabrication of the unit is discussed in some detail and its use is illustrated photographically.

A. H. N.

1280. Oil-Well Casing Failures. R. J. Kettenburg and F. R. Schmieder. *Petrol. Engr. Reference Annual, 1945, 16* (10), 53-58. *Paper Presented before American Petroleum Institute.*—See Abstract 906 (1945).

A. H. N.

1281. Collapse Safety Factors for Tapered Casing Strings. W. O. Clinedinst. *Petrol. Engr. Reference Annual, 1945, 16* (10), 59-60.—See Abstract No. 1097, 1945.

1282. Field Testing of Drilling Fluids. V. B. Zacher. *Petrol. Engr. Reference Annual, 1945, 16* (10), 74. *Paper Presented before American Petroleum Institute.*—A new mud-testing kit and filter-press are described in detail. Report forms for mud testing for routine and special testing systems are presented. A table summarizes the usual defects found in muds and methods for their treatment.

A. H. N.

1283. Rectangular Mixing Tank Simplifies Preparation and Feed of Additives. E. Sterrett. *Oil Wkly, 24.9.45, 119* (4), 56-57.—Blending of acids, thickeners, and other chemical ingredients which must be added to the mud stream to meet special formation conditions, most effectively conditions the mud when a thorough mix is obtained, and when this mix is fed to the stream in metered and equal amounts. To obtain these desired results, one tool-pusher designed and had built a rectangular mixing-tank to take the place of oil-drums, cylinders, and other vessels usually mounted astride the mud line for mixing and feeding additives. This rectangular tank, skid-mounted, is set alongside and just above the rectangular flume which is used to dampen pulsations and present an even flow to the shale-shaker. The tank is welded from steel plate, heavy enough to hold its shape on the ends when supported top and bottom by welding beads, and large enough to give a total capacity of approximately $7\frac{1}{2}$ brl of 42 gal. The unit is divided by cross walls to provide two main tanks of about 120 gal capacity when filled to 6 in from the top, each of the other smaller sections having a 40-gal capacity. This known capacity of each section enables it to be filled to the desired level with water, and the chemical then weighed or measured before blending to provide a mixture of known strength.

A. H. N.

1284. Shale Shaker Actuates Chemical Mud-Feeder. Anon. *Oil Wkly, 1.10.45, 119* (5), 55.—By utilizing available power, a contractor in the West Edmond field is able to mechanically add chemical to the mud stream at a constant rate, thus overcoming a difficult mixing problem. In cases where the mud is conditioned for specific formations by adding a large number of sacks of chemical, the process is carried out much the same as in mixing cement. However, in order to maintain all the mud at the required specifications, a small amount of chemical must be added continuously. To make a feeder, a 50-gal drum was placed over the mud spillway between the shale-shaker and the pits. Into the bottom of the drum was welded a two-inch nipple with a slot to admit a small piece of tin for a valve-disc. A rod attached to the disc

was run out and attached to a turnbuckle by means of a wire line-clamp. The method is illustrated. A. H. N.

1285. The Place of Mechanical Sidewall Coring. Anon. *Oil Wkly*, 10.9.45, **119** (2), 54-55.—The use of sidewall coring for determining subsurface conditions in wells is explained. After the core-tube assembly has reached its position in the body of the tool, the process of extracting a core from the formation is relatively simple. The tool operator lowers the drill-string slowly, carefully observes the weight indicator. When the indicator shows weight being taken, the core-tube is beginning to "bite" into the walls of the hole. Dependent on the formation, the amount of weight taken by the tool will remain fairly constant unless the operator continues to lower until the tube is pushed down through the formation. To prevent this happening, the distance of safe travel is carefully marked on the pipe above the rotary table; the operator knows exactly how far to lower the string to obtain the core. The core-tube may be fractured if excessive weight is placed upon it, and generally a force of 11 "points" is considered maximum. After the core has been cut, the drill-stem is raised to its original position and the core-tube assembly withdrawn through means of a wire line overshot. An upward pull releases the latching device of this assembly, permitting it to be withdrawn through the drill-pipe. At the rig floor the core is extracted by means of a hydraulic jack. A. H. N.

1286. Hardfacing and Rebuilding Bits—A New Material Developed in Britain. Anon. *Petrol. Times*, 18.8.45, **49**, 659.—"Tungsit" which is a hard-facing material, is described and its use in oil-well drilling bits is discussed in some detail. "Tungsit" is basically a cast tungsten carbide—a scientifically controlled mixture of W_2C and WC, taking advantage of the properties peculiar to each—and is one of the hardest products known after the diamond, the hardness of pure "Tungsit" reaching 1900 D.P.H. Pure "Tungsit" is homogeneous in structure. The deposit from the welding rods is heterogeneous, and for purposes where a more homogeneous structure is preferred various special grades of "Tungsit" tubular welding rods have been developed, but pure "Tungsit" remains the basic and main constituent of all the standard grades produced. It is also made as powder, and as rectangular and angular inserts developed principally for use on rotary well-drilling equipment; owing to extreme hardness, the standard insert is brittle, but when welded into position exposure to impact results only in the flaking off of small fragments from the surface, leaving sharp edges.

The economies attendant on the use of "Tungsit" in hard-facing bits are detailed, together with the advantages accruing from keeping full records. Typical record sheets are presented. A. H. N.

1287. Fishing Tools, their Production, Precision, and Design. J. Medford. *Petrol. World*, Aug. 1945, **42** (6), 51-53.—The development, design, and use of the Bowen overshot are briefly discussed. In operating this tool, to take hold, the operator rotates the string slowly to the right as the overshot is lowered over the fish. This aids in the expansion of the grapple and allows the tool to move down over the fish easily. When upward pull is exerted the grapple is contracted by the taper in the bowl and the hold is secured. This means that the grapple has a hold as soon as it is over the fish, eliminating the usual slip travel in the bowl before gripping. If desired, releasing from the fish is simple. A bump-down breaks the hold; a simultaneous rotation of the string to the right, and the drill-pipe may be slowly raised clear of the fish. This simple releasing feature is as important part of the tool's constriction. The fact that this overshot requires right-hand rotation only both for setting and unsetting is equally important, because, not having to turn the string to the left or unscrewing direction, avoids many possible hazards, also it is a vital safety measure. A. H. N.

1288. Caliper Well Logging. Part 2. H. Guyod. *Oil Wkly*, 3.9.45, **119** (1), 57-61.—The determination of well diameters by travelling calipers which record their disposition automatically and continuously at the surface is discussed. Typical logs are presented and their significance is explained. A. H. N.

1289. Caliper Well Logging. Part 3. H. Guyod. *Oil Wkly*, 10.9.45, **119** (2), 65.—The physical properties of shales associated with oil reservoirs is reviewed. The caving of shales is discussed. It is postulated that the presence of oil or gas deposits causes caving. This aspect is to be discussed in future parts. A. H. N.

1290. Caliper Well Logging. Part 4. H. Guyod. *Oil Wkly*, 17.9.45, **119** (3), 52.—A correlation between abnormal caving in shales and the hydrocarbon concentration in the beds overlying and underlying the oil horizon is attempted. Patterns of hydrocarbon concentration in vertical planes and records of abnormal cavings are presented. After the discussion it is concluded that there is so much money involved in the drilling of a deep well that any information which is susceptible of yielding a clue on the presence of oil or gas is worth securing if the resulting expense is reasonable. For this reason it is thought that caliper data should be secured in each wildcat well, and also in field wells where electrical data alone are unable to solve the problem of fluid identification. Even if fluid information is not obtained from these data, the money invested is not lost because of the many other applications of a caliper log. It is noted that caliper logging is still imperfect. A. H. N.

1291. Drilling Cost Accounting. C. H. Westfall. *Oil Wkly*, 1.10.45, **119** (5), 43-45.—The system of accounting followed by one company is discussed in detail. Worker's cards with data and the accounting system are illustrated. Concise data about the drilling and costing of a discovery well are included. A. H. N.

1292. Quad Landing-Craft Engines Drill Deep Well. H. A. Hess. *Oil Wkly*, 10.9.45, **119** (2), 56-57.—The use of multiple engine combinations, developed for invasion, in oilfield operations is discussed. A. H. N.

1293. Drilling in Alaska. B. W. Gillespie and W. A. Coblenz. *Oil Wkly*, 3.9.45, **119** (1), 54-56.—The rigours of the climate 5° north of the Arctic Circle added greatly to the difficulties of transportation and drilling activities of the Seabees of the Navy in their search for Alaskan oil. These difficulties are described. A. H. N.

1294. California's New World Record Hole. O. A. Cavins. *Petrol. Engr. Reference Annual*, 1945, **16** (10), 61. *Paper Presented before American Petroleum Institute.*—The drilling of Standard Oil Co's KCL-20 No. 3 to 16,246 ft (by drill-pipe measurements) in 516 days is briefly described. The precautions taken are outlined. A. H. N.

Production.

1295. Significance of Declining Productivity Index. C. V. Millikan and H. F. Beardmore. *Petrol. Tech.*, 1945, **8** (4), *A.I.M.M.E. Tech. Pub.* No. 872, 1-10.—A productivity index that has a substantially and consistently decreasing value when measured over a period of a few hours is described as a declining productivity index. If its nature is not recognized it may be interpreted as representing an unsettled or unstable condition in a producing well. Its known existence permits certain predictions regarding future performance as compared with the performance of wells not showing a declining productivity index. The more important predictions include: (a) the rate of oil production will decline more rapidly; (b) the gas/oil ratio will usually increase abnormally; (c) the amount of water ultimately produced will be negligible, if any; (d) stop-cocking will increase current production and decrease gas/oil ratio. When such well performance is indicated it follows that certain reservoir performance and operating practices may be anticipated: (1) the ultimate oil recovery will be lower than that expected for a gas-drive reservoir; (2) wells will flow naturally to a lower reservoir pressure and to a lower rate of production; (3) there will be no active water-drive; (4) acidizing, shooting, and reworking can be better evaluated; (5) wells will produce currently and probably ultimately as much oil, and often more, when shut in from 10% to 30% of the time; (6) smaller lifting equipment will be required; (7) wells can be operated alternately. These important predictions can be made from bottom-hole pressure data obtained immediately after completion of the wells.

The phenomenon is probably associated with a particular type of reservoir porosity. G. D. H.

1296. A Method of Determining Fluid Movement in Wells. S. L. Pearse. *Petrol. Tech.*, 1945, 8 (4), *A.I.M.M.E. Tech. Pub. No. 1911*, 1-3.—It is often desirable to determine whether any fluid transfer is taking place in a shut-in well, and the rate of such transfer. A relatively rapid and inexpensive method has been devised which can be used by field crews with a minimum of technical supervision.

Fluid movement is determined by releasing a tracer (dye) in the well at a predetermined depth and, after an interval of time, sampling the well fluid at another level. The testing equipment consists of a combined crusher and sampler unit that is run into the well on a wire line. The rate of movement can be calculated from time-volume relationships. G. D. H.

1297. Fractional Analysis of Well Effluents to Trace Migration of High-pressure Reservoir Gas. E. P. Valby. *Petrol. Tech.*, July 1945, 8 (4), 1-7.—A method is described in which the hydrocarbon weight fractional analyses of the well effluents from a true gas-cap-portion well and a true dark-oil-ring well furnish the basic data for determining the properties of any mixture of production from these two sources. The effect of injected gas on these properties can be computed. Comparison of similar properties of a given well effluent and the properties of mixtures of the basic well effluents will give the relative amounts of production from the two sources and injected gas.

The method can show migration of gas that may represent a serious loss of reservoir energy, and may show the amount of injected gas which is not considered to be enriched, thus aiding in remedial work to control the migration of injected gas. G. D. H.

1298. Reservoir Fluid-Flow Research. N. Johnston and N. Van Wingen. *Petrol. Engr. Reference Annual*, 1945, 16 (10), 108. *Paper presented before American Petroleum Institute.*—See Abstract No. 910, 1945. A. H. N.

1299. Control and Detection of Reservoir Gas Movement in Pressure-Control Operations. N. Van Wingen and E. P. Valby. *Petrol. Engr. Reference Annual*, 1945, 16 (10), 116. *Paper Presented before California Natural Gasoline Association.*—See Abstract No. 730, 1945. A. H. N.

1300. Application of the Electric Pilot to Well Completions, Acidizing, and Production Problems in Permian Basin. P. J. Lehnhard and C. J. Cecil. *Petrol. Engr. Reference Annual*, 1945, 16 (10), 98. *Paper Presented before American Institute of Mining and Metallurgical Engineers.*—See Abstract 284 (1945). A. H. N.

1301. Paloma Unit—An Advanced Oil, Gas, and Products Producing Operation. Part 1. K. B. Barnes. *Oil Gas J.*, 18.3.45, 44 (15), 112.—A pictorial presentation of the activities of the Paloma Unit is made. In this part the drilling of 10,000-12,000-ft wells and the well-head and field equipment are described. Gas control manifolds and metering are briefly discussed. A. H. N.

1302. Performance of Gas Lift through Small Tubings. A. C. Tutschulte. *Petrol. Engr. Reference Annual*, 1945, 16 (10), 84. *Paper Presented before American Petroleum Institute.*—Extensive data are presented in the form of charts on the operation of gas-lift systems for lifting oils. In studying the results the following conclusions are reached: Well-performance characteristics, particularly static formation pressure, productivity index, and formation gas-oil ratio, should be fully determined when the application of gas lift through small tubing is being considered. The factors that affect intermittent gas-lift performance through 1½-in tubing have been developed and are illustrated on the accompanying charts. Through the use of these charts, and provided that the well characteristics are known, it should be possible to predict the performance to be obtained by gas lift through 1½-in tubing. It should be possible in many cases to effect considerable savings in the quantities of gas used, with resultant reduction in operating costs if careful and complete testing of gas-lift wells is conducted and proper analysis is made of the factors concerning the applications of gas lift through macaroni tubing. A. H. N.

1303. West Edmond Needs Pressure Maintenance. A. Gibbon. *Oil Weekly*, 3.9.45, 119 (1), 48.—The general characteristics of reservoirs producing under different

drives are explained. The behaviour of the pool to date strongly indicates that water encroachment will not be a major factor in oil recovery or pressure maintenance in the Hunton Limestone, since the water production in some of the older wells has about levelled off. As a corollary, there should never be a serious water-production problem in the West Edmond field, as there is no water table underlying the pay-zone. This has been proved by wells drilled completely through the Bois d'Arc section. But the water-drive along the western fringe of the structure definitely will not furnish sufficient energy to replace that which has been depleted from the dissipation of the gas dissolved in the oil itself. Another important fact is the evident lack of an initial gas-cap. Wells drilled high on structure encountered no free gas-zone, nor were these wells high gas-oil ratio wells. The absence of an initial gas-cap is confirmed positively by the results of analyses of a number of bottom-hole samples of the reservoir liquid. All samples showed some degree of under-saturation of gas initially. In the absence of a free gas-cap it is quite evident, therefore, that recovery from the West Edmond pool will be obtained almost entirely from the energy represented by the gas originally dissolved in the under-saturated crude oil. The results of the bottom-hole sample analyses made by the U.S.B.M. show the solution gas to be initially 1000 cu. ft./bbl of stock-tank crude. The reservoir volume factor is 1.55 under initial conditions. That factor is the ratio of the volume of reservoir liquid to the volume of the corresponding stock tank oil, and is a relatively high value. This, in part, accounts for the rapid reservoir pressure decline to be had in such pools as the West Edmond-Hunton Lime. The possibilities afforded by pressure maintenance are discussed.

A. H. N.

1304. Calculation of Static Pressure Gradients in Gas Wells. M. J. Rzasa and D. L. Katz. *Petrol. Engr. Reference Annual*, 1945, 16 (10), 148.—See Abstract No. 1111/1945.

