ABSTRACTS.

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The numbers refer to the Abstract Number.

OILFIELD EXPLORATION AND EXPLOITATION.

Geology.

833. Classification of Petroleum Reservoirs. O. Wilhelm. *Oil Gas J.*, 23.2.46, **44** (42), 171.—Typical oil-traps are due to a combination of two or more of a group of factors: (*a*) the attitude of the beds in the reservoir area; (*b*) convexity of the surface of the reservoir bed due (1) to folding, (2) to thickness variation, (3) to porosity variation; (*c*) lateral variation or interruption of porosity and permeability by lithological changes in a bed; (*d*) stratigraphic pinch-out of a bed; (*e*) structural interruption of a bed by faulting or piercement.

Reservoirs may be grouped as follows: (1) Convex traps; (2) Permeability trap; (3) Pinch-out traps; (4) Fault traps; (5) Piercement traps.

Examples are given of combinations of factors, and there is a tabular classification.
G. D. H.

834. Permeability Trap Reservoirs. O. Wilhelm. *Oil Gas J.*, 9.3.46, **44** (44), 91.—Changes of permeability may cause trapping of oil, and a typical permeability trap has the edgewater limit interrupted on the up-dip side of the reservoir and replaced by an impermeable barrier. Convex traps may be modified on one side by a permeability barrier.

Diagrams show various modifications of permeability traps. G. D. H.

835. Feather-edge-porosity Reservoirs. O. Wilhelm. *Oil Gas J.*, 16.3.46, **44** (45), 121.—Certain permeability traps are due to changes of lithology or texture, or to cementation or solution. These reservoirs are commonly described as due to feather-edge porosity. Delta and shoreline deposits provide feather-edge porosity conditions. Limestones afford examples of feather-edge porosity, and asphalt may give rise to some permeability traps. Accumulations may occur in zones of fracture in limestone, sandstone, chert, or siliceous shale. In these cases the wells are frequently along clearly defined zones of disturbance. G. H. D.

836. Lenticular Reservoirs. O. Wilhelm. *Oil Gas J.*, 23.3.46, **44** (45), 115.—Lenticular reservoirs are due to normally interbedded porous lenses, to erratic inclusions of porous rock, or to lenticularity in permeability conditions. Their production always follows the gas-drive depletion pattern, and they may occur on almost any type of structure or where no structure is present.

The shoestring fields of the Mid-Continent are of this type, which is also represented in the Appalachian region. The erratic igneous reservoir rocks of the Balcones fault zone also belong to this type. G. D. H.

837. Location, Depth, and Initial Production of Discovery Wells. Anon. *Oil Gas J.*, 26.1.46, **44** (36), 214.—Brief notes are given on the discovery wells in the new fields and pays in U.S.A., with the depth, producing formation, initial output, and other data. G. D. H.

838. January Completions Gain. Anon. *Oil Wkly*, 25.2.46, **120** (13), 30.—During January, 1946, U.S.A. wildcat completions averaged 80·4 per week. The December 1945 figure was 74·8. 15·9% of the January tests were successful. 26 oilfields, 13 gas-fields, and 2 distillate fields were found; there were 7 new oil-pays, 1 gas-pay, and 3 distillate pays, and 8 oilfields extensions and 4 gas-field extensions.

Tables summarize the discovery results by States and districts, and list the new discoveries together with brief details. G. D. H.

839. Townsite Drilling Campaign Latest Development in Complex Cement Pool. K. B. Barnes. *Oil Gas J.*, 9.3.46, **44** (44), 70.—The Cement pool is marked by a surface anticline. Development started 30 years ago. The productive area is 13,000 acres. New activity has begun between the east and west domes.

In June 1945 a 300-brl well was completed in the Middle Rowe sand, and an 80,000,000-cu. ft/day gas-well has been drilled in the Lower Rowe sand. 7 flowing wells and 3 pumping wells have been completed in the new developments. These wells average 4500 ft in depth. The predominantly oil-bearing horizon of the Noble-Olson sand occurs at about 3400 ft. Between 3700 and 4300 ft are the four sections of the Rowe sands; the Yule sand is at 5200 ft, the Wade sand at 5300 ft, the Upper Kistler at 5500 ft, and the Marchand sand may be at 6300 ft. The Medrano and Marchand sands are outstanding. The former is a flank deposit on the south flank of the west dome. It is 5600–6000 ft deep and 127 ft thick. Several large gas-wells have been completed in it. Oil has been found down-dip. The Marchand also is a flank sand, being on the south side of the east dome at 6500–7200 ft. It is 300 ft thick. There is no gas cap. 24 wells have been completed in the Marchand. G. D. H.

