ABSTRACTS.

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OILFIELD EXPLORATION AND EXPLOITATION.

Geology.

1011. Fault-wedge Reservoirs. O. Wilhelm. *Oil Gas J.*, 20.4.46, **44** (50), 163.—Intersecting faults may give oil-traps—fault-wedge reservoirs. A fault may also be associated with some other trapping feature, such as a change in thickness or permeability, or a pinch-out, again giving trapping. These are double-trap reservoirs. Triple-fault traps are possible. G. D. H.

1012. Explanation of Pinch-out and Erosional Unconformity. O. Wilhelm. *Oil Gas J.*, 30.3.46, **44** (47), 275.—Wedges may be formed by natural thinning or by erosion. The former wedging depends on the relative rates of deposition and uplift or depression. It is very difficult to determine whether erosion has played any part in this type of wedging.

The presence of traps in pinch-outs and erosional unconformities depends on the relative positions of permeable and impermeable beds. G. D. H.

1013. Wyoming Tests in Limelight. Anon. *Oil Gas J.*, 30.3.46, **44** (47), 287.—A test on the River Dome structure in Washakie County, Wyoming, has been drilled to about 11,000 ft. Nothing worth while was found in the Tensleep, and possibly in the Amsden, but, in testing, the Embar lime at 9990–10,020 ft gave 5,000,000 cu. ft of sour gas. A second test at 9990–10,055 ft showed gas and a substantial amount of 41·5° oil. In the Frontier sands at 7229–7272 ft there were signs earlier that a good gas-condensate well could be completed, while a test of the Muddy sand at about 8150 ft is reported to have shown 200 brl/day.

The second well tested the Frontier at 7534–7554 ft, indicating 300 brl/day of condensate. The Muddy is to be tested in this well, which is about 200 ft lower structurally than the first.

Previous wells in the Palæozoic of this part of Wyoming have carried low-gravity, black, highly sulphurous oil, worth less than $1/brl. G. D. H.

1014. New Strike Spurs Inner-basin Play. Anon. *Oil Gas J.*, 20.4.46, **44** (50), 179.—A well (Mountain Fuel Supply Co. 1 Unit) in Uinta County, Wyoming, 30 ml north of the Utah boundary, has topped the Dakota at 12,554 ft, and had a gas-show. Through perforations at 12,660–12,666 ft a 24-hr drillstem test gave 12,300,000 cu. ft. of gas/day and 150 brl/day of 46·5-gravity oil or condensate. The bottom-hole flowing pressure was 4900 lb/sq. in.

The well is in the Bridger division of the Green River basin. It lies midway between Green River town and the Spring Valley pool, which was opened in 1900 and has produced about.200,000 brl of oil. The deepest formation which it tested was probably the Bear River (Upper Cretaceous). The La Barge field is 70 ml north of the test; its production has come mainly from the Wasatch (Eocene). G. D. H.

1015. Present Work of the Pennsylvania Geological Survey in the Oil Fields of Pennsylvania. C. R. Fettke. *Producers' Monthly*, May 1946, **10** (7), 23.—After a preliminary discussion emphasizing the need for geological knowledge in the exploration and recovery of oil, the work of the Pennsylvania Geological Survey in mapping and studying the oilfields of Pennsylvania is reviewed. The method of study is then briefly discussed, and the paper concludes with brief biographies of members of the staff. R. B. S.

1016. Chilean Oil Developments. Anon. *Oil Wkly*, 1.4.46, **121** (5), 42 (International Section).—Swan Lake, 50 ml southeast of the productive Spring Hill structure, is believed to have better prospects than the latter. Spring Hill 2 has reached 3050 ft.

The Mina Rica structure on the mainland (Brunswick Peninsula) is not deemed the most favourable of the group of structures, but it is the most accessible. A well on it was abandoned dry at 1880 ft after having had slight showings. A test, Picket 1, 9 ml north of the Mina Rica structure, is nearing 2500 ft. G. D. H.

1017. Atlantic Deepening Well on its Haiti Concession. Anon. *Oil Wkly*, 11.3 46, **121** (2), 78.—Jurinat 1 was originally abandoned in August 1944 at 7005 ft in the Lower Oligocene. Drilling has now been restarted, and the well has passed 7300 ft. The well lies 50 ml northeast of Fort-au-Prince. G. D. H.

1018. Resumption of Drilling in Philippines Soon. Anon. *Oil Wkly*, 11.3.46, **121** (2), 78.—Before the war encouraging oil indications were found in northern Cebu in a well taken to 8330 ft. Drilling in the Philippines may soon be restarted. G. D. H.

1019. Anglo-Egyptian Brings in Wildcat Test Near Suez. Anon. *Oil Gas J.*, 20.4.46, **44** (50), 91.—On the east coast of the Sinai peninsula, 40 ml south of Suez, Anglo-Egyptian Oilfields, Ltd., has had a good show of oil in a wildcat at a depth of 2700 ft. G. D. H.

1020. Joya Mair Tests Await Construction of Storage. Anon. *Oil Wkly*, 11.3.46, **121** (2), 78.—Two wells at Joya Mair have each indicated a production of 9000 brl/day of heavy oil in short tests. G. D. H.

Geophysics and Geochemical Prospecting.

1021. Geotechniques of Oil Exploration. J. W. Merritt. *Oil Wkly*, 1.4.46, **121** (5), 17.—The increased difficulty of finding oil accumulations by the application of the anticlinal theory and allied concepts led to the search for some direct method of finding oil. Too much has been expected of these direct methods. The aim has been to develop a simple instrument giving direct data, but so far the methods call for interpretation of the data.

The application of the anticlinal theory is an indirect means of oil discovery, and has limitations. Soon the surface anticlines were worked, and buried structures had to be tackled via sub-surface studies and later by the seismograph or the gravity-meter. The magnetometer has also been used for this purpose.

For a direct method of oil discovery to be practicable the oil or gas must make its presence felt by detectable changes, chemical or physical, in the rocks or soil above it; these changes must give patterns the significance of which can be divined. Electrical methods have been applied, it being assumed that the oil or gas caused measurable resistivity changes. It is somewhat doubtful whether there is adequate penetration to make this method widely usable. Geochemistry has been applied in the direct search for oil and gas, particularly in the form of soil analysis. The early shortcomings were associated with a failure fully to appreciate the significance of geological factors in interpreting the data. The analyses may be for hydrocarbons, gaseous, liquid or solid, by a variety of techniques; or they may be for inorganic substances concentrated by reason of the passage of hydrocarbons to the surface. The soil may be sampled, or the gases collected from it; the sample may be from the surface or down to a depth of as much as 20 ft. The sampling points may vary widely in spacing. All these geochemical techniques are based on the belief that oil and gas escape to the earth's surface. Recently it has been observed that maps of the intensity of radio-activity over oil and gas areas closely resemble those obtained in measurements of the amounts of the critical organic and inorganic compounds. Bacteriological studies also have been employed.

The formations overlying oil and gas deposits are permeable, and certain hydrocarbons escape upward through them. The movement is vertical, disregarding dip and permeability variations. The movement is best described in terms of molecules rather than by bulk flow, and the light hydrocarbons transport with them water vapour. These hydrocarbons may be polymerized by radioactive substances. If the passage of the hydrocarbons carries off water from the overlying rocks, solutions will enter this zone from the sides, and so solutes will be deposited, thus increasing the rock density among other features. This change alters the electrical conductivity, and the speed of passage of seismic waves; it also concentrates radioactive substances, and favours the growth of hydrocarbon-loving bacteria. False " highs " have been noted on the margins of low-dip oil- and gas-bearing domes, due to the increased velocity over compensating for increased depth.

Confirmation of pattern rather than the confirmation of data for single sites should be considered as significant. Climatic conditions may cause variation. G. D. H.

1022. Gravimeters. G. S. Heulin. *Form. y Doc. Prof.* (*Madrid*), 1946, **5** (12), 17–21.—A description of the use of gravimeters in detecting changes in subterranean structures. Two gravimeters are described in detail, the principle being the measurement of the very small change in position of a spring-loaded mass under different gravitational pulls. In the first the movement is measured by the change in current due to the distance changing between two plates, and in the second the moving mass cuts off part of the light from a photoelectric cell. The sensitivity of one type of gravimeter is given as 0·64 millidynes. A. C.

Drilling.

1023. Subsoil Problems of the Geologist During Drilling. R. L. Milner. *Ecuad. Pet.*, 1946, **1** (3), 12–15.—The duties of the geologist during drilling are reviewed and some typical problems arising during exploration in Ecuador examined. A. C.

1024. Problems Met in Drilling Abnormal Pressure Formations. G. E. Cannon and R. S. Sullins. *Oil Wkly*, 27.5.46, **121** (13), 33–35. *Paper presented before American Petroleum Institute.*—Data are presented showing the estimated formation pressure in more than 100 wells in Texas and Louisiana where abnormally high formation pressures were encountered. The most important problems in connection with drilling abnormal pressures are lost returns and planning the most economical mud programme. Several possible methods of preventing lost returns are discussed. The method showing the most promise is the use of cement in zones of local weakness. The most important mud treating problems are viscosity control and conservation of weighting material. A centrifugal concentrator can be used not only to conserve weighting material, but also as an aid in controlling viscosity by removing undesirable concentrations of clay fractions from the mud system. Data are presented showing the comparative pump horsepower requirements for an average light mud—*i.e.*, 10·3 lb/gal—and a heavy mud weighing 16·3 lb/gal. The comparative carrying capacity of 1 light and heavy muds is also discussed, the heavy mud having considerably more carrying capacity than the light mud. This to some extent offsets the slower circulating rates which are usually obtained with heavy muds. A. H. N.

1025. Modern Deep Well Drilling Rigs Dieselized. M. D. Pugh. *Diesel Power and Diesel Transportation*, May 1946, **24** (5), 584.—Because of greater flexibility and economy and ease of handling, the diesel or gas engine is rapidly replacing steam power for all oil-drilling operations. Diesel- or gas-engined rigs are capable of drilling to depths of 16,000 ft and such units made by the National Supply Co. are designed to supply 1125 h.p. at the input shaft of the draw-works or hoist. Fitted with three or four engines which are connected by chain drive, they can be compounded or used separately for all drilling operations.

These multi-engines rigs, their construction, and method of operation are described, and the advantages and scope outlined. C. D. B.

1026. Oil-Well Drilling Rigs Produced in Great Britain. Anon. *Oil Engine*, June 1946, **14** (158), 52.—A British engineering development of recent origin is the production of equipment for drilling of oil wells. High-speed oil engines are extensively used, and the majority of the complete outfits are for overseas countries, although some are for use in the home market for exploratory work.

The article deals particularly with those produced by the Oil Well Engineering Co., Ltd., of Cheadle Heath, Stockport, and which have been supplied to or are on order for the major oil companies.

Typical outfits are described for drilling down to 5000 ft using 4½-inch drill-pipe with a maximum input of 425 B.H.P. from two 200-B.H.P. engines running compound with 10% overload. Precision chain drive is used running in oil-baths. The transmission unit, having three forward speeds and one reverse, affords six speeds on the drum and three for rotary drives. Scoop-controlled Fluidrive units are used on the engines with three friction clutches for the draw-works and a dog clutch for the drum, the brakes of which are water-cooled. Most of the sets have sand-reels. Without engines the draw-works weigh about 10¼ tons.

The specification is modified to suit customers' requirements, but most include a slush-pump having a maximum fluid pressure of 200 lb/sq. in.

The transmission arrangements are usually such that the two engines simultaneously can drive both draw-works and pump, or compounded on the draw-works drive. In the event of breakdown of either engine the remaining engine can fulfil either power duty.

One or other of two makes of power unit are fitted—*i.e.*, Paxman or English Electric. These units and details of installation with auxiliaries and control gear are described.

Reference is made to the latest development of rigs for drilling down to 10,000 ft, in which Paxman 12-cyl engines are employed, now under construction at Colchester.

C. D. B.

1027. Modern Mechanical Rig Simplifies Drilling. G. B. Nicholson. *Oil Wkly*, 1.7.46, **122** (5), 17.—The rig described is being tested on its first wildcat territory, and is operated satisfactorily on butane gas as fuel. Among the features of the rig are the simplified controls located in a protected panel immediately behind the driller's position, and the unitization of equipment to facilitate rigging up and tearing down when changing locations. The instrument panel contains numerous hand levers, which are manipulated by slight pressure of the fingers, some of which operate air-valves for controlling all clutches, including engine compounding, pump and hydromatic brake clutches. Also located in the panel are engine throttle levers and dials and guages indicating air pressures, transmission shaft speed, engine vacuum, and oil pressure. Unitization of components is practised extensively in the design of the rig. Different parts are described. A. H. N.

1028. Combination Drive Adapted to Unitized Drilling Power Plant. N. Williams. *Oil Gas J.*, 29.6.46, **45** (8), 83.—The power plant described is contained in three skid-mounted units complete with individual housing forming a single large engine-house when the units are set up on a drilling location. Special features include " steam cooling " for engine jack-water. This system was designed to permit operation of the engines with high jacket water temperature (212–215° F), and consequent maintenance of a more even temperature of the engines. Temperature differentials are reduced over the length of the liners and block over the full load range from idling to full-load speeds. The high temperature, which is above the dew point of the exhaust gases, vaporizes any moisture that might be contained in the fuel or oil, so that it goes out of the exhaust, instead of condensing and being deposited on the cylinder walls, to be wiped down by the rings and mix with the oil to form sludge. Details of circulating the steam are given. A. H. N.

1029. " Packaged Power " Features New Rig Design. K. B. Barnes. *Oil Gas J.*, 27.7.46, **45** (12), 207.—A portable mast rig designed for drilling down to 10,000 ft and the power unit are described in some detail. The rig is powered by 4 193-hp Waukesha engines, each of which is equipped with an air compressor to maintain air for the brakes and clutches. Each engine is coupled to the chain box-type compound by a Fawick air-clutch. Lubrication of the compound is obtained by the chains lifting oil from a bath and distributing it through pipes to a gravity feed system. One of the engines is ordinarily used to run the rotary, while the other three run the draw-works and pumping unit, but all can be used for maximum power in pulling casing or drill-pipe. The engines are synchronized by vacuum throttle control. The engines can be run on butane or on natural gas, the latter being used at the 1 Cush location. Two air-operated Foster friction catheads are incorporated in the assembly, mounted on the transmission output shaft, and give four speeds. Draw-works have eight lifting speeds. A. H. N.

1030. Deep Rotary Drilling Applied to the Appalachians. B. R. Miller. *Oil Gas J.*, 6.7.46, **45** (9), 90. *Paper presented before A.P.I.*—The use of rotary system in Appalachian fields is increasing. Adaptation of rotary equipment to drilling in this section must take into account properly conditioned mud, rigs adequately powered, completion practices, drill-pipe wear, rock-bit footage, and well control. Day-work contracts have placed contractors under restraints and partly removed the incentive to improve performance. These factors with high freight charges for moving rigs, repairs, and supplies great distances, have made rotary drilling costs high. However, rotary drilling has provided such desirable benefits as: (1) Conservation of reservoir pressures; (2) Complete control while drilling and completing; (3) Selective and multiple completions; (4) Saving in casing; (5) Hole size maintained to objective; (6) Reduced drilling time; (7) They eliminate hazards of blowouts and fires; (8) They provide data for reservoir study. Principles to be observed in selecting rigs, drill pipe, bits, etc., are indicated. Mud qualities necessary in these fields are discussed. A. H. N.

1031. Compounding Unit and Transmission Feature New Power Rig. *Oil Wkly*, 17.6.46, **122** (3), 34–37.—Two new, large power rigs which have several new features are described. By unitizing the power-compounding assembly and making it a separate part of the rig, it was possible to design a unit which would insure proper alignment of power drives, provide wide range of operation, and permit rigid placement of specially constructed, air-operated disc clutches. Through this arrangement, one or all three of the 335-h.p. engines of the unit may be compounded in driving either the draw-works or the mud-pumps, or both. The rig is equipped with two power-driven 7½ × 12-inch triplex slush-pumps, either of which may be operated separately or the two simultaneously. Such a feature is of particular importance to the driller where flexibility of power is required. As the depth increases, the driller may compound all the gasoline engines on the pumps, and, through the transmission, adjust the rotary speed to the desired revolution/min. The changeover from one engine to two or three, or change in operating speeds of either the pumps or the rotary table, is easy and simple by means of air-operated controls located at the driller's position. A characteristic of the new rigs is that nine forward and nine reverse speeds can be applied at the rotary table or the line drum. Several photographs illustrate the rig. A. H. N.

1032. Oil Separator Raft Applicable to Marine Drilling. J. E. Kastrop. *Oil Wkly*, 10.6.46, **122** (2), 33.—The separator barge has an open bottom. Thus on receiving contaminated oil the oil rises to the top and the water mixes with the marine or fresh water in which the barge is floating, and is automatically discharged. The uses of such barges are discussed. A. H. N.

1033. A Study of Flow of Plastics Through Pipes. R. C. Binder and J. E. Busher. *J. Appl. Mech.*, June 1946, **13** (2), A101–A105.—The pipe friction coefficient for true fluids is usually expressed as a function of Reynolds number. This method of organizing data has been extended to tests in the flow of different suspensions which behaved as ideal plastics in the laminar-flow range and as true fluids in the turbulent-flow range. In the laminar-flow range, Reynolds number below about 2100, the denominator in Reynolds number is taken as the apparent viscosity. The apparent viscosity can be determined from the yield value and the coefficient of rigidity. In the turbulent-flow range the denominator in Reynolds number is an equivalent or turbulent viscosity equal to the dynamic viscosity of a true fluid having the same friction coefficient, velocity, diameter, and density as that of the plastic. The various experimental data on plastics correlate well with this extension of the method for true fluids. A. H. N.

1034. Plastic Cementing In Permian Basin Gas-Oil Ratio Remedial Work. F. R. Holland. *Oil Wkly*, 17.6.46, **122** (3), 40.—The resinous cement used in this work is a synthetic phenol-formaldehyde compound which, on hardening, forms a plastic similar in many respects to that used in the manufacture of household appliances and everyday articles such as fountain pens, phonograph records, telephones, etc. This material has properties which make it peculiarly suited for well remedial work. When it is in a liquid state it has a very low viscosity as compared to cement slurries. Its viscosity ranges from 1·5 to 4·0 poises. It has specific gravities ranging from 1·2 to 1·5. It is homogeneous material which is not contaminated by coming into contact with brines or muds. None of its ingredients will filter out when pumped through the finest screens, so there is no danger of building up a filter cake on the well-bore when the material is used. The pH of the material is 7·4.

The material hardens in 2 hours through a chemical reaction set up by mixing the materials. No catalysts are used and no heat is generated in the hardening process which might set up porosity in the finished plastic. The temperatures at which this material is hardened range from 80° F to 140° F, which are bottom-hole temperatures encountered in the Permian Basin at depths ranging from 2500 to 10,000 ft. The material hardens with time, increasing in compressive strength for several days. Experience with this material in the field is described. A. H. N.

1035. Casing-Cementing Practices Improved In Illinois–Indiana–Kentucky Completions. J. L. Rogers. *Oil Gas J.*, 13.7.46, **45** (10), 98.—Practical engineering problems encountered in cementing different wells are discussed. A programme of operation is described in detail, including conditioning of mud to 15 c.c. A.P.I. water loss and 36–40 sec viscosity. The success frequency of the methods used was about 97% for 200 multiple-sand completions. A. H. N.

1036. Mathematics of Cementing and Other Problems. Part I. R. E. Edwards. *Oil Wkly*, 27.5.46, **121** (13), 38–40.—In this part elementary calculations of areas and volumes of simple shapes are given. A. H. N.

1037. Mathematics of Cementing and Other Problems. Part 2. R. E. Edwards. *Oil Wkly*, 3.6.46, **122** (1), 33–35.—Simple problems in hydrostatics and hydrodynamics are treated in elementary manner. A. H. N.

1038. Mathematics of Cementing. Part 3. R. E. Edwards. *Oil Wkly*, 10.6.46, **122** (2), 42.—The elements of problems involving the balancing of liquid columns against each other are given. A. H. N.

1039. Mathematics of Cementing. Part 4. R. E. Edwards. *Oil Wkly*, 17.6.46, **122** (3), 45.—Simple problems of flow of cement are explained. A. H. N.

1040. Chemistry of Drilling Fluids. H. T. Kennedy. *Oil Gas J.*, 27.7.46, **45** (12), 181.—The elements of colloidal chemistry of water-base and oil-base muds are outlined. Significance and control of water loss, viscosity, stability, etc., of muds are explained, on the basis of the colloidal structure of muds. The influence of additives like sodium acid pyrophosphate, gum ghatti, starches, calcium chloride, sodium chloride, and others on viscosity and water loss is briefly indicated and illustrated by diagrams. A. H. N.

1041. Improved Muds Contain Carboxymethylcellulose. H. H. Kaveler. *Oil Wkly*, 8.7.46, **122** (6), 33. *Paper presented before American Petroleum Institute.*—The requirements of a good mud are listed as: (1) Low viscosity, compatible with pumpability and carrying capacity for cuttings; (2) Stability of the suspension of the weighting material, particularly in muds weighing more than 12 lb/gal; (3) A high degree of thixotropy; (4) A thin, tough, filter cake of low permeability and of good deplastering quality; (5) Temperature stability; (6) High resistance to electrolytes; (7) Responsive to treating agents and control of properties; (8) Low electrical resistance; (9) Capacity to release larger size cuttings and release gas in the mud pit; (10) Non-destructible by chemical or bacterial action; (11) Retards swelling of "bentonitic" or "heaving" shale; (12) Low initial and low maintenance cost. Tests with muds treated with sodium derivatives of carboxymethylcellulose are then described. Field and laboratory experience has established that alkali metal carboxymethylcellulose impart superior qualities to aqueous well-drilling mud comprising the system; water plus dispersed fine mineral solids. Improvements in all the desirable properties of such muds, more particularly in water loss, filter-cake thickness, gel-strength, viscosity, salt-water resistance, and freedom from fermentation are obtained. Cellulose is an economical material to use in drilling muds, and its use results in substantial savings in direct mud costs, as well as savings in drilling and completion costs. This is particularly true of drilling in areas underlain by salt and anhydrite sections.

A. H. N.

1042. Some Recent Developments in Mud-analysis Logging. B. O. Pixler. *Petrol. Tech.* (*A.I.M.M.E.*), May, 1946, **9** (3); Tech. Pub. No 2026, 1–13.—Mud-analysis logging aims at identifying the fluid content of the formations drilled by the rotary method, and allows the accurate correlation of oil and gas shows with the depth. Mud-analysis logging eliminates much coring, and is especially valuable in cases where coring is particularly hazardous or the electric log is difficult to interpret correctly. An appreciation of the factors that influence the results of mud analysis, such as rate of penetration, mud properties, coring, and the characteristics of the reservoir rock as related to the " flushing effect," permits a better understanding of the mud-analysis log.

Recent studies of the relationship of the two gas readings obtained by the gas-detector instrument have proved significant. The difference between the total combustible gas reading and the higher-molecular-weight gas reading indicates the presence of methane. With few exceptions, zones not showing an increase of methane probably can be condemned.

Altogether mud-analysis logging furnishes valuable information, which generally cannot be obtained by other methods. G. D. H.

1043. Use of Oil-Base Mud at Elk Hills Naval Petroleum Reserve 1. R. W. Stuart. *Oil Wkly*, 27.5.46, **121** (13), 41. *Paper presented before American Petroleum Institute.*—Two commercial oil-base muds now available were tested, and found to have similar characteristics but different controlling features. The methods for controlling these muds have been the deciding factor in their success or failure on many wells. One of these commercial oil-base muds is composed of diesel oil-blown asphalt, sodium chloride, caustic soda, sodium silicate, and tall oil as the active ingredients with crushed limestone as the weighting material. The viscosity and gel of this mud are controlled by the pH, using sodium silicate and tall oil to adjust the pH as desired. This mud forms a viscous emulsion with fresh water; for this reason, great care has to be taken to prevent water contamination. Strong salt water will not interfere with the viscosity control of the mud as much; therefore, salt is used to counteract the effect of an entrained water. The other commercial oil-base mud is composed of diesel oil, air-blown asphalt, and calcium oxide, with ground limestone added for weight. The controlling factors in this mud are obtained at the mixing plant through the use of a diesel oil, having definite characteristics and an air-blown asphalt of a specified nature with the calcium oxide added as a settling inhibitor, which also combines with any water in the mud. This mud is affected by water, but additional calcium oxide will take up any excessive volume of water which might be entrained in the mud.

The use of oil-base mud at Elk Hills shows that whilst it gives no more trouble than water-base muds, it has several additional advantages in coring, in low-permeability production horizons, and in maintaining hole size to gauge. A. H. N.

Production.

1044. Subsurface Temperatures and Viscosity Temperature Relationships of Crude Oils in Appalachian Region. F. M. Tignor. *Producers' Monthly*, May 1946, **10** (7), 12.—Among the physical properties of petroleum that influence its drainage from or flow through reservoir rock, viscosity is one of the most important. The viscosity-temperature relationships reported indicate the value of both subsurface temperature and viscosity data to petroleum engineering studies. The device used to measure the subsurface temperatures, a vapour-pressure-type recording thermometer with a bulb, is described in detail. This recorder is run into a well on a steel wire line; the reeling equipment—a complete unit equipped with a clutch, emergency brake, hand crank, hydraulic governor, and hydraulic speed control—is also described in detail. A lubricator is used for running the recorder into gas wells and oil wells having well-head pressures above atmospheric. All measurements were made while the wells were shut in.