1305. Air-Lift Research Project of the A. & M. College of Texas. S. F. Shaw. *Petrol. Engr*, Aug. 1945, 16 (12), 105.—An air-lift research project as instituted at the A. & M. College of Texas in 1942, for the purpose of determining the maximum capacities of pipes of 1-in, 1½-in, 2-in, and 2½-in diam for both water and oil, with lengths of pipe ranging from 11 to 80 ft. Experiments with approximately 11 ft of pipe were conducted in the gas laboratory; those with greater lengths were carried out in a derrick in the field laboratory of the Petroleum Engineering Dept. The purpose was to determine, so far as practicable, the maximum capacities of these flow-pipes for both oil and water, and, if possible, to derive a factor that would permit the conversion of capacities of water to those of oil, using water as a standard. The facilities of the college did not permit using pipes of greater diameter than 2½ in, or lengths greater than 80 ft, but it was hoped that experiments under these conditions would develop trends of such nature that they would point the way towards a means of determining capacities for much larger diameters and for lengths ranging up to 5000 or even 10,000 ft. The tests were sufficient to indicate that with adequate facilities experiments could be made that would determine the capacities of flow-pipes under any and all conditions, as well as the quantity of compressed air or gas required to lift a unit quantity of liquid under these conditions. Extension of the project should consist of carrying on the tests in wells to depths of 5000 ft or more, in which completions were made with casing of 9½ in or even larger, and where there is available an adequate quantity of gas from a gas-well, or from a compressor plant, at the pressures necessary to handle submergences of 30% or more. Graphs are presented of the data already obtained.

A. H. N.

1306. Experimental Water-flood in a California Oil-Field. E. C. Babson, E. Sherborne, and P. H. Jones. *Petrol. Engr. Reference Annual*, 1945, 16 (10), 128. *Paper Presented before American Institute of Mining and Metallurgical Engineers.*—As a result of an investigation of subsurface conditions in the Chapman zone of the Richfield field, it was concluded that ultimate oil recovery from this zone would probably be low and that natural water encroachment was so localized as to be of little importance from a recovery standpoint. Furthermore, it was found that in many portions of the zone the wells were approaching an unprofitable level of production. After some investigation, it was decided that water-flooding offered the most likely

means of accomplishing this end, but reservoir conditions in the Chapman zone differ so widely from those encountered in any of the flooding projects described in the literature that it was difficult to evaluate the probability of success. Despite encouraging results from laboratory tests, it was not even certain that water would displace an appreciable volume of oil from the Chapman sand under reservoir conditions. Therefore it was decided to initiate a small-scale project, for two purposes: First, to determine whether water would displace oil from the Chapman sand and, second, to obtain information and experience for future operations if water-flooding appeared to be a promising method of secondary recovery.

The paper describes the reservoir, giving significant data, its development and the experimental water-flood and its results. It is found that while it cannot be stated positively at this time that water-flooding will be economically successful in the Chapman zone at Richfield, it has demonstrated that water can be injected into the zone on a sustained basis and that this water will displace appreciable quantities of oil from the sand.

A. H. N.

1307. Water Injection in the Cabin Creek Field, West Virginia. C. F. Terrell. *Petrol. Engr. Reference Annual*, 1945, 16 (10), 188.—The geographical, topographical, and geological dispositions of the field are given, followed by a history of its development. A somewhat detailed description of the water-flooding operations and water treatment—including a system of deaerating the water to remove all the oxygen—is presented.

A. H. N.

1308. Union's Secondary Recovery Experiment Develops Valuable Operating Data. R. Sneddon. *Petrol. World*, Aug. 1945, 42 (8), 39-42.—The results of studies on cores to obtain data on displacement of oil by water and vice versa for a basis of large-scale water flooding operations, are given. The project is discussed in brief.

A. H. N.

1309. Salt Water Disposal in East Texas. Anon. *Petrol. Engr.*, Aug. 1945, 16 (12), 22.—Filters for water disposal in East Texas are discussed in some detail, citing different types. Centrifugal pumps both single- and multi-stage types are studied and illustrated.

A. H. N.

1310. A Review of Performance of Multi-Zone Wells in the Wilmington Field, California. C. Beal and R. Winterburn. *Petrol. Engr. Reference Annual*, 1945, 16 (10), 86.—The field and the producing horizons are described and multizone practices are discussed. It is found that use of multizone completions has been useful in providing for development of several zones where limited surface locations are available, and has afforded means of controlling gas-oil ratios, water production, oil gravity, and pool-production rates by selective production. In some wells repair work has been facilitated by the presence of cemented blank sections. In competitive areas operators have been able to gain advantage through selective production in this type of completion. However, under conditions obtaining in the Wilmington field it has been the general practice to revert to single or combination zone production at the end of the flowing life, principally because of the many mechanical difficulties encountered, which act as serious obstacles to multizone production by artificial lift. Leaks developing between zones, and production of wells as combination wells have led to non-uniform and undesirable combinations of zones in many of the wells under conditions which may eventually reduce oil-recovery efficiency.

Considering the conditions that exist in the field, and assuming that it is desirable to develop and produce all zones simultaneously, it is concluded that development could have been more economically effected and the various zones more efficiently produced if uniform development had been accomplished by single wells to each zone (or in some areas to a combination of two zones) throughout each fault-block. Wells drilled on this basis could be equipped with cemented blank sections if it were anticipated that selective production of a zonal subdivision might eventually become necessary. As far as obtaining the maximum economic recovery from the field is concerned, the competitive advantages gained by most of the operators who have completed multizone wells have not contributed to overall recovery efficiency, and greater recovery might have resulted from single-zone development using cemented

blank sections where necessary to control production. It is emphasised that conclusions in regard to Wilmington are in no way intended to reflect on decisions to use multizone completions in other fields where mechanical problems are less serious, drilling more expensive, and recovery from individual zones relatively low.

A. H. N.

1311. Portable Base Pumping Units. A. E. Caraway. *Oil Wkly*, 1.10.45, **119** (5), 46-47.—The use of a base to carry the whole pumping unit, with a sub-base to provide clearance for the crank, is discussed and a typical unit is illustrated. This system eliminates the need for a concrete base. The outside members of the base serve well as support for guards if these are desired. Holes may be cut in flanges of beams, or sockets may be welded onto beams into which the legs of the guards are dropped, furnishing a sturdy and self-contained system of guards. The sturdy construction of such a base makes it convenient to move from location to location without tearing down, and re-erecting at each move. This ease of portability makes such a unit a money-saver for the larger operator who likes to test the well before a decision is made on permanent equipment to produce. Some wells are not productive enough after their natural flow has ceased to make artificial lift profitable. A portable base unit may save several hundred dollars in the checking and testing of such a well.

A. H. N.

1312. Good Housekeeping on the Oil Lease. O. S. Jones. *Oil Gas J.*, 23.7.45, **118** (8), 36-39.—The losses that may occur from badly kept oilfields are discussed. It is suggested that the modern technical school in the training programmes set up for oilfield personnel should make it clear that clean leases are a definite asset, and that dirty leases are a decided liability. This point also should be stressed in the company schools conducted for oilfield workers. Officials in the policy-determining branch of the oil company must realize that adverse criticism brought about by pollution litigation is not good advertizing. Good will has a cash value, and it can be enhanced by keeping oil properties clean and orderly. It will be further enhanced by making sure that the mineralized water produced with the oil is so handled as not to constitute a threat to the fresh water which is a ranking natural resource.

A. H. N.

1313. Patents on Drilling and Production.—J. A. Riise, jr., assr to Phillips Petroleum Co. U.S.P. 2,370,814, 6.3.45. Appl. 26.6.41. Method of well logging.

J. J. Shanley, assr to Phillips Petroleum Co. U.S.P. 2,370,817, 6.3.45. Appl. 13.2.41. Method and apparatus for treating drilling fluid.

D. Silverman, assr to Stanolind Oil & Gas Co. U.S.P. 2,370,818, 6.3.45. Appl. 30.7.42. Well measurement.

R. C. Baker, assr to Baker Oil Tools Inc. U.S.P. 2,370,832, 6.3.45. Appl. 19.8.41. Removable well-packer.

R. C. Baker, assr to Baker Oil Tools Inc. U.S.P. 2,370,833, 6.3.45. Appl. 16.3.42. Apparatus for cementing well-bores.

C. H. Barnes, assr to Lane-Wells Co. U.S.P. 2,370,929, 6.3.45. Appl. 22.12.41. Formation packer.

L. C. Badgley. U.S.P. 2,370,019, 6.3.45. Appl. 28.8.40. Jet-type pump.

J. J. McNamara. U.S.P. 2,371,248, 13.3.45. Appl. 22.4.42. Well-drilling tool.

A. L. Smith. U.S.P. 2,371,270, 13.3.45. Appl. 29.7.40. Electrical logging of well-bores.

N. B. Dismukes, assr to Standard Oil Development Co. U.S.P. 2,371,383, 13.3.45. Appl. 6.12.41. Plugging strata in bore-holes.

J. E. Eckel, assr to Standard Oil Development Co. U.S.P. 2,371,385, 13.3.45. Appl. 14.2.42. Gravel-packed liner and perforation assembly.

C. J. Haynes, assr to Standard Oil Development Co. U.S.P. 2,371,391, 13.3.45. Appl. 2.1.43. Screen for wells.

E. B. Williams, jr., assr to Howard C. Grubb. U.S.P. 2,371,488, 13.3.45. Appl. 6.5.43. Core-bit.

- E. B. Williams, jr., assr to of one-third to S. P. Daniel and one-third to H. C. Grubb. U.S.P. 2,371,489, 13.3.45. Appl. 9.8.43. Drill-bit.
- E. B. Williams, jr. U.S.P. 2,371,490, 13.3.45. Appl. 10.4.44. Step-cut drill-bit.
- A. Boynton. U.S.P. 2,371,398, 13.3.45. Appl. 27.9.41. Automatically rotatable bit for cable well-hole.
- S. Krasnow. U.S.P. 2,371,628, 13.3.45. Appl. 31.12.40. Method and apparatus for dynamic measurement of bore-hole radio-activity.
- W. H. Stewart, assr to Sun Oil Co. U.S.P. 2,371,658, 20.3.45. Appl. 27.3.41. Method and apparatus for determining current flow in bore-hole casing or the like.
- J. D. Johnston. U.S.P. 2,371,824, 20.3.45. Appl. 20.9.41. Oil-well bailer.
- H. C. Otis. U.S.P. 2,371,840, 20.3.45. Appl. 3.12.40. Well device.
- W. St. Maur E. Crake, assr to Shell Development Co. U.S.P. 2,371,953, 20.3.45. Appl. 24.7.42. Drilling weight-control system.
- R. D. Dawson and C. F. Blankenhorn, assr to Shell Development Co. U.S.P. 2,371,955, 20.3.45. Appl. 31.8.43. Well drilling fluid.
- L. C. Uren, assr to The Texas Co. U.S.P. 2,372,361, 27.3.45. Appl. 26.5.42. Apparatus for placing gravel in wells.
- J. T. Hayward. U.S.P. 2,372,575, 27.3.35. Appl. 10.10.38. Method of freeing pipe jammed in a well.
- A. Boynton. U.S.P. 2,372,656, 3.4.45. Appl. 29.9.41. Flow intermitter.
- P. W. Jenson. U.S.P. 2,372,785, 3.4.45. Appl. 25.1.44. Oil-well pump.
- R. Benke, assr to Atlantic Refining Co. U.S.P. 2,372,875, 3.4.45. Appl. 6.6.44. Coring device.
- R. C. Baker, assr to Baker Oil Tools, Inc. U.S.P. 2,373,005, 3.4.45. Appl. 19.8.41. Retrievable well-packer.
- R. C. Baker, assr to Baker Oil Tools, Inc. U.S.P. 2,373,006, 3.4.45. Appl. 15.12.42. Means for operating well apparatus.
- H. C. Laird and H. C. Otis, said Laird, assr to said Otis. U.S.P. 2,373,034, 3.4.45. Appl. 5.9.41. Well-control device.
- F. J. Spang. U.S.P. 2,373,061, 3.4.45. Appl. 24.1.42. Device for determining the condition of a well-bore from an etched acid bottle.
- G. A. Macready. U.S.P. 2,373,323, 10.4.45. Appl. 21.11.41. Process and apparatus for pressure core drilling.
- J. B. Warren, jr. U.S.P. 2,373,795, 17.4.45. Appl. 6.5.38. Specific gravity indicator for drilling mud.
- D. L. Driscoll, assr to L. F. Baash. U.S.P. 2,373,880, 17.4.45. Appl. 24.1.42. Liner hanger.
- D. G. C. Hare, assr to Texaco Development Corp. U.S.P. 2,373,197, 24.4.45. Appl. 15.1.42. Borehole logging method and apparatus.
- A. Boynton. U.S.P. 2,374,169, 24.4.45. Appl. 14.10.41. Means for cementing between multiple sands.
- K. A. Wright. U.S.P. 2,374,317, 24.4.45. Appl. 10.12.40. Well-production equipment.
- C. V. Millikan, assr to Geophysical Research Corp. U.S.P. 2,374,557, 24.4.45. Appl. 5.10.42. Oil-well testing device.
- J. L. Mauldin. U.S.P. 2,374,765, 1.5.45. Appl. 30.6.42. Hoist-type pump.
- E. E. Byrd, assr to Standard Oil Development Co. U.S.P. 2,374,922, 1.5.45. Appl. 5.10.42. Method of completing wells.
- L. C. Miller, assr of one half to Eastman Oil Well Survey Co, and one half to Eastman Oil Well Survey Corp. U.S.P. 2,375,313, 1.5.45. Appl. 7.2.41. Well tool.
- C. L. Walker. U.S.P. 2,375,335, 8.5.45. Appl. 17.9.41. Collapsible drilling tool.

I. A. Miller and M. M. Verhuel. U.S.P. 2,375,432, 8.5.45. Appl. 9.11.42. Valve structure for use on well casings and the like.

M. De Grootte, assr to Petrolite Corpn Ltd. U.S.P. 2,375,534 to 2,375,539, 8.5.45. Appl. 10.12.43. Processes for breaking down petroleum emulsions.

M. L. Ramey. U.S.P. 2,375,584, 8.5.45. Appl. 12.6.44. Elevator.

J. T. Wood, jr., and E. L. Davis, assr by mesne assignments to The Texas Co. U.S.P. 2,375,972, 15.5.45. Appl. 27.5.41. Formation tester.

W. D. Mounce, assr to Standard Oil Development Co. U.S.P. 2,376,168, 15.5.45. Appl. 19.10.38. Well logging.

G. O. Kimmell. U.S.P. 2,376,542, 22.5.45. Appl. 27.6.40. Method of removing samples from flowing streams.

R. R. Lawrence. U.S.P. 2,376,605, 22.5.45. Appl. 28.1.42. Wire line safety control packer.

J. W. Millington, assr to Sperry-Sun Well Surveying Co. U.S.P. 2,376,610, 22.5.45. Appl. 12.12.41. Electrical prospecting method and apparatus.

S. A. Scherbatskoy, R. E. Fearon, J. Neufeld and G. Swift, assr to Well Surveys Inc. U.S.P. 2,376,821, 22.5.45. Appl. 15.9.41. Well-logging instrument.

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REFINERY OPERATIONS.

Refineries and Auxiliary Refinery Plant.

1314. Stainless Steels Minimize Corrosion in Processing Sour Crude Oils. R. B. Tuttle. *Oil Gas J.*, 16.6.45, **44** (6), 104.—The Wood River Oil & Refining Co's refinery at Hartford, Ill., has recently been operating on a 100% West Texas crude charge for twenty consecutive days out of each thirty-day period, for the remaining ten days a charge of 100% Mid-Continent crude was processed. Both types of crude are pretreated to remove salt and other undesirable materials before processing in the topping-vacuum-cracking plant. The usual products—straight-run gasoline, naphtha, kerosene, and a light gas-oil—are taken off at the atmospheric fractionator, and the cracking of a light and heavy gas-oil is carried out with a conventional type Winkler-Koch unit.

The plant was constructed over four years ago to process Mid-Continent and Illinois crudes, but subsequent operations on sour crude have led to the installation of certain corrosion-resisting equipment. Recent examination showed that metal losses due to corrosion increase to a maximum at the heavy gas-oil cracker. A loss of 25% in six months occurred in the 4-6 Cr condensate line of the vapour separator. The loss in this time is believed nearly equal the loss in previous operation.

Control valves in this section made of 4-6 Cr were pitted, but higher turbulence in the light gas-oil valve is believed responsible for the increased corrosion rate with the item. No metal losses occurred in processing equipment up to and including the crude debutanizer, but from the atmospheric fractionator on through the cracking sections losses increased to a maximum at the heavy gas-oil section of the cracker. There is no corrosion in the heating coil for the vacuum still, made of 4-6 Cr and installed in the latter part of 1944.

No metal losses occurred in the lined or unlined sections of the vacuum column, with but slight losses in the carbon steel product lines, and loss in equipment of 4-6% Cr in the heavy and light gas-oil coils was negligible. Little losses occurred in pipe lines lined with 4-6 Cr in the cracking area, but the condensate line showed 25% loss in the last six months.