840. Phillips Cores Oil-Sand in First Venezuelan Well. Anon. *Oil Gas J.*, 23.3.46, **44** (46), 61.—In Phillips Venezuelan Oil Co.'s first Venezuelan test well, FT-1, oil-saturated sand has been cored at 4675–4702 ft in the La Pica formation. This formation generally has oil-sands up to several hundred feet in thickness in this locality. The well is on the Mata Grande block in Monagas. G. D. H.

841. Southern Chile Wildcat Shows 8000 Brl Daily. Anon. *Oil Gas J.*, 23.3.46, **44** (46), 64.—The Spring Hill wildcat on the Straits of Magellan has shown a potential of about 800 brl/day on test. The oil in this 7500-ft well is of 33° A.P.I. gravity. G. D. H.

842. 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 on short tests. G. D. H.

843. 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.

844. Atlantic Deepening Well on its Haiti Concession. Anon. *Oil Wkly*, 11.3.46, **121** (2), 78.—Jurinet 1 was originally abandoned in August 1944 at 7005 ft in the Lower Oligocene. Drilling has now been re-started, and is below 7300 ft. The well is 50 miles northeast of Port-au-Prince. G. D. H.

Geophysics and Geochemical Prospecting.

845. Submarine Prospecting. R. Sneddon. *Petrol. Engr*, May 1946, **17** (8), 222.—A new bathysphere has recently been tested. It is intended to permit an operator to take gravimeter readings from a permanently level surface rather than from the rising and falling surface of a boat deck. It is 3 ft in diameter and 5 ft high, and capable of standing immersion to 100 ft. Portholes are provided for examining the sea floor when it is illuminated by a spotlight. If necessary the chamber can be released from the heavy base, and it will then rise to the surface.

The internal fittings include oxygen supply, air purifier, and telephone.

It is not intended that the bathysphere shall be lifted on board at every move, but that it can be made fast and towed. G. D. H.

Drilling.

846. Engineering Refinements Feature New Heavy Rig. G. Weber. *Oil Gas J.*, 11.5.46, **45** (1), 95.—The rig is powered with 3 engines totalling 975 h.p. Designers of the rig have centralized all control levers and instruments in one panel located at the driller's position. Small hand levers actuate the air-valves that operate all clutches in the draw-works transmission, on the compound drive, hydromatic brake, rotary pumps, and sand reel. Hand throttles in the panel control the engines singly or in compound, and the control may be transferred to a foot pedal for use in hoisting. Instruments showing air pressure, engine vacuum, transmission-shaft speed, and oil pressure are also installed in this panel. An auxiliary instrument panel installed in front of the draw-works shows pump and bit pressures and rotary speed. Two additional foot pedals at the driller's panel actuate the air-operated friction clutches to the rotary and automatic rotary-side cathead. Complete pneumatic operation of the rig is made safe and dependable by adequate compressor capacity. Three compressors, driven individually by the three prime movers, afford an immediate pressure build-up on starting any engine. Since two compressors are capable of maintaining sufficient air pressure, the third is available as a virtual standby. The large-duel-type air reservoir is mounted on the compound drive, and is equipped with safety valves and water traps to remove all condensate from air lines. The pneumatic system operates best at 125 p.s.i. In case of emergency, clutches on compound transmission, and pump can be operated manually. Engine and low-speed drum clutches can be locked in position allowing the rig to be operated without air. The hoisting and other important units of the rig are described. A. H. N.

847. Large Rig Pneumatically Controlled. K. M. Fagin. *Petrol. Engr*, May 1946, **17** (8), 51–54.—Details of a new large power-type rotary drilling rig manufactured by Oil Well Supply Co. are given. The rig has been used on drilling down to 9200 ft and was designed for 16,000 ft depths. Pneumatic controls for the clutches are used. A. H. N.