The rate of heat transfer through liquid is greater than through gas, and consequently the response of the thermometer to changes of temperature is more rapid when the thermometer is immersed in liquid than in gas. In making observations of temperatures in wells the temperature gauge was lowered into the well to the first or upper point of measurement, where its descent was stopped for 10 minutes if the gauge was immersed in liquid, and as long as 60 minutes in static gas. The gauge was also stopped similar lengths of time for temperature recordings at each successively lower point of measurement. Subsurface temperatures were measured in several pumping wells from which the rods had been pulled so that the temperature-gauge could be run in the tubing. In some other wells the tubing had been removed for clean-out work, and the gauge was run in the casing. In no well was the gauge run in the annulus between the casing and tubing.

The results of the subsurface temperature measurements made during 1945 in thirty-nine wells in the Appalachian region are tabulated, and two depth-temperature charts are illustrated. These data show that the actual deviation of the individual points from the curves of average values of the depth–temperature relationships is such that these curves cannot be used indiscriminately for estimating subsurface temperatures even in the areas represented by these data.

The results of absolute viscosity determinations on fifteen crude oil samples from thirteen fields representing thirteen different oil-producing sands in New York, Pennsylvania, and West Virginia at three different temperatures are also tabulated and shown graphically. The viscosity measurements were made with calibrated Ostwald–Fenske pipettes.

The paper is well illustrated, and eight references are given. R. B. S.

1045. A Neutron Method of Measuring Saturations in Laboratory Flow Experiments. E. Brunner and E. S. Mardock. *Petrol. Tech.* (*A.I.M.M.E.*), March 1946, 9 (2); Tech. Pub. No. 1986, 1–10.—In experimental studies of the mechanism of oil production it is frequently necessary to measure the oil saturation in a porous medium containing oil, gas, and perhaps brine. The measurement may have to be made at high pressure, without interrupting flow, and on a relatively small section to eliminate end effects. Resistivity methods may be used for obtaining brine saturations; gas saturations may be obtained from the apparent compressibility of the gaseous phase, although this demands interruption of flow.

A beam of neutrons is very penetrating, and its scattering by substances containing hydrogen, such as oil, is qualitatively different from that due to other substances. The neutron source employed was a metal cylinder 6 cm long and 1·8 cm in diameter, containing 211 mg of radium (as the bromide) mixed with powdered beryllium metal.

Neutrons passing through a substance rich in hydrogen are quickly slowed down; collisions with the heavier nuclei of other atoms cause a less deceleration of the neutrons. Hence the number of slow neutrons emerging from an object irradiated by fast neutrons gives a rough index of the amount of hydrogen it contains. Boron and lithium are easily disintegrated by slow neutrons, and so the latter are readily detected in an ionization chamber lined with one of these elements or filled with boron trifluoride gas. Such a chamber must be adjusted to operate in the presence of gamma-ray ionization. Alternatively, the slow neutrons may be detected by measuring the radioactivity they induce in a suitable material. Rhodium has been proved quite suitable for this purpose, since it is not strongly activated by fast neutrons or neutrons of intermediate speed.

The steel core-holder was 2·6 inch internal diameter and with 0·5-inch walls. The unshielded side of the neutron source was towards the core-holder and at a fixed distance from it. A second lead shield was placed on the opposite side of the core-holder. The two rhodium detector plates were held between the neutron source and the core-holder. The plate is first exposed for 5 min, then quickly removed from the neutron source-holder and placed in position near the Geiger–Mueller tube, and exactly 15 sec after removal counting is started and continued for 3 min. The timing is done automatically, since it is most important. The background count is deducted in order to obtain a measure of the activity of the plate. The second plate is exposed at the appropriate time, and the plates are used alternately, each being used at approximately half-hour intervals.

A calibration curve for interpreting the neutron data on saturations was obtained by weighing. It is preferable to plot relative activity against saturation. The positions of the neutron apparatus and the porous medium must be the same under test as in calibration. Tests with different hydrocarbons showed that some factor other than carbon/hydrogen ratio is involved. When used with a two-phase hydrocarbon system, oil and gas, a calibration curve will be needed for each pressure, since the gas density varies with pressure. For three phases, oil, gas, and brine, the saturation of one must be measured independently of the neutron method—*e.g.*, the brine saturation might be determined electrically, but the neutron apparatus must be calibrated with the three phases.

The neutron apparatus can be used to measure saturation distribution accurately, provided the gradient is not too high. G. D. H.

1046. Meaning of Petroleum Reserve Estimates. R. J. Gonzalez. *Oil Wkly*, 10.6.46, **122** (2), 49–50.—A comparative study of the two methods of reserve estimates, the A.P.I. and P.A.W. methods, is made. It is concluded that: (1) Properly interpreted, the A.P.I. and P.A.W. reserve estimates are consistent, although they use different methods for determining discoveries and estimated year end reserves; (2) The two methods indicate a declining trend in discoveries during the war, the average for 1941–44 being at least one-third less than 1937–40; (3) Experience for the last 8–15 years indicates that initial estimates of discovery, made at the close of the discovery year, are later revised upward by 150–200% on the average; (4) Revisions for the period 1937–44 appear to have been distributed about as follows to the sequence of prior years: 30%, 12, 10, 8, 6, 5, 4 to the seventh prior year, and 25% to all other prior years; (5) It would be better for the industry to use the rate at which reserves are being produced rather than " years' supply " as an index of the relation of reserves and production. A. H. N.

1047. An Application of Statistical Methods to Core Analysis Data on Dolomitic Limestone. A. C. Bulnes. *Petrol. Tech.* (*A.I.M.M.E.*), May 1946, **9** (3); Tech. Pub. No. 2025, 1–16.—Methods of statistical analysis have been applied to the study of core analysis data of dolomitic limestone from the San Andres formation at Wasson and the Clearfork formation at Fullerton. Probability relationships are shown to connect the porosity and the permeability, and the porosity and the fluid saturation. Thus, the porosity-permeability relationship expresses the probability that a sample of porosity, *f*, will or will not be permeable.

The over-all porosity frequency distribution of the reservoir, together with the frequency curves of permeability (one for each class interval of porosity), provide a precise basis for computing the weighted average productive porosity of the reservoir for any assigned value of the minimum productive permeability. The probability that the permeability of a core specimen from Fullerton will exceed a given value appears to be dependent on the percentage porosity of the specimen, its void structure type (*i.e.*, porosity in the qualitative sense), and the given value of the permeability. If continuous profiles of void structure type and porosity are available, together with the appropriate porosity-probability of permeability plots, the net pay thickness may be estimated.

The Invasion Index of a well is defined in terms of the porosity and permeability data. This index is suggested as a basis for comparing wells as regards their suitability as fluid-injection wells. G. D. H.

1048. Exploration and Production of Petroleum. I. Anon. *Ind. Min.* (*Argentina*), 1946, **6** (58), 85–88.—Methods of surface prospecting are classified into six groups—viz., measurement of gravity, changes in magnetism, seismographic, electrical resistance, soil analysis, and analysis of hydrocarbons in the soil. The details and applications of these methods are considered. A. C.

1049. Exploration and Production of Petroleum. II. Anon. *Ind. Min. (Argentina)*, 1946, 6 (59), 41–44.—A review of exploration methods used in conjunction with drilling, including electrical resistance, geochemical analysis, differences in radioactivity as detected by gamma rays, and fluoroscopic examination. The paper referred to in this and the preceding abstract is a digest of a book published by the Standard Oil Co. A. C.

1050. Plastic to Increase Oil Well Output. Anon. *India Rubber J.*, 1946, **111** (1), 3.—A plastic, phenolic resin has been tested in a West Texas oilfield (11,500 ft underground) to seal walls against the intrusion of natural gas, and the tests indicate that a well, the allowable output of which was as low as 1 brl per day through this cause, could be restored to normal production. The resin, introduced into the shaft as a true liquid, permeates the porous rock through which the gas has been filtering, and hardens. C. N. T.

1051. Core Analysis Based on Vacuum Distillation. C. M. Beeson and N. Johnston. *Petrol. Tech. (A.I.M.M.E.)*, March 1946, **9** (2); Tech. Pub. No. 2017, 1–14.—The gravimetric–vacuum distillation method of core analysis was developed to permit rapid and accurate determinations of the oil/water ratios of small samples or sands containing little oil. The method usually cleans the samples so well and with so little alteration that rapid determinations of the porosity and permeability may be made on the evacuated cores.

The distillation tubes and traps can be constructed by simple glass-blowing from the usual glassware. Electrical heaters are used, and the traps are immersed in a mixture of kerosine and solid carbon dioxide. The procedure requires about 40 min, and consists of raising the temperature and maintaining it between 675° and 725° F for at least 10 min while the pressure is held between 1 and 2 mm of mercury. The fluids condensed in the trap are separated by centrifuging, and the volume of water is recorded. Determinations of changes of weight with an analytical balance of all parts of the apparatus permit computation of the weight of oil distilled and total weight of oil recovered.

An appendix discusses in detail calibration tests for determining the oil/water ratio. It also deals with the change in gravity of oil during vacuum distillation, the reliability of the method for finding the oil/water ratio, and the determination of permeability, porosity, and saturation. G. D. H.

1052. Secondary Recovery Production Research. (A Monthly Review.) R. V. Hughes. *Producers' Monthly*, May 1946, **10** (7), 9.—This month's review is restricted to a discussion of the effects of organic material in flood-water and methods for its removal: one of the chief requirements for an ideal flood-water being the absence of all organic material. Many pressure plants in the Bradford field have been equipped with chlorinators for killing all organic growth, which in turn is removed from the input waters by the filter system. Copper sulphate, sodium hypochlorite, and calcium hypochlorite have been used in the past for destroying organic growths without gaining particular favour. The majority of failures of the chlorination method are not the fault of the principles of chlorination nor of the equipment used, but are due to insufficient attention being given to the condition and chemical properties of the raw water in use, and other simultaneous water treatment at the pressure plant.

Several kinds of bacteria can cause corrosion of iron by direct oxidation or by the formation of acids or hydrogen sulphides, both of which attack iron. Not only such corrosion products, but the bacteria themselves may be carried to the sand face of the input well to cause plugging.

As it normally requires so little chloride to destroy organic growths and all operators use considerably more than the requirements, there is a general feeling that no living organism should reach the sand face of input wells. Since it is known that they do, there must be some overlooked factors. Some authorities have stated that sulphate-reducing bacteria are not destroyed by the usual chlorination process, and these attack sulphates in the water, producing hydrogen sulphide, which causes corrosion, etc., as mentioned above. Sulphate-reducing bacteria, however, are not common in raw water supplies. One is therefore led to conclude that the amount of chlorine added to the water is not a guide as to its effectiveness. The only guide is the measure of residual chlorine at designated points in the water system. Adequate residual chlorine at the filter discharge does not insure protection beyond that point. The proper residual should exist at the sand face initially and at the suction end of the pressure pump at all times to insure adequate protection. Other factors complicate the problem : sufficient oxygen must be present to meet the organic oxidation demand before the chlorine becomes effective, but excess oxygen increases corrosion ; excess of chlorine makes the water more acid, and in many pressure plants lime or caustic soda is subsequently added to increase the pH.

In conclusion the author states that careful study of the entire water-treatment problem and co-operation on the part of the commercial laboratories and the producers can only result in better defining the ideal flood-water and how to obtain it.

R. B. S.

1053. Effect of Oil-Soluble Wetting Agents on Water and Oil Production in Secondary Recovery. J. N. Breston and W. E. Johnson. *Producers' Monthly*, May 1946, **10** (7), 28.—This paper is a preliminary report on some of the researches carried out by the Pennsylvania Grade Crude Oil Association on the general problem of increasing oil production by reducing the water intake of the loose sands and increasing production of the tight sand. Most of the work done to date has been concentrated on the selective plugging the input well.

Various methods of selective plugging have been proposed. Among them are : (1) the use of an aqueous dispersion of a bituminous substance which will penetrate the sand and then coagulate at the desired place ; (2) the injection of a solvent containing a dissolved plastic material. The water in the sand gradually dissolves the solvent, causing the plastic to be precipitated ; and (3) to preferentially oil-wet as much as possible of the sand contiguous to the well. It is expected that this should reduce the water permeability of the sand.

Using oil alone, it is not easy to oil-wet a sand surface which is already water-wet. To accomplish this easily it has been suggested that an oil-soluble wetting agent be incorporated in the crude which is to be employed in oil-wetting the sand. Two of such oil-soluble wetting agents were selected as representative, and were used in the experiments reported. One of these was an alkyl amine called Paramin, which is made by chlorinating and then aminating a kerosine fraction of crude oil. The other was a substituted oxazoline called Alkaterge-C, which is a high-molecular-weight amine. These compounds were used in 1% concentration in the crude oil for the sand-wetting experiment. The specific problem for investigation was to determine if and how much the water permeability of a water-wet or watered-out sand would be reduced by preferentially oil-wetting the sand with the aid of these oil-soluble wetting agents. The experiment was tried on a long diamond core (18 in.), taken from a horizontal well of the Franklin, Pennsylvania, oil mine, and on two sections of a diamond core of Bradford sand, using 1% solutions of the wetting agents.

The experimental procedure is described, and the results obtained are shown tabularly and graphically. These results indicate that instead of reducing the water permeability of the core by oil-wetting the sand with the aid of this wetting agent, the permeability was increased. Saturating with plain crude did, however, reduce the water permeability, but only for a few hours, lasting only until the crude was flooded out. Evidently, though the sand had become oil-wetted, the reduction in interfacial tension between the oil and flood-water made it easier for the water to pass through the oil-wet sand. However, the experiments also indicated that increased oil recovery in water-floods may be possible by the use of oil-soluble wetting agents. There was a decrease in residual saturation in each experimental flood following a saturation with crude plus wetting agent. Water production is increased along with oil production. Economically the increased oil production may possibly compensate for the increased water production.

The authors state that further experiments are necessary to substantiate and elaborate on these results. Six references are given. R. B. S.

1054. Amine Type Wetting Agents as Acid Corrosion Inhibitors. J. N. Breston. *Producers' Monthly*, May 1946, **10** (7), 19.—The purpose of a corrosion inhibitor is : (1) to protect steel equipment from corrosion and avoid leaks, and (2) to maintain a constant pH in the flood-water—*i.e.*, to keep the acid from being spent on the iron and steel. Since acid flood-water (pH 2·5–3) had been found favourable for flooding purposes, experiments were conducted to find suitable acid corrosion inhibitors. Such an inhibitor should be water soluble, effective for days, and not plug the sand or interfere with oil recovery.

Commercial inhibited acid did not produce the desired results because (1) much of the inhibitor would precipitate out on diluting the acid, and (2) it was not effective in keeping down the pH of the water more than two or three days. However, slightly water-soluble wetting agents had previously been found to reduce corrosion considerably : also some of the amines (which are water soluble) are effectively germicidal and keep down bacterial growths.

Extensive tests were made of the Pennsylvania Grade Crude Oil Association to determine the value of such agents as acid corrosion inhibitors. These tests are described in detail, together with illustrations of apparatus and tables and graphs of the results obtained. They indicate that certain amine-type wetting agents could be used effectively to inhibit acid corrosion of iron and steel in dilute acid solutions (pH 2·5). The inhibitors are effective in concentrations as low as 5 p.p.m., and it is expected that the concentration may be reduced even further after the metal has once been wetted effectively with the inhibitor. The inhibitors tested are less effective when used to protect brass, and give only limited protection to copper. Hard water and dilute brines do not impair their effectiveness. They will not protect metal from oxygen corrosion, but will reduce iron pick-up by oxygen-free water. Since these inhibitors are effective in concentrations of but a few parts per million, and none of them is expensive, their use is economically possible.

Only one reference is given. R. B. S.

1055. Current Concepts of Secondary Recovery. N. van Wingen and N. Johnston. *Oil Wkly*, 1.7.46, **122** (5), 24. *Part of a paper presented before American Petroleum Institute.*—The literature is studied and the results are summarized. (These summaries cannot be further abstracted, as they are themselves condensed statements very concisely made, and should be consulted.) However, a point worth noting is that the majority of the research performed to date has dealt with unconsolidated sands, and has been conducted without the consideration of a second immiscible liquid phase to simulate interstitial water. Yet, as producing sands normally contain water, it is to be seriously questioned if results of experimental laboratory work on samples 100% oil saturated can be applied to actual field problems. Likewise, it is to be cautioned that any conclusions based on experimental work performed with one type of sand do not necessarily apply quantitatively to any other sand. Also, great care should be exercised with regard to the application of results of laboratory experiments to problems of reservoir behaviour, as a small model may not always adequately duplicate the behaviour of the prototype. Nevertheless, the literature does contain very useful and valuable results, which are summarized. A. H. N.

1056. Fluid Power Makes Subsurface Production Data Automatically Available. K. B. Barnes. *Oil Gas J.*, 29.6.46, **45** (8), 94.—The working of the hydraulic system of deep-well pumping is described : power oil is pumped by a triplex pump to the underground combination of engine and pump. The hydraulic engine piston actuated by the power oil drives the pump piston. The power oil is exhausted into the well. Bottom-hole pressures are evaluated from the pressure required by the power oil to lift the oil and well-depth data. The calculations required are indicated.

A. H. N.

1057. Stripper Well Pumping Problems. C. D. Borland. *Oil Wkly*, 1.7.46, **122** (5), 28.—A brief discussion of troubles encountered with pumping small volume wells from gas, wax, sand, old equipment, etc., is given. A. H. N.

1058. Coagulation in Flood-water Treatment. Anon. *Oil Wkly*, 17.6.46, **122** (3), 62.—The most widely used coagulants in various treatment processes are compounds of iron and aluminium—namely, aluminium sulphate, potassium alum or ammonia alum, sodium aluminate, aluminium chloride, ferric chloride, ferrous sulphate, chlorinated copperas, and ferric sulphate. Of these compounds, alum is the most widely used for coagulation in flood-water treatment. Aluminium or iron sulphate added to raw, untreated water for coagulation acts in three general ways: (1) formation as aluminium hydrate or ferric hydrate, which is the gelatinous flocculent precipitate referred to as the "floc"; (2) formation of a positive trivalent Al or Fe ion, which is effective in precipitating negative colloids; and (3) formation of a negative divalent ion (SO_4), which is effective in precipitating positive colloids. In these actions, as is true of the entire coagulation process, it is very essential to have good floc formation, not only to permit proper action of the floc, but also a rapidly settling heavy floc, which may nearly all be removed by settling prior to filtration. This allows maximum length filtration runs between filter back-washings. Control of pH of water is an essential factor. A. H. N.

1059. Some Factors Influencing the Plugging Characteristics of an Oil-well Injection Water. W. F. Cerini, W. R. Battles, and P. H. Jones. *Petrol. Tech.* (*A.I.M.M.E.*), May 1946, **9** (3); Tech. Pub. No. 2028, 1–12.—A test for determining the plugging characteristics of an oil-well injection water has been developed. It consists in measuring changes of the filter-rate of a water at constant pressure with cumulative throughput when passing the water through a medium-grade sintered glass disc. This test has been applied to evaluating the plugging characteristics of the treated injection water used in an experimental water-flood in the Richfield district. The tests show that the finished water from the treating plant rapidly developed increasing plugging tendencies on ageing, even though the initial quality of the water from the plant filter as determined from the evaluation test was good. The plugging material formed upon ageing the water was approximately 40% inorganic and 60% organic, the former consisting of 90% calcium carbonate and 10% ferric hydroxide. The presence of live bacteria alone did not appear to cause appreciable plugging. At a pH of 6·4 or lower the growth of bacteria was inhibited. Lowering of the pH of the treated plant water from 7·5 to 6·4 by injection of carbon dioxide reduced the formation of plugging material with ageing. Treatment with chlorine, hydrochloric acid, or a combination of carbon dioxide and chlorine materially increased the formation of plugging materials with ageing.

No entirely satisfactory explanation can be offered to cover the occurrence of the plugging materials and the effects of the various treatments, the data indicate rather conclusively that none of the treatments would in themselves produce a water which would not cause plugging after ageing. They also show that a simple filtration after ageing would produce a relatively stable non-plugging water of better quality than could be produced by chemical treatment, ageing, and filtration. Storage, and ageing, cannot be avoided, and hence that installation of a filter in the input-well supply line would appear to be the best means of preventing plugging. G. D. H.

1060. Laboratory Investigations of Chemical Changes on East Texas Oilfield Water Affecting its Injection into Subsurface Sands. F. B. Plummer and I. W. Walling. *Petrol. Tech.* (*A.I.M.M.E.*), March 1946, **9** (2); Tech. Pub. No. 2019, 1–14.—The presence of sulphate-reducing bacteria in oil-wells producing salt water has been demonstrated. At 125° F bacteria alone reduce the sulphate content of East Texas brines by only 3% in 30 days, with the formation of hydrogen sulphide, and sodium or calcium hydrogen sulphide, and sodium or calcium hydroxide chiefly. The hydrogen sulphide reacts with soluble iron compounds to produce iron sulphide in the absence of oxygen, and ferric hydroxide where oxygen or air is present. These compounds, if formed or carried into a well, lead to clogging of the sand. A reduction of the amount of sludge due to iron compounds may be attained by reducing the sources of iron, by using concrete or lined iron tanks, and coating pumps, pipelines, etc., with non-metallic material.

Where iron or other metals and iron sulphide are already in the water containing bacteria, 100% reduction of the sulphates is complete in 30 days or less; where magnesium is present, reduction is complete in 15 days. Little reduction took place at 60° or 70° F, and maximum reduction and most formation of hydrogen sulphide occurred at 125° F, with no reduction at 150° F. The greater the amount of ferrous sulphide sludge, the greater the sulphate reduction.

Phenol, formaldehyde, creosote, thiokol, and other bactericides killed the bacteria in the brine and prevented sulphate reduction and hydrogen sulphide formation. The bactericides should be applied to the stagnant spots of the fluid-circulating systems. Streamlining by eliminating stagnant spots is beneficial, since the sulphate-reducing bacteria are strictly anaerobic. Oxidized ferrous sulphide sludge (ferric hydroxide sludge) prevented sulphate reduction.

The addition of bactericides, and frequent aeration or oxidation of the substances which favour bacterial growth, may provide a solution of the hydrogen sulphide problem of fields like East Texas. G. D. H.

1061. Efficiency of Water Drive in Illinois Sand Reservoirs. A. W. Baucum and W. D. Steinle. *Oil Gas J.*, 27.7.46, **45** (12), 199. *Paper presented before A.P.I.*—The geological structural features of the reservoirs and the properties of both formation media and reservoir fluids are described and quantitatively tabulated where possible. Production data and well-spacing are then discussed and results of the recovery briefly analysed. A. H. N.

1062. Mid-Continent's Shallowest Water-drive Project Affords Interesting Study of Contrast to Deeper, Flush-type Oil Production. R. O. Bankson. *Oil Gas J.*, 29.6.46, **45** (8), 109.—The field is comparatively small. So far, 75 acres have been drilled up and flooded, and the development of 60 additional acres planned for the near future will complete the work on the acreage owned in this area. To January 1, 1946, 217,402 brl of oil have been produced, and, of this, 68%, or 147,711 brl, were recovered from 34 acres. The water-flood recovery from the 34-acre parcel which has now been abandoned amounted to 4345 brl/acre. Operation of the remaining 41 developed acres is continuing. The wells are shallow and easy to drill; total time for drilling, shooting, cleaning out, and moving away is some 50 hours. Details of the field characteristics are given. A. H. N.

1063. Design and Operation of Subsurface Salt Water-disposal Systems. H. H. Elliston. *Oil Wkly*, 10.6.46, **122** (2), 34.—Cost estimates are given for injection of salt water for disposal purposes. A detailed study of the engineering of salt-water disposals shows that the most economical way is to form mutual, non-profit associations of companies—*i.e.*, to treat the problem as a large unit. Important items to be considered and a classification of the various schemes available are given in a long outline form. A. H. N.

1064. Separator Pressure Used for Salt-water Disposal. G. B. Nicholson. *Oil Wkly*, 27.5.46, **121** (13), 36–37.—The system described uses knock-outs converted from separators for removing all the water possible from the production, employing a closed disposal system which utilizes knock-out pressures for injecting the water into input wells. A relatively small percentage of emulsified water remains with the production after leaving the knock-outs, and only this portion is directed through the gun-barrels and heating system with the oil for treatment. Details of the system are given. Between 85% and 90% of the water is removed, and it is claimed that this fact reduced the extent of corrosion in the lines, treaters, etc., as a closed system is used. A. H. N.

1065. Penetron Detection of Corrosion Inside Distillate Producing Equipment. F. B. Gordon and P. H. Lipstate, Jr. *Oil Wkly*, 17.6.46, **122** (3), 38.—The use of penetrating gamma rays by means of the " penetron " to detect corrosion inside pipe lines proved successful in showing thinner pipe walls where corrosion attacks were pronounced. A. H. N.