Replacement with 4-6 Cr material is taking place, and it is estimated that this will reduce future metal losses. Thorough examinations are made periodically, and all measurements of wall-thickness are recorded. G. A. C.

1315. Corrosion Problems* in the Petroleum Industry. A. H. Stuart. *Petroleum*, 1945, 8 (8), 153.—In sand-blasting operations, the pits produced by the grains of sand should not be deep, otherwise paint film may bridge the gaps and leave very small cells, in which corrosion may eventually commence. Combinations of zinc sulphate and potassium chromate, the aqueous solutions being sprayed on the surface simultaneously to precipitate an insoluble zinc sulphate, have shown promise in the experimental stage; and a dry surface is not a necessity. Paint is subsequently applied. Red lead is almost without rival as an anti-corrosive pigment. G. A. C.

1316. Guide to the Selection of Corrosion-Resistant Piping Materials. From the Chart Prepared by G. L. Vane Bogart, Research Engineer, the Crane Company. *Petrol. Engr.*, 1945, 16 (11), 177.—A tabulation shows, by means of reference letters, whether or not the following metals and alloys: iron and steel; Ni-Resist cast iron; 18-8 Mo steel; monel metal; nickel; red brass; acid-resisting bronze and aluminium, may be used with sixty-six materials, including hydrocarbons, gases, elements and inorganic and organic chemicals. Other letters indicate: (1) That the materials may be used with caution, *i.e.*, used where corrosion is permissible; for temporary installations; or where cost of better materials is too high, and (2) that information is lacking.

Reference notes are also included showing recommendations relative to valve parts, elevated temperature effects, control of solutions, etc. W. H. C.

1317. Preventing Boiler Metal Embrittlement. J. D. Betz. *Refiner*, July 1945, 24 (7), 254-258.—Boiler-metal embrittlement (more correctly termed intercrystalline cracking) is a potential source of danger in all steam-generating plants. While many technical articles have been presented on the subjects of embrittlement, most of these deal with the research and laboratory data on which our present knowledge of embrittlement is based. The purpose of the paper is briefly to outline the present status of the embrittlement problem in so far as it affects the practical operation of a power plant. There is as yet no complete agreement on the basic theoretical physical and chemical causes for the phenomenon of embrittlement. Investigators also are not in complete agreement as to the solution to the problem. Some investigators believe the best solution to the embrittlement problem to be in the production of different types of steel for boiler metal. Other investigators indicate the solution to be in the correction of boiler-water characteristics. While use of special steel for boiler construction is theoretically a good answer to the problem, it is also a long-range proposition, and therefore the correction of the boiler-water characteristics is of more practical significance in preventing embrittlement in boilers which are now being designed as well as those which are in operation. This article is concerned with the prevention of embrittlement by correction of boiler-water characteristics.

A. H. N.

1318. Water Treatment. M. P. Robinson. *Refiner*, Sept. 1945, 24 (9), 347-348.—A new large water-treatment plant for a high-octane gasoline refinery is described. In a minimum of ground space, the water-treating plant was designed to meet the following requirements: (1) softening to zero hardness to prevent boiler scale; (2)

proper reduction of silica for scale prevention; (3) reduction of the high carbonate alkalinity in the raw water to prevent the necessity for excessive boiler blowdown, and the inhibition of steel embrittlement; (4) removal of all suspended matter; (5) heating the raw make-up water to a satisfactory temperature for efficient chemical treatment; (6) deaeration of the treated water for the prevention of oxygen corrosion; (7) reheating and deaeration of returned condensate for prevention of oxygen corrosion; (8) removal of oil from the steam used for heating and deaeration; (9) the maintenance of a phosphate excess in the finished water, which when mixed with the deaerated condensate, would maintain the accepted safe phosphate concentration in the boilers as additional insurance against scale formation; (10) cleansing the filters without loss of water, without contamination by non-deaerated wash water, and without disturbing the quiescent settling conditions accompanying the treating process.

A. H. N.

1319. Talco Refinery Trade-Waste Treating Purifies Water for Cooling. C. G. Rook, jr. *Refining*, July 1945, **24** (7), 271-272.—After analysis of the water, the following procedure was adopted. The water was to be neutralized to 7.0 pH with sulphuric acid. This treatment served two purposes. It broke out the oil in emulsion as well as neutralizing the water. After neutralization with the sulphuric acid, an iron compound was introduced. In this case it was cuprous or ferrous sulphate. The purpose of the iron is to precipitate the sulphides and to affix the water for ferric hydroxide flocculation for the removal of turbidity. After introduction of the copper a suitable amount of chlorinated lime is introduced—enough to precipitate the iron as ferric hydroxide and to adjust the pH of the finished to 8.0. Chlorinated lime is used because it not only oxidized the ferrous ion rapidly, but has also a great odour-removing quality.

The system adopted is described in detail.

A. H. N.

1320. Compressed Air-Refinery Production and Maintenance Tool. E. C. Powers. *Refiner*, July 1945, **24** (7), 273-275.—The various uses to which compressed air can be put to operate auxiliary plant like air motors, hoists, etc., are described.

A. H. N.

1321. Theory of Ejectors. H. G. Elrod, jr. *J. Appl. Mech.*, Sept. 1945, **12** (3), A-170-A-174.—This paper extends an ejector theory which has previously been confirmed by the experiments of others. By means of the theory a new criterion of ejector performance has a new equation for ejector design are derived. Both the criterion and the equation are illustrated by a sample calculation in which a convenient computation procedure is employed. The procedure is adaptable to calculations for dissimilar fluids.

A. H. N.

1322. Inspection and Maintenance of Refinery Safety-Valves. E. R. Wilkinson. *Refiner*, July 1945, **24** (7), 245-248.—Spring-loaded relief valves are discussed in greater detail than deadweight safety-valves in this paper. Inspection and maintenance of safety valves at Baton Rouge refinery, where 6000-7000 valves are in continuous operation, are described.

A. H. N.

1323. Plant Design of Compressor Piping. B. C. Thiel. *Refiner*, July 1945, **24** (7), 259-262.—The basic principles involved in the design of the piping of compressor plants are presented. The treatment of the problems are mostly graphical.

A. H. N.

1324. Ras Tanura Refinery Project. Anon. *Petrol. Engr*, July 1945, **16** (11), 61-75.—The Arabia American Oil Co's refinery at Ras Tanura, Saudia Arabia, which was commenced in June 1944, is expected to start operations in September at half its designed capacity. The plant consists of two crude-oil distillation units, each processing 25,000 bbl/day; two large units for the thermal reforming of heavy straight-run gasoline; and other equipment; for producing motor gasoline, diesel oil, and fuel oils.

The crude-oil sources are those from the Abqaiq field, which will be pumped through a 12-in line, 40 miles (now under construction) via the principal Dammam field at

Daharan, and thence through a 10-in line 39 miles via the newly discovered Quatif field to the refinery. From the Damman field there is a 12-in line for the supply of crude to the Bahrein refinery, a distance of 34 miles, of which 17 miles is submarine and about 9 miles is overland across Bahrein in a direction slightly south of a line from west to east to the refinery. Cathodic protection is installed from both shores. All crude will be stabilized at Daharan before sending on to the two refineries.

The article is mainly devoted to constructional details, topography of the district, and lay-out of the subsidiary installations. The land elevation at the refinery is only 6 ft above high-tide water, and required filling from adjacent sand-dunes, and consequent erection of structures on piles emplaced on the sandstone formations 10 ft below general level. Oily water and sewage, in consequence, must be pumped to the sea. Inundation by water from exceptional high tides was another factor to be guarded against. The loading terminal is 6 miles from the refinery, and consists of a jetty to accommodate four ships and a submarine, loading and unloading line is provided for one tanker. 76 million gal per day of cooling water from the sea is lifted by propeller type pumps and passes via a concrete canal, 2000 ft long, to a settling basin, and then through a travelling screen to the suction sump, from which it is lifted by four high-pressure pumps and pumped through a concrete pipe to the refinery. Discharge from the units is made some miles away from the intake. Steam and electric power is provided by three boilers of 200,000 lb capacity, operating at 650 psi; and three turbine generators of 6000 kw give 13,000-volts, 60-cycle, 3-phase power. As the available water contains 3000 p.p.m. of total solids, and is limited in supply, the boilers are operated on a closed system and all condensates are conserved. Maps and illustrations of the units and photographs of the wharf and constructional work in progress are shown. Offices and houses, etc., are briefly described. 7000 natives were employed on the construction. W. H. C.

Distillation.

1325. Calculation of Plate Columns for Binary Distillation by the Ponchon Method. R. R. White. *Refiner*, Sept. 1945, 24 (9), 357-362.—The application of the Ponchon method to the cases where open steam is used and to columns with multiple feed or multiple products is discussed in some detail. The example problems presented demonstrate the extreme flexibility of the Ponchon method for computing plate columns. The concept of addition and differences points eliminates the necessity for involved algebraic manipulation regardless of the complexity of the operation under consideration. The representation of a fractionating column on the enthalpy-composition diagram gives a clear and exact picture of the effect of operating variables in distillation problems. Its only apparent disadvantage as compared with other graphical methods is that in some cases it requires larger graph paper. A. H. N.

1326. Refiner's Notebook. Types of Reflux. W. L. Nelson. *Oil Gas J.*, 16.6.45, 44 (6), 143.—Computations are given for hot, cold, internal, and circulating refluxes necessary to maintain thermal balance at the top of a tower, and estimation of reflux ratio described. G. A. C.

Absorption and Adsorption.

1327. Foaming a Factor in Absorber Design. H. C. Schutt. *Refiner*, July 1945, 24 (7), 249-253.—After discussing the types of absorption methods used in industry and the significance of foam, it is concluded that the foaming of liquids represents a major problem in industrial process design. The specific operating and test data given in this article indicate the importance of the proper selection of the absorbent for an absorption recovery cycle applied as an integral process step of modern refining operations. If an indigenous menstrum is used, information on its foaming characteristics should be obtained so that proper design allowances can be made. A thorough investigation of the foaming phenomenon as it concerns the refining industry seems highly desirable. The experimental data presented in this article are insufficient for an exhaustive analytical study and mainly intended to define the problem and suggest ways and means for its practical solution. A. H. N.

Cracking.

1328. Improvements Increase Efficiency of Fluid Catalytic-Cracking Process. E. V. Murphree, C. L. Brown, E. J. Gohr, C. E. Jahnig, H. Z. Martin, and C. W. Tyson. *Oil Gas J.*, 3.3.45, 43 (43), 64.—The difference between the old and the modernized fluid catalytic cracking processes, called the upflow and downflow operation respectively, is clearly shown by diagrams. In the downflow method the reactor is wide and allows low vapour and catalyst velocities, with the consequent separation of the catalyst in the reactor requiring only a one-stage cyclone for the separation of about $\frac{1}{2}\%$ of the circulating catalyst to be recovered. In the upflow method the reactor is narrow and longer, so that the velocities are higher and the catalyst is transported with the overheads and has to be separated by a three-stage cyclone.

The new process is fully described and illustrated by a flow-sheet and sketches of particular parts of the equipment.

Catalyst Flow.—The catalyst from the regenerator stand-pipe enters the reactor inlet, where it meets the preheated feed in the ratio of 5–30 lb of catalyst to 1 lb oil, depending on the conditions employed. These ratios require a large circulation of the catalyst amounting to 8–50 tons/min for a 15,000 bbl/day plant. In the reactor the dense turbulent catalyst bed settles out from the vapours as a dense beard in a clearly defined zone level which can be adjusted for the severity of cracking desired. On leaving the fluidized reaction bed the catalyst passes to the bottom of the reactor, where it is steam stripped, to remove hydrocarbons, and through a slide-control valve into the spent catalyst line, in which it is air transported to the regenerator. In the regenerator the catalyst mixes as a dense fluid of such a volume as to afford sufficient time for regeneration. For the 15,000-bbl/day unit a hold up of 150–500 tons is usual.

Oil Flow.—The charge-stock is preheated by exchange from the fractionator bottoms stream to between 100° and 400° F. as required. The feed, which may be varied from a naphtha to a heavy fraction, is passed to the reactor with hot catalyst controlled out by the slide-valve of the regenerator at 1000–1150° F., which heats and vaporizes it to 800–1000° F. The cracked vapours, as overheads, pass via the cyclone separator to the bottom of the fractionator and up through five disc and doughnut trays, down which the heavy bottoms (cycle) stream is flowing. This cools and fractionates the vapours into wet gas, light distillate gas oil, and cycle stock. The cooling stream, which also serves to remove any entrained catalyst, is passed through heat-exchangers to heat part of the fresh feed, any excess of heat being used for producing high-pressure steam. Part of the stream is also passed through a Dorr thickener, the stream returning to the fractionator for further cooling operations. The reactor is usually maintained at 8–12 p.s.i., turbulence aids uniformity of temperature, and severity of cracking is attained by simple regulation of the catalyst level in the reactor, or by change in rate of the catalyst circulation.

Air Flow.—The air flows through an auxiliary burner used for starting up the plant, and then flows to the spent catalyst return line, where it dilutes the solids flowing from the spent catalyst standpipe and enters the regenerator. The catalyst is burned to a carbon content of 1–0.5% at 1000–1150° F. under 2–4 p.s.i. The flue gases pass through a one-stage cyclone to a Cottrell precipitator, via a waste-heat boiler. The catalyst storage and plant performance are widely treated. Yields and qualities of aviation components from operations on paraffinic and naphthenic stocks and the acid treatment of products from a paraffinic gas oil are tabulated, but octane values are not allowed to be given. The anti-knock qualities of motor gasoline from cracking paraffinic and naphthenic stocks at 965° F. are shown, the octane values, C.F.R.—R. clear being 96.8 and 99.8, respectively; they have Reid vapour pressures of 10 p.s.i.

W. H. C.

1329. How Catalytic Cracker was Modified to Increase Throughput 50 Per Cent. J. H. Kunkel. *Petrol. Engr.*, July 1945, 16 (11), 137.—In the manufacture of 100-octane aviation components the Bayway refinery, New Jersey, fluid catalytic cracking plant, is closely integrated with the Baltimore refinery, Maryland, to which the *isobutanes* from the Bayward polymerization units are car transported for alkylation. The modifications to the Bayward cracking plant were made to increase the *isobutanes* for alkylation or for use as repressuring agent and increase the make of catalytic

base stock. The plant designed for 13,000-brl/day, single-pass cracking of heavy gas oil had also been operated on second-pass retreating of the first-pass catalytic naphtha, and one-pass cracking of light virgin gas oil up to December 1944. During that month single-pass trials, cracking light gas oil, were made to ascertain the reactor limits, and indicated that a feed of 16,000 brl/day could be maintained as the optimum, without after-treatment of the catalytic base. In April 1945 the reactor was lengthened from 28 to 53 ft and the acid-treating plant was also enlarged to refine the C 6's to 340° F. fraction in order to reach 19,500 brl/day maximum. Other changes made to avoid bottlenecks, and to help maintain this maximum throughput, were: (a) to obtain a higher carbon burning capacity; (b) to lower carbon yield; (c) to raise gas-compression capacity; (d) to obtain better tower fractionation.

Catalyst Regeneration.—To obtain increased flow of air in air-compressor lines, orifices were replaced by Pitot tubes, the air line to spent catalyst injector was increased from 8 to 12 in; the secondary air line to auxiliary burner was regularly used. These improvements resulted in a 5% burning capacity. Cooling water for the steam turbine-blower was chlorinated to eliminate algae formation. A new line from precipitator direct to regenerated hopper, in place of the line formerly going to the third multicyclone, overcame partial plugging and erosion of the multicyclone, resulted in increased burning capacity, and reduced the amount of fines carried to the precipitator. The increase of air obtained gave a higher pressure on the regenerator, and to avoid exceeding the critical velocity, a damper was placed in the flue between multicyclone and precipitator. The placing of an automatic control of the oxygen excess in the flue gas of regenerator gave a 3% increase in regeneration. Regenerator temperature was increased by 10° to 1600° F., and afforded an increase in burning capacity from 8800 to 10,000 lb/hr.