848. Hydraulic Hoisting Used In Proposed Rotary Rig. N. Williams. *Oil Gas J.*, 18.5.46, **45** (2), 148.—A working model of rotary rig which is equipped with hydraulic jacks is described. A radical departure from conventional equipment, the hydraulic hoisting system as applied to the working model has as its essential elements three high-pressure cylinders with their reciprocating lifting plungers, a centrifugal pump to circulate the activating fluid, fluid transmission lines to and from the cylinders, a control-valve arrangement, a primary power source for the pump, and a fluid supply tank. The hoisting assembly is built into and forms an integral part of the derrick mast. In this, two of the hydraulic cylinders with their tubular supports comprise the two front legs of the mast. Use is made of the tubular supports for transmission of activating fluid to and from the cylinders. The third cylinder is suspended by a differential-joint connection, allowing free movement, from the centre of a horizontal crosshead connecting the tops of the lifting piston rods which extend upward from the hydraulic cylinders forming the mast leg members. Attached by a hinge-pin connection to the bottom end of the piston which extends downward from the centre cylinder is a hook of more or less conventional type, from which the swivel, kelly, and drilling-string load is suspended in conventional manner. The operation of the rig is described. A. H. N.

849. Portable Mast Takes to Water. P. C. Courtney. *Oil Gas J.*, 20.4.46, **44** (50), 141.—From the discussion in the paper it appears that economic advantages obtainable from use of portable masts and derricks on land may be expected also from their use on water locations. Incorporated into the design of the portable masts operating in coastal waters are two features which have contributed greatly to safety and efficiency. One involves the elimination of extensive interior bracing so that the driller can have a clear, unobstructed view to the derrick man. The other feature enables the driller to erect the derrick without having a slack line during the process. The interior bracing, essential to support the front legs in all open-face masts, has been eliminated by lacing all four sides. This, of course, necessitates racking the drill pipe inside instead of outside the base. Since the space occupied by racked pipe is as great at the top of the stands as it is on the derrick floor, it was necessary to design the mast so that the inside area at the working-board level would not only provide for free movement of the travelling block, but would also accommodate the working boards and the full pipe setback. This results in a bulge in the mast.

In conventional masts a safety hazard is encountered during erection due to the hoisting line becoming slack when the centre of gravity of the structure passes over the supporting pin. This condition is avoided in the bulge-type mast by a base design which causes the centre of rotation to shift automatically from the front to the rear legs just before that critical point is reached. This eliminates the possibility of the mast falling back into the ginpole during erection and obviates the necessity of pulling it over centre when lowering. A. H. N.

850. Penetration Rates in Hard Formation Drilling. J. E. Warren and R. B. Schabarum. *Oil Gas J.*, 8.6.46, **45** (5), 82. *Paper Presented before A.P.I.*—To find out whether the bit in a rotary drilling rig grinds the cuttings to fine dimensions, a basket was placed above the bit. Cuttings collected from the basket are very large compared with those appearing at the surface. It is concluded that the large cuttings are ground up in the annulus by the drill-pipe collars and tool joints against the wells of the well.

The economics of drilling as affected by hole size are discussed. A. H. N.

851. Drilling Tower for Continental Shelf Use. G. B. Nicholson. *Oil Wkly*, 20.5.46, **121** (13), 34.—An octagonal tower built in sections of tubular components is proposed for continental shelf drilling. A model of the tower is described in the paper as the full scale prototype has not been built as yet. The tower has a buoyancy tank at its bottom and another in its fourth section (the tower may be made of any number up to six sections). It can be floated and towed to the location when by flooding the chambers it is made to sink and settle on the bottom of the sea for drilling. A. H. N.

852. Problems Encountered in Drilling Abnormal Pressure Formations. E. Cannon and R. S. Sullins. *Oil Gas J.*, 25.5.46, **45** (3), 120. *Paper Presented before A.P.I.*—The most important problem in connection with the drilling of abnormally high formation pressures is the prevention of lost returns. Methods that can be successfully employed in one area may not be applicable in another; however, several possible solutions to the problem are presented which are: (1) Careful control of the circulating rate. This also involves careful control of mud weight; (2) The use of very deep protective strings of casing; (3) Cementing zones of local weakness; (4) Use of sealing agents. Controlling the physical and chemical properties of a relatively high weight mud is complicated and more expensive than when dealing with normal mud weights. Methods are available for obtaining almost any desirable mud property. Careful planning of the mud programme and the use of every available means for conserving materials will result in a considerable reduction in mud costs, as well as more efficient operations. A. H. N.