1066. Formation Penetrating with Shaped Explosive Charges. R. H. McLemore. *Oil Wkly*, 8.7.46, **122** (6), 56.—The charge is an adaptation of the techniques used by the Army during the war in the " bazooka " rockets and various other demolition charges. The principle of the " shaped " charge, often called the " cavity effect of explosives," consists of leaving a cavity in the explosive at the very spot where the maximum force is desired. In packing the explosive into the charge, a cavity in the shape of a cone is left in the forward end of the charge. Upon detonation, the explosive force is focused in this cavity, and emerges as a high-velocity stream of hot gases intermingled with fine particles of the material used in forming the cavity. In the formation penetrator this cavity is placed in the charge, so that it will be adjacent to the formation at the point at which penetration is desired. The size and shape of the cavity, the material with which it is lined, and the type of explosive used, all have an effect on the penetration which will be attained. Experiments on steel cylinder blocks as targets show that the shape charge can drill a hole right through the block which the ordinary charge left unaffected. A. H. N.

1067. Efficient Use of Oil-well Packers. J. M. Walker. *Oil Wkly*, 1.7.46, **122** (5), 20.—Different types of well-packers available are described. In selecting a packer the first consideration is that of the most suitable size, but after this requirement is fulfilled, several others have to be taken into account, including the method of removing the packer. Some of the considerations necessary are discussed.

A. H. N.

1068. Water Well Intake Chart. K. B. Nowels. *Oil Wkly*, 8.7.46, **122** (6), 39.—A nomographic chart is presented for solving water well intake problems in five spot water-flood spacing pattern. A. H. N.

1069. Drilling and Production Patents. L. E. Beck. U.S.P. 2,400,478, 21.5.46. Power-driven earth auger.

F. A. Kent and C. W. Patrick. U.S.P. 2,400,515, 21.5.46. Method of purifying and deodorizing crude oil.

W. L. Denman, assr to Dearborn Chemical Co. U.S.P. 2,400,543, 21.5.46. Method of treating waters and composition therefor.

J. Neufeld, assr to Well Surveys. U.S.P. 2,400,593, 21.5.46. Method of and apparatus for investigation of cased drill holes.

G. Althoff. U.S.P. 2,400,622, 21.5.46. Device for the hydraulic transmission of power.

G. E. Archie, assr to Shell Development Co. U.S.P. 2,400,678, 21.5.46. Method and apparatus for electrically logging wells.

W. A. Eaton, assr to Bendix-Westinghouse Automotive Air Brake Co. U.S.P. 2,400,688, 21.5.46. Fluid pressure control system.

C. Prather and F. A. Rydberg. U.S.P. 2,400,712, 21.5.46. Drill pipe spinner.

W. B. Rhees. U.S.P. 2,400,713, 21.5.46. Process and apparatus for the demulsification of hydrocarbons.

A. McMillan, assr to Chain Belt Co. U.S.P. 2,400,765, 21.5.46. Mechanism for actuating clutches and the like.

W. P. Stilley. U.S.P. 2,400,853, 21.5.46. Well drilling apparatus.

J. H. McFarlane. U.S.P. 2,400,941, 28.5.46. Sucker rod connection.

R. C. Baker, assr to Baker Oil Tools. U.S.P. 2,400,970, 28.5.46. Lock device for well tools.

P. H. Brace, assr to Petrolite Corpn. Ltd. U.S.P. 2,400,975, 28.5.46. Apparatus for electrically resolving water-in-oil emulsions.

B. L. Evering and A. P. Lien, assrs to Standard Oil Co. U.S.P. 2,400,985, 28.5.46. Desalting crude oils.

V. Voorhees, assr to Standard Oil Co. U.S.P. 2,400,986, 28.5.46. Desalting crude oils.

S. M. Akeyson and W. L. Stockham, assrs to Nobs Chemical Co. U.S.P. 2,401,035, 28.5.46. Well screen.

H. L. Cupples, assr to The United States of America. U.S.P. 2,401,053, 28.5.46. Measurement of surface tension.

A. J. Granberg. U.S.P. 2,401,067, 28.5.46. Water separator.

O. V. Lindquist, assr to J. K. Smit & Sons. U.S.P. 2,401,087, 28.5.46. Diamond drill bit.

R. G. Taylor, jr., assr to The Guiberson Corpn. U.S.P. 2,401,119, 28.5.46. Well tool.

C. W. Kandle. U.S.P. 2,401,250, 28.5.46. Earth drill.

J. E. Walstrom, assr to Schlumberger Well Surveying Corpn. U.S.P. 2,401,280, 28.5.46. Method for locating permeable formations traversed by boreholes.

J. M. Pearson and C. R. Nichols, assrs to Sperry-Sun Well Surveying Co. U.S.P. 2,401,371, 4.6.46. Electrical prospecting method and apparatus.

F. J. Wright, assr to The Denison Engineering Co. U.S.P. 2,401,397, 4.6.46. Control valve for hydraulic systems.

F. B. Doane, assr to Magnaflux Corpn. U.S.P. 2,401,467, 4.6.46. Method of and apparatus for magnetic testing for cracks or other imperfections.

M. G. Schutte and N. L. Schutte. U.S.P. 2,401,515, 4.6.46. Underreamer.

R. C. Mason. U.S.P. 2,401,576, 4.6.46. Device for measuring length of a line run into or removed from a bore hole.

E. G. Schick, assr to Schick-Siegal Industries. U.S.P. 2,401,665, 4.6.46. Oil well choke.

W. A. Eaton, assr to Bendix-Westinghouse Automotive Air Brake Co. U.S.P. 2,401,680, 4.6.46. Fluid pressure control mechanism.

C. Heeter, assr to C. M. Heeter, Sons & Co. U.S.P. 2,401,871, 11.6.46. Vacuum sand pump for wells.

E. B. Williams, jr. U.S.P. 2,401,893, 11.6.46. Side wall core barrel.

A. Pranger, assr to The Guiberson Corpn. U.S.P. 2,401,960, 11.6.46. Pressure drilling head.

R. A. Salathiel, assr to Standard Oil Development Co. U.S.P. 2,401,966, 11.6.46. Process and agent for breaking petroleum emulsions.

A. J. Zschokke, assr to Lane-Wells Co. U.S.P. 2,402,002, 11.6.46. Contact means for electrically operated well tools.

E. R. Zeek, assr to Specialties Development Corpn. U.S.P. 2,402,196, 18.6.46. Method of and apparatus for separating fluids.

K. A. Wright, assr to B. and W. U.S.P. 2,402,223, 18.6.46. Rotary well bore cleaner.

F. C. Carpenter, assr of one-half to Eastman Oil Well Survey Co. and one-half to Eastman Oil Well Survey Corpn. U.S.P. 2,402,238, 18.6.46. Well deflecting tool.

L. C. Hufford. U.S.P. 2,402,284, 18.6.46. Pressure control.

J. M. Shimer. U.S.P. 2,402,300, 18.6.46. Fluid actuated mechanism.

E. R. Price, assr to Bendix Aviation Corpn. U.S.P. 2,402,344, 18.6.46. Fluid pressure system.

J. P. Ratigan. U.S.P. 2,402,345, 18.6.46. Apparatus for cleaning pipes and tubing.

K. C. D. Hickman, assr to Distillation Products. U.S.P. 2,402,401, 18.6.46. Apparatus and method for dehydrating in the frozen state.

S. C. Hurley, jr. U.S.P. 2,402,405, 18.6.46. Photoelectric inspection device.

J. El Munn, assr to Chemical Service Co. U.S.P. 2,402,433, 18.6.46. Treatment of oil wells.

V. E. Haury and S. A. Ballard, assrs to Shell Development Co. U.S.P. 2,402,495, 18.6.46. Capillary active salts.

D. M. Lawrence, assr to Bendix Aviation Corpn. U.S.P. 2,402,499, 18.6.46. Pressure regulating system.

R. B. S.

Oilfield Development.

1070. February Exploratory Drilling Increases. Anon. *Oil Wkly*, 25.3.46, **121** (4), 43.—During February U.S. exploratory well completions averaged 78·8 per week. 21·3% of the tests were successful. 71 oil discoveries have been made in January and February, 51 being new fields; 26 new gas discoveries have been made, 24 being new fields.

Tables summarize by States and districts the exploratory drilling results for February and for the first two months of 1946, classifying the discoveries according to their types. The February discoveries are listed with pertinent data. G. D. H.

1071. Completions Ahead of 1945 Rate. Anon. *Oil Wkly*, 22.4.46, **121** (8), 43.—During the first three months of 1946, 6355 wells were completed in U.S.A., 12·5% more than in the first quarter of 1945. 2029 wells were completed in the four weeks ended March 30, 1945. Marked increases over the first quarter of 1945 were shown in Texas, Oklahoma, Louisiana, Illinois, Kansas, and Pennsylvania.

A table summarizes the completion results during March and during the first quarter of 1946. G. D. H.

1072. Summary of February Completions. Anon. *Oil Gas J.*, 30.3.46, **44** (47), 308.—During February 1940 wells were completed in U.S.A., 112 finding oil and 213 obtaining gas. G. D. H.

1073. Alberta in 1945. C. O. Nickle. *Oil Wkly*, 1.4.46, **121** (5), 24 (International Section).—During 1945 minor oil-pools were opened at Hay Lake and South Princess, the Conrad pool was expanded, and large extensions were made to the Medicine Hat, Princess, and Viking-Kinsella gas reserves.

124 wells were completed in 1945, 17 being at Turner Valley. 57 wells were dry; 46 obtained oil and 16 gas.

Conrad produces from the Ellis at about 3000 ft. The trap is a pinchout. 14 producers and 13 dry holes have been drilled within a 6-ml radius. The producing area is about 2½ ml long and up to 1 ml wide.

Empire-Pacific 1, 6 ml south of the Devonian oil-wells at Princess, was completed as a Chert zone discovery at 3323 ft, giving 45 brl/day of 28-gravity oil by pumping. The Chert is the erosional surface of the Madison limestone. Empire-Pacific 2, ¼ ml to the south, flowed 60 brl of 28-gravity oil with 6000 Mcf of gas/day from the Madison limestone at 3315 ft. This well found the Devonian dolomite water-bearing.

3 ml southeast of the Princess Devonian wells a Sunburst (Lower Cretaceous) sand discovery was made at 3184 ft. The well gave 45 brl/day of 28-gravity crude with very little gas. Two large Sunburst gas-wells, with some oil, were completed several miles south and southwest of this well.

The Devonian dolomite pool at Princess is a narrow strip, 1¼ ml long. The Princess area may have gas reserves of 300,000 million cu. ft.

The Hay Lake dome is 4 ml north of the Montana border. Madison limestone production has been found at 3094 ft. The Medicine Hat pool now covers 58,000 acres, and has gas reserves estimated at 170,000–400,000 million cu. ft. Production is obtained from the Upper Cretaceous at 925–1225 ft. The Viking-Kinsella gas-pool covers 50 sq. ml., and has reserves of 200,000 million cu. ft. The pool may ultimately cover 400 sq. ml, and may have reserves of 600,000 million cu. ft. This field produces from the Upper Cretaceous Viking sand at 1940–2375 ft.

The Brazeau anticline is viewed favourably. Madison limestone was found at 9498 ft, but was underlain by younger beds at 9597 ft. The Madison was re-entered at 11,351 ft and the Blairmore at 11,599 ft. A small gas-flow was met in the tight lower limestone. The upper limestone is also tight, but has given more gas and a show of crude. After acidization the well gave 2,500,000 cu. ft. of gas/day with some light oil. Further acid treatment quadrupled the gas flow. G. D. H.

1074. Decline Noted in Year's Production in Ecuador. Anon. *Oil Wkly*, 1.4.46, **121** (5), 50 (International Section).—During 1945 Ecuador produced 2,622,724 brl of oil. The 1944 figure was 2,892,188 brl. 2,475,113,000 cu. ft. of gas was treated in 1945 to recover 41,768 brl of gasoline. G. D. H.

1075. Argentine's 1945 Output Shows 5·6% Drop. Anon. *Oil Gas J.*, 20.4.46, **44** (50), 91.—In 1945 22,880,000 brl of crude was produced in Argentina. Private production amounted to 7,426,143 brl. Natural-gas production in 1945 was 21,495,915,000 cu. ft, 8·1% less than in 1944. G. D. H.

1076. Discovery of Petroleum in Chile. A. D. Bolland. *Bull. S. Amer. Inst. Pet.* 1946, **2**, 311–312.—Springhill No. 1 (Tierra del Fuego) came into production on December 29, 1945. The crude has a gravity of 39·7° A.P.I., and is suitable for the production of lubricating oils. A. C.

1077. South American Petroleum Reserves. V. Oppenheim. *Bull. S. Amer. Inst. Pet.*, 1946, **2**, 267–271.—Production in 1944 was 338 million brl (about 13% of total world production). Known reserves are about 30,000 million brl, but a much fuller survey of the continent is required before true reserves can be estimated. A. C.

1078. Petroleum Activities in Colombia. E. Ospina-Racines. *Bull. S. Amer. Inst. Pet.*, 1946, **2**, 275–284.—During 1945 47 new wells were started and 63 completed. 8 companies were developing concessions and over 19 million brl exported. Detailed production figures are given. A. C.

1079. Debate Over Concession where New Czechoslovakia Producer is Located. Anon. *Oil Wkly*, 1.4.46, **121** (5), 49 (International Section).—A field, discovered in 1945, near Zizkow, just north of Lundenburg in Moravia, is the first area which might potentially meet a substantial part of Czechoslovakia's needs. The field is in an extension of Austria's Vienna Basin, in which lies Zistersdorf. Four wells have been completed, defining reserves of 7,000,000 brl.

The matter of the concession is under discussion, since an agreement had been reached regarding a contract with an American-owned company before the German occupation. G. D. H.

1080. French Production. Anon. *Oil Wkly*, 11.3.46, **121** (2), 78.—In September 1945 Pechelbronn was producing 925 brl/day. A year earlier the figure was 1250 brl/day. G. D. H.

1081. Arabian American Output Doubled in Year's Time. Anon. *Oil Wkly*, 1.4.46, **121** (5), 49 (International Section).—In 1945 the Arabian American Oil Co. produced about 21,300,000 brl of oil in Saudi Arabia. The 1944 production was 7,800,000 brl. The new refinery at Ras Tanura was completed in December 1945, and has a 60,000-brl/day throughput. G. D. H.

TRANSPORT AND STORAGE.

1082. Measurements of Friction in a Pipe for Subsonic and Supersonic Flow of Air. J. H. Keenan and E. P. Neumann. *J. Appl. Mech.*, June 1946, **13** (2), A91–A100.—The apparent friction coefficient was determined experimentally for the flow of air through smooth pipes at subsonic and supersonic velocities. Values of the Mach number ranged from 0·27 to 3·87, and of Reynolds number from 1×10^5 to $8{\cdot}7 \times 10^5$. In supersonic flow the results were found to be strongly influenced by the presence of oblique shocks formed at the junction of nozzle and pipe. The effect of these shocks on the coefficient of friction was determined. Nozzle forms were devised which eliminated the shocks and their effects. It was found that at distances from the pipe inlet greater than 50 diam the apparent coefficient of friction for compressible flow at Mach numbers greater or less than 1 is approximately equal, for equal Reynolds numbers, to the coefficient of friction for incompressible flow with completely developed boundary layer. Mach numbers greater than 1 are rarely maintained for lengths greater than 50 diam. For attainable lengths the coefficient of friction is a function of the ratio of length to diameter and the Reynolds number, with the Mach number at entrance determining the maximum attainable length. A. H. N.

1083. On the Velocity Distribution of Turbulent Flow in Pipes and Channels of Constant Cross Section. C. Wang. *J. Appl. Mech.*, June 1946, **13** (2), A85–A90.—This paper follows the Prandtl conception of momentum transport and gives a critical examination of the so-called Prandtl–Nikuradse formula and the von Karman formula for the velocity distribution of the turbulent flow in tubes or channels at large Reynolds number. It shows that both formulæ would not give a good picture of the turbulent flow near the centre of the conduit, and they actually do not. A new formula for the velocity distribution is developed from a study of the mixing-length distribution across the section. This new formula checks quite well with the experiments, and yields the same skin-friction formula as derived by von Karman and Prandtl, which itself is in very good agreement with experiments. A. H. N.

1084. 1946 Pipeline Construction Programme—One of the Largest in Peacetime History. *Oil Gas J.*, 27.7.46, **45** (12), 159.—Tabulated data are given of pipeline projects for 1946, which show the lines planned, completed, and under construction in the United States, for (1) major products; (2) natural gas transmission lines; and (3) new and expanded crude oil lines for the first half of the year. The data show the company, mileage, size, and location. The total mileage covered and the size of the line shown for (1) is 2014, (6–8 inch); (2) 4125, (12–25 inch); (3) 1495, (6–10 inch).

In Europe, Asia, and the South Americas the following construction is shown. In the U.S.S.R., natural gas lines: (1) of about 300 miles, from the Western Ukraine to Kiev is under construction; (2) from Saratov to Moscow, about 500 miles is nearing completion, a parallel line is also planned. A crude-oil line is nearing completion which will serve a refinery at Ufa from the oilfields at Tuimazy. In the Middle East a Trans-Arabian pipeline is being planned for the Trans-Arabian Pipe Line Co., Standard of California and Texas Co., extending 1000 miles from the Persian Gulf to the Mediterranean coast.

In South America, the Bolivian Government Oilfields 6-inch pipeline will transport crude from Camiri to Tintin, a distance of 255 miles, and it is reported the plan will include a products line between Camiri and Sucre, of about 186 miles. In Venezuela, the Lake Maracaibo producers are considering the construction of a new big-inch line from the fields to the Paraguana Peninsula. Several companies are contemplating the building of a line from Puerto Cruz to near Las Mercedes, in the State of Guarico, E. Venezuela. It is reported that the Mexican Government is planning for a new line for crude oil from the Poza Rica field to Salamanca. The Government also plans for a transmission system to convey 35 million cu. ft. natural gas per day for supplying the industrial needs of Mexico City. The Gas Industry de Monterrey is planning the construction of a line 140 miles long to convey gas from Hildalgo-Reynosa for serving Northern Mexico. Negotiations are under way with the Reynosa Pipe Line Co. to build a 30-mile line from near Weslaco Texas to the International Bridge.

W. H. C.

1085. Far Eastern Oil Picture Clarifying; Numerous Changes under Way. W. W. Burns. *Oil Gas J.*, 6.7.46, **45** (9), 60.—The first of a two-part discussion of the restoration of the peace-time rôle of oil in the Far East.

In the Philippines, oil distribution is now being handled by the Pacific Oil Storage Co., guided by the military authorities. Storage capacity at Bataan is about 400,000 brl, and is to be increased to 920,000 brl, storing aviation and motor gasolines, diesel oil, kerosine, and range oil. A drum plant is to be constructed. A scarcity in oil-barge and tankers exists, vessels having been sent to China.

As for China, the policy of its Government regarding movements of foreign-flag vessels is unknown. Vessels intended for the Chinese Government have not been handed over, because it is not yet ready to operate them. The country's petroleum industry is to be developed by the Government. Foreign oil companies are ready to resume pre-war distribution operations.

In Korea, the political situation with the important oil installations in the hands of the Russians, coupled with the financial insolvency of Korea economy, makes private oil-company operations impossible for many years to come. It is thought that normal operation in Japan is likely to be delayed beyond 1948, but plans have been made for the commercial companies to operate. G. A. C.

REFINERY OPERATIONS.

Refineries and Auxiliary Refinery Plant.

1086. Modern Refining Processes, Part 10.—Refinery Losses—Where they are and How to Reduce Them. G. Armistead. *Oil Gas J.*, 13.7.46, **45** (10), 108.—Refinery losses are classified, and the main sources are shown in a diagram indicating the stages in which they occur from the receipt of the crude oil and through the storage, processing, refining, and blending stages to the transfer of products from the refinery for marketing, the various losses being discussed under the following sections : unloading and loading losses ; line and vessel leaks ; condensing and cooling losses ; evaporation losses ; processing losses. Losses are classified as : (*a*) evaporation and other escape into the atmosphere ; (*b*) loss through plant-water effluent ; (*c*) miscellaneous losses, such as incomplete emptying of tank cars, acid sludge losses, etc. ; (*d*) loss through leakage into the soil. Economic losses are noted—*i.e.*, high-value products that may gain admittance to low-value products, and, though no actual loss occurs, a financial loss results. Weight balances are discussed, and one is shown in a typical over-all monthly refinery weight balance for a 5000 brl/day refinery employing thermal and catalytic cracking. The weight balance shows only the extent to which total input to a given system is accounted for, and does not indicate the avenue of any loss or losses thus detected, although pointing out their magnitude. The basic requirement for the control of refinery losses and the maintenance of the maximum economic liquid recovery is the provision of a routine continual check on possible losses, and the provision of adequate means for making such detailed investigations as are indicated as necessary. By such means the over-all unaccounted-for loss should not exceed about 1%, and for an individual unit should be somewhat lower. Eight literature references are given. W. H. C.

1087. Steam and Power Generation in the American Refinery. W. F. Ryan. *Oil Gas J.*, 6.7.46, **45** (9), 76.—The Louisiana Station power-plant is described in this Part (2) of the article.

This plant is situated at Baton Rouge, and is now owned and operated by the Gulf States Utilities Co., as part of their system.

Originally built in 1930, it contained three 15,000-kW turbine generators operating at 600 psi and 750° F and exhausting at 141 psi to deliver 135 psi steam to the refinery. Capacity has now been increased to 123,500 kW with 7 turbine generators and 8 boilers of more than 3 million lb/hr total capacity, with no change in operating pressure or temperature.

The water-treating plant precipitates 15–20 tons of mud and silt per day from 4 to 5 million gal of Mississippi River water, and cost $850,000.

Water is drawn through two 16-inch siphon pipes into a 60-ft deep well, equipped with 3000 g.p.m. motor-driven deep well-type pumps. The clear water is pumped through zeolite softeners to the boiler-feed system, which includes a 200,000-gal reserve tank.

The boilers are equipped to burn 10 or 12 different fuels, including natural and refinery gas, fuel oil, acid sludge, pitch bottoms, and other refinery wastes.

Desuperheating of the exhaust to meet refinery requirements is accomplished by passing the exhaust from the turbines through a throughfare desuperheater, thus eliminating supplying turbine by-passed steam to the refinery. Since more steam is passed through the turbine, the yield of by-product power is increased, more than 45 kWh/1000 lb of process steam delivered being obtained. Total blow-down exceeds 500,000 lb/hr at certain river stages ; a heat exchanger replaces the original flash-tank. This, together with the use of a " house-turbine " to replace the reducing valve on the 135 psi mains to the 5 psi auxiliary exhaust system, has played a part in effecting an increase of 25% yield of by-product power.

G. A. C.

1088. Plant Requirements Dictate Design for Steam and Power Generation in the American Refinery. Part 3. W. F. Ryan. *Oil Gas J.*, 13.7.46, **45** (10), 85.—A noteworthy advance was made in 1941 in steam and power generation for refineries when public-utility installations were designed, and built by the Pacific Gas and Electricity Co. for the refineries of the Tide Water Associated Co. at Avon; the Shell Oil Co. at Martinez; and the Union Oil Co. at Oleum in California. The three installations are basically the same in design. Details are given and the set-up is shown by a photograph and in a flow diagram, and a sectional drawing shows the high- and low-pressure turbines. Each installation includes 3 boilers each having a capacity of 230,000 lb/hr steam at 1525 psi and 940° F serving the H.P. turbine, exhausting at 225 psi, part of this going to the L–P turbine. The combined power generates 43,500 kW. The balance of the H–P exhaust steam flows in a closed circuit through a heat exchanger and an evaporator condenser in series, passing out as H–P condensate at 392° F, to a boiler feed-heater, which also receives the condensate from the L–P turbine exhaust in a second closed circuit after preheating by exhaust steam from auxiliaries. In this way, the feed-heater cycle provides deaerated boiler feed-water at 397° F. The heat-exchanger and the evaporator condenser mentioned, contain an open circuit in which preheated treated water is fed to the vaporizer condenser, and is vaporized and passed to the heat-exchanger, in which it is superheated, giving steam at 145 psi for refinery processing. The merits and disadvantages of this system are discussed. A plant designed and installed in Persia in which salt water is used is described, and a heat-balance flow diagram shows its construction and operating characteristics. No records of steam and electric power-generating plants are available for plants constructed during the war. A new installation is mentioned; it is designed for temperatures and pressures approximately as those above, and to use treated water. The elimination of the evaporator cycle will materially increase the yield of by-product power, but the water-treating plant may cost $1,000,000, and a continuing problem in operating will be incurred. The co-ordination of refinery processes with power generation is discussed, and pertinent issues in refinery economics are brought forward showing the intimate relation between refinery processes and power generation, and emphasizing the opportunity for highly specialized design in this connection. The possibilities of extending heat exchange appear to lie entirely in the direction of producing steam from the waste heat of the various process plants. The exchange of waste heat from refinery liquids, flue gases, etc., from tube-stills or cracking units, is elaborated, and a typical arrangement for generating steam in tube-stills is described. Briefly, a boiler drum is fitted adjacent to the tube-heater, to which preheated boiler feed-water is introduced. The water flows through a nest of heating tubes situated in the lower part of the convection bank of the tube-heater, the flow being upward and counter current to the flue gases, and back to the drum, where the steam and water are separated. W. H. C.