Reduction of Carbon Production.—Originally slurry oil, containing high carbon-producing fractions that add to the burning load, was pumped directly from fractionator bottom to reactor feed. The duty and operating data of a Dorr thickener which was installed in the transfer line to the slurry pump are described, and show that carbon production was reduced 20%. Other modifications, such as enlarging all lines, changing pump from centrifugal to reciprocating, and installing a flow controller, increased the thickener capacity by 30%. Replacing the conventional stripper of the spent catalyst, in the hopper, by a disc and doughnut dispersed-phase stripper has greatly reduced the occluded oil vapour formerly carried over to the regenerator.

Higher Gas-compressor Capacity.—Compressor limitations were improved by the installation of clearance bottles on the suction lines; a 10% gain resulted.

Fractionator Performance.—Difficulties of coke formation at bottom of fractionator, which limited feed rate and affected column control, were finally overcome, after various attempts, by removing the fractionator bottom disc, raising vapour inlet 4 ft, and repositioning it from the centre of tower to the perimeter, and by quenching the vapour at the inlet by a steam condensate, resulted in the decrease of temperature from 900° to 775° F. These changes resulted in the elimination of the coke troubles over a period of eleven months following their completion. W. H. C.

1930. Houdry Fixed-Bed Catalytic Cracking Unit. E. E. Pettibone. *Petrol. Engr*, June 1945, 16 (9), 149.—A Houdry fixed-bed catalytic cracking unit designed for a throughput of 16,200 brl per stream day has been erected at Cleveland, Ohio. The unit is in two separate sections, a six-case fixed-bed cracking section with heater fractionating and stabilizing towers, and a treating section having the same general equipment, but with only three cases. The six-bed section converts mixed virgin gas oils from the refinery's crude and vacuum pipe-stills to a feed for the second section, which produces base stock for blending into 100-octane aviation fuel. By-products are catalytic gas oils, isobutane for alkylation feed, isopentane, naphtha, and fuel gases. Each pair of cases in the six-case section have their own inlet and outlet manifolds, the motor valves being automatically controlled by a single cycle timer, so that each pair is on stream for 10 min. During the next 5 min the oil vapours are removed and purged for regeneration, which latter takes 10 min, after which period a further 5 min is occupied in removing air and combustion products in preparation for the return of the oil vapours.

Part of the exothermic heat released by the burning of the carbon deposit on the

catalyst is used to produce over 80,000 lb per hour of 450 lb steam in specially designed boilers.

The main control-room is furnished with all necessary instruments and is pressure-ventilated to preclude explosive and corrosive vapours. G. A. C.

1331. Paulsboro T.C.C. Unit Designed for Treating or Reduced Crude Cracking Operations. Part 3. Principal Controls. J. H. Kunkel. *Petrol. Engr.* June 1945, 16 (9), 235.—The rate of feed and recycle flow in the Paulsboro unit is maintained by two rate-of-flow controllers. The flow from the vaporizer furnace through a tar-stripper and then through the superheater before entering the reactor is automatically controlled at all points. A diagram of the reactor, catalyst elevators, and thermofor kiln is situated in the main control-room, and gives operators a complete picture. Adequate safety precautions are taken. For instance, a rate-of-flow controller alarm is installed on the superheated steam line into the bottom of the reactor, an audible alarm notifying loss of steam.

Provision is made for opening and closing pressure-actuated valves by manual means. The catalyst is controlled and recorded, and the kiln-feed elevator stopped or started by automatic methods employing pilot valves energized to control the chopper-type valve regulating the flow of catalyst. Kiln control is identical to that in the reactor catalyst hopper. The chopper valve at the kiln bottom is manually controlled to govern the rate of circulation from 50 to 130 tons per hour. Fractionator controls are installed, flow of quench and sidestream being governed, and fractionator temperature recorded. G. A. C.

1332. Mechanism of Flow in Fluid-Catalyst Cracking. H. P. Wickham. *Refiner*, July 1945, 24 (7), 263–266. *Paper Presented before American Society of Mechanical Engineers.*—The general principles of and factors affecting the flow of materials in a fluid-catalyst cracking unit are discussed. Density and fluidity control are effected by the ratio of catalyst to air. Density differences are utilized to balance the system of flow. A. H. N.

1333. Catalytic Cracking of Texas Panhandle Gas Oil by *cyclo*Version Process. A. E. Buell and B. Skinner. *Oil Gas J.*, 5.5.45, 43 (52), 87.—Since June 1944 Phillips Petroleum Co's commercial "cat cracker" has been in operation, and is to process about 12,000 bbl per day of Texas Panhandle gas oil to produce raw materials for the manufacture of aviation gasoline components and high-grade automotive fuel-stocks. The *cyclo*version process produces premium-quality gasolines. The desulphurizing action of the natural catalyst used yields a recycle gas oil showing a 50–60% sulphur content reduction.

The octane numbers of *cyclo*version gasolines are 76–77, an increase of 16–19 clear A.S.T.M. over products from thermal cracking. The virgin gas oil is catalytically cracked by a single-pass operation on cracking cycles of 4–10 hr before regeneration, the products then being separated into light olefins, high-quality gasoline, and catalytic gas oil. This gas oil is then thermally cracked to produce additional gasoline, light olefins, and residual fuel oils. There is no practical difference in temperature between the operations, and it has not been necessary to replace *cyclo*version catalyst to maintain activity, and replacement due to four inspections per year would amount to a catalyst cost of about \$0.0016 per barrel of charge, a fact contributing materially to the over-all low operating cost of the process.

The relatively high operating pressure of the process (75–81 lb/sq in) results in reduced size of equipment and lower gas compression costs. Dry gas production, exclusive of propylene, is about 632 M.B.t.u. per barrel of charge. A wide range of charge stocks can be handled by the *cyclo*version process. G. A. C.

Special Processes.

1334. New Methods of Producing Butadiene. Anon. *Oil Gas J.*, 16.6.45, 44 (6), 151.—New methods of producing butadiene from *diisopropyl* and ethylene have been patented. U.S. Pat. 2,376,961 employs the pyrolysis at 1350–1550° F. of *diisopropyl* (2 : 3-dimethylbutane), itself synthetically produced by alkylation of *isobutane* and ethylene. Pat. 2,376,986 describes the controlled air oxidation of ethylene; 2,376,987

the catalytic conversion of ethylene oxide and ethyl alcohol to butadiene; and 2,377,025 cites passing acetaldehyde and ethylene vapour at atmospheric pressure over a catalyst having a base of aluminium, magnesium, or zinc. G. A. C.

1335. Fischer-Tropsch Synthesis and the Petroleum Industry. V. I. Komarewsky and C. H. Riesz. *Nat. Petrol News. Tech. Sec.*, 7.2.45, 37 (6), R. 97.—The application of the Fischer-Tropsch process to the petroleum industry is outlined and the historical development of the syntheses is surveyed. The early work on hydrogenation by Sabatier, Fischer-Tropsch, and others is discussed. With a cobalt catalyst, Fischer-Tropsch obtained saturated and unsaturated gaseous and liquid hydrocarbons, alcohols, acids, aldehydes, ketones, and esters. In 1923 Fischer and Tropsch announced the "Synthol" process, in which an iron-alkali catalyst was used. Synthol consists of the above-mentioned products with only about 1% of hydrocarbons. By heating synthol at 842° F., hydrocarbons were obtained. In 1926 the Fischer-Tropsch Kogasin synthesis was announced. This synthesis takes place under the reverse conditions by which synthol is produced. Kogasin is almost free from oxygenated compounds, and consists largely of hydrocarbons ranging from methane to paraffin wax. The laboratory and commercial development of the kogasin synthesis are fully outlined. In 1936 an advance in the kogasin process was announced by Fischer and Pichler; by working at 75–220 p.s.i. with an iron or cobalt catalyst, an optimum yield of solid and liquid hydrocarbons was obtained. They called this process the middle-pressure synthesis. In 1938 the high-pressure wax synthesis was described. This process uses catalysts of group VIII, especially ruthenium at 1500 p.s.i. and at 383° F., and gives hydrocarbons and high-melting-point waxes approximately in the proportion of 2 parts wax to 1 part of oil. Kogasin products are composed of straight-chain paraffins and olefins with only small amounts of aromatics and naphthenes and oxygenated compounds, and consequently the gasolines from kogasin have only low octane values, as shown below. Lubricating oils are not produced directly, but methods for their production from kogasin are outlined.

Composition of Kogasin. (Cobalt Catalyst.)

	% by weight.	Olefins % by volume
C ₃ and C ₄ hydrocarbons	8	55
Gasoline (to 302° F.), octane number 55	46	45
Naphtha (202–392° F.)	14	25
Diesel oil (high cetane number)	22	10
Paraffin wax from oil (m. pt. 122° F.)	7	—
Paraffin wax from catalyst (m. pt. 194° F.)	3	—

Egloff *et al.* increased the octane number of a kogasin oil from 20–66 by thermal reforming and cracking, and the catalytic polymerization of the cracking gases, with a yield of 84.3%.

Since 1940 two new processes have been reported by Fischer and his co-workers: the naphthene synthesis and the *iso*-synthesis. In the former, naphthenes and aromatics are produced; the latter presumably forms *iso*-paraffins directly, the C₄ fraction of which is reported to contain 90% of *isobutane*. Very little information of these processes is available. The difficulties encountered in the Fischer-Tropsch synthesis and the mechanism of the reaction are fully discussed. Sabatier's and also Fischer and Tropsch's conception that carbides were formed and then reduced by the hydrogen-producing methylene radicals is amplified by Crackford's explanation of the reaction mechanism involving chemisorption and reduction of carbon monoxide: $2\text{Co} + \text{CO} + \text{H}_2 \longrightarrow \text{Co}_2\text{C} + \text{H}_2\text{O}$, and reduction of carbide by molecular hydrogen resulting in the formation of surface methylene radicals, and according to the amount of chemisorbed hydrogen present producing: if large, methane; if small, hydrocarbons: $n\text{Co}_2\text{C} + n\text{H}_2 \longrightarrow (\text{CH}_2)_n + 2\text{Co}$, the synthesis of paraffins or olefins depending on the conditions prevailing. Herrington and Woodward consider a cobalt catalyst to possess two active centres: (a) which causes formation and polymerization of methylene groups, probably CoC, and (b) which effects the liberation of the products, probably Co, metal. When (a) predominates, liquid products result; when (b) predominates, gaseous products are formed. The authors consider that the catalyst surface, and particularly the composition of the catalyst, greatly influence

the reaction, and that a multi-component or complex-action catalyst best fulfils the requirements for the Fischer-Tropsch synthesis by having: (1) the ability of forming carbides with the CO; (2) hydrogenating ability; and (3) polymerizing ability; these affording an explanation of several phenomena observed during the reaction by other workers, and which are discussed.

It is believed that recognition of the factors outlined will narrow the search for catalysts which control the synthesis reaction to the formation of the types of liquid hydrocarbons most desired.

The utilization of the process to convert natural gas to gasoline is probable now in certain areas. Future research may lead to a broad application in the production of high-quality fuels.

W. H. C.

1336. British Research on Petroleum Substitutes. 7(2) Synthetic Lubricating Oils. R. M. Bridgwater. *Petroleum*, 1945, 8 (8), 152.—Products obtained by the hydrogenation of coal are unstable, cracking being unavoidable. Polymerization of olefins and saturated hydrocarbons with or without the aid of catalysts can be effected to yield compounds of widely varying molecular complexity. Volatile halides such as chlorides of zinc, tin, and aluminium accelerate polymerization.

Low-temperature carbonization gas spirit yields oils of somewhat poor quality, which are not improved by solvent extraction. The polymerization of ethylene yields oils with moderate viscosity indices; the catalyst used influences the viscosity of the product. Chloro-compounds, when condensed, yield oils with viscosity indices about 105 and having pour points about 55° F., provided suitable catalysts are used. The primary products of the Fischer-Tropsch process after polymerization with aluminium chloride yielded oils of fair quality, by a method used by Synthetic Oils, Ltd. At the Fuel Research Station the 80–140° C. fraction of the primary synthesis product yielded an oil of promise, which failed, however, to meet the Air Ministry specification.

G. A. C.

1337. British Research on Petroleum Substitutes. 8(1) Methane. R. M. Bridgwater. *Petroleum*, 1945, 8 (9), 179.—Methane occurs naturally in Britain in association with coal seams, but controlled removal is not yet possible. Sewage gas contains 70% of methane, but supply is limited. Methane is synthesized by the Sabatier and Senderens process from hydrogen and carbon monoxide; the first commercial process was worked by the Cedford Gas Co., nickel being the catalyst. The method was subject to research, and eventually a gas containing 77.7% of methane was produced. The Fuel Research Station experimented with molybdenum catalysts, but it was found that 90% conversion was only obtained at a pressure of 200 atm and a throughout of 2000 vol of gas per vol of catalyst space per hour; and in 1939 methane synthesis was still a long way from being a commercial proposition. Graham and Skinner submitted town's gas to catalytic methane synthesis to obtain a gas calorific value of 722 B.T.U. per cu ft.

G. A. C.

Metering and Control.

1338. Measurement of Flow of Fluids through Orifice Meters. W. L. Cowan. *Refiner*, Sept. 1945, 24 (9), 363–372.—This forms a part of the Southern California Meter Association Meter Course. In this part of the course, the practical aspects of metering liquids and steam are described and illustrated.

A. H. N.

1339. Fundamentals of Orifice Meter Measurement. J. B. Taylor, jr. *Refiner*, July 1945, 24 (7), 269–270.—This paper forms a part of the Southern California Meter Association Meter Course. The flow of fluids in orifices is described and the fundamental principles used in the calculations are briefly reviewed.

A. H. N.

1340. Fundamental Gas Laws and their Application to Orifice Metering. E. Valby. *Refiner*, July 1945, 24 (7), 267–268.—This paper forms a part of Southern California Meter Association Meter Course. In it the basic principles of metering by means of an orifice, taking into account supercompressibility effects, are presented.

A. H. N.

1341. Functions and Fundamentals of Temperature in Refinery Process Control. D. M. Boyd, Jr. *Refiner*, Sept. 1945, 24 (9), 334-337.—Basically instrumentation is the control of a product by its physical properties. At present only two of these properties—temperature and pressure—are being extensively used in refining. It is evident that many additional properties that can be used, such as refractive index, absorption spectra, and dielectric property. Some separations in refinery processing must be made on such slight changes in temperature that it seems logical that one or more of these other properties may offer much better approach to proper control. In this paper the development of temperature process control is traced and the control of temperatures in a 100-octane gasoline plant is used to illustrate the principles.

A. H. N.

1342. Electronics—Its Application to Petroleum Technology. F. R. Staley. *Oil Gas J.*, 5.5.45, 43 (52), 82.—Electronics deals with the conduction of electricity through a vacuum or a gas; the electronic tube is an electrical device that controls current very rapidly without the use of moving parts. There are many types of such tubes, devised for specific purposes. The Phanotron, for instance, is a mercury-vapour-rectifying valve, suitable as a power source for magnetic fields of rotating machines and magnetic separators.

Electronic tubes are employed in the Ignitron contactor to close and open the primary circuit or a resistance welder, thus greatly increasing the speed of forming liquid-tight and gas-tight joints. Thyatron synchronous precision controls used to control the time interval and current magnitude for each weld consist of an adjustable synchronous timer, an electronic switch and an electronic heat control for finely adjusting current.

The electronic tube can generate alternating currents from a direct current line. In the brazing and soldering of small parts the tubes can induce a current in the surface of the piece and cause it to heat largely by resistance losses.

Pliotrons, high-vacuum tubes that contain at least three elements—cathode, anode and grid—are used in the "dynetric" balancing machine to magnify minute voltages produced by rotor unbalance.

Electronic control finds a very wide range of application, in power conversion, amplification, and in electronic timing and switching circuits.

Electronic tubes are used to convert light into electricity and back into light again, a typical vacuum phototube consisting of a cathode coated with a photosensitive substance and an anode of distinctive shape. The X-ray tubes are used in radiography, fluoroscopy, and diffraction; and television depends on the cathode-ray tube to translate variations of current strength into proportional variations of light brilliance.

G. A. C.

1343. Electronics—Its Application to Petroleum Technology. Part III. F. R. Staley. *Oil Gas J.*, 16.6.45, 44 (6), 120.—A few typical industrial electronic circuits are described, with elementary diagrams showing all sequences. An important application of interlocked magnetic and phototube controls is in the control of grinding and cutting tools following contours to a high degree of accuracy. Phototubes initiate a voltage to operate the shutter of night aerial cameras.

Automatic time-cycle valve control, for periods from a few minutes to several hours, operating fifty or more valves in exact sequence, is possible in modern cracking plants producing aviation gasoline, toluene, and butadiene, by use of electronic timers.