853. Improved Techniques and Methods in Controlled Directional Drilling. G. Jackson. *Petrol. Engr*, May 1946, **17** (8), 84.—The two main reasons for drilling directionally are: (1) to reach oil in places difficult to reach vertically; and (2) to put out fires in oil wells by means of relief wells. Directional drilling was used extensively in Huntington Beach. Production figures of directional wells in this field during the years 1941–44, inclusive, are as follows:

1941	4,329,359 brl
1942	4,500,870 ,,
1945	5,389,934 ,,
1944	9,026,794 ,,
Total	23,246,948 ,,

Among the applications of controlled directional drilling are: (1) deflecting from accessible locations to inaccessible locations; (2) deflecting around and under salt-dome overhangs that are difficult to drill through; (3) deflecting out of salt-dome cores to adjacent oil-sands; (4) deflecting relief wells into wild, burning, or cratered wells to bring them under control; (5) deflecting a hole from an unproductive to a productive portion of a lease; (6) deflecting an old depleted well to a new location in producing territory; (7) deflecting across faults or out of fault zones into a productive area; (8) deflecting a hold back into the lease after it has deviated over a lease line; (9) deflecting a plurality of wells from one location, or from a physically restricted area such as an island; (10) deflecting a series of holes for sub-surface geological exploration; (11) deflecting a hole so a sand can be cored after it was first drilled through without coring; (12) sidetracking fish or obstructions in the well; (13) deflecting a well back into a hole that has caved and was lost; and (14) deflecting off at an angle in oil formations to give greater penetration. The methods adopted are very briefly described. A. H. N.

854. The Chemical Treatment of Drilling Fluids. P. E. Chaney and W. F. Oxford, Jr. *Petrol. Engr*, June 1946, **17** (9), 158.—The chemistry of the colloidal systems of clay in water dispersions is discussed in some detail followed by a study of the effects of cement contamination of mud and the steps to be taken in curing the troubles. A long appendix gives in outline form mud troubles and their treatment.

A. H. N.

855. Water-Base Mud Developments. W. R. Kelley, T. F. Ham, and A. B. Dooley. *Oil Gas J.*, 11.5.46, **45** (1), 117. *Paper Presented before A.P.I.*—An abridged form is presented of a comprehensive review of water-base muds. The conclusions drawn are: (1) Laboratory data and scattered field evidence indicate that mud filtrates, mud cakes, and mud particles decrease optimum well productivity in varying degrees; (2) (*a*) By prudent application of the knowledge gained from accumulated data, operators are trying to reduce the detrimental effects of muds on the oil-zones. Where high formation pressures, high permeabilities, and low fluid viscosities are anticipated, efforts to achieve optimum productivity indices become less important; (*b*) The various muds described have important applications in the mechanics of drilling, casing, and completing wells. Long intervals of open hole, troublesome formations, low clearances for tools or casing, and long periods of suspended circulation require expert mud supervision; (3) Further laboratory and field experiments are justified on the basis of present information; (4) It is difficult in most cases to make good qualitative completion comparisons, and still more difficult to make quantitative studies because of varying individual well conditions, which may mask results of a specific procedure used; (5) There are many factors which need to be known in order to determine the effect of drilling fluids on productive intervals. Some are listed as follows: (*a*) Representative sand permeability data; (*b*) formation pressures; (*c*) viscosity of the oil in place; (*d*) gas–oil ratios; (*e*) water cut; (*f*) productivity index data over a period of time after well completion; (*g*) relative influence of mud filtrates, formation water, saline water, or fresh water on representative formation samples. Laboratory experiments on the effects of the various waters should duplicate field conditions as nearly as possible; (*h*) type and description of completion methods used; (*i*) degree of sand consolidation; (*j*) complete characteristics of the drilling fluid used; (*k*) length of time the productive interval is exposed to drilling fluid, and (*l*) completion date in relation to field history.

There is evidence to support the basic concepts presented in this paper. However, in many cases only inferences are possible. By drilling a carefully selected well with the best drilling fluid available and then killing the well with less desirable fluids, we should obtain results which would add materially to the knowledge of the reactions of a productive sand to the various types of muds and treatment. Pertinent data such as productivity indices could then be obtained at specific times after different fluids are employed in the well, leading to more quantitative conclusions on mud behaviour in well completions. A. H. N.