1089. Fin-Tube Exchanger Units. Refiner's Notebook No. 99. W. L. Nelson. *Oil Gas J.*, 29.6.46, **45** (8), 127.—Double-pipe heat exchangers in which inside flow tubes have longitudinal fins give high over-all transfer rates when the low-film-rate fluid is passed on the fin side of the exchanger. For computing the film transfer rate on the fin side of the tube, use can be made of the chart given in *Refiner's Notebook No.* 91 (Abstr. 783), constructed for flow inside plain tubes, supplemented by a correction for the conduction due to increased area of the fins. This—*i.e.*, the "equivalent" fin-side area—is described, and can be obtained from the chart here presented. Examples are given and solved by the use of the two charts mentioned, and/or by using the latter with one of the charts given in *Refiner's Notebook* No. 94 or 95. The method of computing the pressure drop in fin-tube exchangers is outlined. W. H. C.

1090. Pressure Drop Through Tube Bundle of Exchanger. W. L. Nelson. *Oil Gas J.*, 22.6.46, **45** (7), 129.—Issue 98 of the *Refiner's Notebook* gives a chart, drawn by means of the Fanning equation for turbulent flow, from which the friction loss of a fluid flowing through the tube bundle of an exchanger can be estimated. Three examples are given. G. A. C.

1091. Pressure Drop Through Tube Side. W. L. Nelson. *Oil Gas J.*, 15.6.46, **45** (6), 137.—No. 97 in the *Refiner's Notebook* series gives a table showing in-and-out pressure drop per pass for typical conditions through exchanger tubes; a chart is provided for use with $\frac{5}{8}$ and $1\frac{1}{4}$-inch tubes.

Specific gravity at the film temperature is an important factor. Friction loss through other sizes can be interpolated from the chart. G. A. C.

1092. Anchor Bolt Calculations. S. M. Jorgensen. *Refiner*, 1946, **25** (5), 97–101.—An evaluation of stresses in anchor bolts and between base-plate and foundation is arrived at by comparison with stresses in a reinforced beam subject to an eccentric axial load in a plane of symmetry. Formulæ are developed and the method of application is set out, including cases involving slender towers with large overturning moments. G. R. N.

1093. Do You Get 90 Per Cent Salt Removal? F. D. Fuqua. *Oil Gas J.*, 13.4.46, **44** (45), 105.—The method of desalting Oklahoma crude oils as practised at the Ben Franklin Refinery, Ardmore, and the plant system used for charging 3000 brl/day are described and shown by a flow diagram. The procedure is conventional in form, as it entails the introduction of fresh water to the crude, emulsification, and de-emulsification, but close attention must be given to the following operating conditions: maintaining the proper pressure drop across the emulsifying valve; holding the most suitable temperature within the settler to break the emulsion; maintaining sufficient back pressure to prevent vaporization in the system; close control of the fresh water to maintain the desired brine concentration in the settler; close control of the volume of chemicals added. The results of desalting trials are discussed and typical operating data are tabulated of desalting at various pressure drops and temperatures. Pressure drop is probably the most critical of all variables. With minimum pressure drop salt removal is poor, ranging from 60–80% salt removal, a 40–50 psi differential across the emulsifying valve seems ideal for the crudes in question, but 75–100 psi is not so reliable. This is shown in the graphs of pressure drop in relation to salt content of the final treated crude, and in the pressure drop *vs.* salt removal. Temperature must be high enough to reduce the surface tension of the oil to the point that water will break out. Assuming that surface tension is a direct function of viscosities, temperature–viscosity curves of each crude have been plotted and projected. It appears from these that an S.U. viscosity of approximately 40 sec or less in the crudes must be reached to obtain optimum salt removal. The importance of maintaining low viscosity and the quantity of water added and the brine concentration are discussed. No bad effects from the presence of solids have been found; apparently all solids are discarded with the water drawn from the vertical settler. A definite advantage, however, is assumed in the contact coalescing value of suspended solids when present in the emulsion. Settling time is discussed, and a table shows the emulsion " break " obtained in normal operations which gives the settling time and amount of water found at various points in the system.. Contact coalescing is discussed. The baffle section is intended to create a turbulent flow and a contact surface to coalesce, so far as possible, the droplets of water before they reach the vertical settler. Also, if any salt still remains coated with a paraffin sheath, the additional contact in this hot section tends to break down final resistance before entering the vertical settler. The salt-removal system described secures 90%, or more, salt removal at a cost for chemicals of less than two mills per barrel of crude processed. W. H. C.

1094. British Aviation Fuel Manufacture in the Middle East. Part I. Research and Development. Anon. *Industr. Chem.*, 1946, **22**, 468–475.—An account is given of the increase in production from 25,000 Imp. gals/day of 87 octane no. aviation fuel in 1939 to 1 million gals/day of 100/130 grade and 130,000 gals/day of 87/90 grade in 1944 at the Abadan Refinery of Anglo-Iranian Oil Co., Ltd. The development of engines and engine testing is briefly traced, together with the production control methods used. F. S. A.

Distillation.

1095. Questions on Technology. W. L. Nelson. *Oil Gas J.*, 22.6.46, **45** (7), 127.—The Distex process is described with a simplified flow diagram. This process is a combination of distillation and extraction for separation of hydrocarbons where plain fractionation is not practicable. A solvent such as aniline, phenol, or chlorex is introduced as a scrubbing agent near the top of the column during distillation, and appears at the bottom mixed with the high-boiling product. The solvent alters the vapour-pressure characteristics of the hydrocarbons so that their boiling points are spread out. The solvent is recovered by stripping and recycling. G. A. C.

Absorption and Adsorption.

1096. High-Pressure Absorption. H. F. Wade. *Refiner*, 1946, **25** (5), 92–96.—A discussion on the general factors affecting absorber pressure, the effect of it on compressor horsepower and on plant cost, and its limitations in connection with the development of high-pressure natural gas resources. G. R. N.

Cracking.

1097. Cycle Stocks from Catalytic Cracking. C. L. Brown, A. Voorhies, junr., and W. M. Smith. *Industr. Engng. Chem.*, 1946, **38**, 136–140.—Hydrogenation of the aromatic constituents in refractory catalytically cracked, cycle stocks to their corresponding naphthene derivatives results in improved catalytic-cracking feed-stocks which are superior even to the original virgin gas oils. Hydrogenation conditions used are generally the same as for the conventional high-pressure destructive hydrogenation of gas oils directly to gasoline, except for the catalyst, which, similarly, is sulphur resistant. Yields of hydrogenated cycle stock are 100% or more in all cases, with little change in boiling range and virtually complete sulphur removal. A combination of catalytic cracking with hydrogenation of all cycle stock and recracking to ultimate gasoline yield, combined with the fullest utilization of light hydrocarbons (C_3, C_4, C_5) by isomerization, alkylation, etc., is shown by calculation to result in an over-all volumetric yield of over 90% of 100-octane gasoline. Lower pressures (750 compared to 3000 psi gauge) result in partial saturation of aromatics with rather complete desulphurization. A. W.

1098. Simplicity and Flexibility of Thermofor Catalytic Cracking. H. D. Noll, K. G. Holden, and E. V. Bergstrom. *Refiner*, 1946, **25** (5), 123–129.—A small T.C.C. unit is here proposed as one means whereby operators of small refineries may meet the problem of producing higher yields of quality gasoline at a reasonable manufacturing cost and provide ample allowance for further increases in quality should the competitive situation so demand. Discussed is a small-scale integral T.C.C. unit designed to process from 1000 brl/stream day upward of virgin charging stocks ranging from heavy naphthas to vacuum distillates. The unit is characterized by high yields of high-quality product at high liquid recoveries with low investment cost and low operating and maintenance costs. The integral design and simplicity of construction details make for a high percentage of on stream time. G. R. N.

Polymerization.

1099. Modern Refining Processes.—Part 11. The Gas Reversion and Polyform Processes. G. Armistead. *Oil Gas J.*, 27.7.46, **45** (12), 189.—The gas reversion or polyforming process as usually practised is a high-pressure, coil-only thermal operation in which a stream of C_3 and/or C_4 hydrocarbons is passed with the oil feed through a cracking coil for the purpose of (1) Effecting polymerization of the C_3 and C_4 hydrocarbons to others of gasoline boiling range; (2) Effecting alkylation and other interaction between the light stream and the oil feed undergoing cracking, including reactions such as cyclization; (3) Dilution of the oil-feed so as to permit more severe conditions and increased extent of conversion. A distinction is drawn between gas reversion and polyforming, the former being an operation in which the light hydrocarbon stream is separately cracked, in part, before being mixed with the partly cracked stream of heavier material. In the polyforming operation the light and heavy stocks are first mixed and then passed through the cracking coil.

Conventional naphtha polyforming is described and shown in a flow-sheet, the heavy naphtha is passed through a high-pressure absorber, in which it is contacted with stabilizer gases and absorbs the desired amounts of butane–butylene and propane–propylene, the enriched naphtha being passed to the cracking coil operated at up to

1150° F and up to 2000 psi. The reacting time is from 0·05 to 0·08 cu. ft of coil volume, per barrel, per day naphtha throughput. The stream from the furnace is quenched en route to the separating column, in which any polymerized tar is removed; the light products pass overhead to the stabilizer, from which stabilized cracked gasoline flows as bottoms, and the light gases pass overhead to the absorber for recycling. Control of the amount and character of the light hydrocarbons for recycling is done in the stabilizer and absorbing sections. The recycle ratios of the composite stream are governed largely by the individual conversion characteristics of the propane and butane. These points are discussed.

Recycle ratio is also related to the obtainable ultimate yield, increase in recycle ratio giving increase in ultimate yield, but lower resultant octane level because of the reduced severity and conversion per pass. The gas-reversion operation is described and shown in a flow diagram of a combination crude and gas-reversion cracking unit. This carries out naphtha reforming, single-pass viscosity breaking and gas-oil cracking.

The unit comprises two furnaces having (1) crude oil heating and naphtha reforming coils; (2) gas-oil cracking and viscosity-breaking coils; all exits, except the crude coil, leading to the separator, a fractionator and stabilizer and absorber, in series. The crude-coil exit leads to a conventional fractionator from which the reduced crude is pumped to the viscosity-breaking coil, the exit of which has a connection for quenching the stream by cycle gas oil from the bottom of the intermediate fractionator. The light hydrocarbons from the reforming coil are recovered and used as described above; but in this unit the C_3 and C_4 cut may be separated as a condensate from the stabilizer overhead and pumped (1) with the feed to the gas-oil cracker and (2) with the reduced crude fed to the viscosity-breaking coil. The dilution thus made effecting increased cracking per pass and retarding coking.

Cracking pressures of 1000–3000 psi and temperatures up to 1150° F are employed. The fractionating system is operated at 250–400 psi to give the desired light hydrocarbons. The dilution ratio (oil feed : recirculated C_3 and C_4) used is generally around 1 to 1·5. A graph shows the trend of yield-octane relationships for a number of low-octane heavy naphthas when effecting the maximum obtainable recovery of C_3 and C_4 hydrocarbons and recycling them to extinction. The mechanism of these processes is discussed. The quantities of aromatic hydrocarbons produced, including toluene and xylenes, are sufficient to warrant the commercial separation of the individual compounds. W. H. C.

1100. Meeting of the Division of Rubber Chemistry, High Polymer Forum, and Divisions of Paint, Varnish and Plastics, Cellulose, Colloid, Organic, and Physical and Inorganic Chemistry of the American Chemical Society, April 9–10, 1946. *India Rubber World*, 1946, **114** (2), 221–228.—Abstracts of papers read before this meeting are given, the following titles being of most interest: "Research leading to Commercial Butadiene Synthetic Rubber" (W. L. Semon) (Charles Goodyear lecture for 1944), "Disorder in Linear Condensation Copolymer Solids" (C. S. Fuller, W. O. Baker), "Relative Activities of Ethylene Derivatives in Copolymerization" (F. R. Mayo), "Some Recent Results in the Field of Copolymerization" (T. Alfrey), "Partial Conversion Properties of Copolymers" (F. T. Wall), "Copolymerization of Vinyl Compounds with Dienes" (A. Goldberg, T. Alfrey, W. P. Hohenstein), "Copolymerization" (I. Skeist), "Viscosity of Dilute Solutions of Long-Chain Molecules" (M. L. Higgins), "Thermal Polymerization of Methyl Methacrylate" (C. Walling, E. R. Briggs), "Temperature Dependence of Osmotic Pressure of Polyvinyl Chloride Solutions" (P. Doty, E. Mishuck), "General Theory of Emulsion Polymerization with Respect to Reaction Loci" (W. D. Harkins), "Thermal Polymerization of 2-Vinyl-Naphthalene" (J. M. Grim, W. E. Baldwin, W. H. Hill), "Chain Transfer in Polymerization of Styrene" (R. A. Gregg, F. R. Mayo), "Degradation of Vinyl and Diene Polymers" (R. B. Mesrobian, A. V. Tobolsky), "Polytetrafluoroethylene, a New, Heat-Resistant, Chemically Inert Plastic" (M. M. Renfrew, E. E. Lewis), "Vinyl Alkyl Ethers" (C. McKinley, C. E. Schildknecht, A. O. Zoss), "Copolymerization in Suspension (Pearl Copolymerization)" (W. P. Hohenstein, F. Leonard), "Properties of Monomeric and Polymeric Alkyl Acrylates and Methacrylates" (C. E. Rehberg, C. H. Fisher), "Investigation of Polymerization of Styrene with a Low Temperature Calorimeter" (F. G. Brickwedde), "Electrical Properties of Butyl Rubber" (I. C. Eaton, A. V.

Roberts, E. E. Sheldon), "Polymerization of *p*-Chlorostyrene in the Presence of Polymethyl Acrylate" (R. B. Carlin, N. E. Shakespeare). C. N. T.

Physical Refining.

1101. Pure Hydrocarbons from Petroleum. J. Griswold, D. Andres, C. F. Van Berg, and J. E. Kasch. *Industr. Engng. Chem.*, 1946, **38**, 65–71.—The Distex or extractive distillation process is described, with its application to the separation of straight-run fractions consisting of paraffins, naphthenes, and aromatics. The process differs from azeotropic distillation in that the boiling point of the solvent used is well above that of the hydrocarbons being separated, its purpose being to spread the volatilities of the close-boiling hydrocarbons. The effectiveness of several solvents for paraffin–naphthene separation has been evaluated from vapour–liquid equilibrium data using heptane and methyl *cyclo*hexane. Details are then given of the apparatus and procedures used to resolve a narrow-boiling C_6 petroleum fraction using aniline—one of the most effective solvents. The results obtained indicate that the Distex operation is effective and feasible for the separation and preparation of pure hydrocarbons from the three hydrocarbon groups present in light petroleum fractions. A. W.

1102. Pure Hydrocarbons from Petroleum. J. Griswold and C. F. Van Berg. *Industr. Engng. Chem.*, 1946, **38**, 170–177.—The Distex process has been applied to the separation of a narrow-boiling heptane fraction from petroleum. The pilot plant used is described in detail, together with its performance at different reflux ratios in separating the heptane fraction into paraffinic, naphthenic, and aromatic portions. Pure heptane was obtained from the paraffinic portion by batch fractionation. A. W.

1103. Some Developments in the Refining of Transformer Oils. J. C. Wood-Mallock. *J. Inst. Petrol.*, 1946, **32**, 365.—The requirements of transformer oils are listed as high insulation resistance, high dielectric strength, high specific inductive capacity, low loss factor, high heat conductivity, high heat capacity, low freezing or set point, low volatility, low viscosity, low water tolerance, high resistance to chemical or physical change, particularly under oxidizing or hydrolysing conditions, passivity to copper and cellulose. The methods used to attain these requirements are studied.

A. H. N.

Special Processes.

1104. The Cracking of Middle Oil from the Fischer Tropsch Process. F. E. T. Kingman and C. M. Cawley. *Petroleum*, 1944, **9**, 126–128.—Fractions of the oil product of the Fischer–Tropsch synthesis readily undergo cracking to yield liquid and gaseous olefins. Thus, the middle oil fraction may be thermally cracked at about 600° C to yield liquid hydrocarbons containing 80–90% of olefins and gaseous hydrocarbons containing 60% of olefins. The nature as well as the yield of products may be modified to some extent by the use of a cracking catalyst.

This paper describes an investigation the main object of which was to find whether the cracking of Fischer–Tropsch oil would yield liquid olefins suitable for the preparation of lubricating oil by polymerization. The results given deal chiefly with factors affecting yield. The properties of the olefins themselves and their behaviour on polymerization will be dealt with in a separate paper.

The middle oil fraction submitted to thermal cracking boiled between 200° and 300° C. A vertical, electrically heated tube having a reaction space of 35 ml was used. The cracking temperature varied between 570° and 635° C and the throughput from 40 to 110 g per hour. The reaction times under these conditions varied from about 30 to 10 seconds.

At 635° C and a throughput of 90 g per hour the total yield of liquid product was 67·6% by weight of the original oil with a yield of spirit to 200° C of 20·4% (also based on the original oil). Recycling the oil boiling above 200° C gave a total yield of 37·8% of spirit to 200° C (bromine number 130) and a yield of gas of 39·3 litres per 100 g of raw material. The spirit to 170° C had a bromine number of 148 and contained approximately 80–90% of olefins with less than 2% of aromatics.

The gaseous product from thermal cracking contained only a small proportion of hydrogen; the olefins, which increased from 57% at 570° C to 63% at 635° C, consisted mainly of ethylene and propylene with a smaller proportion of butylene and a very small amount of butadiene.

The use of a catalyst consisting of mixed alumina and silica increased the yield of gas and had a marked effect on the nature of the products. The spirit had a lower olefine content and a higher content of both aromatic and saturated hydrocarbons. The gas contained a greater proportion of hydrogen; the proportion of total olefins was not greatly changed, but the catalyst favoured the production of propylene and butylene in place of ethylene, and the formation of butadiene was completely suppressed. K. C. G. K.

1105. Synthetic Fuels in Germany : (2) Hydrogenation. *Petroleum*, 1946, 9, 102.—A summary of German hydrogenation plants is given in tabular form; 15 plants being included.

Separate sections deal with the hydrogenation of coal and tar, vapour-phase hydrogenation, the D.H.D. process, and finally the production of iso-octane and alkylate.

K. C. G. K.

1106. Synthetic Fuels in Germany, 3 (1). Fischer–Tropsch Process, Lubricating Oils, and Acetylene. *Petroleum*, 1946, 9, 158.—The Fischer–Tropsch process yields a diesel oil of high cetane number. During the war this was blended with tar from the low-temperature carbonization of brown coal and used in farm tractors and heavy trucks. The spirit produced has a low octane number (about 50), but was used for motor transport. The butane fraction was compressed and also used for driving vehicles.

The paraffin wax was also utilized. The operation of the plants was varied as required to give the range of products desired.

The gas for the process should be a mixture of two parts of hydrogen to one part of carbon monoxide. The catalyst used is very sensitive to sulphur, which was removed as far as possible by washing first with ammonia and then passing through a mixture of iron oxide and sawdust (to remove hydrogen sulphide). Organic sulphur was removed in towers filled with an iron oxide–sodium carbonate catalyst at 200–300° C.

Important features are the design of the reaction vessels and the method of manufacturing the catalyst. The reaction is highly exothermic, but the temperature must be held at about 200° C. Each of the 24 reaction vessels at the Carrières–Kuhlmann plant (Harnes, France) consisted of 600 baffles pierced by 600 tubes, the space between tubes and baffles being filled with catalyst. Water under pressure flowed through the tubes, its temperature being controlled by the steam pressure in the system. The gases passed through 16 vessels arranged in parallel, and the effluent was cooled. After separating the condensate, the gases passed through the other 8 vessels arranged in parallel.

The catalyst used at Harnes consisted of: cobalt = 18%, magnesium oxide = 1·8%, thorium oxide = 0·9%, kieselguhr = 79·3% by wt. Cobalt and thorium were recovered from the used catalyst.

The O.X.O. Process.—This was used to manufacture higher alcohols from Fischer–Tropsch olefines, for use in soap-making. C_{11}–C_{17} olefines are passed with sulphur-free water-gas over ordinary Fischer-Tropsch synthesis catalyst. The aldehydes formed are hydrogenated by passage with pure hydrogen over a nickel catalyst.

K. C. G. K.

PRODUCTS.

Chemistry and Physics.

1107. Heats of Combustion and Formation at 25° C of the Alkylbenzenes through $C_{10}H_{14}$, and of the Higher Normal Monoalkylbenzenes. E. J. Prosen, W. H. Johnson, and F. D. Rossini. *Bur. Stand. J. Res. Wash.*, 1946, **36** (5), 455.—Values are given for the heats of combustion (in oxygen to form gaseous carbon dioxide and liquid water) and the heats of formation (from the elements, solid carbon (graphite) and gaseous hydrogen), at 25° C, for benzene, toluene, the four C_8H_{10}, the nine C_9H_{12}, and the twenty-two $C_{10}H_{14}$ alkylbenzenes, in both the liquid and gaseous states, and for the higher normal monoalkylbenzenes in the gaseous state.

The method of calculation used is described, and the constants on which the calculations are based are given. Previous experimental data on heats of combustion of the alkylbenzenes are compared with the selected " best " values obtained from this work. A full bibliography is appended. T. M. B. M.

1108. Heats of Combustion of Four *cyclo*Pentane and Five *cyclo*Hexane Hydrocarbons. W. H. Johnson, E. J. Prosen, and F. D. Rossini. *Bur. Stand. J. Res. Wash*, 1946, **36** (5), 463.—The heats of combustion of *cyclo*pentane, methyl*cyclo*pentane, ethyl*cyclo*pentane, *n*-propyl*cyclo*pentane, *cyclo*hexane, methyl*cyclo*hexane, ethyl*cyclo*hexane, *n*-propyl*cyclo*hexane, and *n*-butyl*cyclo*hexane have been measured with a bomb calorimeter. Values are given for $-\Delta Hc^{\circ}_{298\cdot16}$, the heat of combustion at 25° C, and constant pressure of the liquid hydrocarbon in gaseous oxygen to form gaseous carbon dioxide and liquid water, with all the reactants and products in their thermodynamic standard reference states, in international kilojoules, per mole, and also in terms of the conventional thermochemical calorie.

A bibliography is appended. T. M. B. M.

1109. Dehydroisomerization of *n*-Butane. H. S. Bloch and R. E. Schaad. *Industr. Engng. Chem.*, 1946, **38**, 144–147.—The conversion of *n*-butane into a mixture of *n*-butylenes and isobutylenes has been carried out at atmospheric pressure with a catalyst comprising a dehydrogenating component (chromia–alumina) and an olefin-isomerizing component (silica–alumina–thoria). A catalyst bed composed of a mixture of granules of the two components was much more effective than a bed of granules made of the mixed powders. Under the most favourable conditions (525–575° C, gaseous hourly space velocities of 1500–1200) butylene yields of 25–30% were obtained with a dehydrogenating efficiency of approximately 85%. About one-fourth of the yields of butylene was isobutylene. A. W.

1110. Conversion of *n*-Heptane to Isobutane. O. Grummit, E. N. Case, and C. V. Mitchell. *Industr. Engng. Chem.*, 1946, **38**, 141–144.—Experiments with water- or hydrogen chloride-promoted aluminium chloride and *n*-heptane, with and without the addition of sodium, magnesium, or aluminium, have been run at 95–100° C and atmospheric pressure to determine the yields of isobutane, light paraffins (C_5–C_7), heavy paraffins (C_8 and higher), and the oil from the catalyst complex. These metals exert a very marked influence on the promoted catalyst as shown by decreased conversions, increased isomerization to light paraffins, and decreased cracking-isomerization to isobutane and oil. Because aluminium has the greatest effect in retarding oil formation, which inactivates the catalyst, it is the best of the three metals tested for controlling this reaction as a route to the production of isobutane and of light paraffin hydrocarbons. A. W.

1111. Catalytic Conversion of Hydrocarbons. F. E. Fisher, H. C. Watts, G. E. Harris, and C. M. Hollenbeck. *Industr. Engng. Chem.*, 1946, **38**, 61–64.—The activity of the catalyst in the catalytic aromatization of aliphatic hydrocarbons was improved to an appreciable extent by the addition of antimony tetroxide to the chromia–alumina catalyst. The aromatization reaction was carried out on three different types of charge stocks : a heptane fraction from a natural gasoline, a heavy straight-run gasoline, and a thermally cracked gasoline. The reaction temperature was about 550° C, and both the liquid and gaseous products were analysed. The production of aromatics during any one reaction period increased through a maximum, and then decreased. The yield of gaseous products paralleled the formation of aromatics until excessive cracking superseded the dehydrogenation-cyclization reaction. A. W.

1112. Hydrogen Fluoride–Paraffin Systems. E. B. Butler, C. B. Miles, and C. S. Kuhn. *Industr. Engng. Chem.*, 1946, **38**, 147–155.—Mutual solubilities of low-molecular-weight hydrocarbons (isobutane, *n*-butane, propane) and of hydrogen fluoride in two liquid-phase systems, with and without water and alkylate, were determined for the range 0–50° C, with alkylate concentrations up to 30% wt in the hydrocarbon phase, and water contents up to about 10% wt in the acid phase. Anomalous solubilities of isobutane in the presence of alkylate and water are considered to be related to the greater alkylating activities of isoparaffins. Tentative correlations of the data with analyses of plant streams are presented. A. W.