Central-feed automatic lubrication systems employ these timers. High-tension electronic tubes are used in the recovery of catalyst particles, ranging from 10 to 15 microns, that escape from the regenerators of fluid catalytic cracking units. Electronics is applied to carrier currents for voice communication and supervisory control. In the electron microscope the source of illumination is a hot cathode which emits electrons made to move at a high velocity under the control of an anode. The very high magnifications obtainable find employment in the determination of particle size and shape, analysis of materials, and study of molecular structure.

The mass spectrometer, using gas molecules ionized in a quadrant-shaped vacuum tube, finds application in the manufacture of gasoline, synthetic rubber, explosives, and chemicals, and in detection of small traces of gases.

G. A. C.

1344. Measurement of Solids in TCC Process. A. E. Kelly. *Refiner*, Sept. 1945, 24 (9), 336-341. *Paper Presented before Southern California Meter Association.*—The Thermoform Catalytic Cracking unit is divided into a catalyst section and an oil section, which are integrated in the reactors. The oil section, which handles the hydrocarbons before and after the reactors, contains equipment common to the oil industry, but the catalyst section is novel. In the catalyst section the process solves the problem of coke removal by moving the pelleted or bead catalyst continuously through the reaction and regeneration steps. The purpose here is to discuss the general methods and equipment used in the measuring and establishing of catalyst flow rates, catalyst levels, and reactor seals. This is done by giving a diagram of the plant and describing in detail the different measuring and control components. A. H. N.

1345. Some Aspects of Standardization in Oil Measurement. H. Hyams. *J. Inst. Petrol.*, Sept. 1945, 31 (261), 339-342.—A preliminary report by the Chairman of Standardization Sub-Committee No. 1—Measurement and Sampling. A. H. N.

Safety Precautions.

1346. Analysis of Fireproofing Methods used in Refinery Construction. E. F. Brummerstedt. *Nat. Petrol News, Tech. Sec.*, 7.2.45, 37 (6), R. 86.—The protection of structural steel work in a refinery is described and a fireproofing specification is given which defines the structure components to be covered and the materials to be used in fireproofing. The material specified is Portland cement mortar, composed of 1 part cement and 3 parts of sand by volume, applied as a 2-in minimum covering, all members being previously wrapped with the wire mesh specified. The wrapping of the structural materials, such as beams, channels, and angle struts, and the protective cement coating are shown in diagrams. Methods of applying the protective coating cements, etc., are described—viz., "Guniting" or pneumatic application, is favoured as the simplest and most economical; poured cement; brickwork and pre-fabricated methods are discussed as to their advantages or disadvantages from the aspect of suitability, ease of application and cost of construction. W. H. C.

PRODUCTS.

Chemistry and Physics.

1347. Heats of Combustion and Isomerization of the Eight C_9H_{12} Alkylbenzenes. W. H. Johnson, E. J. Prosen, and F. D. Rossini. *Bur. Stand. J. Res. Wash.*, 1945, 35, 141.—Continuing the work on determination of heats of combustion, formation, and isomerization of hexanes, heptanes, and octanes already reported (*Bur. Stand. J. Res. Wash.*, Prosen and Rossini, 1941, 27, 289 and 519; 1945, 34, 65 and 163), the heats of isomerization of the eight C_9H_{12} alkylbenzenes have been determined by measurement of the ratios of heats of combustion in the liquid state using specially purified samples of these compounds and the procedure described.

These data were combined with the value previously reported for the heat of combustion of *n*-propylbenzene to obtain values for the heats of combustion of each of the C_9H_{12} alkylbenzenes in the liquid state at 25° C. T. M. B. M.

1348. Thermodynamic Properties of Methane at Low Temperature. W. H. Corcoran, R. R. Bowles, B. H. Sage, and W. N. Lacey. *Ind. Eng. Chem.*, 1945, 37 (9), 825.—The thermodynamic properties of methane from 70° to -230° F. and from atm pressure to 1400 lb psi, absolute have been derived from literature data, and are presented in tabular and graphical form. A. W.

1349. Thermodynamic Properties of 1:3-Butadiene in the Solid, Liquid and Vapour States. R. B. Scott, C. H. Meyers, R. D. Rands, Jr., F. G. Brickwedde, and N. Bekkedahl. *Bur. Stand. J. Res. Wash.*, 1945, 35, 39.—The butadiene was purified: (i) by distillation and taking a "heart" cut; (ii) fractional distillation; (iii) fractional distillation using a specially designed column; and (iv) fractional crystallization.

Estimation of the purity of the various samples based on melting-point data and vapour-pressure measurements are given.

A calorimeter of special design with electrical control and measuring circuits is described, and was used for determination of specific heat, heat of fusion, and heat of vaporization. Values for specific heats from -258° to $+30^{\circ}$ C. and heats of vaporization from -26° to $+23^{\circ}$ C. are tabulated. The accuracy of the calorimetric measurements was discussed.

Pressure-volume temperature measurements were made by two different types of apparatus (both fully described), one for the range 195 – 288° K. and the other for 0 – 152° C. The accuracy of measurements made is discussed, and results compared with those of other observers.

Special manometers are described for determination of density of the superheated vapour which was carried out in the range 30 – 150° C. Density of the saturated liquid was measured in a specially constructed pycnometer in the range -78° to $+95^{\circ}$ C.

The critical constants for 1 : 3-butadiene are tabulated, and tables embodying the results of all these measurements are included for specific heats, enthalpy, and entropy of the solid, liquid, and vapour.

T. M. B. M.

1350. Phase Behaviour of Binary Carbondioxide-Paraffin Systems. F. H. Poettmann and D. L. Katz. *Ind. Eng. Chem.*, 1945, **37** (9), 847.—The vapour-liquid equilibria and critical loci of the binary carbondioxide-propane, carbondioxide-butane, and carbon dioxide-pentane systems have been determined. The complete transition from the carbondioxide-ethane system, which forms constant boiling mixtures, to the carbon dioxide-pentane system, which has normal behaviour, is shown. The experimental data are presented in both graphical and tabulated form. A. W.

1351. Vapour-Liquid Equilibria in Mixtures of Volatile Paraffins. G. H. Hanson, G. G. Brown. *Ind. Eng. Chem.*, 1945, **37** (9), 821.—Two five-component mixtures were prepared of volatile paraffin hydrocarbons having critical temperatures of approximately 100° F. and critical pressures of about 2000 lb psi, absolute. Vapour-liquid equilibrium determinations were made on these two mixtures at 100° F. and at pressures up to that of the single phase. Equilibrium constants at 100° F. from these two mixtures were compared with those from a binary and ternary mixture, each of which has a critical temperature of 100° F. and a critical pressure of approximately 2000 lb psi absolute. Within the limits of experimental error, it is shown that equilibrium constants of the volatile paraffin hydrocarbons in binary or complex mixtures of paraffins, may be defined by specifying the temperature, pressure, and "convergence pressure" corresponding to the temperature of equilibrium. The convergence pressure is the critical pressure of a mixture at its critical temperature, and at any other temperature is that pressure at which the equilibrium constants appear to converge to unity.

A. W.

1352. Variation of Viscosity of Liquids with Temperature. P. P. Kobeko, E. V. Kurshinskii, and N. I. Shishkin. *Symp. Visc. Liquids and Colloids, Acad. Sci. U.S.S.R.*, 1944, **2**, 71–75.—The derivation of expressions for change in viscosity with temperature are briefly discussed. Curves of $\log \eta = f\left(\frac{1}{T}\right)$ are plotted, on the one diagram, for a wide variety (19) of substances, ranging from compressed gases to high-melting silicates. A general similarity of type is observed for the majority of the curves. It is considered that viscosity-temperature relationships present a unified picture and that distinctions between "simple" and "complex" liquids are not justified. In the case of a change from the liquid to the gaseous state there is a sudden inversion of the curve at the critical point. The course of a typical complete viscosity-temperature curve, including both the liquid and gaseous regions, is plotted and discussed.

V. B.

1353. Theory of the Viscosity of Liquid Mixtures. Ya. I. Frenkel. *Symp. Visc. Liquids and Colloids, Acad. Sci. U.S.S.R.*, 1944, **2**, 30–34.—A mathematical discussion, dealing with binary mixtures. Starting from a consideration of a molten salt as being a liquid mixture of anions and cations, the treatment is developed to deal with mixture

viscosities from the standpoint of diffusion mechanism, and from that of the free volumes. The formula suggested differs from those put forward earlier by other workers, principally in that it introduces a supplementary "mutual" viscosity, characterizing the inter-action of the components of the mixture. It is considered that viewing the viscosity of a mixture on the basis of free volumes is more correct than on a consideration of the diffusion mechanism.

V. B.

1354. Determination of Pressure-Viscosity Coefficient and Molecular Weight of Lubricating Oils by Means of Temperature-Viscosity Equations of Vogel and Eyring. A. Cameron. *J. Inst. Petrol.*, Oct. 1945, **31** (262), 401-414.—A summary of the literature available and the correlation of pressure-viscosity coefficients and molecular weights are presented.

A. H. N.

1355. Method for Calculating the Properties of Hydrocarbons and its Application to the Refractive Indices, Densities, and Boiling Points of the Paraffin and Mono-Olefin Hydrocarbons. W. J. Taylor, J. M. Pignocco, and F. D. Rossini. *J. Res. Nat. Bur. Stan. Wash.*, 1945, **34** (5), 413.—A method is described for the calculation of the properties of hydrocarbons, involving the summation of contributions from component parts of the molecule (*i.e.*, CH₃, CH₂, CH, and C) together with contributions from interactions between adjacent component parts. For the paraffin hydrocarbons the calculations were made in terms of the difference in the value of the property between a given normal paraffin and its isomer, the required constants being evaluated from data on thirty-three paraffins, from C₅ to C₈. For the mono-olefin hydrocarbons calculations were based on the difference in the value of the property between the given mono-olefin and the corresponding paraffin having the same carbon skeleton, the constants being obtained from data on fifty-eight mono-olefins, from C₅ to C₇.

C. L. G.

Analysis and Testing.

1356. Analysis of cycloPropane-Propylene Mixtures by Selective Hydrogenation. E. S. Corner and R. N. Pease. *Ind. Eng. Chem. Anal.*, 1945, **17** (9), 564.—A new method is given for the analysis of cyclopropane-propylene mixtures by selective hydrogenation, and accuracies of $\pm 0.5\%$ are claimed. The gaseous mixture is first passed over a nickel-kieselguhr catalyst poisoned with mercury to hydrogenate the olefin, and then over the non-poisoned catalyst to hydrogenate the cyclopropane. The presence of inert components, such as gaseous paraffins, does not interfere with this analysis, and hence an advantage is obtained over other methods. Small samples (~ 1 c.c. at N.T.P.) may be analysed with good accuracy, and 15-30 min are required for each determination.

A. W.

1357. Analysis of Ternary Mixtures of Three Isomeric Hexanes. V. A. Miller. *Ind. Eng. Chem. Anal.*, 1945, **17** (9), 566.—Solution temperature measurements were made using all the isomeric hexanes, with both nitrobenzene and diethylphthalate. Data are given which make it possible for a hexane ternary mixture, composed of 2,2-dimethylbutane, 2,3-dimethylbutane, and 2-methylpentane, to be analysed with an accuracy of 0.5% in about an hour.

A. W.

1358. Ultraviolet Absorption Spectra of Aromatic Hydrocarbons as an Analytical Tool (2). R. Schnurmann and S. Whincup. *Petroleum*, 1945, **8** (8), 142.—The scope of the spectographic method of aromatic hydrocarbon analysis is limited by the purity of the chemicals used, for example in the synthesis of the separate isomers of xylene; by the adjustment of the relative position of the nicol prisms and in the timing of the photographic exposures.

G. A. C.

1359. Separation and Determination of Aromatic and Mono-olefin Hydrocarbons in Mixtures with Paraffins and Naphthenes by Adsorption. B. J. Mair. *J. Res. Nat. Bur. Stan. Wash.*, 1945, **34** (5), 435.—A method is described for the separation of: (a) paraffins plus naphthenes; (b) mono-olefins; and (c) aromatic hydrocarbons from mixtures by desorption with ethyl alcohol from a column of silica gel into which the mixture has been introduced. A procedure is outlined for determining the

aromatic content of straight-run petroleum distillates, involving a correction for sulphur content. C. L. G.

1360. A Scheme for the Photometric Determination of Minute Amounts of Arsenic, Copper, Lead, Zinc, and Iron (with Certain Other Metals) in Organic Compounds, e.g., Medicinals. N. Strafford, P. F. Wyatt and F. G. Kershaw. *Analyst*, 1945, **70**, 232. Devised principally for application to organic compounds with a very low metal specification limit, this scheme is sufficiently flexible to be adapted to materials with a somewhat higher metal content. The interferences of other common metals, supposed present in amounts up to 500 ppm, have been investigated. Under the given conditions the method is found to be specific for arsenic, lead, and iron. Bismuth interferes with the determination of copper; cadmium is included with the zinc. Conditions are described for eliminating these interferences and for determining bismuth, nickel, and cadmium. C. F. M.

1361. Determination of Fat in Mixtures Containing Fatty Acids, and Determination of Unsaponifiable Matter in Oils and Fats. N. D. Sylvester, A. N. Ainsworth, and E. B. Hughes. *Analyst*, 1945, **70**, 295.—A solution containing the fat and fatty acids is passed through a column of aluminium oxide. The fat is readily washed through by a solvent (e.g., chloroform or ether), while the acids remain strongly adsorbed on the column.

Unsaponifiable matter is estimated by saponifying the oil or fat and extracting the soap solution with ether. The extract is washed with dilute acid to decompose the small amount of soap present, and the resulting fatty acids are removed by passing the ether solution through an adsorbing column. C. F. M.

1362. Rapid Methods for Determination of Phosphine and Hydrogen Sulphide as Impurities in Acetylene Generated from Commercial Calcium Carbide. V. Brameld. *Analyst*, 1945, **70**, 279.—The impure acetylene is passed through sodium hypochlorite solution and (after removal of the excess sodium hypochlorite) phosphate is determined colorimetrically as the blue phosphomolybdate reduction compound, while sulphate is determined turbidimetrically as barium sulphate. C. F. M.

1363. Rapid Determination of Iodine Value of Castor Oil. R. Rosenbusch and R. Parker. *J. Soc. chem. Ind.*, 1945, **64**, 211.—The addition of 2 ml of 2.5% solution of mercuric acetate in glacial acetic acid shortens the absorption time from 1 hr to 3–5 min. C. F. M.

1364. Pressure Viscosity and Consistency of Greases. A. E. Hickel. *Refiner*, July 1945, **24** (7), 276–279.—The term "pressure viscosity" is used to denote the viscosity calculated from a Standard Saybolt viscometer orifice adapted to be subjected to a pressure differential. It has been found that with semi-fluid greases the actual pressure viscosity is within 10% (low) of the true Saybolt viscosity, while with heavy oils the results obtained are within 4% (low) of the true Saybolt viscosity. Greases above semi-fluid consistencies, and up to wheel-bearing greases or heavier, are closer to the actual or true pressure viscosity without any additions or deductions, but the temperatures of greases as well as the air temperature in the cabinet must be constant for 10–15 min so that both thermometers are exactly the same, and a careful operator can check and duplicate results every time. The apparatus and the technique of measurement are described in detail. A. H. N.

1365. Standardization of Methods of Determining the Viscosity of Petroleum Products. P. M. Golenev. *Symp. Visc. Liquids and Colloids, Acad. Sci. U.S.S.R.*, 1944, **2**, 188–191.—In the U.S.S.R. the Engler viscometer is still used for specifications and testing purposes. This instrument has, for practical purposes, only a narrow range (1–17° E), and is inaccurate, particularly at the lower end of the scale, where the variation of 1.5% permissible in the standard method (and often exceeded in practice) amounts to a variation of 10% when expressed as kinematic viscosity. The use of an absolute capillary viscometer is now also a standard method; the viscometer is based on the work of Ostwald–Fenske–Pinkevich. The apparatus specified is effective in the range 1–10,000 cs. and at -20° to $+150^{\circ}$ C. The reproducibility laid down is 0.8%,

but better results can in fact be obtained. It is urged that all specifications, etc., should henceforth be expressed in absolute units, so as to allow the use of the empirical Engler scale to be discontinued.