856. Use of Oil-Base Mud at Elk Hills Naval Reserve No. 1. R. W. Stuart. *Oil Gas J.*, 25.5.46, **45** (3), 128. *Paper Presented before A.P.I.*—It is believed that the use of oil-base mud in these wells proved that this mud has a definite place in drilling, coring, and completing certain wells. During the drilling operations it is found that, with careful supervision, oil-base mud is no more trouble and does not present any greater problem than the use of natural mud in the same area. Oil-base mud in conjunction with certain plastic tracers soluble in oil but not in water, such as have been developed in Shell Oil Co. Inc., will probably give the most accurate core analysis date obtainable at the present time. In low-pressure, or low-permeability sands, and sands containing bentonitic material, the use of oil-base mud in completions will be a definite benefit. Although it was necessary to drill and complete the wells at Elk Hills during the war-time emergency in a minimum of time, and with a minimum of testing, it is believed that the core-analysis data obtained from these wells using oil-base mud made possible a more thorough and accurate knowledge if reserves and reservoir characteristics necessary for the best future reservoir control. Stanolind Oil & Gas Co's producing department has made a thorough study of oil-base mud drilling. A well in the North Katy field, Texas, has just been completed, coring through two oil-sands with oil-base mud. Electric logs were made by the two well-known services. Gamma ray and neutron logs were also run, both before and after cementing. Caliper logs and temperature surveys were made. The hole-caliper survey showed not more than 1-in. over gauge at any point and the various other logs correlated closely with the core data, to show formational breaks with a doubtful fluid definition. Some flushing was found in the cores, but the water saturation values determined by core analysis correlated surprisingly well with capillary pressure-saturation tests, indicating accurate connate water figures in the oil zone. A. H. N.

857. Oil-Base Mud, Available in Forms which can be Built Up into a Wide Range of Specifications. E. H. Short, Jr. *Oil Gas J.*, 1.6.46, **45** (4), 64–65.—The use of oil-base muds in the Gulf Coast area is briefly discussed. They are particularly useful in low-pressure completions where water-base muds would penetrate the pay formations. Sections of heaving shale have been drilled in a number of Gulf Coast wells with oil-base mud, and caliper surveys have shown that bit-sized holes were maintained throughout the sections. It is unnecessary to discard oil-base mud after being used in one well. It can be placed in a storage tank and used in drilling other wells. In some cases it may be necessary to change the character of the used mud to meet viscosity and weight requirements. Operators who have used oil-base mud state that it has remarkable qualities for jell forming which permits retention of cuttings.

Only a few extra equipment—*e.g.*, covered storage—are necessary. A. H. N.

858. Varying Mud Power Pump Speeds. G. C. MacDonald. *Oil Wkly*, 20.5.46, **121** (12), 44.—Normally the pump is connected to the internal-combustion engine through a single-speed transmission gear, and the only way of changing speed is to change that of the engine. Advantages of changing the speed of the pump without that of the engine are discussed, and cost reduction and other advantages accruing during drilling and coring operations when flexibility of mud velocity is allowed are illustrated. A. H. N.

859. Casing Landing Practice. J. B. Dettotre. *Petrol. World*, June 1946, **43** (6), 39–43. *Paper Presented before A.P.I.*—The advancement of casing programme design technique is pointed out in contrast to a lack of corresponding improvement in landing practice. It is suggested that individual attention be given to each well in a new field until enough information is available to warrant the adoption of standard procedure. Long oil strings and long intermediate protective strings are presented as being the most hazardous, and particular attention is directed to the necessity of keeping their landing weight to a minimum consistent with the other factors involved. Several common landing methods are discussed, showing their weaknesses under certain conditions. A chart is presented to show a method of determining the depth to the freeze point. Another chart shows a method of evaluating the effect on the load at the landing head of pressure and temperature changes. An example procedure is worked out to show the need of engineering consideration of the landing problem. The conclusion that the landing weight of long strings

should be held to a minimum is emphasized by reference to A.P.I. data on bi-axial loading which shows a substantial reduction of the resistance of casing to burst and collapse when tensile loads are more than half the yield strength of the pipe.
A. H. N.

860. Deeper Completions Emphasize Need for Improved Casing-Landing Practices. J. P. Dettetre. *Oil Gas J.*, 18.5.46, **45** (2), 139. *Paper Presented before A.P.I.*—The stresses imposed upon casings on landing are calculated and shown to be large in magnitude. An example is worked out to illustrate the methods of landing. It is noted that several operators have stated that they intend to install strain-gauges equipped with recording apparatus on the landing joint of casing so that data can be developed as to the actual variation of the load at the landing head. It is believed that an experiment of this type will bring to light reasons for some of the troubles that have occurred in casing after it has been landed. Reference to the data on biaxial loading in the A.P.I. paper on " Setting Depths for Casing " will show that large tensile loads have a substantial reducing effect on the resistance of casing to burst and collapse, especially when the tensile loads exceed 50% of the yield strength. Taking this into consideration, the reasons set forth in this paper for keeping the landing weight to a minimum without placing any pipe in compression take on added significance. A. H. N.