1113. Vapour–Liquid Equilibria of Binary Hydrocarbon Systems. J. M. Harrison and L. Berg. *Industr. Engng. Chem.*, 1946, **38**, 117–120.—Six close-boiling binary hydrocarbon systems have been investigated. Minimum azeotropes exist between 2 : 2 : 3-trimethyl butane–benzene, boiling at 75·6° C at 736 mm, and containing 56·7 mole-% benzene; between 2 : 2 : 3-trimethyl butane–*cyclo*hexane, boiling at 79·45° C at 744 mm, and containing 47·8 mole-% 2 : 2 : 3-trimethyl butane; and between benzene-*cyclo*hexene boiling at 78·9° C at 740 mm and containing 65·7 mole-% benzene. No azeotrope was found in the systems 2 : 2 : 4-trimethyl pentane–methyl *cyclo*hexane and *cyclo*hexane–*cyclo*hexene. A. W.

1114. Boiling Point Relations Among Mononuclear Aromatics. H. Corbin, M. Alexander, and G. Egloff. *Industr. Engng. Chem.*, 1946, **38**, 147–155.—The variation of boiling point (t) with the number of carbon atoms (n_c) has been determined for 10 homologous series of mononuclear aromatic hydrocarbons leading to equations which are all of the form :

$$t = a \log (n + 4{\cdot}4) + K$$

The variation of the difference in boiling point (δ) between an aliphatic compound and its phenyl derivatives with the number of carbon atoms has been determined for 9 homologous series giving equations all of the form :

$$\delta = p + q \log n_c$$

Comparisons have been made among phenylalkanes, phenyl alkenes, and phenyl alkynes; phenyl alkanes and phenylcyclanes; 1-phenyl and 2-phenyl compounds, and monophenyl and polyphenyl compounds. A. W.

1115. The Influence of Structure on the Oxidation Reactivity of Hydrocarbons. P. George and A. Robertson. *J. Inst. Petrol.*, 1946, **32**, 400–407.—The mechanism of oxidation on the basis of a chain reaction, the first isolatable product of which is a hydroperoxide, is discussed, and lines of further experiments to understand the oxidation of oils are indicated. A. H. N.

1116. A Review of the Mechanism of the Oxidation of Liquid Hydrocarbons. P. George and A. Robertson. *J. Inst. Petrol.*, 1946, **32**, 382–391.—In the oxidation of liquid hydrocarbons the primary intermediate is a peroxide. If a C–H bond is attacked a hydroperoxide is formed. Conjugated olefins yield ring peroxides by 1 : 4 addition of the oxygen, and also more complicated polymeric peroxides. Polycyclic aromatic hydrocarbons give transannular peroxides. After the primary formation of a hydroperoxide the course of the oxidation is governed by its decomposition. Although this is a complex reaction, there is much evidence that the ketone is the key decomposition product from which the more highly oxidised compounds are derived. Hydroperoxide formation on both the thermal and catalysed reactions proceeds by a chain mechanism. Whilst the catalyzed reactions involve free radicals as the chain carriers, there is some evidence that in the thermal reaction the chain carriers can be free radicals or energy-rich molecules, depending on the particular hydrocarbon which is oxidized. In the uncatalyzed oxidation the autocatalytic increase in the rate is due to a hydroperoxide catalyzed reaction developing side by side with the thermal oxidation. This phenomenon has been observed in many gas-phase chain reactions, and is known as degenerate chain branching. A. H. N.

1117. Oxidation and Anti-Oxidation. E. A. Evans. *J. Inst. Petrol.*, 1946, **32**, 392–399.—The chemistry of oxidation and dehydrogenation of several compounds and a brief study of several anti-oxidants are given. A. H. N.

1118. Gas-Hydrate Composition and Equilibrium Data. E. M. Frost and W. M. Deaton. *Oil Gas J.*, 27.7.46, **45** (12), 170.—The experimental techniques tried and the procedure adopted for obtaining the composition of the hydrates formed with carbon dioxide, methane ethane, and propane at temperatures below 32° F are described. The composition of the hydrates were obtained by direct measurement of the gas and water resulting from the decomposition of the hydrates. Pressure–temperature equilibrium curves plotted from the data are shown in a graph for the gases and natural gas, and include the location of the curves plotted from the data, previously reported, for temperatures above 32° F. The hydrate compositions have also been calculated from the equilibrium data, and the mathematical analysis by which the heats of formation above and below the freezing point of water were obtained is shown.

The hydrate compositions obtained were :

	Formula from direct Measurement	Calculated Formula
Methane	$CH_4 : 7\ H_2O$	$CH_4 : 7\ H_2O$
Ethane	$C_2H_6 : 8\ H_2O$	$C_2H_6 : 8\ H_2O$
Propane	—	$C_3H_8 : 18\ H_2O$
Carbon dioxide	$CO_2 : 7\ H_2O$	—

The composition and hydrate data points of natural gas are shown in a table for the gases mentioned and for butane and higher hydrocarbon fraction. W. H. C.

Analysis and Testing.

1119. Theory and Application of the Parallel Plate Plastometer. G. J. Dienes and H. F. Klemm. *J. Appl. Phys.*, June 1946, **17** (6), 458–471.—A method has been established for the measurement of the viscosity of high polymers at low rates of shear in the range 10^4–10^9 poises using a parallel-plate plastometer. This is based on a mathematical criterion for separating the viscous portion of the deformation from the " elastic " and " delayed elastic " components. Experimentally, the plate separation is measured at a given temperature as a function of time. The theory furnishes a relation, which is also the criterion for predominantly viscous deformation, between viscosity, plate separation, applied load, and time. This relation, a modified form of Stefan's equation, is used for calculating the viscosity from the experimentally observed quantities. The method has been applied to polyethylene and vinyl chloride–acetate resin compounds. The viscosity–temperature behaviour of these materials is shown to be simple over the temperature range studied—that is, log viscosity varies linearly with the reciprocal of the absolute temperature. Data are presented which show that polyethylene resins and polyethylene resin–paraffin wax mixtures follow Flory's relation—*i.e.*, log viscosity varies linearly with the square root of the weight average molecular weight. Accordingly, the parallel plate plastometer offers promising possibilities for the empirical determination of the weight average molecular weight of these materials. Data are also presented on plasticized vinyl chloride–acetate resin systems which point to a close parallel between the effects of increasing temperature and increasing plasticizer concentration. A. H. N.

1120. Viscometer for Low Viscosity Liquids. *The Laboratory* (*Fisher Scientific Co.*), 1946, **16** (1), 8.—The newly patented Fisher–Irany viscometer gives more reliable results than are possible when working with highly mobile liquids in conventional viscosity apparatus. The outstanding feature of the instrument is that the flow of the sample is retarded to increase the time required for the sample to fall a short distance. This increase in efflux time is accomplished by a long capillary of helical shape, obviating the need for an ultra-fine capillary or a large volume of liquid, and thus retaining the normal pressure head and bore. Any error in timing the fall is therefore of minimal consequence.

Efflux times with this viscometer are about ten times those observed in a standard Ostwald pipette, and allow accurate timing of fast-flowing liquids. This is of advantage in determining intrinsic viscosities of high polymers in very dilute solutions, since these depend on reliable evaluation of small differences in the low-viscosity range. Errors due to the volatility of low-viscosity liquids are counteracted by the construction of the viscometer, which is such that it can be charged and then hermetically closed by a stopcock. The design also permits the use of reduced or increased pressure, as well as the use of any vapour or gas other than air in the communicating space above the surface of the liquid. The factor for the instrument is substantially the same for various liquids, whereas the Ostwald constant may deviate 7% within the same range of viscosities. C. N. T.

1121. Viscosity Blending Chart. W. L. Nelson. *Oil Gas J.*, 6.7.46, **45** (9), 107.—No. 100 in the *Refiner's Notebook* series gives a chart from which the viscosity of blends of oils may be estimated; with the proviso that the viscosity must be at the same temperature for both oils. An example is provided and worked out.

G. A. C.

1122. Viscosity of Coal-Fuel Oil Suspensions. V. F. Kustov and L. L. Khotuntzev. *Petroleum*, 1946, **9**, 134–135.—See Abstract No. 1057 of 1945. K. C. G. K.

1123. Analyses of Mixtures of Light Gases by Infra-red Absorption. N. D. Coggeshall and E. L. Saier. *J. Appl. Phys.*, June 1946, **17** (6), 450–456.—A discussion of the application of infra-red absorption methods of analysis for light gases which do not obey Beer's law of absorption due to pressure broadening. Some of these gases do not obey Beer's law in the pure state or when contaminated by foreign gases. The method of analysis depends on the nature and intensity of the pressure broadening effect of the different components in the sample on each other. Data are presented showing the nature of some of these effects and illustrating the accuracy obtainable for certain types of analyses. The instrumentation used in routine gas analyses by infra-red in the laboratory of Gulf Research and Development Co. is described.

A. H. N.

1124. The Flash-point of Lubricating Oils for Internal Combustion Engines. S. Sirtori. *Chimica e ind.*, 1946, **28**, 12–14.—Tests were carried out to determine the variations of flash-point of a motor oil (20·5 cs at 98·9° C) with additions of volatile diluents (gasoline, kerosine, gas oil). Both the open (Marcusson) and closed (Pensky–Marten) flash-points were determined. This latter is markedly affected by small traces of diluent; the open flash-point is less influenced. The value of flash-point as an oil characteristic is questioned; if it is retained, the open test is recommended, and low results are an indication to determine the content of the oil in excessively volatile fractions by an alternative method (*e.g.*, evaporation loss), as there is no reliable quantitative relationship between dilution and drop in flash-point. Figures are given showing the marked decrease in flash-point of I.C. engine oils after a very short period of normal use. V. B.

1125. The Sludge Test for Transformer Oils. C. H. Barton. *J. Inst. Petrol.*, 1946, **32**, 408–413.—The B.S.I. Sludge Test is critically studied. It is concluded that: (*a*) The results quoted in this paper demonstrate the unreliability of the B.S.I. Sludge Test and supporting the view that the reason for the unsatisfactory repeatability and reproducibility does not lie in details of technique, materials, and apparatus, but in the specified conditions of the test. (*b*) The lack of repeatability and reproducibility is sufficient to disqualify the test on a basis for specification figures, apart from the fact that the soundness of basing such specification figures on sludge alone is open to serious question. (*c*) Since, in its present form, the B.S.I. Sludge Test is unsuitable as a control on the quality of transformer oils, the test should either be abandoned or completely revised. A. H. N.

1126. Sludging Value of Transformer Oil. Influence of Condenser Water Temperature. P. W. L. Gossling and J. Romney. *J. Inst. Petrol.*, 1946, **32**, 424–433.—It is shown that the influence of condenser-water temperature on sludge value is such that the permissible variation in this factor in the standard method is itself sufficient to make possible relatively large differences in sludge values obtained. It is submitted that adoption of new limits for condenser-water temperature suggested would result in a considerable improvement in precision. The condenser-water temperature also influences the acidity development during the test. A. H. N.

1127. Oxidation Tests for Transformer Oil. A. A. Pollitt. *J. Inst. Petrol.*, 1946, 32, 414–423.—The American, British, and chief European procedures for carrying out oxidation tests on mineral insulating oils are described and criticized. A. H. N.

1128. Engine Testing of Fuels and Lubricants. 2. Diesel Fuels. P. H. Moore. *Petroleum*, 1946, 9, 130–132.—The ignition quality of a diesel fuel is, in addition to stability and non-corrosiveness, perhaps its most important single property.

Ignition Delay. Prolonged ignition delay leads to too much fuel in the combustion chamber, giving rise to knocking or rough-running conditions due to excess pressure. The high-speed diesel is more sensitive to ignition quality than the low-speed engine. Thus the development and widespread use of the high-speed diesel have directed special attention to ignition quality.

Cetane Numbers. Fuels with cetane numbers between 37 and 60 are stated to show little difference in the amount of exhaust smoke generated, fuel consumption, or power output.

Very high ignition-quality fuels have certain drawbacks due to slowness of burning. This is shown by synthetic fuels with very long paraffinic chains and cetane numbers of 100 or more. Griep and Goddin point out that to take advantage of such fuels the compression ratio must be lowered and the engine supercharged to bring maximum pressures back to normal. It is stated that a 20% increase in output can be obtained thereby, using, for instance, a 75-cetane fuel.

Other Fuel Characteristics. Another fuel characteristic influencing engine operations is volatility (the higher the volatility, the lower combustion chamber deposits and exhaust smoke). Low viscosity and specific gravity also minimize deposit formation.

The two reference fuels used to determine the ignition qualities of diesel-fuels are mesitylene, for poor fuels, and cetene (1-hexadecene), for good ones. These two compounds are blended for test purposes, cetene having a defined number of 100 and mesitylene one of 0. Mesitylene has been replaced by α-methylnaphthalene and cetene by cetane (n-hexadecane). The relationship between cetene number and cetane number has been established as cetane number = cetene number × 0·875.

Determination of Ignition Characteristics. Many types of engines and methods have been developed. One measures the ignition delay angle of the engine in terms of degrees of crank-angle between injection of fuel and combustion. Another uses a variable-compression engine and lowers the compression ratio until misfiring occurs. In that case both reference and sample fuels should, when matched, misfire at the same compression ratio.

A further method is to throttle the air intake until misfiring occurs. When ignition failure takes place, the vacuum at the suction to the engine is recorded. Then a reference fuel is blended to match the sample.

Cetane Tests Compared—Laboratory Tests. There is a tendency for various makes of diesel engines to give slightly different cetane numbers. Many physical and chemical tests have been developed to examine ignition quality. Most fall into line with engine results at times, but it is usually necessary to carry out the final determinations on an engine. When using laboratory tests, care must be exercised when examining additive-containing fuels.

Ignition Characteristics. Paraffinic-base distillates generally give the best ignition characteristics, followed by naphthenics, while the aromatic type is least suitable. Olefinic hydrocarbons give fairly high rating, and are superior to the naphthenic and aromatic types.

The influence of chemical structure on cetane number has been dealt with in several publications. By adding paraffinic side-chains to aromatic nuclei the cetane number is increased up to a certain limit. Generally, the more hydrogen atoms present in a molecule, the better its ignition qualities. The ideal molecular shape for the molecule of a diesel fuel is the opposite of the compact, rigid-looking molecule giving good anti-knock properties in the petrol engine.

To improve quality, solvent refining, hydrogenation, or blending with better-grade material may be employed.

Ignition Accelerators. A great number of such compounds are known. The alkyl nitrates are perhaps the most important, particularly amyl nitrate. Acetone peroxide is, however, claimed to be the most effective accelerator.

Most ignition accelerators are blended with the fuel, although in some cases they are added to the intake air. These ignition promoters seldom improve starting characteristics and usually lower the flash point.

Startability Improvers. By direct injection of diethyl ether into the cylinder during cranking, a diesel engine may be started at −40° F, whereas trouble commences at about 20° F with normal high-cetane fuel. K. C. G. K.

Gas.

1129. Gasoline from Natural Gas. P. C. Keith. *Oil Gas J.*, 15.6.46, **45** (6), 102.—The Hydrocol process for conversion of natural gas into gasoline is described.

A plant, designed to process 64,000,000 cu.ft. of natural gas per day, is to be erected at Brownsville, Texas, to produce 5800 brl of motor fuel, 1200 brl of synthetic diesel oil, and 150,000 lb of crude alcohols in water solution per day. The plant will cost $15,000,000, and be in operation late in 1946. The cost of production of the gasoline is estimated at 2½ cents/gal.

The process is based on that of Fischer–Tropsch, and is a result of research into the engineering problems of this process. Natural gas is converted into a mixture of carbon monoxide and hydrogen, followed by the production of liquid hydrocarbons by catalytic reaction.

The process requires the separation of 40,000,000 cu.ft/day of high-purity oxygen from air; the recovery of 0·25 gal of natural gasoline and butane per 1000 cu.ft. of feed gas; the partial combustion of 64,000,000 cu.ft./day of natural gas with the oxygen to produce the carbon monoxide and hydrogen mixture termed Hydrocol gas; and the conversion of this into gasoline and other synthetic products. The products are separated by fractionation and absorption, and the gasoline treated to remove oxygenated compounds. It is stated that the process will ensure adequate and cheap supplies of gasoline, city gas, and petroleum products in the States for centuries, make available cheap oxygen for use in other industries, and provide raw materials for a great new synthetic chemical industry. G. A. C.

Engine Fuels.

1130. Modern Refining Processes. Part 6. Use of Inhibitors in Motor Gasolines. G. Armistead. *Oil Gas J.*, 13.4.46, **44** (49), 97.—Recent studies of gasoline stability and the effect of various factors during long storage periods at tropical temperatures has greatly increased the knowledge of oxidation phenomena of gasolines, and has indicated the requirements for maximum stability of gasolines, from the aspects of gasoline oxidation and ethyl fluid decomposition.

Broadly, the conclusions arrived at may be summarized as follows: (1) Motor gasoline containing cracked constituents requires inhibiting for maximum storage stability, regardless of prior treatment; (2) All leaded gasolines under severe storage conditions require inhibiting; (3) Catalytic-cracked gasoline, which is now replacing some thermal-cracked gasoline in motor fuel, is of better stability, and thus appreciable improvement in overall base gasoline may be expected. It is, however, realized that for even the severest conditions encountered in more temperate climes there will be exceptions to the conclusions (1) and (2). The results of the tropical tests, nevertheless, forms a basis for present time specifications and practices.

The properties of gasolines most important to refiners from the viewpoint of gumming and its associated engine troubles are: (1) the amount of actual or preformed gum, the non-volatile oxidation products dissolved in the gasoline at a given time; and (2) the tendency of the gasoline to form gum under favourable conditions. The methods used in the several tests and what the results indicate are discussed. The use and mechanism of additives are discussed, and a table is given showing the maximum and minimum quantities of the inhibitors commonly used in motor gasoline—

viz., *n*-butyl-*p*-aminophenol, isobutyl-*p*-aminophenol, di-sec.butyl-*p*-phenylaminediamine, wood-tar distillate, butylaminophenol, and butylphenylenediamine, and whether they are corrosive to iron or affected by water, caustic, or air. Similar data are given for the metal inhibitor, disalicylpropylenediamine. The work carried out by the gasoline additives project of the Co-ordinating Research Council (see abstract No. 810, 1946) is discussed and the conclusions recorded. It is pointed out that the conclusions do not take into consideration the copper-dish gum or the improvement in induction period resulting from the inhibitor addition. The A.S.T.M. induction period is very high, as was necessary to meet the very severe conditions of the test, and is equivalent to approximately 580 minutes by the U.O.P. induction period test. As catalytically cracked gasoline made from silica–alumina catalyst processes have now become major components of motor gasolines in place of thermally cracked products, it is expected than an appreciable improvement in motor gasoline blends will accrue. This aspect is discussed in relation to the types of feed-stocks used; the chemical treatment employed—*i.e.*, caustic washing, sweetening, etc.—refinery economics, and the inhibitors employed. W. H. C.

1131. Refiners Ready to Produce Aviation Safety Fuel. F. R. Staley. *Oil Gas J.*, 15.6.46, 45 (6), 136.—Safety fuel contains no highly volatile hydrocarbons and is about as safe as kerosine. It can be manufactured by alkylation or by polymerization plus hydrogenation.

Isobutane from natural sources and refinery olefinic gas are the basis of the former process; and in the other method olefinic gases are polymerized and combined with hydrogen; the cost, however, is higher than for alkylation. It is expected that supplies will meet the needs of aviation engines produced with injection systems. G. A. C.

1132. Antiknock Properties of Materials from Superfractionation of Natural Gasoline. T. W. Legatski and H. R. Legatski. *Refiner*, 1946, 25 (15), 109–112.—The antiknock characteristics of narrow-boiling range fractions isolated from Mid-Continent debutanized natural gasolines by superfractionation and with concomitant sulphur removal are compared with the properties of their parent materials. Data on the nature and the properties of the hydrocarbons present in the close-cut fractions are also included. A schematic flow-sheet for a complete superfractionation and desulphurization operation potentially applicable to the treatment of natural gasoline condensates is described. An account of a representative single superfractionator unit with its auxiliary equipment is also given. G. R. N.

Gas Oil and Fuel Oil.

1133. Carbon Hydrogen Ratio of Catalytically Cracked Distillate Fuel Oils. S. P. Cauley and E. B. Delgass. *Oil Gas J.*, 27.7.46, 45 (12), 166.—Studies of a procedure for estimating the minimum quality requirement of a domestic heating oil necessary for satisfactory performance are reported. It was considered that the problem would be simplified if the minimum quality could be expressed in relation to some key physical property of an oil and its distillation characteristics. For the key characteristics the carbon–hydrogen ratio was adopted as most indicative of performance. Studies to correlate the C/H ratios of pure compounds with other factors, which included the U.O.P. " K " factor, etc., were discouraging, but the correlation with diesel index showed a definite trend and, after making a boiling-point correction, a reasonable correlation was obtained.

The procedure adopted consisted of plotting the C/H ratio against an arbitrary factor " A," which is equal to the numerical value obtained when subtracting one-twentieth of the boiling point from the diesel index. A graph shows these relations plotted from the tabulated data for 24 paraffins, 25 naphthenes, 5 dicyclic, 4 olefins, and 14 aromatic, pure compounds. A nomograph based on this chart is given.

The application of this correlation for use with distillate fuel oils is described. It provides a comparison of the actual C/H ratios and those estimated by the graph, and also shows the relation of the factor " A " to the actual C/H ratio.

In the studies with catalytically cracked distillate fuels, a sample of each fuel was fractionated in a true-boiling point still and physical tests were obtained on each cut.

These data were plotted on a mid per cent basis against per cent overhead. The physical tests on nine cracked fuels are given and their evaluations are shown in graphs.

From the charts it is observed : (1) that the C/H ratios of fuels derived from intermediate type charge stocks have higher C/H ratios in the more volatile fractions than in the heavier cuts—*i.e.*, the heavier cuts are more paraffinic ; (2) the C/H ratios of fuels derived from naphthenic stocks have less variation throughout the whole distillation range and tend to show a reverse trend of those from intermediate stocks. The C/H ratios estimated by this method have been used in the Socony–Vacuum combustion tests of domestic fuels and have shown good correlation with the relative performance ratings of such fuels. It can be seen from the equation for factor " A " that, if the boiling range of fuels being considered is fixed, estimated C/H values are proportional to diesel values. The lower C/H ratios of heavy fractions of catalytic stocks derived from intermediate type stocks is of interest in connection with performance in vaporizing pot-type burners. In these types of burners it is desirable to avoid excessive carbon deposits in the bottom of the burner. Seven literature references are given. W. H. C.

1134. Average Refinery Yield of Residual to Shrink Sharply, Hulse Predicts. *Oil Gas J.*, 15.6.46, **45** (6), 93.—A decline in yield of residual fuel from the present 26% to 10% in the next 15 to 20 years is predicted.

This is due to increased production of gasoline and distillate fuels ; and importations of residual fuel oils will be necessary to meet anticipated demand. Forecasts of total petroleum demand in the United States was 5,650,000 brl daily in 1950 and 5,900,000 brl daily by 1965 compared with 3,900,000 brl daily in 1939. The demand for domestic fuel for oil-burning installations is estimated to be 350,000 brl daily in 1946, 500,000 in 1950 and 565,000 brl daily in 1965, an increase of about 65%. The demand for paraffinic fuels for diesel engines will also expand.

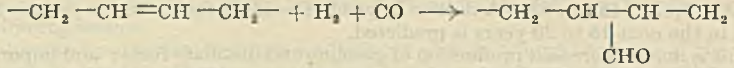
A downward trend in volatility, gravity, and diesel index has resulted from diversion of light distillates to gasoline manufacture. G. A. C.

Lubricants.

1135. Sliding Friction Under Extreme Pressures—Part 1. S. J. Dokos. *J. Appl. Mech.*, 1946, **13**, A148–A156.—The programme of this investigation on sliding friction is concerned with the evaluation of the frictional forces which occur under very high contact pressures and under varying conditions of speed, temperature, and lubrication. The work presented herein covers the experiments which have been made on sliding friction at normal temperatures. Further experiments on boundary lubrication at normal temperatures and sliding friction at elevated temperatures will be reported in a second paper. This report indicates the behaviour of sliding friction when large normal loads react between surfaces in contact over a wide range of sliding velocities. At velocities less than 1 inch/second magnified photographs of the ruptured surfaces indicate clearly the phenomenon of stick-slip. From the experimental records obtained, it was possible to show that a functional relation exists between the following variables : (1) The sliding velocity ; (2) the normal load ; and (3) the frequency of stick-slip. New experimental evidence is presented indicating that the natural frequency of the apparatus involved influences the phenomenon of stick-slip.