V. B.

1366. Single-Cylinder Engine Tests of Substitute Motor Fuels. D. B. Brooks. *Bur. Stand. J. Res. Wash.*, 1945, **35**, 1.—Determinations of the power, thermal efficiency, and combustion performance of a reference gasoline and a series of substitute fuels have been made on the C.F.R. single-cylinder, variable-compression engine. These were carried out at the compression ratio giving: (a) trace knock on the gasoline (5.11); and (b) trace knock with each fuel.

The substitute fuels examined were: (i) 190-proof ethyl alcohol; (ii) 200-proof ethyl alcohol; (iii) 75% ethanol, 25% diethyl ether; (iv) 50% acetone, 50% butanol; (v) 27% acetone, 6% ethanol, 67% butanol; and (vi) 28.5% acetone, 71.5% butanol. Compression ratios for trace knock under optimum conditions for these were: (i) and (ii) 9.91; (iii) 8.60; (iv) 8.18; (v) 7.81; and (vi) 7.43.

Curves and tables are given relating fuel consumption, spark advance, and L.H.P., with specific fuel consumption for each of the thirteen runs. Power is also shown related to fuel heat input of the fuel at compression ratio of 5.11 and at compression ratio for trace knock, with each fuel. The properties of the theoretical fuel-air mixtures are also tabulated.

The optimum spark advances and per cent. of minimum spark advance for each fuel at each mixture ratio (at compression ratio 5.11) were corrected for humidity, and are shown plotted against fuel-heat input in B.Th.U./lb of dry air. Thermal plug temperatures at optimum spark advance are also shown plotted against fuel-heat input at compression ratio 5.11 and compression ratio for trace knock with each fuel. Power curves at fixed spark advances are also known. Conclusions are:

(i) At constant compression ratio 2-3% more power is obtained with the acetone blends, whereas with 190- or 200-proof ethyl alcohol the increase is somewhat larger (4-5%). At lean mixtures the substitute fuels show slightly better thermal properties than does gasoline.

(ii) Analysis of the optimum spark advances indicates that the rates of burning of the substitute fuel are equal at best mixture ratio, with the exception of the ether blend, which may burn a few per cent faster.

(iii) All the substitute fuels can be used at compression ratios yielding more power than that allowable for the gasoline, with a corresponding increase in thermal efficiencies. The permissible increase in power range up to one quarter for ethyl alcohol, the thermal efficiency of which is 36%, based on the higher heating value.

(iv) Analysis of power, rate of burning as indicated by optimum spark advance, and thermal plug temperatures, versus fuel heat input, reveal no material differences in the combustion performances of these fuels.

(v) Relative power at equal heat input/lb of air is the same for these fuels at both compression ratios used.

T. M. B. M.

1367. Extension of Octane Scale above 100 O.N. Anon. *J. Inst. Petrol.*, Oct. 1945, **31** (262), 418-420.—The re-calibration of *iso*-octane + 4 ml. T.E.L./Imp. gal in *n*-heptane + 4 ml. T.E.L./Imp. gal.

A. H. N.

1368. Sulphur Estimation by Lamp Method Using I.P., Test 107/45(T). A. R. Javes. *J. Inst. Petrol.*, Sept. 1945, **31** (261), 343-346.—The paper deals with the tentative standard adopted in the sixth edition (1945) of "Standard Method for Testing Petroleum and its Products" for estimating sulphur by a modified lamp method, and discusses its accuracy.

A. H. N.

1369. Backward-Feed Distillation Column. W. M. Langdon. *Ind. Eng. Chem. Anal.*, 1945, **17** (9), 590.—An apparatus for backward-feed distillation is described. The feed being introduced at the top of the stripping column, it has several advantages over the usual methods. For instance, distillation rate is adjusted rapidly and closely by means of a stopcock, and there is practically no fire hazard. The disadvantages and advantages of this type of column are detailed.

A. W.

1370. Laboratory Distillation at Atmospheric Pressure of Normally Liquid Hydrocarbons. H. J. Hepp and D. E. Smith. *Ind. Eng. Chem. Anal.*, 1945, 17 (9), 579.—The construction and operation of a generally useful analytical still are described. Points of interest in the design are: (a) The insulation of the column with a specially designed electrical heater, enabling automatic, adiabatic control; (b) high reflux ratios are obtained using a special head provided with electrical means for automatic external control.

Columns of the described design containing up to 100 theoretical plates have operated satisfactorily. Suitable fractionating columns are described, and the factors involved in the separation of near-boiling components are briefly indicated. "Short-cut" analytical procedures for routine work are mentioned. A. W.

1371. Use of Liquid-in-Glass Thermometers. J. G. Durham. *J. Inst. Petrol.*, Sept. 1945, 31 (261), 356-357.—A short communication from the National Physical Laboratory regarding the use, storage, and special precautions to take with mercury in glass thermometers. A. H. N.

1372. "Eagle" Single-Compartment Bottom Sampler. R. G. Mitchell and S. A. Hunn. *J. Inst. Petrol.*, Oct. 1945, 31 (262), 415-417.—The advantage of being able to obtain liquid samples right from the bottom of tankage on storage installations, refineries, and tankers, and the shortcomings of existing samplers for this purpose, led the authors to evolve the apparatus described, which measures $2\frac{3}{4}$ in diam by approximately $8\frac{1}{2}$ in high, weight 6 lb, and is capable of obtaining 160 c.c. of liquid from the very bottom of a tank. A. H. N.

1373. An Air-free CO₂ and H₂ Generator. Anon. *Chem. and Ind.*, 1945, 270.—Made by Quickfit and Quartz, Ltd, for micro and semi-micro analyses and small-scale hydrogenations. C. F. M.

Gas.

1374. Design of the Goleta Dehydration Plant. R. H. Hull. *Refiner*, Sept. 1945, 24 (9), 353-356. *Paper Presented before California Natural Gasoline Association.*—One of the unique features of this dehydration installation is that it operates as part of an underground storage project for natural gas. Gas from many sources is put into the formation of the Goleta gas-field during the summer, so it can be withdrawn as needed during the winter. Even then demand for the gas varies, with the result that the dehydration plant has three-contact columns, which come into play in keeping with demand. Design and operation of the unit are similar to requirements for dehydration in natural gasoline manufacture. A. H. N.

Engine Fuels.

1375. Chemical Composition and Road Antiknock Performance of Possible Post-war Motor Fuels. J. F. Jordan. *Refiner*, Sept. 1945, 24 (9), 327-333. *Paper Presented before American Chemical Society.*—The significance of present-day test results and their indications of future possibilities are explained. A. H. N.

1376. Alcohol-Water Injection as a Detonation Depressor in Gasoline Engines. *Nat. Petrol News, Techn. Sec.*, 7.2.45, 37 (6), R88 and **Operating Economics of Alcohol-Water Injection at Full Engine Load Told Society of Automotive Engineers.** (*Abstracts of a Paper Entitled "Alcohol-Water Injection,"* by A. T. Colwell, R. E. Cummings, and D. E. Anderson, Presented at the Society of Automotive Engineers Meeting on Jan. 8, 1945).—The injection of water as an internal coolant in aviation engines to suppress detonation has afforded remarkable boosting of power for take-off and during flight, but alcohol or alcohol-water mixtures are reported to give superior results. The theory of internal coolants is discussed. The alcohol is not used as a primary fuel, and its injection is not for the anti-knock qualities in the fuel itself, but to supplement it and give maximum performance. The value of injection is limited to definite temperature and load conditions of the engine; under other conditions it would not improve engine efficiencies, and might impair them. The effects produced by injec-

tions are not known, but they may be due to the high latent heat of evaporation of the water or alcohol or mixture and some function of specific heat. The results of trials of anti-detonant injection in the form of alcohol-water mixtures of different ratios in vehicle engines of different type and differing compression, and with various grades of fuels in varying proportions up to 25% of the fuel, are given in twelve graphs which show the performance under the conditions given. The plots show that the burning characteristics are altered, reducing the rate of pressure rise in the cylinders, lowering peak values, and flattening the indicator diagrams. The economics of such injection operations are discussed. 100% alcohol is more efficient than the mixtures, but mixtures are quite satisfactory and much cheaper. A 50:50 mixture appears to be the most economical for the best results. With a gasoline of the proper octane rating, little advantage would accrue by the use of a coolant; the best gains were obtained when using a gasoline of 10-15 octane numbers lower than the engine requirements when operating on straight fuel. The development of types of automatic alcohol-water injection systems suitable for vehicles is discussed. The automatic feature would govern the flow of the coolant mixtures from low to maximum power to that found most efficient in operation. Supplementary equipment for existing carburettors is described, and it is thought possible that injection may be effected by a dual-fluid carburettor. Other sections of the paper relate to the procedure and instrumentation of the trial equipment; engine wear, corrosion, and cleanliness; and a cost analysis is given.

W. C. H.

Gas and Fuel Oils.

1377. Stability of Fuel Oil. W. E. J. Broom. *J. Inst. Petrol.*, Sept. 1945, **31** (261), 347-352.—A preliminary report by the Chairman of Stability of Fuel Oils Panel of Standardization Sub-Committee No. 4—Gas, Diesel, and Fuel. A. H. N.

1378. Use of Cracked Gas Oils as Burner Fuels being Tested. Anon. *Nat. Petrol. News. Tech. Sect.*, 7.2.45, **37** (6), R.124.—The Western Petroleum Refiners Association have issued a progress report on the use of cracked oils from catalytic and thermal operations on different types of crude oils. The tests have been carried out according to the requirements of Commercial Standards Test 101-43 for determining smoke, and a 20-hr burning test using 80 lb of fuel. The tests made are defined. Tests are being conducted with "Coleman Model M-511" heaters, with 10-in breeze-type vaporizing burners fitted for easy removal on completion of each test. The "set-up" is described and illustrated and the test procedure is defined. The fuel-input rate was set at 3.60 lb/hr. At the conclusion of the 20-hr test the deposits are carefully removed from the burner, that from the pot-bottom being segregated from the carbon from the sides. Deposits were weighed before and after drying, and a determination of characteristics was made. The Association's proposed development programme as to cracked oils and blends in co-operation with stove manufacturers and refiners, and the activities of the A.S.T.M. on fuel oils, are discussed. W. H. C.

Lubricants.

1379. Engine Testing of H.D. Oils. Anon. *J. Inst. Petrol.*, Sept. 1945, **31** (201), 362-368.—A preliminary report by the Heavy Duty Engine Oil Panel of Standardization Sub-Committee No. 5—Engine Tests. A. H. N.

1380. Viscosity of Lubricating Emulsions and Solutions of Soaps in Mineral Oils. D. S. Velikovskii. *Symp. Visc. Liquids and Colloids, Acad. Sci. U.S.S.R.*, 1944, **2**, 214-216.—In the case of a colloidal solution, such as soap in oil, viscosity is not a fundamental characteristic, and results obtained in a viscometer cannot be used as a guide to behaviour. A surer indication is obtained by determining the mechanical equivalent of the internal friction by means of a suitable testing machine (cf. Abs. 1056, 1945); the results thus obtained are, in the case of high velocity gradients, comparable to those obtained in a capillary viscometer, but for low velocity gradients the latter may be up to 3000 times as great as the value obtained mechanically. The mechanical equivalent of internal friction varies linearly with the concentration of soap in oil (variation of viscosity determined by a viscometer, is non-linear in such cases); the

angle of slope of the curve characterizes the "thickening power" of the soap. In the case of emulsions, these are at present being used to a considerable extent as lubricants for I.C. (tractor) engines. The viscosity of such emulsions, when determined in the usual manner, is 3 to 4 times that of an engine oil, although operational results are satisfactory. Emulsions are particularly suitable for lubrication of I.C. engines, since these have frequent starts and stops, and the mechanical equivalent in the case of emulsions, is particularly favourable at the moment of initial movement. Confirmation of this is found by the low wear in the case of tractor engines lubricated by emulsions. For emulsions, the mechanical equivalent of internal friction is in linear relationship to the content of Ca soap and of water, which allows the mechanical equivalent of emulsions of known composition to be calculated.

V. B.

1381. Principles Governing the Production of Lubricants with Small Viscosity-Temperature Coefficients. P. P. Kobeko and N. I. Shishkin. *Symp. Visc. Liquids and Colloids, Acad. Sci. U.S.S.R.*, 1944, 2, 161-166.—It is pointed out that the mixing of similar liquids has little effect in improving the viscosity-temperature coefficient of the mixture, as compared with that of the components. If, however, the solute has a M.W. which is very great compared with that of the solvent, then the change in viscosity with temperature is similar to that of the latter, which in the case of non-viscous solvents is very small. Results are given on measurements of the viscosities of solutions of polystyrene (M.W. = 400,000) and synthetic rubber in toluene and turpentine, respectively, over the temperature range -80 to $+100^{\circ}$ C. Whilst an ordinary lubricating oil changes in viscosity by 10^{10} times within this temperature interval, the change in the case of the solutions examined is only about 10^2 - 10^3 times. Results are also given for a mixture of rubber, turpentine, and transformer oil.

V. B.

1382. Factors Causing Lubricating Oil Deterioration in Engines. (*Laboratory Evaluation*). R. E. Burk, E. C. Hughes, W. E. Scovill, and J. D. Bartleson. *Refiner*, July 1945, 24 (7), 280-286. *Paper Presented before American Chemical Society*.—The deterioration of lubricating oil in internal-combustion engines is largely due to oxidation reactions. It is shown that these reactions are primarily catalytic at the engine temperatures in question, the catalysts being metals and metal compounds, such as iron, copper, lead, and their compounds. The effects of other possible catalytic materials, such as blow-by gas components, are considered. These observations are applied to a laboratory test procedure for evaluating the Service stability of oils in which an attempt was made to develop a set of conditions and catalysts which duplicate those of the present Chevrolet engine test. The degrees of reproducibility and of correlation with engine results are shown in detail. Correlation of the test with four B oils has been found to be good except on the point of bearing corrosion. Additional procedures are described for determining the tolerance of oils to more severe conditions, since the results indicated that the above conditions and catalysts are not universally suitable.

A. H. N.

1383. Manufacture of Lubricating Oils. V. A. Kalichevsky. *Refiner*, Sept. 1945, 24 (9), 342-346.—The refining is discussed under groups of processing showing similarity in their refining action. Commercially important processes belonging to each individual group are: 1. Solvent deasphalting—propane deasphalting; 2. Single-solvent refining—Chlorax, furfural, nitrobenzene, and phenol processes; 3. Double solvent refining—Duo-Sol process employing propane and cresylic acid; 4. Dewaxing—cold settling (practically obsolete), cold pressing, naphtha centrifuging, benzol-ketone, Bari-Sol (chlorinated solvents), and propane dewaxing processes; 5. Adsorbents—clays and synthetic adsorbents applied in finely divided state (contact process) in coarse particles (percolation process), or, occasionally, while the oil is distilled (Filtrol process).

A. H. N.

1384. Lubrication Vade Mecum. 3(2) *Alphabetical Index of Machines*. E. W. Steinitz. *Petroleum*, 1945, 8 (8), 155.—The alphabetical index of machines is continued, in connection with the lubrication charts based on classification of machinery and uses.

G. A. C.

Bitumen, Asphalt and Tar.

1385. Bitumen and the Bitumen Industry, with Special Reference to Aliphatic Bitumen 4(1) Asphaltic Bitumen in Road Construction. J. S. Jackson. *Petroleum*, 1945, 8 (9), 170.—The earlier macadam type of road surface employed interlocking stone aggregates to which fine material was added, water being the binder. The limited effective range of water content led to the development of tar macadam, coal-tar having more permanent binding properties.

Bitumen became available about 1920, and rapid developments in road-making technique followed, the most important being hot-mix asphalt. The nature and amount of filler are an important factor, so is the application of the optimum percentage of bitumen binder, to give a waterproof, resilient, and slightly flexible structure. Bitumen binders remain plastic under winter conditions and show no significant tendency to flow at high atmospheric temperatures, and the continuous waterproof surface eliminates the danger of surface water reaching the foundations. The hot-mix process has certain practical restrictions; and cutbacks, or liquid asphaltic bitumens, graded on a viscosity basis, provide a bitumen binder which can be applied at lower temperatures to give a mix which could be spread cold. G. A. C.

1386. Problem of Devising Tests for Soil Stabilization. L. G. Gabriel. *J. Inst. Petrol.*, Sept. 1945, 31 (251), 353-355.—A preliminary report by the Chairman of Soil Stabilization Panel of Standardisation Sub-Committee No. 7—Asphaltic Bitumen. A. H. N.