861. New Multi-Stage Cementing Technique. R. Sneddon. *Petrol. Engr*, June 1946, **17** (9), 152.—A multi-stage cementing operation is described in detail. Quantities, depths, pressures, and other data for the operation are given. A. H. N.

862. Deep Test at Signal Hill. N. A. D'Arcy, Jr. *Petrol. Engr*, May 1946, **17** (8), 74.—The equipment technique and results attained in the Shell well Alamitos 48 A, in its 14,950 ft depth, are given. Analysis is made of the drilling bits and of other data obtained in drilling. A. H. N.

Production.

863. The Relation between Well Spacing and Recovery. W. V. Vietti, J. J. Mullane, O. F. Thornton, and A. F. Van Everdingen. *Oil Gas J.*, 1.6.46, **45** (4), 77. *Paper Presented before A.P.I.*—The authors conclude that no correlation exists between well spacing and recovery for the Mexia-Powell fault-line fields, and that recoveries obtained by open-flow production from areas within a reservoir cannot be used to derive or substantiate a mathematical relationship between spacing and recovery for the reservoir. There exists a difference of opinion as to the effect of spacing on recovery. Some authors contend that there is a mathematical relationship between the two. Such a relationship was recently proposed, based on recovery from the Mexia-Powell fault-line fields. A critical review of the information on these fields by the authors shows that the data cannot be used to derive such a formula. The differences in unit recoveries are small, and are attributable to factors other than spacing. Recoveries from areas of different spacing within a field heretofore have been used to derive or substantiate formulæ relating spacing and total recovery. This procedure is incorrect, as the difference in recovery exist because per well-producing rates are not related to the volume of pay or to the recoverable oil attributable to the well. The amount of the resulting drainage cannot be calculated easily, but in some cases may be approximated by assuming equal recovery/well. The choice of well locations (spacing) should be based on the principles which govern reservoir performance, and not on empirical formulæ proposed in the early days of the petroleum industry. A. H. N.

864. Viscosity of Air, Water, Natural Gas, Crude Oil, and its Associated Gases at Oilfield Temperatures and Pressures. C. Beal. *Petrol. Tech.* (A.I.M.M.E.), March 1946, **9** (2); Tech. Pub. No. 2018, 1–22.—The viscosity of oilfield fluids is of importance, since it controls the flow of the fluids in porous media and in pipes. Air is used in secondary recovery projects, and so must be included. The viscosity of gas-saturated crude at reservoir pressures and temperatures is of value in making estimates of oil reserves and rate of oil recovery from flush-pools when production decline data are limited.

Charts are presented for converting various viscometer units into centipoises, and there are graphical summaries of published data on the viscosity of air, water, and natural gas at high temperatures and pressures. As far as possible, the charts have been constructed to cover the ranges 60° to 300° F, and 14·7 lb/sq. in to 8000 lb/sq. in.

Bicher and Katz' correlation is presented for predicting the viscosity of natural gas with an average deviation of 5·8%.

Correlation charts have been constructed for predicting the viscosity of crudes under various conditions by employing 1215 viscosity observations from 836 crude samples taken in 630 fields, 459 of which were in U.S.A. and 75 in California. 786 values for gas-free crude were used; 351 were for gas-saturated crude and 78 for under-saturated crude. Results show that crude oil viscosity under various reservoir conditions can be predicted with average deviations ranging from 24·2% for gas-free crude to 2·7% for under-saturated crude above the bubble point. The viscosity of gas-saturated crude could be predicted with an average deviation of 13·4%, using only the viscosity of gas-free crude and the amount of gas in solution. The gas solubility in crude oil at various pressures, temperatures, and oil gravities can be estimated from a correlation of 351 viscosity observations, with an average deviation of 22%. The crude-oil viscosity at reservoir pressure and temperature may be predicted with a 19·8% deviation from a knowledge of the oil gravity, original gas/oil ratio, and reservoir pressure and temperature. This is within the accuracy of most reservoir computations. G. D. H.