The following conclusions are drawn : (1) For clean contact surfaces the coefficient of sliding friction greatly increases with decreasing velocity ; (2) Two distinct types of sliding friction are recorded by the dynamometer at the various velocities. At velocities less than the critical velocity stick-slip friction is present, and at sliding velocities greater than the critical velocity a uniform friction record is obtained ; (3) Three velocity ranges were obtained in which the coefficient of friction is decidedly influenced by the normal load. In the slowest and fastest velocity range the coefficient of friction decreases with increasing load. In the intermediate range of velocity the opposite occurs ; (4) The sliding velocity stick-slip frequency curves indicate that the nature of sliding friction is influenced by the mechanical properties of the apparatus ; (5) The point of intersection of the various velocity-frequency curves occurs at a certain critical velocity, beyond which stick-slip is no longer recorded. The frequency at this point is approximately equal to the natural frequency of the dynamometer and the normal load arm; (6) The stick-slip frequency f_s can be expressed as a simple function of the normal load L, and the sliding velocity v. This relation holds for the range of the normal load investigated; (7) The validity of the laws of Amontons and Coulomb is not apparent from the results of this investigation; (8) When high pressures exist between the surfaces, great distortion occurs beneath the surface of the metals in contact. Thus friction is not merely a surface effect, but is dependent on the bulk properties of the metals on contact; (9) At high pressures large particles of the softer metal are sheared off and adhere to the plastically deformed surface of the harder metal. A. H. N.

1136. Secrets of German Lubricating Oil Technology Revealed. Part IV. Additives and Special Lubricants (cont.). C. I. Kelly. *Petrol. Times*, 1946, **50**, 751.—Some details are given of the manufacture of ester-oils by the O.X.O. process: lower olefines are polymerized by aluminium trichloride and then submitted to the O.X.O. process which produces high molecular weight aldehydes for conversion into alcohols and carboxylic acids; these or the carboxylic acids plus lower alcohols give esters. The basic reaction of the O.X.O. process consists of the reacting of olefines with water gas in the presence of a Fischer–Tropsch catalyst to give aldehydes according to the general equation:



$$-CH_2-CH=CH-CH_2- + H_2 + CO \longrightarrow -CH_2-CH-\underset{\substack{| \\ CHO}}{CH}-CH_2$$

The following additives and the processes for their manufacture are also reviewed: (*a*) The oxidation inhibitor R; (*b*) The corrosion inhibitor KSE; (*c*) The extreme pressure additives: (i) Mesulfol-2; (ii) J7; (iii) Etrol C.

The oxidation inhibitor "R," also known as "ZS-1" was claimed to have no effect on pour-point, bearing corrosion, wear and oiliness, and to be the most effective one examined for improving the stability of polyethylene-mineral oil mixtures.

The very good corrosion-resisting properties of KSE are found from tests which show that 3% of this additive in a lubricating oil reduces the rate of iron corrosion to 2% of the rate with the oil alone.

What is already known about the extreme pressure additive Mesulfol-2 is briefly reviewed: however, the data on this additive made available up to this date is not adequate or complete. The J7 additive for "running-in" oil (a chlorine–phosphorous dope) is reviewed in detail and its method of manufacture described. The Etrol C additive is only briefly reviewed: the information obtainable to date on this additive is also scanty. R. B. S.

1136A. Secrets of German Lubricating Oil Technology Revealed. Part IV. Additives and Special Lubricants (concluded). C. I. Kelly.. *Petrol. Times*, 1946, **50**, 860.—The additives used by the Germans which are discussed in this section are: (*a*) Single-function additives: (i) Pour-point depressants, such as Paraflow; (ii) Viscosity index improvers, such as Paratone (Oppanol); (*b*) Multi-function additives, such as Voltol; (*c*) Other special additives: (i) Graphite; (ii) Tricresylphosphate; (iii) Chromium acetonyl acetonate.

Paraflow was manufactured mainly from the brown coal tar variety of hard paraffin wax in a chlorinated form, naphthalene, and some polystyrene by a condensation process aided by aluminium chloride. The various types of Oppanols and Voltrols and their manufacture are briefly reviewed. As well as the three special additives mentioned above, seven others are listed. R. B. S.

1136B. Lubrication of Steam Turbines. S. J. M. Auld and C. Lawrie. *Trans. Inst. Marine Engrs*, Aug. 1946, **58** (7).—The basic requirements of turbine oil are discussed in the light of modern turbine development, and the methods whereby these requirements are met in practice are fully described. The trends in turbine design are towards higher temperatures and speeds, with forced lubrication involving smaller quantities of oil in circulation and consequently the duty imposed on turbine oil becomes continually more severe. The authors describe the latest laboratory test methods and indicate the lines on which turbine oil specifications might be laid down. Practical consideration is given to storage and handling and to the treatment of used oil. I. W. E.

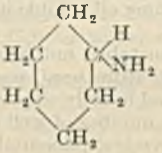
1137. Emulsification and Demulsification. 2. Emulsifying Agents. A. H. Stuart. *Petroleum*, 1946, 9, 129.—Chemical and electrical demulsification processes are reviewed.

Solid Emulsifying Agents. The action of these is due to differential wetting, as in the "Froth-flotation" process. Silica will emulsify kerosine in water, and carbon black will produce a water in kerosine emulsion. A suitable mixture of silica and carbon black will inhibit any emulsification.

The Use of Amines. Triethanolamine, $N(C_2H_4OH)_3$, is one of the most valuable emulsifying agents, in combination with fatty acids, in particular oleic and stearic acids. The former is used for the emulsification of liquids, and the latter is more suitable when it is desired to emulsify waxes and highly viscous products. For the emulsification of vegetable oils moderate stirring without heat is usually sufficient, but for waxes and highly viscous materials heat is necessary (90° C is generally suitable). A method generally applicable in difficult cases of wax-emulsification is first to dissolve the wax in a suitable mineral oil, and then to emulsify the solution, as with soluble oils.

Wax emulsions are generally used to produce dry films. A type of emulsifying agent giving greater water-resistance is morpholine, $O{\cdot}(C_2H_4)_2NH$. It is used as in the case of triethanolamine, but as it is more volatile, it gradually evaporates from the wax film left by the emulsion, leaving it water resistant.

Another recently introduced amine which shows great promise is *cyclo*hexylamine :—



Soluble Oils. These are used for "cutting oils" with machine tools. Their function is to provide a little lubrication and a lot of cooling. The fluid is recirculated. Another use of these so-called "soluble oils" without the addition of water is as a lubricant for textile machinery. Stains on the fabric can then easily be washed out.

Asphalts. The Pitch Lake of Trinidad is an example of a naturally produced emulsion resulting from petroleum reaching the surface with spring water containing colloidal clay and silica, together with sodium and iron salts, etc. It is a water-in-oil emulsion containing about 29% of water.

Most asphalt and asphaltic bitumen now used in road construction is a manufactured emulsion.

Generally speaking, an oil-in-water emulsion with about 60% of oil is employed for road surfacing. K. C. G. K.

1138. Emulsification and Demulsification. A. H. Stuart. *Petroleum*, 1946, 9, 163.—*Chemical Demulsification.* One of the major problems of demulsification is met with in the treatment of crude petroleum. The emulsion is stabilized in practically all cases by finely divided solid matter, such as silica or clay, whose action is oleophilic. A demulsifying agent is therefore introduced having strong adsorptive properties, which converts the oleophite particles into the oleophobic (hydrophilic) type. This starts inversion, which encourages coalescence of the water droplets. Under the action of gravity, separation then occurs. Among the substances used are: oleylhydroxystearic acid, benzene sulphostearic acid and their ammonium salts.

The Use of Electrical Phenomena. Some crudes form exceptionally stable emulsions, and an electrical method has been found effective, where chemical methods fail. An alternating current is used which is stepped up via a transformer to very high voltages; 5000 to 10,000 v/inch is common, but 100,000 v/inch has been employed. The emulsion is submitted to the action of this field. The globules of water represent the internal phase, being surrounded by the non-conducting oil, and acquire an induced charge, positive on one side and negative on the other. These water globules tend to form chains between the two electrodes. The small globules in any one chain coalesce, and the larger drop formed separates from the oil by gravity. Temperatures up to 180° F may be applied in some cases. K. C. G. K.

1139. Steam Turbine Lubrication Problems and their Solutions. A. Wolf. *Petroleum*, 1946, **9**, 136.—This is the first of an extensive series of articles, also including a study of modern inhibited oils for turbines operated by steam at moderate to high steam pressures and temperatures and for other machinery requiring lubricants of "turbine oil quality." An extensive synopsis of the main subjects to be discussed is given. At present there are no published and generally accepted specifications for turbine oils which assure satisfactory running behaviour from an oil. The trouble occurring will be due mainly to oxidation and very rapid deterioration of the oil, resulting in corrosion and deposit-formation. Such lubrication troubles are much more frequent in modern turbines operating at high pressures and temperatures than in former types. The oxidation test is therefore of prime importance with turbine oils. The present B.S.S. test is inadequate, its utility being strictly limited to the elimination of any highly naphthenic, uninhibited oils. However, some of the larger oil companies, particularly in America, have developed accelerated life tests which are a great improvement on the B.S.S. British Air Ministry or Indiana oxidation tests. The A.S.T.M. has also an oxidation test under review. It consists essentially of bubbling a slow current of oxygen through a definite volume of the oil under test and of water in a large test-tube held at 95° C in an oil or steam bath and surmounted by a water-cooled reflux condenser. A spiral of iron wire and one of copper are immersed in the oil-water mixture and serve as powerful oxidation catalysts. If required, the test may be made more severe by adding oil-soluble iron soaps (such as ferric naphthenate) to the oil.

The rate of deterioration of unstable, uninhibited turbine oils is remarkably high, considering the moderate temperature used, even without the additional oxidation catalyst. A highly solvent-refined heavily clay-treated, very pale, uninhibited turbine oil may develop a neutralization number of well over 1·0 mg KOH/g oil in as little as 50 hours. The acidity time curve is exponential, indicating auto-catalytic oxidation.

By contrast, a high-quality, well-inhibited turbine oil may take over 6000 hours to reach an acidity of 1·0 under the above conditions. K. C. G. K.

1140. What is a Lubricant? H. E. Mahncke. *Diesel Power and Diesel Transportation*, 1946, **24** (7), 842.—A lubricant may be defined as any substance which will reduce the friction between one object and another in contact with and in motion with respect to it. Friction is defined, and the author reviews past and present theories as to its origin and the sorts of substances which can effect its reduction, with emphasis on petroleum products. The intrinsic properties which characterize a lubricant—*i.e.*, viscosity and oiliness—are discussed separately and in detail.
C. D. B.

1141. Lubrication Vade Mecum. Addendum (3). E. W. Steinitz. *Petroleum*, 1946, **9**, 107.—Under section IX (continued) the following are included: air-liquefying plant, barrel cleaning and washing machines, tableting and pelleting machines, glass-bottle making and glass-blowing machines.

Section X (transportation) includes notes on the lubrication of: cableways, steam capstans, diesel, electric and steam locomotives. K. C. G. K.

1142. Wax Mould Lubricant. Anon. *India Rubber J.*, 1946, **111** (2), 4.—A few per cent of a recently announced wax (available in solid, granular, powdered and atomized forms) added to neoprene and synthetic rubbers gives good mould release properties, overcoming the tendency to become tacky, and facilitates production of sheets or films of vinyl or similar plastics. Improvement of hot melts of coating, impregnating, sealing, and potting compounds is effected, and the wax also imparts improved properties of moisture resistance. C. N. T.

1143. Special Characteristics of a Self-scouring Wool Lubricant. A. Moscowitz. *Amer. Dyestuff Reporter*, 1946, **35**, 310–311.—The latest developed product in this field combines surface activity, lubricity, and water-solubility. Earlier wool lubricants were generally oleophilic in character, and when used as an emulsion, this generally broke on the fibre, and left much to be desired in the way of penetration, stability, and uniformity of application. For cohesion of the wool fibre, the ideal lubricant should have a high viscosity (within the range of practical application), and must not be tacky or exhibit gumming properties. The new product has a viscosity of about 400 sec (S.U.) at 100° F, exhibits the above desirable properties, and has proved effective in use, increasing the tensile strength of the yarn by about 20% in comparison with more conventional lubricants. In the presence of mild alkali, excellent coverage and normal shrinkage are obtained without the use of soap, and self-scouring is achieved by virtue of surface activity and water-solubility, even in the presence of as much as 35% of foreign oil. C. N. T.

Bitumen, Asphalt and Tar.

1144. Bituminous Emulsions. Anon. *Paint Technology*, 1946, **11** (125), 197.—The film of bitumen on mineral particles obtained when a bituminous emulsion is used for preparing bituminous aggregates will tend to re-emulsify under long exposure to dampness or rain. The British patent No. 547,242 granted to the Standard Oil Development Co. states that this tendency is lessened by the use of compounds of aluminium, tin, boron, chromium, zinc, molybdenum, and vanadium, and an aliphatic amine containing more than 11 carbon atoms in a straight chain—*e.g.*, *n*-heptadecylamine. The specification describes a series of tests in which an emulsion containing 1% of the amine mentioned and 0·2% aluminium sulphate was used—(the components, amounts, and procedure of making it are given) was applied to a stone aggregate and tested for adhesion by the shaking test. Comparative tests being made with a standard emulsion. The results are given in the following table, which shows the merits of the process.

Average Time (minutes to remove 50% of the asphalt) :

Condition of Stone	Time of cure (hour)	1 Standard emulsion	2 1% of the amine	3 0·2% $Al_2(SO_4)_3$	4 1% of the amine and 0·2% $Al_2(SO_4)_3$	5 2 and 3 calculated
Dry	4	0·2	90	12·5	300	102·5
...	24	0·8	60	45	270	105
Wet	4	0·1	2·5	3·2	300	5·7
,,	24	0·7	37·5	33·8	270	71·3

W. H. C.

Special Hydrocarbon Products.

1145. Industrial Use of Petroleum Waxes. J. C. Dean. *Refiner*, 1946, **25** (5), 87–91.—About 80% of the production of petroleum waxes is used for the treatment of paper. Three basic types of wax-treated paper are made. The wet-waxed paper types are those which have a continuous surface film of wax, and may contain as much wax as the base paper stock. Fully refined wax is used, and to overcome its inherent brittleness up to 25% of microcrystalline wax is blended with it. The dry-waxed paper type is obtained by the controlled use of wax (either refined or scale wax), so do not possess a continuous surface film of wax. The laminated paper type employs wax as a binding as well as a moisture-proofing agent. Microcrystalline rather than ordinary paraffin wax is the most satisfactory for this purpose. Other uses for paraffin wax with particular reference to the microcrystalline type are described—*e.g.*, protective coating for liquid containers, impregnating insulating materials, blending with synthetic rubber preparations to retard " sun checking " and as a moulding wax in electrotype processes. G. R. N.

1146. Crystallography of Waxes and Related Substances. L. Ivanovszky and J. H. Wredden. *Petroleum*, 1946, **9**, 110.—2. The crystallography of thin wax films produced under set experimental conditions without the use of solvents is discussed. In particular, the influence of the rates of cooling and pressure on shape and growth of crystals is considered.

Microscopical examination was carried out using polarized light (crossed nicols), which gave more contrasting pictures than transmitted light or dark-ground illumination. The study of stress patterns in the photomicrographs gives additional information on the mechanism of crystal formation.

The four methods found most suitable were: (1) Slow, pressureless cooling; (2) slow cooling under slight pressure; (3) shock cooling under slight pressure; (4) shock cooling under pressure.

Striking differences in the structure of thin films of paraffin wax are illustrated and deductions made concerning the type of structures existing in different layers of wax blocks. It is well known that samples taken from different parts of slabs or larger blocks may differ in physical properties to some extent—*e.g.*, in melting point. This may be due not only to segregation currents occurring during solidification, but also as a result of different crystallographic habits and molecular re-orientations.

K. C. G. K.

1147. Crystallography of Waxes and Related Substances. 3 (1), Photomicrographs. L. Ivanovszky and J. H. Wredden. *Petroleum*, 1946, **9**, 143–146.—A selection of 24 photomicrographs of various types of waxes is given, the molten material being treated as discussed in Part 2 (the methods of preparing the wax films are: 1. Slow pressureless cooling; 2. Slow cooling under slight pressure; 3. Shock cooling under slight pressure; 4. Shock cooling under pressure). K. C. G. K.

Derived Chemical Products.

1148. Chemicals from Olefines. H. D. Axe. *J. Soc. Dyers and Colourists*, 1946, **62** (5), 129–132.—Petroleum is now giving rise to a chemical industry similar to, but wider in scope than, that resulting from the distillation of other fuels such as wood and coal. The availability of olefines from the petroleum industry in vast quantities at very low cost has resulted in the production of synthetic chemicals such as aliphatic alcohols and their compounds, esters and ketones, plastics, synthetic resins, synthetic rubber, detergents, wetting agents, new drugs, hydrogen, and special types of carbon black.

The cracking process, intended originally for the production of lower from higher-molecular-weight hydrocarbons, initiated this development. 40 gal of fuel oil feedstock produce *ca* 1000 cu.ft. of gases, of which about 25% are olefinic, the composition being governed to a large extent by the cracking temperature. The chemical separation of the more reactive olefines gives rise directly to intermediates for chemical synthesis.

Typical products such as isopropyl alcohol, diisopropyl ether, acetone, diacetone alcohol, mesityl oxide, methyl isobutyl ketone, diisobutyl ketone, *sec.*- and *tert.*-butyl alcohols, methyl ethyl ketone, allyl alcohol, and chloride and methallyl alcohol and chloride are described, and examples of their industrial utility are quoted. At higher cracking temperatures, more unsaturated hydrocarbons (*e.g.*, butadiene) and aromatics (*e.g.*, benzene, toluene, and xylenes) can be formed from non-aromatic oils, especially in the presence of catalysts and under high pressures. Alkyl phenols, of importance in resin and disinfectant manufacture, are produced in quantity, although the yield is relatively low compared with that of other products.

High-temperature cracking of natural gas results in complete decomposition of the hydrocarbons into hydrogen and carbon. The former is, after purification, used for ammonia (and fertiliser) production; the carbon formed has a different physical character from the carbon black made by the relatively wasteful " channel " process, and is of use in rubber compounding. Because of its rather unusual properties, it is also of value to the dyestuffs industry.

Pyrolysis of the lower olefines can also give rise to low-molecular-weight aromatics in relatively high yields. Higher-molecular-weight olefines (C_8–C_{20}) are also produced, and yield products similar to those mentioned above. Typical examples are higher secondary alcohols (gum and resin solvents, and emulsion stabilizers) and sodium higher alkyl sulphates, which are polar and have extremely good surface-active properties (*e.g.*, wetting, detergent, penetrating and emulsifying action in water). Being almost neutral, very difficult to hydrolyse and stable in acid or alkali, they are of particular value to the dyestuffs and textile industries. They give good lowering of surface tension, and do not precipitate in hard water, since the calcium and magnesium salts are water-soluble, detergent, and surface-active. C. N. T.

1149. Chemicals from Lighter Hydrocarbons. J. E. Bludworth. *Refiner*, 1946, **25** (5), 102–105.—A general discussion is presented of the possibilities of manufacture of chemicals from propane. A tree of chemicals from this hydrocarbon is depicted separately for the four basic methods—viz., oxidation, pyrolysis, chlorination, and nitration. Proposals to utilize excess propane in the manufacture of chemicals must be accompanied by consideration of market demand for these chemicals and the effect of the increased supply on the price. G. R. N.

1150. Chemical Smokes and Smoke Screens. H. A. Levy. *Chem. Ind.*, 1946, **58** (6), 980.—Types of petroleum-based smokes, smoke-generating formulations and equipment, and peacetime applications are discussed. Smoke screens are of two compositions—a dispersion of solid particles in air or dispersions of minute droplets in an atmosphere in which they are not converted into the gaseous phase. Petroleum products are used for military purposes; they are low in cost and form screens of good opacity and permanence. For white smokes, lubricating oil fractions of poor viscosity index to which 12·5% ammonium chloride has been added are vaporized, 0·5–1·7% sodium stearate being added to increase the viscosity of the oil, and thus prevent too rapid settling out of the chloride.

For camouflage purposes tinted smokes were produced by adding dyes of the anthraquinone groups, such as auramine "O" for yellow; para-nitraniline and β-naphthol for red, 1 to 3 lbs dye per gallon of composition. When pigments such as umbers and sienna instead of dyes are used, two or more separate fluids are consumed in a special smoke generator, the pigments are suspended in a volatile liquid vehicle of between 100° C and 200° C boiling point, the liquid being admitted to the generator some distance from where the oil vapour smoke fluid enters. Prior mixing yields a smoke in which the pigmented particles are smeared in oil, and a white smoke results.

For continuous generation of volumes of smoke the exhaust manifold of an internal-combustion engine is used. The composition, supplied from a storage tank, flows through an atomizing nozzle fitted into the exhaust manifold, and the smoke screen is discharged from the pipe to form a curtain 8–20 ft high. A Ford Model A standard 4-cyl engine can vaporize from 5 to 20 gal of composition per hour. A steam boiler can be used, the composition being admitted through the throat of a Venturi nozzle, where it is mixed with steam and discharged to the atmosphere. A blanket screen to shroud a square mile can be produced for $200 per hour using a car exhaust; with a steam generator the cost is $160.

Post war applications include screens to protect late maturing crops from frosts, the formation of fogs in the motion picture industry, and night visible smokes.

G. A. C.

1151. The Solubility of DDT in Kerosines. E. E. Fleck and H. L. Haller. *Industr. Engng. Chem*, 1946, **38**, 177–178.—The solubilities of technical and pure DDT in a number of kerosines over the range +30° to −30° C have been determined. It is indicated how the aniline point of a kerosine may be used as a general guide to its solvent power for DDT. The addition of petroleum fractions rich in alkylated naphthalenes retards the crystallization from kerosine solution held at −30° C.

A. W.

Miscellaneous Products.

1152. Plastics from Petroleum 2 (2). Manufacturing Methods. W. S. Penn. *Petroleum*, 1946, 9, 106.—*Vinyl Plastics.* The production of the following plastics is discussed: polythene, polyisobutylene (for use as a plasticizer for polythene) and polystyrene.

Acrylate Plastics. The acrylate and methacrylate plastics are made usually from either hydroxypropionic derivatives or from halogenopropionic derivatives. These substances are obtained from acetone, which is derived from petroleum. The best-known plastic of this type is perspex.

Alkyds (or glyptals). These are made by condensing polybasic acids with polybasic alcohols. The majority of the compounds used can be extracted from petroleum.

Miscellaneous Plastics. There are several thermosetting plastics, some of which are derived from petroleum. Most are made by condensing one compound with formaldehyde—*e.g.*, aniline, furfural, lignin, *p*-sulphonamide, etc. Silicone plastics are made from silicone tetrachloride and various aliphatic and aromatic halides. Nylon is made by condensing adipic acid and hexamethylene diamine. Resins are also made from chlorinated diphenyl, naphthalene, cumene, etc.

Synthetic Rubbers. These are probably the most important of the synthetic materials derived from petroleum so far.

The most important synthetic elastomers are GR–S (approximately a 75 : 25 butadiene, styrene copolymer), neoprene (a chloroprene polymer), butyl (a 97·3 isobutylene ; isoprene copolymer), and thiokol (in principle, an ethylene disulphide, sodium polysulphide condensation product).

Various petroleum derivatives are used extensively as solvents in both the natural rubber and synthetic rubber industries. K. C. G. K.

1153. Plastics from Petroleum 3 (1). Production. W. S. Penn. *Petroleum*, 1946, 9, 164–165.—The article is devoted to production processes of plastics from petroleum. The information given is summarized in a chart. The production of the following types is discussed :

1. *Protein, Urea and Melamine—Formaldehyde Plastics.* The only common raw material derived from petroleum is formaldehyde.

2. *Cellulose Plastics.* The main cellulose plastics which may be manufactured from chemicals derived from petroleum are the acetate, aceto-propionate, aceto-butyrate, and the ethyl and benzyl ethers.

3. *Bakelite Plastics.* These contain about 50% of formaldehyde. The phenols, cresols, etc., are synthesized from benzene, toluene, and similar hydrocarbons, which, with certain exceptions, are not extracted from petroleum in great proportions. However, the output of such hydrocarbons from petroleum could be increased.

4. *Vinyl Plastics.* Petroleum products are pre-eminent in this field, particularly in the U.S.A. and Canada. A good example is P.V.C., made by polymerizing vinyl chloride.

5. *Acrylate Plastics.* Acrylates may be obtained from petroleum in several ways. Acetone may be prepared from propylene and methyl methylacrylate from acetone. The acrylates and methacrylates may also be produced via ethylene.

6. *Alkyds.* These are made by condensing polybasic acids and polyhydric alcohols. Phthalic anhydride, glycerol, and ethylene glycol are the commonest starting materials, although there are many others, most of which may be obtained from petroleum. Ethylene glycol is readily made from ethylene, and phthalic anhydride from naphthalene, which in turn is obtained from petroleum. Glycerol, too, is now made on a large scale from propylene and isobutene. K. C. G. K.

1154. Ultrasonic Naftalan Emulsion. M. M. Nevyadomskii (from *Nauka i Zhizn'*, 1945, No. 4, 22). *Petroleum*, 1946, 9, 154.—Oil emulsions were first made using ultrasonics by Wood and Bayleigh in 1927. Ultrasonic emulsions of oil for medical purposes were introduced by the author in 1935.

In the course of a study of the chemotherapy of cancer the author discovered the tumour-destroying action of Naftalan petroleum (on test-animals) in 1930. A 68% successful cure in mice was achieved by direct introduction of Naftalan gas-oil into the nodules.