Derived Chemical Products.

1387. Oxidation of Paraffins. Part I. E. Stossel. *Oil Gas J.*, 21.7.45, 44 (11), 130.—The first of three articles dealing with the oxidation of paraffins, with special reference to the preparation of synthetic fatty acids and fats such as butter substitute in Germany, starting from Fischer-Tropsch slack wax.

The major steps in the oxidation of paraffin waxes to form fatty acids and other oxygenated products are presented, and theories of the sequence of steps in the oxidation process are discussed.

The period of oxidation may be greatly shortened by the use of catalysts which: (i) tend to minimize the induction period for oxygen absorption; (ii) destroy any hydrocarbon oxidation inhibitors which may be present; and (iii) form pro-oxidants which influence the course of the oxidation in a certain direction.

The weight of catalyst used varies from a few thousandths up to 3% by weight. Suitable ones are carboxylic acid salts, especially oleates, naphthenates, palmitates, cinnamates, abietates, and resinates combined with Cr, Se, Mo, Fe, V, Sb, and Bi. Mixtures may show greater activity than components. Separation of the oxidized acid fraction from the neutral oxidation products and unchanged material, or separation of the oxidation products from the unoxidized hydrocarbons, may be effected in several ways—e.g., (a) using physical differences such as melting points or solubility; (b) using differences in chemical behaviour such as saponification or esterification with occasional fractional distillation. T. M. B. M.

1388. Oxidation of Paraffins. Part II. E. Stossel. *Oil Gas J.*, 18.8.45, 44 (15), 145.—A description is given of the preparation of fats and soaps in Germany from the slack wax obtained as a by-product of Fischer-Tropsch synthesis.

400,000 tons of technical fats are said to be used annually in Germany, 70% mainly consisting of synthetic fatty acids, being used for soap manufacture.

Paraffins (Fischer-Tropsch slack wax) of from twenty to thirty carbon atoms were generally used for the production of higher fatty acids for soap manufacture by catalytic oxidation with air. The distribution of air through the liquid is of great significance during oxidation, and the selection of catalysts plays an important part in accelerating the process at low temperatures by shortening reaction time and controlling the course of oxidation, especially in decreasing formation of oxy-acids and minimizing over-oxidation of reaction products. The oxidation must be interrupted before all the paraffin is oxidized, and the temperature must be kept as low as possible.

The oxidation can be conducted as a continuous process in aluminium or acid-

resisting steel towers lined with silver, nickel, or chromium alloys and packed with Raschig rings or fibre glass of relatively large diameter (0.008 in). At a pressure of from 4 to 6 atm and at a temperature of 100–110° C. a reaction time of 10–20 hr is reported.

When an acid number of about fifty is reached the reaction product is treated with steam and water to separate water solubles, and then saponified. The crude fatty acids are liberated from their soaps by mineral acid, distilled with steam in vacuo, and separated into at least three fractions viz. (i) $\angle C_9$, (ii) C_{10} – C_{18} (the most useful material for soap), and (iii) $> C_{18}$, the unsaponifiable material being returned to the reaction vessel.

The fatty acids are normally saturated carboxylic acids containing approximately the same proportion of acids of even and odd carbon atoms, small amounts of unsaturated acids may, however, occur.

The separation of other oxidized products after separation of the acids, and other processes, will be discussed in a third article in this series. T. M. B. M.

1389. Commercial Production of Pure Hydrogen from Hydrocarbons and Steam. R. M. Reed. *Refiner*, Sept. 1945, 24 (9), 349–352. *Paper Presented before American Institute of Chemical Engineers.*—The reaction of hydrocarbons and steam at 1400–1800° F. over a nickel catalyst to produce carbon oxides and hydrogen, followed by the water gas-shift reaction at 800° F. over an iron oxide catalyst, has been utilized commercially in the U.S. on a large scale since 1930 to produce hydrogen containing 1.0–1.5% methane and 1.5–2% carbon monoxide. Calculations with available equilibrium data indicate that above 1500° F. methane and steam can produce hydrogen containing less than 0.1% methane without the use of excessive quantities of steam. A commercial plant has recently been placed in operation which produced hydrogen of the following analysis from propane and steam:

Component.	Per cent.
Carbon dioxide	0.001
Oxygen	0.005
Carbon monoxide	0.001
Methane	0.016
Nitrogen	0.007
Hydrogen	99.968
	<hr/>
	100.000

To produce this hydrogen, propane is desulphurized and reacted with steam in two stages, after which the crude hydrogen is cooled and CO_2 removed by scrubbing with mono-ethanolamine solution. Final purification is effected by two stages of carbon monoxide conversion, each followed by carbon dioxide removal. Available data for the equilibrium constant of the water gas reaction may be correlated by the relationship—

$$\frac{(CO)(H_2O)}{(CO_2)(H_2)} = K_p = 49.5e^{7350/(T^{\circ}F. + 400)}$$

This correlation has been checked over the temperature range from 80° to 1800° F. A. H. N.

1390. Chemicals in War-Time Germany. Part I. Anon. *Chem. Tr. J.*, 1945, 117, 397.—A review is given in *Chemical and Engineering News* of September 10 of technical and industrial developments in Germany in the production of chemicals.

At Leuna, methanol, isobutyl alcohol (for conversion to iso-octane), and higher alcohols (for hydrogenation to fuel components) were produced, in addition to synthetic fuels, the total capacity for which was 600,000 tons p.a. Total production of synthetic fuels was increased five-fold during the war, the Bergius process being found preferable under war-time conditions to the Fischer-Tropsch. Owing to shortage of unsaturated hydrocarbons from petroleum, acetylene from calcium carbide, or from waste gases by the arc process, was the starting product for a large number of syntheses, including butadiene (via acetaldehyde-aldol or formaldehyde-acetylene), ethyl alcohol, ethylene

(polymerized to lubricants), vinyl ethers (using alkali alcoholate catalyst), vinyl amines, vinyl *isobutylphenol* (using Zn or Cd salts of organic acids). A catalyst of major importance was copper or silver acetylide, with which addition to acetylene takes place of alkylolamines, vinyl amines, aldehydes, or ketones, etc., leaving the triple bond. Thus from acetylene and formaldehyde butynediol was produced, being converted to tetrahydrofuran, thence to butadiene. Another important catalyst was nickel carbonyl, which was used to introduce CO into the molecule, thus ethyl acrylate was produced from acetylene, water and carbon monoxide, and adipic acid from tetrahydrofuran. Acrylonitrile was obtained by direct addition of HCN to acetylene using copper acetylide catalyst, with the addition of alkali chloride in aqueous HCl. With mercuric chloride catalyst vinyl chloride was produced, and with zinc acetate, vinyl acetate. Other compounds synthesized from acetylene included glycerol, erythritol, maleic acid, succinic acid, methyl vinyl ketone, allyl alcohol, and hexamethylene diamine.

Production of synthetic detergents reached 75 million lb p.a., including Igepons and Igepals, alkylbenzene sulphonates, and aliphatic sulphonates; an important discovery was that the addition to a synthetic detergent of 25% of cellulose glycolic acid sodium salt increased its effectiveness to that of soap. Emulsifiers produced included the older long-chain aryl polyglycol-ether type and the Emulphor STH and STX types, made by condensing long-chain aliphatic sulphonchloride (Mersol) with ammonia and then with chloroacetic acid. These were valuable in drawing oil emulsions, having excellent anti-rust and lubricating quantities. Demulsifying agents for crude oils were of three types: alkyl polyglycol ethers, amides of hydroxyoleic and sulphate ester, and the sulphonate of di (ethylhexyl) maleate. Cellulose fibres were rendered water-resistant by treatment with hexamethylene diisocyanate or an emulsion of paraffin wax containing zirconium oxychloride (Persistol).

The main development in the plastics field was the polyurethanes produced from diisocyanates and polyalcohols, and used as fibres, bristles, sheeting, adhesives, etc. Copolymers of vinyl chloride and methyl acrylate or diethyl maleate increased in importance, and an improved melamine resin was obtained from condensing with formaldehyde the reaction product from benzonitrile and dicyandiamide. Of the synthetic rubbers, Buna S. was the most important, Nekal, a synthetic emulsifier, being used, and a tackifier, Koresin, produced by condensing *p-isobutyl phenol* and acetylene. Polyisobutylene and polyethylene (Lupolen) were produced, but there was little Perbunan or Neoprene.

In addition to the polyurethanes, which were considered superior to nylon in water-resistance and dyeing characteristics, fibres were produced from polyesters and polyamides.

C. L. G.

Coal, Shale and Peat.

1391. Coal—Science—and the Future. A. Parker. *Chem. and Ind.*, 1945, 234-239.—A general survey of the trends of production and use of coal. C. F. M.

Miscellaneous Products.

1392. Manufacture, Blends, and Uses of Sulphated Oils, 4(2). S. Glicher. *Petroleum*, 1945, 8 (8), 145.—The determination of the acetyl value is of importance chiefly in the cases of castor oil and waxes, but the usual determinations are not very reliable. The author proposes a method in which pyridine catalyses spontaneously the hydrolysis of the acetic anhydride. Methods for total fat content, sulphated and unsulphated oil, saponifiable and unsaponifiable matter determinations are given. Tests for oxidized fatty acids inform on the quantity of oxidized and semi-oxidized oils and fats present in sulphation products or in basic raw materials. Sulphate content is a measure of the degree the material has been sulphated. Details for the determination of total and inorganic SO₂ are shown.

G. A. C.

ENGINES AND AUTOMOTIVE EQUIPMENT.

1393. New Engine Design Cuts Fuel Consumption 25%. R. L. Boyer. *Petrol. Engr*, July 1945, 16 (11), 187.—A new arrangement of the fuel-feed system of a diesel engine

has enabled the Cooper-Bessemer Corporation to market a diesel engine which will operate on either oil or gas without spark-ignition, and which reduces the fuel consumption from 20 to 25%.

The development leading up to the burning of gas on the diesel cycle is explained by comparing it with the normal spark-ignited engine operating on the Otto cycle. An outline is given of the work carried out with a single-cylinder diesel engine built in 1927. At that time it was assumed that air-gas mixtures could not be compressed to 400 psi for the diesel cycle without the chance of pre-ignition, as compression much above 125 psi in the regular type of gas engine was likely to cause pre-ignition. The 1927 engine was built for the compression of air only, and the gas was injected at 1000 psi on top dead centre of the piston. Under these conditions the engine ran under compression ignition, but gave better performance if pilot oil was also injected. As, however, a high-pressure compressor for the gas was required in addition to the usual oil-injecting mechanism, further work was not then continued. At that time no thought was given to the possibility of introducing the gas with the air intake, as it was assumed that pre-ignition would result. Another point not considered when burning gas was that, due to the inherent efficiency of the diesel cycle, the amount of gas required is considerably less than with the Otto cycle, and the gas-air ratio at full load is still a very lean mixture not too easily ignited. Continuation of the work after some years and by applying the new conceptions of pressure combustion, it was found possible to admit the gas with the air intake without the chance of pre-ignition occurring.

Further, on very heavy overloads with natural gas the mixture will not easily fire without the pilot oil flame.

With this dual-fuel engine, assuming the engine is running on oil and on load, if the gas is admitted to the air intake the governor immediately reduces the oil-feed to compensate for the amount of gas admitted. Then all that is necessary is to reduce the fuel oil injected to the desired minimum and govern the percentage of gas admitted according to the load. A diagram showing the changing wheel of the control box and arrangement of the dual-feed system, and a photograph of a 675 hp engine are given.

W. H. C.

MISCELLANEOUS.

1394. Code of Electrical Practice for the Petroleum Industry. A. D. Maclean. *J. Inst. Petrol.*, Oct. 1945, 31 (262), 379-392.—The development of a code by a Subcommittee of the Institute of Petroleum is described by the Chairman. A. H. N.

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INSTITUTE NOTES.

DECEMBER, 1945.

FORTHCOMING MEETINGS.

Wednesday, 9th January, 1946. **"The Production of Iso-Hexane and Iso-Heptane by Super-Fractionation,"** by the Sunbury Research Station (Anglo-Iranian Oil Co., Ltd.).

Wednesday, 13th February, 1946. **Presidential Address** by Professor F. H. Garner, O.B.E.

APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

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

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

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

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BELCHETZ, Leonard, Refinery Technologist, Shell Refining & Marketing Co., Ltd. (H. E. F. Pracy ; C. H. Barton.)

BEVAN, Leslie, Chemist, Ministry of Aircraft Production. (J. Mason ; W. H. Hoffert.)

BROWN, Ewart George, Chemist, Imperial Chemical Industries, Ltd. (K. Gordon ; E. R. H. Davies.)

BURGESS, Henry Marshall, Lt.-Col., R.A.S.C. (Attached National Oil Refineries, Ltd.) (R. B. Southall ; E. Thornton.)

CAMERON, Ian, Assistant Chief Engineer, National Oil Refineries, Ltd. (R. B. Southall ; E. Thornton.)

- COSKER, William Lancelot, Research Chemist, British Diesel Oil & Petrol Co., Ltd. (*G. S. Pound ; A. Collier.*)
- COWDEN, Leslie Milligan, Assistant District Manager, Anglo-American Oil Co., Ltd. (*F. Dakin ; E. J. Newton.*)
- DAINTITH, Harold, Engineer, Valvoline Oil Co. (*J. M. Marshall ; H. Healey.*)
- HAYGARTH, Cecil Harry Spencer, General Sales Manager, Shell-Mex & B.P., Ltd. (*J. A. Oriel ; J. S. Jackson.*)
- HOLDING, Alfred Edward, Student, Royal School of Mines. (*V. C. Iling.*)
- MAKOWER, Arthur Denis, Research Chemist, Lobitos Oilfields, Ltd. (*C. Barrington Brown ; J. S. Parker.*)
- PAGE, George Frank, Manager, Leyland & Birmingham Rubber Co., Ltd. (*A. Harland ; F. Tipler.*)
- SNOWDEN, Alfred Cecil, Installation Manager, Petroleum Board. (*E. P. Lancashire. ; A. Harland.*)
- SWANN, Raymond Vaughan, Chemist, A.I.D., Harefield. (*J. Mason ; H. G. L. Wilkinson.*)
- VERSEFELD, Ivan Henry, Fuel Technologist, Vacuum Oil Co. of South Africa, Ltd. (*R. G. Pomeroy ; T. Bedford.*)

Transfers.