865. Vapour-Phase Equilibrium Cell Aids Condensate-Field Studies. C. J. Deegan. *Oil Gas J.*, 18.5.46, **45** (2), 128.—Graphs are presented showing phase equilibrium data for condensate-field products, and a brief explanation of their use to predict the extent of production of the different components under varying reservoir conditions are presented. A. H. N.

866. Well-Interference Effects. Part 2. K. B. Barnes. *Oil Gas J.*, 20.4.46, **44** (50), 136.—For the purpose of assigning acreage and allowables for wells in Kansas interference tests were made. Also presented at the hearings were interference data of the "reverse-pattern type" taken by a major company in another producing area. Summaries of these tests, which altogether involve 83 wells in six producing areas, are given in diagram form in this article. The general procedure used was to shut in the pool, usually for 7 days, and during the shut-in period observe the rise in fluid levels of all wells in the selected area. Depths to the fluid level of each of the wells were obtained by sonic measurements at 72, 96, 120, and 168 hours after the field was shut in. The number of tubing collar reflections to the fluid-level point, in a measurement, were converted into the number of feet from the casing head to the fluid level. Correction for ground elevation was then made, to express the fluid levels as feet above a uniform subsea elevation across the producing area. At Boyd this subsea elevation was — 1475 ft, at Richardson — 1725, at South Silica — 1500. A centrally located well in the selected area then was pumped at a constant rate, usually for 5 days. While the pumping of the central well continued, fluid-level measurements of the wells were made at 24, 48, 72, 96, and 120 hours after pumping started. Fluid level in the producing well also was obtained at the same time. Each pool tested is briefly discussed. A. H. N.

867. Well Interference and Reservoir Drainage. Part 4. K. B. Barnes. *Oil Gas J.*, 18.5.46, **45** (2), 120 (this part concludes the series).—Previously established pressures are altered when fluid flow occurs within a productive area. This simple natural law is the basis of well-interference tests. A well is produced. If the pressure drops in adjacent wells, it is proof that there is continuous permeability and formational interconnection between the wells. More important, though, is the corollary that the pressure declines or interference data so established are prima facie evidence that oil present in the formation is flowing from the location of the one well to the other well. When flow occurs, drainage occurs. Such tests thus can help to prove or disprove whether drainage of the particular area can be accomplished—and by what wells and over what distances. Several well-interference tests in difficult fields are described. In some of the illustrations given, the data prove that continuous permeability and formation interconnection exists for distances of 1, 2, 3, and even more miles. On the other hand, simply because these things have been found in certain pools is, of course, not evidence that faults, impermeable barriers, and formational discontinuities do not exist in some other pools, between comparatively short distances. For this very reason, interference tests are helpful tools to use in studying spacing and drainage problems. In these problems, if interference data show fluid flow to be possible over a certain distance, it would seem that reasons for advocating well spacings on lesser footages should be based on considerations other than those of fluid-flow relationships in the physical sense—and vice versa.

A. H. N.

868. Unitized Portable Compressor Plant as Used for Pressure Maintenance. F. L. Kallam. *Petrol. Engr*, May 1946, **17** (8), 70.—It is claimed that the present average cost of discovering, developing, and producing new reserves in the U.S.A. is greater than the selling price of the resulting new crude oil. Obviously, a barrel of extra oil, even at a relatively high production cost, is more profitable than that which may be discovered after a string of dry holes. Thus secondary recovery efforts to obtain additional oil from established reserves is of utmost importance. Probably the most important of all such methods are the gas-injection processes to formations where the primary recovery forces are fast being depleted. Other reasons are given for pressure maintenance. Unitized compressors are described in general terms and illustrations are presented. A. H. N.

869. Selective Acidizing Increases Well Capacity. P. L. Shelton and J. M. Clark. *Petrol. Engr*, May 1946, **17** (8), 235.—Recent potential tests conducted on several wells located in the Carthage gas-field of Panola County, Texas, have shown that selective acidizing of certain wells increases the total productivity as much as 50 to 75%. In the wells there are two distinct sections in addition to the regular pay section, and this fact presented difficulties in completion. Past experience had shown that treating individual sections by killing the well and mudding off each acidized section does not increase the total volume when the well is finally brought in for production. Once a section has been acidized and then mudded off, the effects of the treatment are reduced to such an extent that no material benefits are realized. Therefore a new technique was adopted. The well was completed so that each section with a definite break could be acidized and tested separately without killing the well. Two packers and two side-door chokes were used for this purpose. Thus each zone would be acidized separately and independently of the others by manipulating the chokes. Details are given of the method. A. H. N.