An obstacle in the way of applying the method to human subjects was that the oil, when introduced into the blood, would rapidly cause blockage of the blood-vessels and death, as had been shown in tests with animals.

To overcome these disadvantages, the oil has to be introduced in such fine form that the dimensions of the oil particles would not exceed those of the erythrocytes, having a diameter of 6–12 micron. Using ultrasonics it is possible to obtain an ideal disintegration of the oil down to a droplet size of 0·5 micron and less. This is achieved by the vibration of a metal rod at a rate more than 1,000,000 times per second (with magneto-striction equipment) or of a quartz plate (in the case of apparatus operated by a piezo-quartz crystal). At the same time, the emulsion formed is extremely stable. Such emulsions after storage for 1 to 3 years show almost no change in the size of the oil droplets. They are completely non-toxic. Experiments on 1000 animals have shown that a 12% gas-oil emulsion injection gives up to 90% cures of tumours.

During 5 years work at the Moscow polyclinic more than 15,000 injections of such emulsions have been given with favourable preliminary results. K. C. G. K.

1155. Surface Active Compounds. H. H. Mosher. *Amer. Dyestuff Reporter*, 1946, **35** (7), 168–173.—A general review is given of the properties and mechanism of operation of surface-active compounds, together with a description of their utility in textile operations. Typical examples of their use as: (1) luboil emulsifiers for correcting yarn dryness; (2) detergents; (3) anionic dyeing auxiliaries; (4) wetting, penetrating, dispersing, deflocculating, dye-retarding, softening, or finishing agents are quoted. Some surface active compounds are antiseptic and moth-proofing, whilst others may be developed into useful dye mordants, durable textile finishes, water-proofing, and fire-retarding agents. C. N. T.

1156. Why Lead is Scarce. Anon. *Chem. Ind.*, 1946, **58** (6), 978.—The principal reasons for the short supply of lead in the United States are discussed.

Labour troubles at the mines and smelters; a low ceiling price; inadequate exploration to prove reserves during the war years; a sudden reduction of imports by about 30% from the 1945 level are factors on the supply side. Increased consumption due to the requirements of the housing programme, petroleum, and automobile industries have made inroads into stocks. For example, for the production of tetraethyl lead, it is estimated that 11,000 tons will be required for the second quarter of 1946, 37% higher than for a comparable pre-war period. Tables give stocks of primary and secondary lead, total lead supply, and world lead production and consumption.
G. A. C.

1157. The Contribution of the E.R.A. to International Research on Transformer Oils. P. W. L. Gossling and A. C. Michie. *J. Inst. Petrol.*, 1946, **32**, 356–364.—This paper deals with the research on sludge and acidity in transformer oils, which has been carried out by the E.R.A. over a long period. A. H. N.

1158. Petrochemistry Directs Natural Gas Conversion at Lion Oil Co. Plant. A. L. Foster. *Oil Gas J.*, 22.6.46, **45** (7), 98.—The processes by which natural gas is converted to ammonium nitrate at the Ozark Ordnance Works, El Dorado, Ark., is described.

The plant includes sulphur-removal, gas-reforming, compression, and purification units, the ammonia synthesis plant, a unit for conversion of ammonia into nitric acid and for producing the nitrate; together with auxiliary power plants.

Sulphur is removed from the raw natural gas by reaction with zinc oxide, the oxide being regenerated by heating. Low-pressure steam, superheated to 400° C, is mixed with the purified gas, and enters the reformer containing 97,000 lb of nickel metal catalyst supported on earth material, about 22,000 cu.ft. of gas being processed for each ton of ammonia synthesized. The gas leaving the primary reformer now contains only 1·5% of methane, with 11% carbon monoxide, 11·9% dioxide, and 70–75% hydrogen. The gases are mixed with air and go to the four secondary reformers at 900° C, passed over the metal catalyst, the emerging gases now containing 9·6% carbon monoxide, 11% of the dioxide, 57% hydrogen, and 21·4% nitrogen. The gas volume has now increased to 114,000 cu.ft./ton of ammonia produced.

The gases are now passed into the carbon monoxide converter at 540° C and reacted with steam over iron oxide (Fe_3O_4) catalyst, to convert the monoxide into dioxide. After this the gases pass through a steam interchanger, a gas interchanger, and then a water-cooled tower, emerging at 30° C, then conveyed to the compression unit, where the gas is compressed to 225 p.s.i.g. and water-scrubbed to remove carbon dioxide. The washing water is caused to generate a portion of the electric power used by passing it through four Morris hydraulic turbines which drive a 750-kW A.C. generator. In the fourth and fifth stages of the high-pressure compressors the gas is raised to 1800 p.s.i.g., passed through copper ammonium formate solution to remove all monoxide and dioxide, leaving a purified gas containing 25% nitrogen and 73–74% hydrogen, which is fed to the converter, where combination takes place over a promoted iron catalyst to form ammonia, special cooling and ducting arrangements being made. The ammonia is oxidized by burning in the presence of platinum rhodium gauze at

900° C finally to produce nitric acid, which is mixed with ammonia to form the nitrate. About 500 tons of ammonia per day is produced.

It is anticipated that the demand for fertilizer will exceed supplies. G. A. C.

ENGINES AND AUTOMOTIVE EQUIPMENT.

1159. An Analysis of the Effects of Fuel Distribution on Engine Performance. D. B. Brooks. *Bur. Stand. J. Res. Wash.*, 1946, **36** (5), 425.—The effects on engine performance of typical cases of maldistribution of the fuel-air mixture in a single-cylinder engine have been examined. Relating engine power to fuel consumption, engine performance curves were derived analytically from an empirical equation for typical examples of poor mixture distribution.

It was shown that minimum specific fuel consumption is a good index of distribution, improvement in this variable generally being accompanied by improvement in other engine performance variables of interest.

A method which has been developed for ascertaining the attainable improvement over a given distribution is described. T. M. B. M.

1160. The Diesel Process in the Entropy Diagram. M. Abdu Ibrahim and K. Elser. *Sulzer Tech. Rev.*, 1946, No. 3, 12–22.—Two main difficulties are encountered in the representation of the working process in the temperature–entropy diagram. These are: (1) the modification of the physical and chemical properties of the working medium as a result of combustion; and (2) the dependence in time of the heat supplied to the gas on the combustion and on the flow of heat through the walls.

Eichelberg proposed a combustion line for the diesel process divided as follows: 30% heat effectively supplied at constant specific volume; 50% at constant pressure and 20% at constant temperature of the working gas. The article deals with the process in a more refined fashion, taking into account the successive changes in the composition of the gas and the distribution of the heat extraction through the cylinder walls over the whole working cycle. A new division of the heat supply to the combustion process in its separate parts is also proposed. The decisive factors in the problem are influenced by engine design, and consideration was limited to the working process of a 2-stroke diesel engine with direct injection and moderate mean piston speed. A practical example illustrates the comparison of the new proposals with those of Eichelberg. I. G. B.

1161. Testing Engine Bearings. J. Palsulich and R. W. Blair. *Aircraft Production*, 1946, **8**, 409.—In an abstract of the paper read before the S.A.E., details of the following properties and characteristics of aircraft engine bearings are given :—

1. Maximum load-carrying capacity—the test rig uses a test bearing identical with the crankpin bearing used in production engines.
2. Friction and lubrication characteristics—of highly loaded sleeve bearings investigated on a 4-bearing friction machine designed by U.S. Bureau of Standards.
3. Fatigue life—of various bearing materials and designs of splines on master-rod bearings.
4. Corrosion resistance—done on a small laboratory (TBC) machine developed by Shell Development Co.
5. Wear resistance—on wear of overlay normally used on silver and bronze bearings, due to combination of wear and corrosion.
6. Cavitation—erosion resistance. I. G. B.

1162. The Rolls-Royce Merlin. Anon. *Aeroplane*, 1946, **71** (1837), 162.—The article gives a table of Merlins in civil and service use, and is claimed to be the most complete and accurate yet published. The engine characteristics are described under the headings; mark number; take-off boost and b.h.p.; low-gear combat ratings, boost, b.h.p. and altitude; high-gear combat ratings, boost, b.h.p. and altitude; weight (dry); remarks (special features). I. G. B.

1163. Athodyds for Aircraft. Anon. *Flight*, 1946, **50**, 155.—The article discusses the characteristics and some possible applications of the "athodyd" or "ram-jet." At high speeds of flight the dynamic pressure of air at intake obviates the need for a compressor in the conventional jet engines. The turbine, which serves only to drive the compressor, is also unnecessary. This leads to the conception of a forward-facing duct in which air is compressed in a divergent portion, fuel added and burnt in the pressurized region and ejected to produce expansion and jet reaction.

Disadvantages of the athodyd are high fuel consumption (50–100% greater than gas turbine); necessity to provide launching power and low climb performance. Unlike the rocket, it loses power with height, but gains in efficiency with higher forward speeds. At 40,000 ft and with speeds up to 900 m.p.h. the turbine jet provides greater thrust per unit frontal area than the athodyd, but beyond this speed the athodyd gives considerably more thrust. On the basis of specific fuel consumption the relatively large difference between jet and athodyd narrows at forward speeds of 1000 m.p.h. and greater.

Outside official circles, little is known of athodyd research in Great Britain, but the recent R.A.E. exhibition included a hypothetical athodyd-propelled aircraft. Another illustration depicted the Leduc proposal for an aircraft exhibited in the Paris Salon in 1938. In the U.S.A. the Johns Hopkins University and associated organizations appear to have produced evidence of the practicability of this method of propulsion. The U.S. Navy is experimenting with a 70-lb athodyd (the " Cobra ") capable of delivering thrusts sufficient for speeds up to 1500 m.p.h. In Germany, interest was also shown; on the DO 217 a Saengar athodyd was mounted on the fuselage; Focke-Wulf proposed a machine with two units at the extremities of the tail plane and a Walter bi-fuel rocket in the tail of the fuselage for take-off power; Heinkel, Skoda, and Messerschmitt also made practical proposals. The flying bomb is correctly termed a " stuttering " or " pulsating " athodyd. I. G. B.

1164. Allis–Chalmers Gas Turbine. Anon. *Diesel Power and Diesel Transportation*, May 1946, 24 (5), 596; May 1946, 24 (6), 720.—Recognizing the need for a gas turbine test unit capable of testing high-temperature materials under full-scale service conditions, the Bureau of Ships of the U.S. Navy arranged in 1940 for Allis–Chalmers to design and construct a 3500-h.p. experimental gas turbine unit capable of operating at 1500° F, and which was subsequently installed at the U.S. Naval Engineering experimental station at Annapolis in 1944. The experimental unit was designed to supply information to guide designers of future gas turbines for operating at this temperature for industrial and marine applications. The unit has been under test at progressively increasing turbine inlet temperatures for about two years.

The fundamental problems are discussed, and service and industrial requirements reviewed.

Features of the design of this experimental unit and the reasons for the particular layout adopted are discussed in detail. For convenience of making the necessary observations and for utmost accessibility during test a parallel arrangement was used in which one turbine drives the gas generator compressor and the second the power turbine, coupled to a water-brake for power measurement. Air leaves the gas generator compressor at 45 lb gauge and is passed via a counter-flow heat exchanger, where at full load its temperature is raised by the turbine exhaust gas from 363° F to 750° F, into two horizontal combustion chambers, supplying the gas generator turbine and the power turbine separately. These two turbines are similar, having five stages and operating at 5200 r.p.m., excepting that the latter has slightly longer blades and is fitted with an air-operated internal by-pass which is opened for starting. The high-temperature turbine wheel is air cooled. The blades and discs are constructed from Timken steel alloy containing 16% chromium, 25% nickel and 6% molybdenum. The 20-stage axial flow air compressor has a full-load capacity of 40,000 cu.ft/min. at 45 lb/sq. in. gauge and an efficiency of 85%. Turbines and compressors are fitted with sleeve bearings.

The combustion chambers each have a single oil burner. Air necessary for combustion passes through a central flame tube, the remainder flowing between the flame tube and the outer wall of the chamber, thus reducing the wall temperature and avoiding the need of refractory materials. The maximum heat release is 2,500,000 B.Th.U./cu.ft/hour. No. 2 furnace oil is used as fuel. It is predicted that boiler and fuel may be used for marine applications and powdered bituminous coal for industrial installations.

The unit can be started up by motoring up to 25–35% full speed by an electric motor of less than 100 h.p. Testing procedure is outlined and instrumentation described and some test results are given. 50 hours have been run at inlet temperatures of 1350° F, and it is estimated that the overall plant efficiency at inlet temperatures of 1500° F will be about 40%. C. D. B.

1165. "Jet Propulsion." F. B. Halford. *J. Roy. Soc. Arts*, 1946, **94**, 576.—The author deals specifically with the possibilities of jet-propelled civil aircraft and states the broad principles of jet propulsion, of increased flight speed and its limitations and compressibility. For a hypothetical high-altitude air-liner, 4 units each developing 2550 lb thrust at 40,000 ft would be required. Cruising at 600 m.p.h. possible future characteristics would be—expansion ratio 15 : 1; compressor efficiency 85%; combustion chamber "drag" efficiency 95%; turbine efficiency 90% and specific fuel consumption 0·88 lb/hr/lb thrust. The weight would be about 6000 lb and overall diameter 60 inch. The author completes his case by indicating the lower operating costs possible with jet-propelled air liners. I. G. B.

1166. Precision Sheet Metal Work in the Aircraft Gas Turbine. Anon. *Aircraft Production*, 1946, **8**. 414.—A review is given of the methods of manufacture of combustion and exhaust systems by the Burnley group of Joseph Lucas, Ltd. A large proportion of sheet metal is used in the construction of combustion systems, and much of it must withstand high operating temperatures, while tolerances of many of the components are fine for this class of work.

Particularly interesting are the accounts given of the methods used for deep-drawing and resistance welding of Nimonic sheet; radiological inspection and metallographic examination of welded joints and processes in the assembly of swirl-vane units. I. G. B.

1167. Aluminum Alloys for High-Duty Engine Bearings. H. Y. Hunsicker and L. W. Kempf. *Diesel Power and Diesel Transportation*, July 1946, **24** (7), 856.—Experimental work conducted by the Aluminum Co. of America on aluminum bearings for engines has evolved some promising alloys, and the paper describes tests conducted on two of these—namely Al–Sn–Cu–Ni containing 6·5% tin, 1% nickel, and 1% copper, Al–Sn–Si–Cu containing 6·5% tin, 2·5% silicon, 1% copper, and 0·5% nickel, the balance in each case being made up with aluminum of commercial purity. Test results obtained on a bearing fatigue testing machine, a scuffing test machine, and Timken machine are reviewed, the performance being compared with steel-backed tin babbitt and copper lead bearings. These and subsequent service tests show a marked superiority in several respects of the aluminum alloys, particularly with regard to load capacity, embedibility, and friction under high loads. They are stated to have a high resistance to corrosive attack by organic acids and permit the use of compounded lubricating oils. Journal wear was similar to that obtained with copper-lead bearings, and greater than that of babbitt bearings. Mention is made of the need for certain design changes in adapting existing equipment to take aluminum bearings and methods of manufacture are briefly described. C. D. B.

MISCELLANEOUS.

1168. Dictionary of Technical Petroleum Terms. Anon. *Riv. Ital. Petrol.*, 1946, **14** (158), 18–19.—A further instalment of a series. Terms are given in Italian with their English, French, Spanish, and German equivalents. V. B.

1169. Japan's Post-War Petroleum Needs Estimated at Less than Half Those of Prewar. W. W. Burns. *Oil Gas J.*, 13.7.46, **45** (10), 70.—The Petroleum Advisory Board set-up is described; it is composed of civilians loaned from four petroleum concerns, the Asiatic, Standard-Socony, Caltex Tide Water and, in the future, one from the Union Oil Co. of California, who act solely for General MacArthur and who have only limited communication with their firms under Military censorship. Future operations of the companies will be as a joint organization, even when Japan eventually (several years at least) is opened to foreign commercial enterprise. The relationship will be as follows: "The military will import all petroleum products for military use and will retain ownership. The contractor (the five companies) will receive and store these products and will transport the products required to maintain prescribed levels in all Army depôts and distribution points in Japan. The contractor as directed will ship to points outside Japan and to allied occupation forces." The civilian and military oil requirements will split at the tanker and in no way interfere with each other, the civilian supply being distributed by the Japanese-directed Petroleum Distributing Co-ordinating Committee, under military control, as at present. Inspections were made of 15 refineries, 8 synthetic oil plants, and 15 distributing installations and it was decided to allow the refining of 329,000 brl (the crude oils in stock) during the three last quarters of 1946. The recovered hidden military stocks are discussed, so far those found have been used for civilian consumption. No importation is allowed for this purpose. The Petroleum Advisory Group have estimated that Japan's postwar petroleum needs to be from 12,000 to 16,000 brl/day, the prewar amount being 40,000 brl/day. North and South Sakhalin production was about 12,000 brl/day. Synthetic fuel production in 1944 was 718,000 barrels, five out of 7 synthetic plants are to be altered to manufacture ammonium sulphate instead of aviation fuel. Japan's indigenous oil production will never amount to much; the reserves are estimated at only 12,000,000 barrels. For 1946 the production is estimated at 1,400,000 barrels representing about 30% of her needs. Refinery capacity is about double the indigenous production. Until normal commercial operations are resumed the Petroleum Advisory Group will function and constantly review all phases of Japan's oil economy. General MacArthur has appointed a civilian custodian who will eventually work out some method of solving foreign property ownership. W. H. C.

1170. German Oil Industry. B. O. Lisle. *Petroleum*, 1946, **9**, 160.—A survey of present conditions in the German oil industry. It is shown that the restoration of the industry so far carried out is inadequate to meet the minimum essential civilian requirements. K. C. G. K.

1171. Aviation at Work. H. David. *Oil Gas J.*, 22.6.46, **45** (7), 78.—The use of aircraft in the petroleum industry is reviewed. In addition to the transport of executive personnel the aeroplane is employed for oil exploration and mapping, in the transportation of supervisory personnel to and from the wells, and of small equipment. Survey of the intended route for a pipe line and the patrolling of existing lines are more easily accomplished by the use of the aeroplane; they are also equipped as flying laboratories to follow up ground tests on fuels and lubricants. Oil companies employ pilot salesmen in their aviation sales departments, the latter to contact field offices, airline and airport executives and aircraft manufacturers. Exploration, drilling and supply of special equipment in foreign areas where communications are poor or non-existent are facilitated by aviation. G. A. C.

BOOKS RECEIVED.

Review of Petroleum Geology in 1945. F. M. Van Tuyl and W. S. Levings. Pp. 203. Golden, Colorado: Colorado School of Mines, 1946.

No. 3 of Vol. 41 of the Quarterly of the Colorado School of Mines comprises the fourth of the annual reviews of petroleum geology prepared under the sponsorship of the American Association of Petroleum Geologists. It covers important developments in its subject during 1945 and an innovation in the present issue is a section on exploration and development in fields other than in the United States. A valuable feature is the bibliography of 59 pages, the entries being arranged under subject and geographical headings.

Anaerobic Corrosion of Iron in Soil. R. L. Starkey and K. M. Wright. Pp. 108. New York: American Gas Association, 1946.

This report includes the results of the American Gas Association Iron Corrosion Research Project which had the specific object of studying conditions favouring microbial corrosion in soil and of gaining information concerning the mechanism of the corrosion process in order to ascertain means of detecting corrosive locations. A bibliography of 203 references is included.

A Survey of General and Applied Rheology. G. W. Scott-Blair. Pp. 196 + xv. London: Pitman, 1945. 18*s*.

Starting with a historical and general introduction to rheology, consideration is then given to rheological phenomena and their measurement, the latter part of the book dealing with rheological interpretations and the evidence of psycho-physical investigations.

Solvents. Thos. H. Durrans. 5th edn. reprinted. Pp. 202 + xvii. London: Chapman & Hall, 1946. 17*s*. 6*d*.

In this latest edition the section dealing with petroleum hydrocarbons has been rewritten. In general form the book follows its predecessors, Part I dealing with the scientific fundamentals broadly and Part II discusses the individual solvents.

Modern Synthetic Rubbers. H. Barron. 2nd edn. reprinted 1945. Pp. 355 + xii. London: Chapman & Hall, 1945. 28*s*.

Part I deals with general considerations of natural rubber and synthetic rubber-like materials and the economics of synthetic elastic materials. In the second part the chemical and physical background of these materials is discussed, while Part III, which occupies half the book, is devoted to 18 chapters on the technology of synthetic elastic materials. Petroleum as a raw material for synthetic rubber is covered in 24 pages in chapter 7.

Journal of the Iron and Steel Institute, Vol. CLI, 1946. Pp. 775 + xiii. London: The Iron and Steel Institute, 1946.

This volume contains a paper on "Emulsions of Oil in Water as Corrosion Inhibitors," by P. Hamer, L. Powell, and E. W. Colbeck (I.C.I. Ltd., Alkali Division) which describes an investigation undertaken with the object of preventing corrosion in recirculating cooling-water systems.

Proceedings of the A.S.T.M. Vol. 45, 1945. Pp. 1058 + vi. Philadelphia, Pa.: American Society for Testing Materials, 1946.

This volume contains the 1945 reports of the various A.S.T.M. committees, including that of Committee D-2 on Petroleum Products and Lubricants, D-3 on Gaseous Fuels, D-9 on Electrical Insulating Materials, and D-16 on Industrial Aromatic Hydrocarbons.

Compilacion de los Estudios oficiales Geologicos en Colombia. Vol. 6. Pp. 504. Bogota: National Geological Service, 1945.

A series of papers covering part of a general survey of the mineral wealth of Colombia. Two supplements are included in separate bindings: the first (pp. 33) consists of a large-scale geological map of Colombia with accompanying explanations, and the second (pp. 127) contains a complete bibliography of previously published works on the geology and geography of the country. A. C.

Boletin de Minas y Petroleos. No. 150. Pp. 199. Bogota: Ministry of Mines and Petroleum, 1945.

An account of official proceedings whereby granting of certain concessions for exploiting the crude oil and mineral resources of Colombia, and withdrawal of others, was made legal. A. C.

Memoria del Ministro de Minas y Petroleos al Honorable Congreso Nacional. Vol. I (supplement). Pp. 143. Bogota: National Press, 1946.

Report of the newly elected Minister of Mines and Petroleum on the progress of his Ministry since taking office. The report includes current production figures for petroleum, silver, and gold, and gives details of work undertaken on behalf of the Ministry by the recently commissioned National Laboratories in Bogota. A. C.

INSTITUTE NOTES.

OCTOBER, 1946.

"OIL FIRES."

During the late war much contact occurred between "Fire Fighters" in general and "Oil Men," who fight rare peace-time fires "incidentally." Much good has accrued from these contacts and many lessons are to be learned from "experience" and "experiments."

At the Meeting of the Institute on December 11, which incidentally creates a precedent in being a joint meeting with the Institution of Fire Engineers, the "experience" is being well presented by Mr. E. P. Lancashire, who was active on behalf of the Petroleum Board in most major war-time oil fires. "Experiment," with most interesting results, is presented for Lord Falmouth's Department by Dr. Burgoyne and Mr. N. O. Clark.

Do *you* know what *really* happens when a pool of oil burns ? ? ?

Extra effort to attend will be well repayed and will help to ensure good discussion.

Preprints will be available on application to the Secretary.

STUDENTS' SECTION (LONDON BRANCH).

After a lapse of six years the London Branch of the Students' Section is resuming its activities. In order that its programme shall be representative of the wishes of all members an exploratory meeting has been arranged for 6 p.m. on Monday, November 18, 1946, at Manson House, 26, Portland Place, London, W. 1. Light refreshments will be provided at 5.30 p.m.

Through the courtesy of the Anglo-Iranian Oil Co., Ltd., a visit to the Eakring Oilfields has already been arranged; details will be announced at the meeting. Any further information can be obtained from N. E. F. Hitchcock, Stifford Cottage, High Street, Cranford, Middlesex. (Telephone : Hayes (Middx.) 1278.)

INSTITUTE OF PETROLEUM ELECTRICAL CODE.

A suggested Code of Electrical Practice applicable to conditions in the petroleum industry has recently been issued by the Institute of Petroleum. A survey of current practices disclosed that a considerable diversity prevailed, particularly on oilfields, and to a lesser extent in refineries and installations overseas. There was thus a general demand in the industry for a document such as this Code which would be representative of the considered views of the industry itself based on experience of its special conditions and which would give general guidance on the selection and methods of installation of suitable electrical equipment for each type of operation encountered. It was felt that this would be helpful also to British manufacturers interested in supplying its needs.

The Code embodies the results of an examination by a committee of engineers of the practice adopted by the major British oil companies, and also of Codes of Practice, Regulations and legal requirements applicable to the industry both in Great Britain and abroad, including in particular various American codes and publications.

Account has been taken where appropriate of the Codes of Practice and Standard Specifications produced by such British authorities as the Institution of Electrical Engineers, British Standards Institution, the Ministry of Fuel and Power, and the Factories Department of the Ministry of Labour and National Service.

The scope of the Code is somewhat wider than is usual in codes of this kind, since its field of application embraces conditions and operations throughout the industry from the oil well to the delivery of finished products. Furthermore, it is not confined to offering guidance in regard to the use of electricity for lighting, power and instruments, but takes account also of the problems arising from accumulations of static electricity which may be produced in certain operations in the industry, and also of protective measures that may be taken against the effects of electricity in the form of lightning.