- ADAMSON, Anthony Reginald, Engineer Sub-Lieut., R.N.V.R. (*A. H. Richard ; C. A. P. Southwell.*) (*Student to Associate Member.*)
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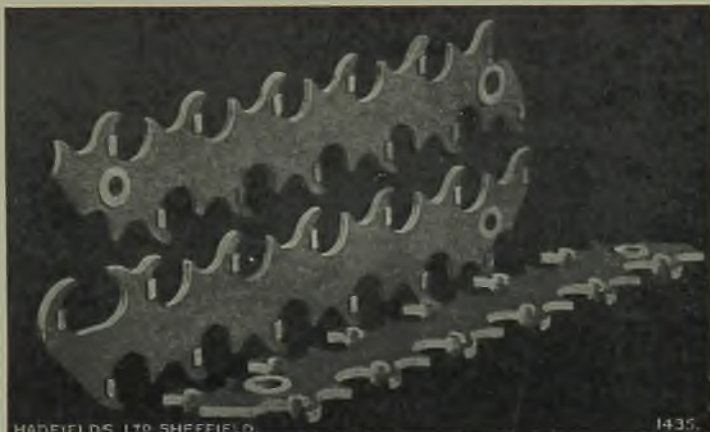
BOTTOMLEY, Gwyn Yarker, National Oil Refineries, Ltd.		Oil Engineer.
HALL, Peter George,	”	”
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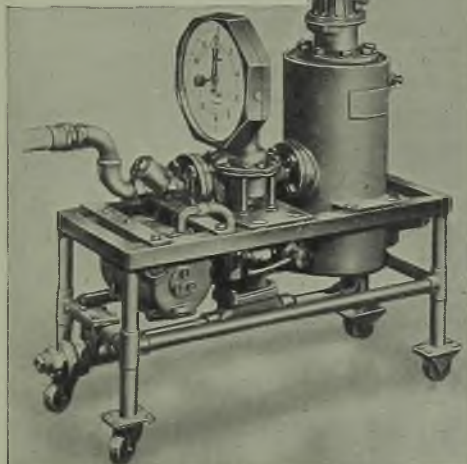


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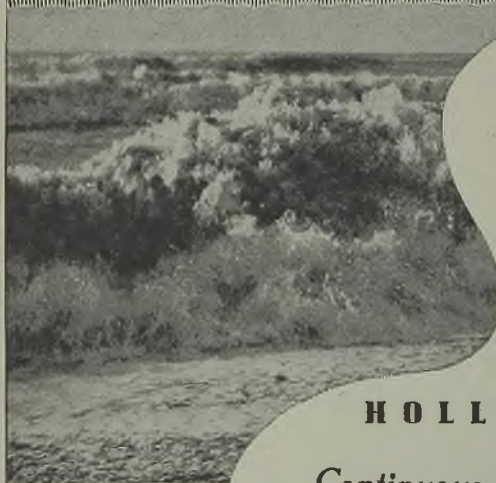
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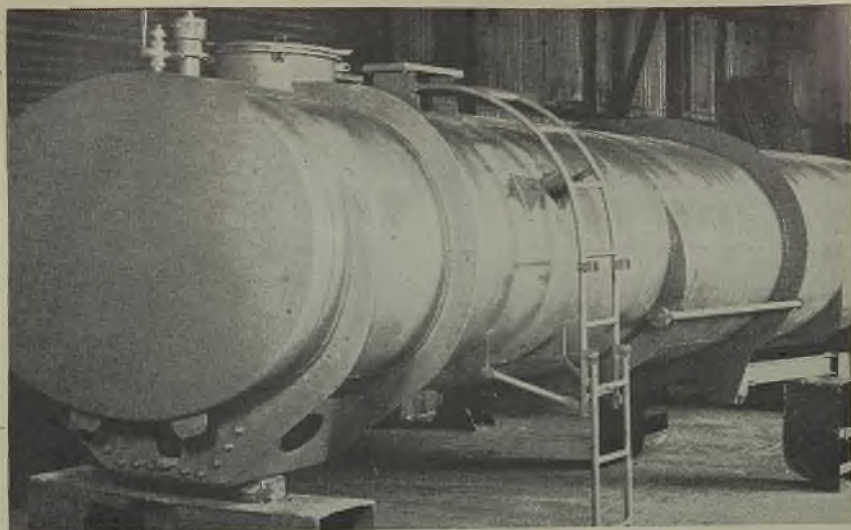
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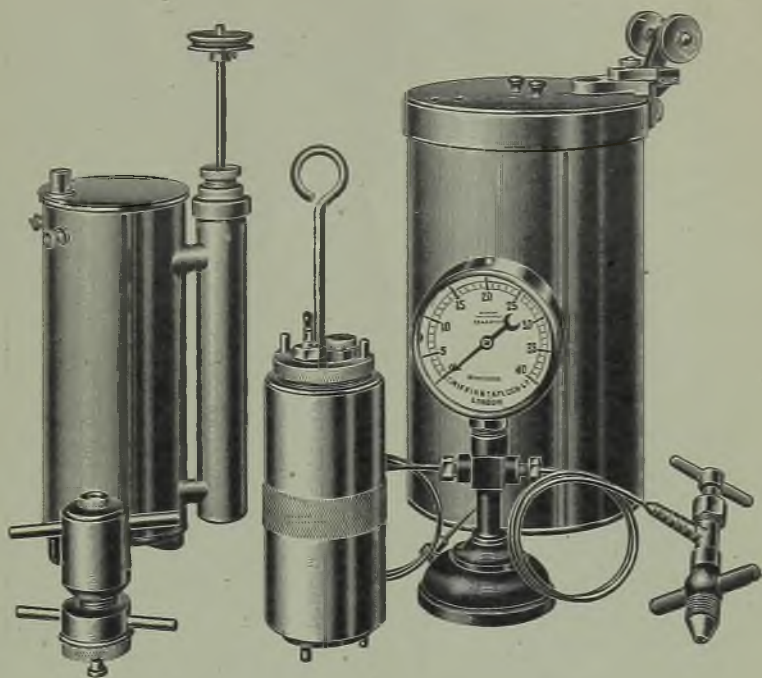
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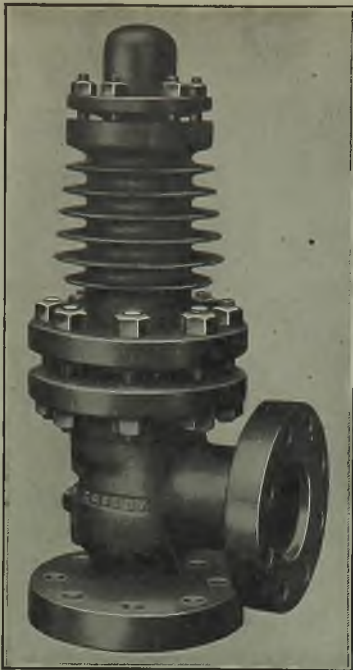
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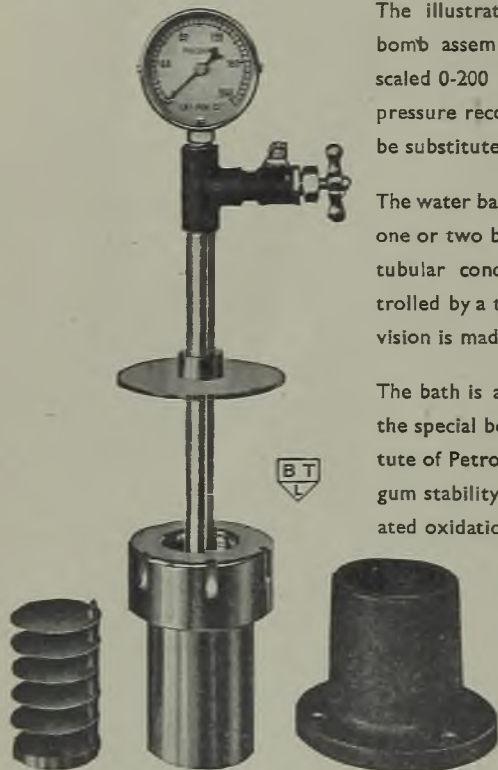
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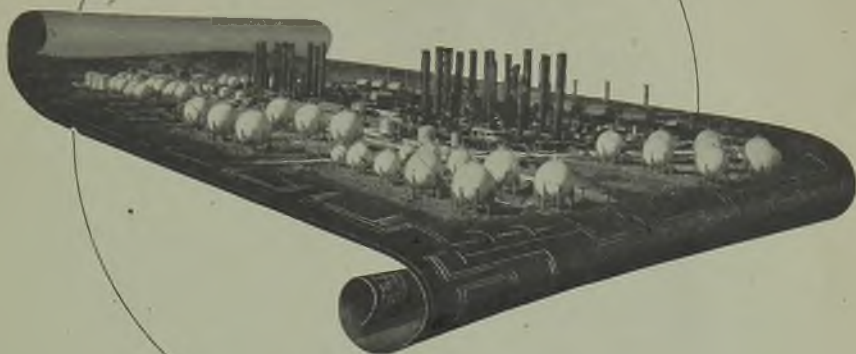
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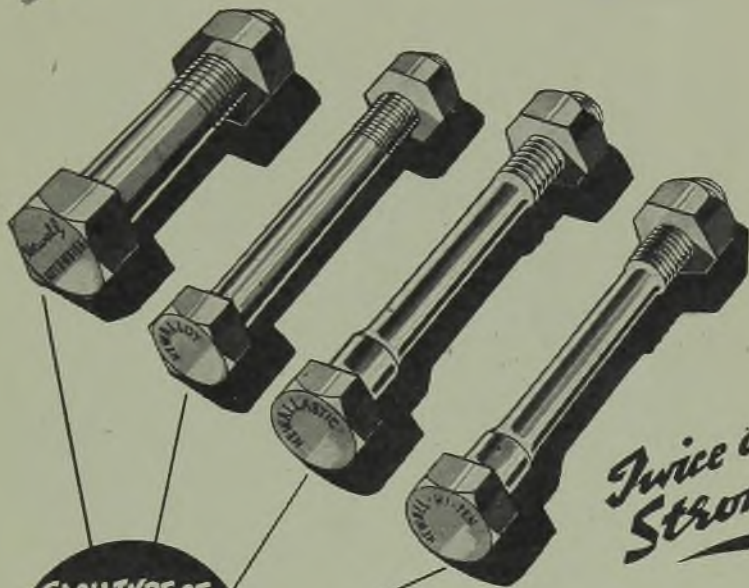
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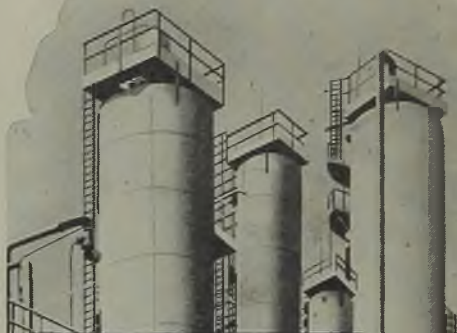
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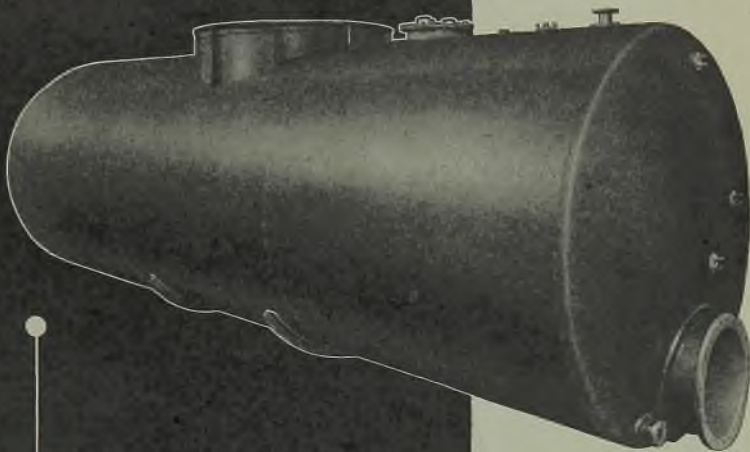
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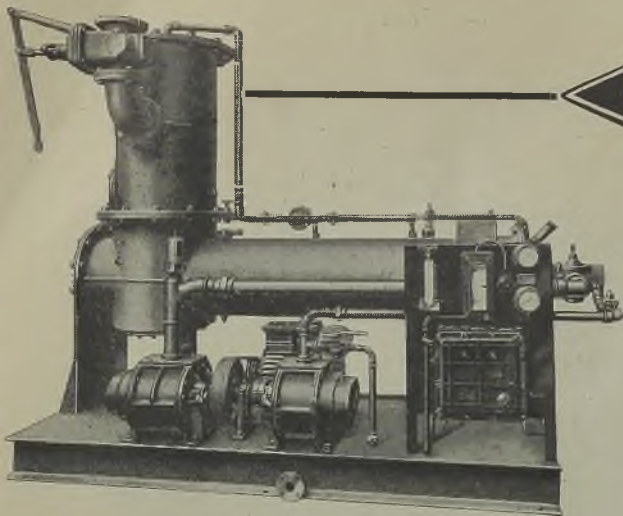
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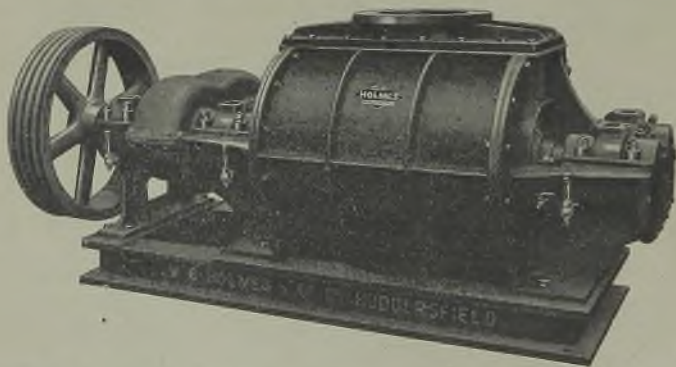
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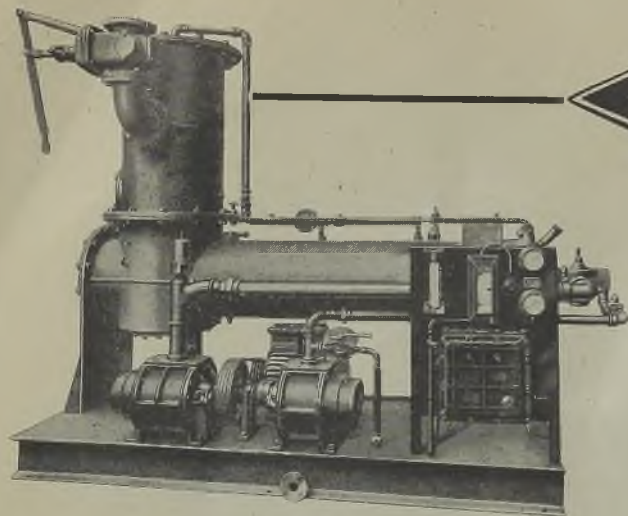
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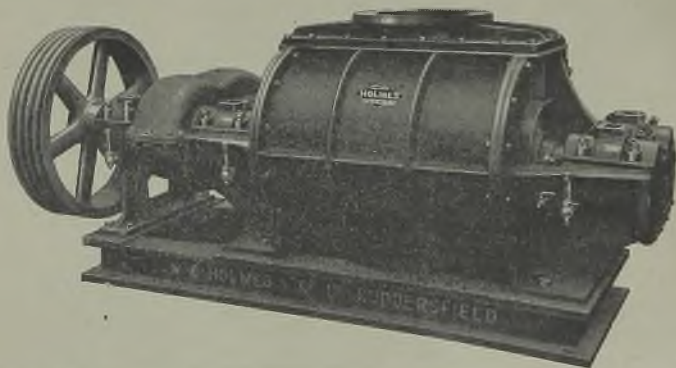
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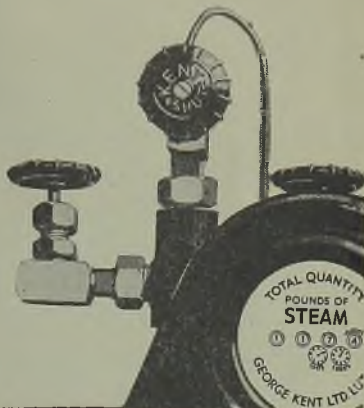
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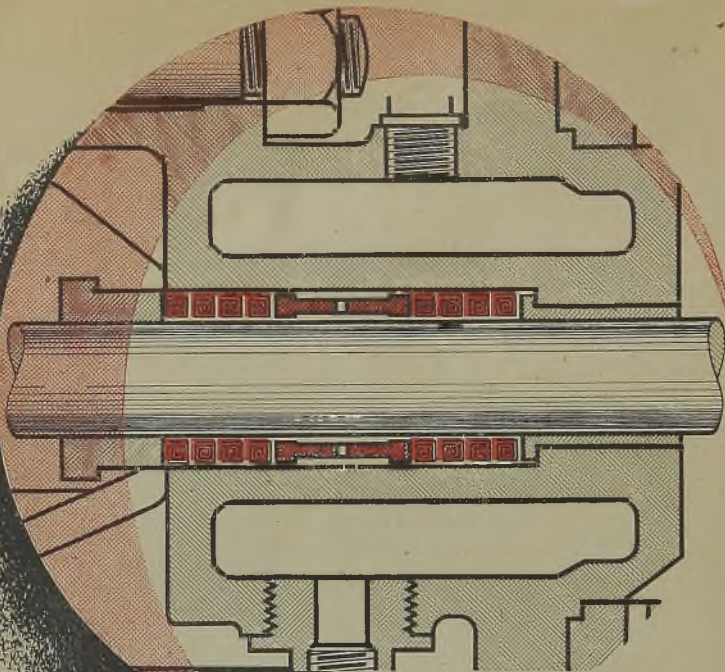
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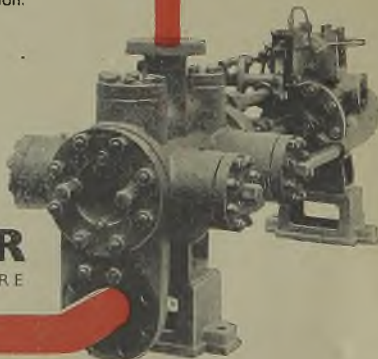
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