Whilst the Rules and Recommendations embodying the practice suggested in the Code are comparatively brief, a number of schedules are included to describe and explain the arguments upon which these are based. One of these reviews the incidence of risk of a fire arising from electrical causes and discusses preventive measures, and attempts to classify in a logical manner the conditions giving rise to such a risk and the areas over which dangerous conditions may be considered to exist. Another schedule deals at some length with the question of the generation of static electricity. Another gives notes on protection against lightning. The suggested Rules are divided into groups, for each of which there is a corresponding explanatory schedule, and it is considered that these explanatory schedules should therefore not only facilitate the interpretation of the Rules, but enable suitable practice to be adopted in regard to unusual applications of electricity that may arise from time to time.

In a foreword to the Code the Council of the Institute point out that it represents their present views and is issued provisionally at this stage with a view to experience being gained in its application, after which it will be reviewed and either confirmed or amended as may then be found desirable.

The price of this 77-page publication is 5*s*., post free, and copies are obtainable from the offices of the Institute.

ELECTION TO COUNCIL.

The attention of members is drawn to the following extracts from the By-Laws governing election to the Council of the Institute :—

(*a*) The Council of the Institute shall be chosen from the Fellows and Members only.

(*b*) Every Fellow, Member, and Associate Member of the Institute may send in writing to the Council the name of a Fellow or Member whom he desires to recommend for election to the Council. This nomination must be signed by at least nine other Fellows, Members, or Associate Members and delivered to the Secretary not later than 30th day of November in any year. No Fellow, Member, or Associate Member may sign more than one Nomination Paper in any one year.

APPLICATIONS FOR MEMBERSHIP OR TRANSFER.

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

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

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

Applications for Membership.

Al-Anwar, Mohamed Salah Eddine, Engineer, Shell Company of Egypt, Ltd., Alexandria. (*H. A. Blackmore ; D. R. Howgill.*)

Bickerton, Richard Samuel, Engineer, Matthew Wells & Co., Ltd. (*V. H. Stott ; M. Mason.*)

Brock, Thomas Arthur, Junior Technical Assistant, Anglo-Iraniun Oil Co. Ltd. (*W. H. Thomas ; A. R. Javes.*)

Clarke, Albert Edward, Research Chemist, Joseph Lucas Ltd. (*F. H. Garner ; A. H. Nissan.*)

Fitzgerald, Patrick, Company Director & Sales Manager, Southern Capital Oil Co. Ltd. (*J. H. Varley ; R. R. Dunn.*)

Huguin, Eugene Louis Pierre, Director General, Societe miniere des schistes bitumineux. (*W. A. Keightley ; A. E. Dunstan.*)

Jones, Ernest James, Accountancy Assistant, National Oil Refineries Ltd. (*R. B. Southall ; E. Thornton.*)

Lloyd, Ronald Edgar, Assistant District Operator, Petroleum Board. (*C. Chilvers ; R. D. Streeton.*)

Nellensteyn, Frederik Jan, Director of the State Road Laboratory, The Hague, Holland.

Nisbet, Hugh Bryan, Professor of Chemistry, Heriot-Watt College, Edinburgh. (*R. Crichton ; S. J. M. Auld.*)

Nuttall, Alfred Laurence Falkiner, Petroleum Geologist, Petroleum Division, Ministry of Fuel and Power. (*T. Dewhurst ; G. W. Lepper.*)

Stothard, Thomas Hall, Research Section Leader, British Celanese Ltd. (*G. M. Dyson ; A. W. Pottier.*)

Tait, Keith Gordon, Constructional Engineer, United British Oilfields of Trinidad Ltd. (*R. D. Crook ; W. R. P. Hodgson.*)

Whyte, Daniel, Lubrication Engineer, Anglo-Iranian Oil Co. Ltd. (*S. J. M. Auld ; E. R. Blane.*)

Applications for Transfer.

Ault, William Sinclair, Chief Technical Adviser, Shell-Mex and B.P. Ltd. (*J. A. Oriel ; E. LeQ. Herbert.*) (*Member to Fellow.*)

Carder, William Aubrey, British Mexican Petroleum Co. Ltd. (*H. C. Tett ; H. F. Jones.*) (*Student to Associate Member.*)

Castle, Arthur Frederick, Assistant Production Superintendent, Apex (Trinidad) Oilfields Ltd. (*A. H. Richard ; H. W. Reid.*) (*Associate Member to Member.*)

NEW MEMBERS.

The following elections have been made by the Council in accordance with the By-Laws, Sect. IV, para. 7.

Elections are subject to confirmation in accordance with the By-Laws, Sect. IV, paras. 9 and 10.

As Fellows.

Courtan, Maurice M.
Gollin, G. J.
Maxwell, G. B.
Mead, Brian.
Salomon, Tobie G.

Transfers to Fellow.

Javes, A. R.
Moore, P. H.
Thorpe, T. C. G.

As Members.

Baddiley, J. R.
Biddolph, G. W. J.
Fothergill, H. C. S.
Smith, Clement G.

Transfer to Member.

Balfour, N. R.

As Associate Members.

Boon, Cyril B.
Brooks, Roy.
Butler, A. H. S.
Day, S.
Firminger, John.
Hall, P. C.
Holmes, G. W. D.
Jagger, H.
Jennison, J. A.
Langston, R. P.
Litherland, F. W.
Miller, W. G.
Rees, L. M. J.
Stroud, H. J.
Walker, A.
Williams, H. D.

Transfers to Associate Member.

Bowker, Thomas D.
Parr, R. W.
Perks, J. G.

As Student.

Paul, P. F. M.

PERSONAL NOTES.

H. D. **Fletcher**, M.I.Mech.E. (Member), attorney and general manager of Apex (Trinidad) Oilfields, Ltd., is retiring this year after twenty-three years with the company.

He joined the company in 1923 as assistant manager and field superintendent and was appointed to his present position in 1937. He will be succeeded by L. A. Bushe (Member).

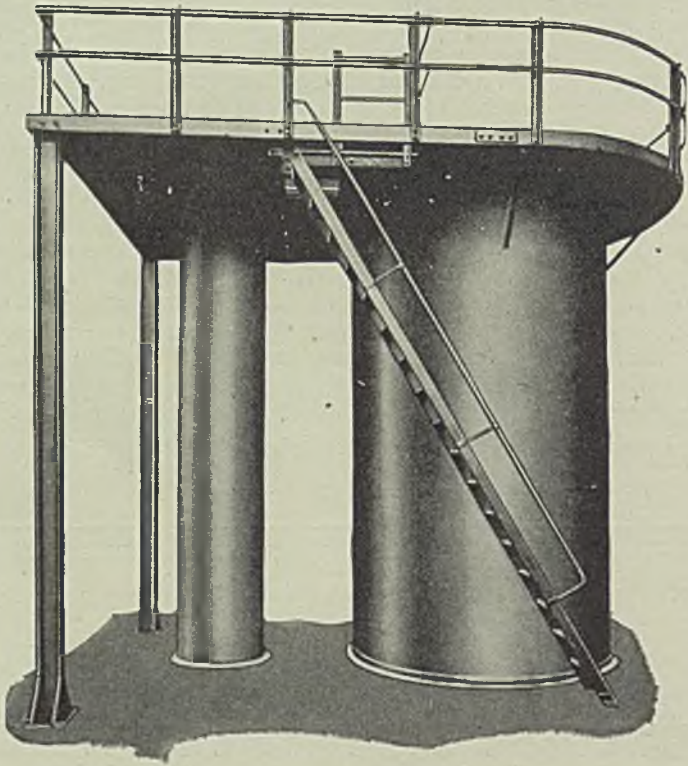
SILVER JUBILEE OF AGWI PETROLEUM CORPORATION, LTD.

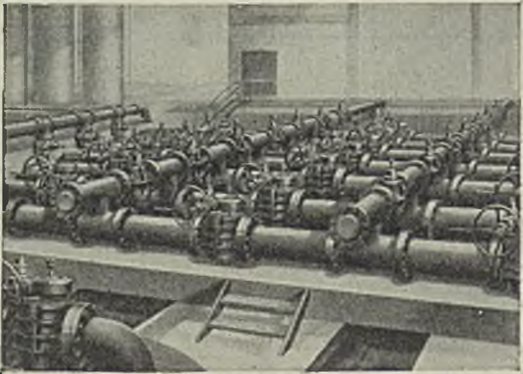
Founded in 1920, the Agwi Petroleum Corporation Ltd. should have celebrated its Silver Jubilee last year, but the function was delayed until September 6, 1946, and this enabled most of the ex-service men to be present.

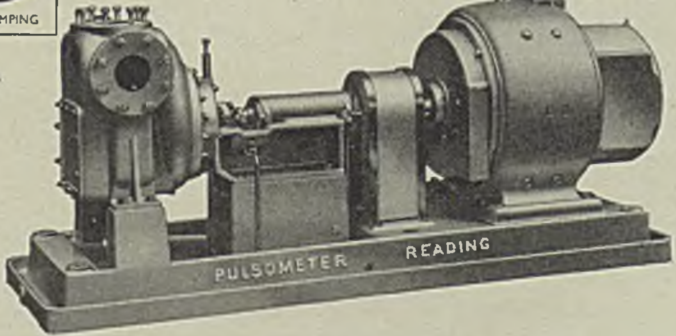
Mr. H. D. Demoulins, a Director, presided over the gathering of around 500 in the Guildhall at Southampton. Mr. Demoulins referred briefly to the history of Agwi and to the fact that one of the earliest processes operating at the refinery was vapour-phase cracking, with which the name of Sir Oliver Lodge was associated.

Referring to the Fawley Refinery, Mr. Demoulins expressed the Board's admiration for the loyalty and devotion shown by the staff during the blitz period. With regard to Agwi's part in the war effort, he said that in the 15-months from D-Day they had handled 2-million tons of oil products and received and bunkered over 2,000 ships. He also mentioned that Fawley had been a base for Pluto and the southernmost point of the British pipeline system.

Concluding, Mr. Demoulins said that post-war problems would take them into a wide field, and that the Fawley refinery had an important contribution to make to the national economy.






PULSOMETER
READING

LUMMUS WILL HELP YOU PLAN

NEW LUBE OIL PLANTS . . .

. . . to produce maximum yields of high grade lube stocks at minimum cost.

. . . to meet changing marketing conditions.

For three major oil companies, Lummus is now building three lube oil plants—eleven units in all—incorporating vacuum distillation, propane deasphalting, solvent refining, solvent dewaxing, and clay finishing. These plants will have a total capacity of 7,500 barrels of finished oil per day. Incidentally, when completed they will be the 15th, 16th and 17th solvent refining plants and the 20th, 21st and 22nd solvent dewaxing plants designed and built by Lummus.

Lummus engineers are available for a thorough study of individual problems. They are ready to project processes through laboratory and semi-commercial operation, and equipped to determine construction and operating costs for a thorough consideration of the economics of each proposal. Lummus Laboratories and pilot plants have every facility for lube oil evaluation, including propane deasphalting, solvent refining, solvent dewaxing and clay finishing.

Are you interested in modern *low-cost* lubricating oil plants ?

Write for copy of "Development of the Postwar Petroleum Refining Picture," an interesting analysis and prediction of post-war Refining and Marketing Developments.

R. H. DODD
Representing The Lummus Company
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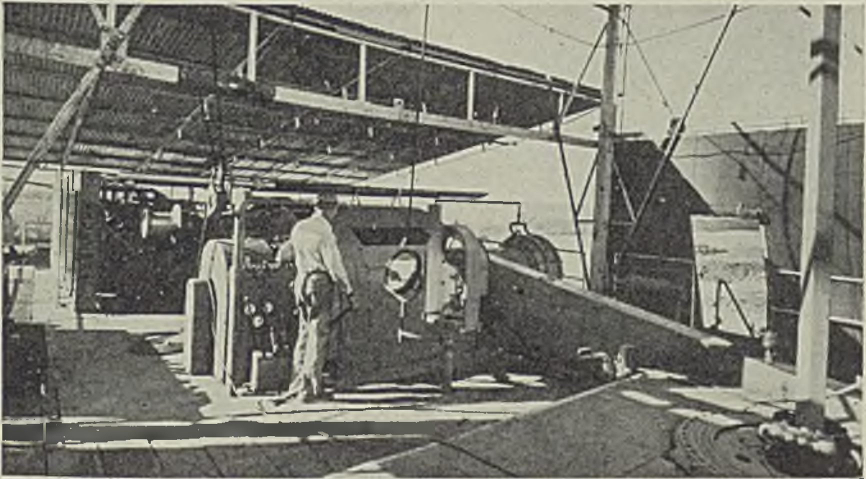
England.

Lummus
PETROLEUM REFINING PLANTS

IDEAL DRILLING EQUIPMENT



Floor view of a heavy Ideal Drilling Rig.

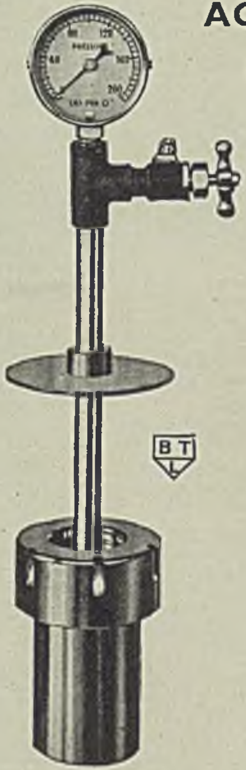
For the deepest and most severe drilling successful operators use the most reliable equipment.

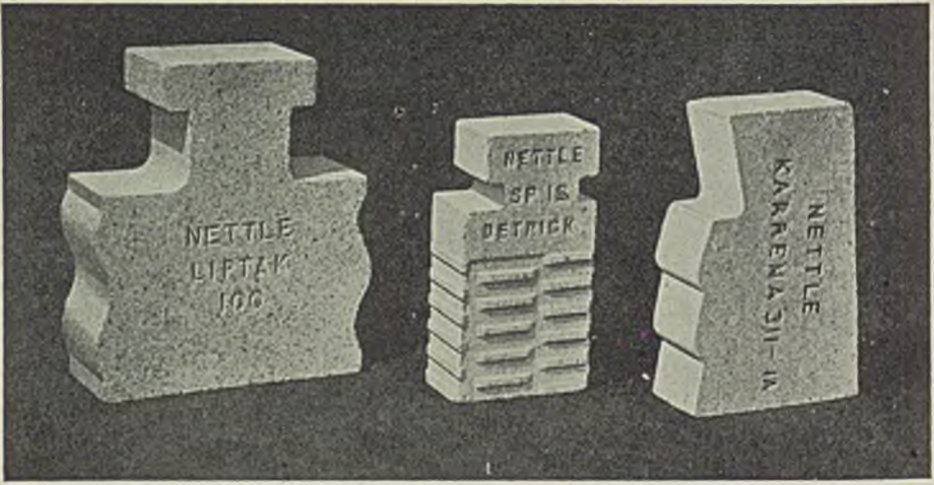
IDEAL Consolidated Rigs are known and used in all deep fields for their reliability and efficiency, and their assurance of continuous and trouble free operation.

The illustration shows the IDEAL No. 125 Consolidated Draw-works (rated for 15,000 ft.) and the IDEAL SHS–20½″ Rotary Machine on a deep well in Oklahoma.

Particulars of IDEAL Equipment furnished on request.

NATIONAL
OWECO
RIVER PLATE HOUSE LONDON E.C.2.





FOR OIL FIRED FURNACES

THISTLE ($35/37\%$ Al_2O_3) Firebrick is a general purpose first quality firebrick which enjoys a wide reputation for regularity of quality.

NETTLE ($42/44\%$ Al_2O_3) is a super grade brick of exceptional uniformity manufactured under close control in a modern plant and fired in Tunnel Kilns. The brick to brick variation in quality and shape is reduced to the absolute minimum. Recommended for those parts of the lining where conditions are more severe.

STEIN SILLIMANITE (62% Al_2O_3) has outstanding resistance to spalling, hot-load strength and volume stability. Recommended for any parts where unusually severe conditions are experienced.

SUSPENDED ARCH AND WALL TILES. We specialise in the manufacture of the various well-known types of these tiles in which accuracy of shape is an important consideration.

PLASTIC REFRACTORY.

MAKSICCAR PATCH is supplied in " ready to use " consistency. Will be found valuable for repairing damaged brickwork, etc.

EXPORT PACKING.

Standard crates 34" × 29" × 24" overall hold 100—9 × 4½ × 3" squares or 112—2½". Gross weight approximately 8¾ cwts. each.

REFRACTORY CEMENTS.

The following range offers a wide selection according to users requirements :—

NETTLE CEMENT (42% Al_2O_3) Refractory test Seger Cone 34 = 1750° C.
Contains a proportion of pre-calcined material which eliminates shrinkage in drying and in use.

THISTLE FIRECLAY is a finely ground fireclay of similar characteristics to Thistle brick.

MAKSICCAR II DRY REFRACTORY CEMENT. Refractory test Seger Cone 31 = 1690° C. Moderate air-setting bond.

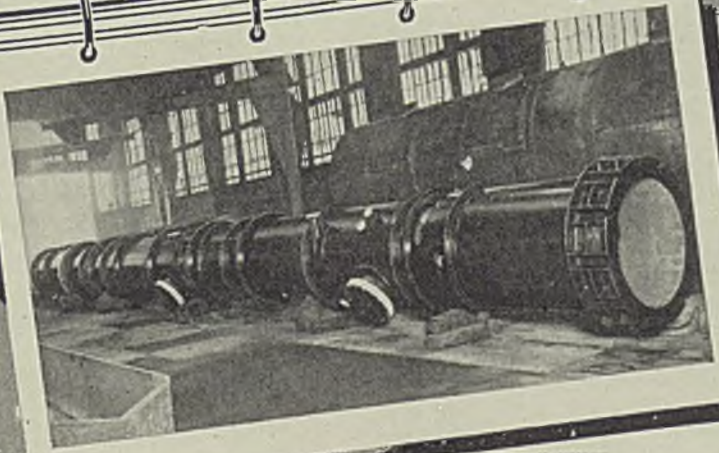
MAKSICCAR II PLASTIC REFRACTORY CEMENT. Refractory test Seger Cone 30 = 1670° C. Strong air-setting bond.

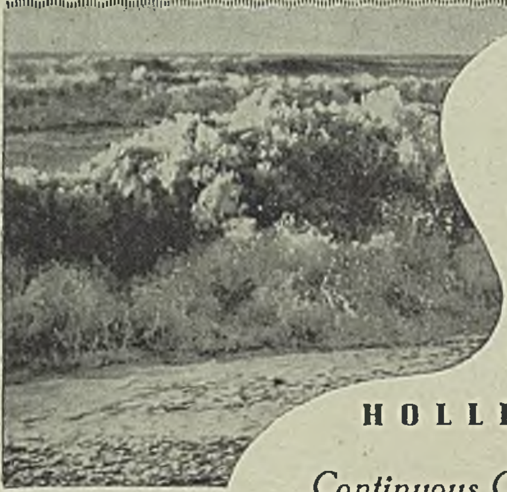
STEIN SILLIMANITE CEMENT has similar characteristics to Sillimanite brick. Also recommended as a wash-coating over brickwork to protect against corrosion.

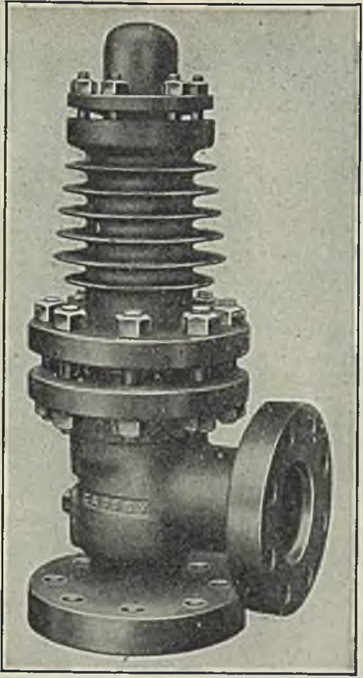
Approximately 6 cwts of Refractory Cement per 1,000 9 × 4½ × 3" is required for jointing.

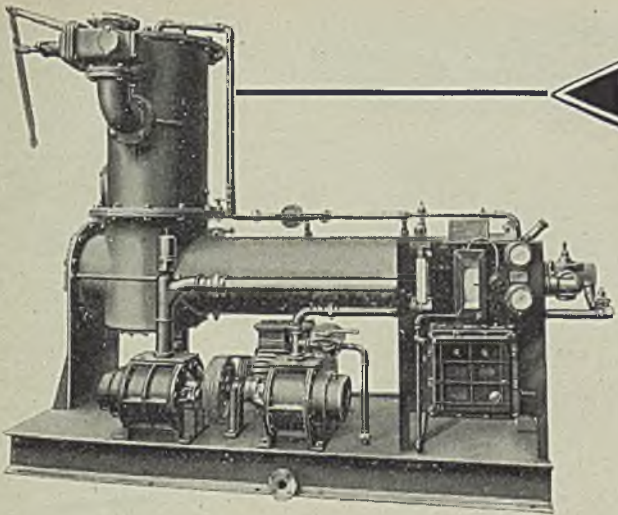
STEIN

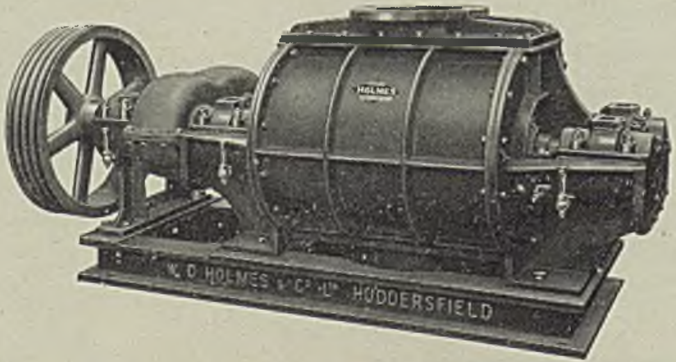
JOHN G. STEIN & CO., LTD.
BONNYBRIDGE SCOTLAND

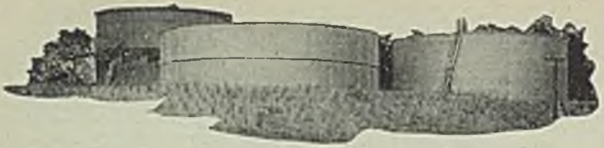


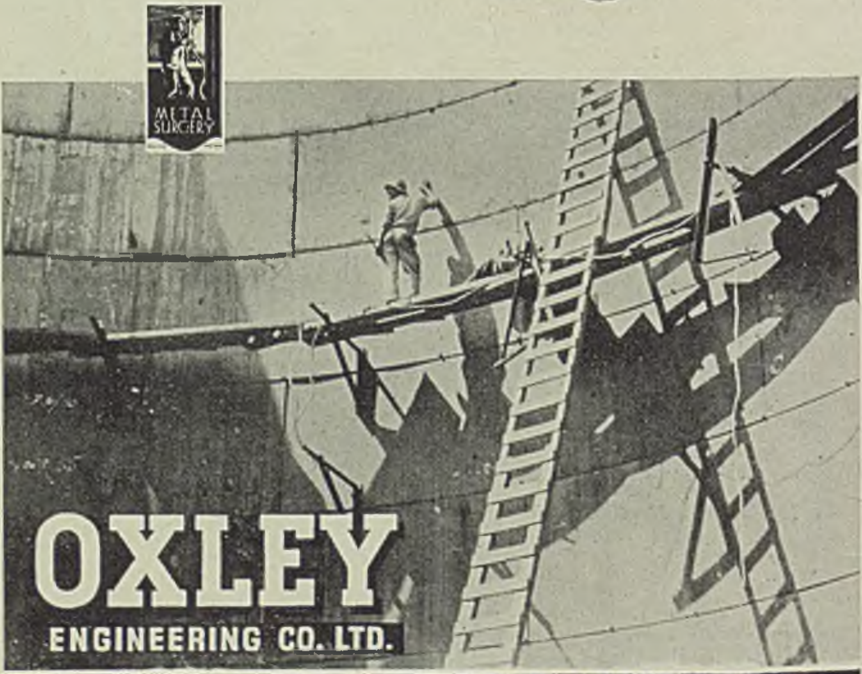







HOLMES
W. C. HOLMES & Co. Ltd. HUDDERSFIELD

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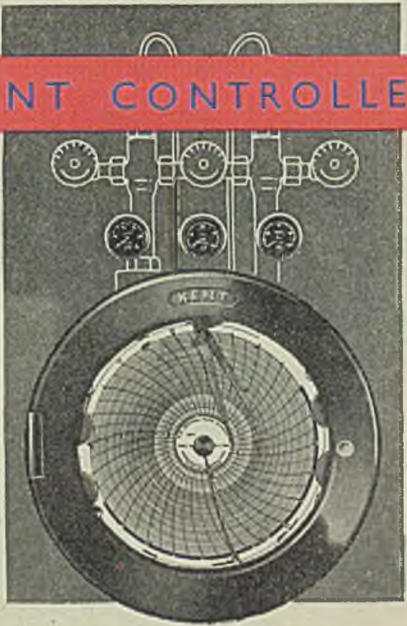
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