870. Effect of Well Spacing on Water Flood Operations and Economics. K. M. Fagin. *Petrol. Engr*, June 1946, **17** (9), 64.—The project of water flooding the Woodson field, Texas, is described in some detail. The geology and history of the sand are described, followed by a core analysis of the formation and of the probable reserves of the pool. Two schemes of well spacing have been adopted : The Tannehill sand was originally developed with oil-wells drilled 300 ft apart (one well to about two acres). The Davis flood was developed with new input water-wells drilled on 300-ft centres between the original wells. In this 2-acre flood pattern the input wells are abour 212 ft from the oil-wells. The Odell and Hughes flood, however, was developed, in general, by converting every other well to a water-input well, and resulted in having one water-input well to every 8 acres with the oil-producing wells situated either 300 or 424 ft from the input wells. The details of preparing the input wells are given. The David flood was begun in February 1941, with an average injection rate of about 40 brl/well/day. This rate was stepped up to 65 brl/well/day during the next 4 months, and reached a peak of about 100 brl/well 14 months after the beginning. The input rate was reduced gradually from this peak to the current rate of 45 brl/well/day. The Odell and Hughes flood has followed the same average input rate/well, but this flood is still at the peak rate of 90 to 100 brl/well/day, and the oil production is still at the peak. A. H. N.

871. Producing Oil with Quantities of Water. S. F. Shaw. *Petrol. Engr*, June 1946, **17** (9), 100.—The production of oil with a large proportion of water by means of gas-lift is discussed in some detail. In order that an operator may arrive at some conclusion as to whether it would be profitable to instal a compressor plant for producing oil from wells making large quantities of water, it is desirable to ascertain conditions and trends that would lead towards a definite conclusion considerably in advance of the time when action must be taken. Data that should be observed while the well is flowing naturally are as follows: (1) Consideration of the size of casing, and its influence on the possible daily rate of liquid extraction; (2) Percentage of water accompanying the oil at different periods, and construction of graphs indicating the increase in percentage of water content in a given period of time; (3) Anticipate so far as possible the quantity of gas required to lift a barrel of liquid under given conditions of submergence, percentage of water, and quantity of liquid that will be lifted, when it becomes desirable to employ gas-lift; (4) Determine the manner in which disposal of salt water can be handled. The retention from abandonment of a well or wells down the flank of the structure should be considered; (5) Determine the cost of treating the fluid. It is usual, however, when producing large quantities of liquid with high percentage of water, that the temperature of the water is so high that treatment costs are quite low.

If the life of the plant, when employing gas-lift, promises to be more than 2 or 3 years, the possibility of building a plant to handle all the gas required should be given serious consideration; if the life is to be less than 2 years, it would probably be advisable to instal a plant of size sufficient only to maintain the input ratio at some figure below 10,000 cu ft/brl of oil. A. H. N.

872. Paraffin Control of Pumping Wells by Hydraulic Power. G. M. Wilson. *Oil Wkly*, 20.5.46, **121** (12), 36.—The process consists of pumping an oil-soluble plug through the tubing or production lead line. The plug, made of materials which cause it to dissolve after being submerged in oil for several hours, will retain its shape long enough to permit it to be pumped through the pipe, pushing accumulated paraffin ahead of it. It is designed to conform itself to abrupt changes in pipe direction. The equipment required is simple and inexpensive, operates easily, and has now been applied to a sufficiently large group of wells in diversified fields to determine its feasibility. In another application of fluid power, and utilizing the same power on the lease as used for plug type of cleaning, paraffin is quickly and easily scraped off the inside of the production tubing by hydraulically raising the inner string. Spring type scrapers, positioned at one-joint intervals on the inner string throughout the length of the paraffin zone interval, are pulled through the paraffin deposits, effectively scraping loose the material. Principal advantages of this new procedure are that paraffin control can be handled by the lease pumper merely by turning several valves, requiring no extra labour, or pulling equipment. A. H. N.

873. Pumping Directionally Drilled Wells. Anon. *Petrol. Engr*, June 1946, **17** (9), 230.—In a very short report it is stated that exceptionally good performance of sucker rods has been obtained on whipstocked wells. When directional drilling first made its appearance, 90 days was considered a reasonable length of time for sucker rods, and not more than 6 months for the life of tubing. Although the life of sucker rods and tubing is not definitely established under present operating conditions, it is a known fact that many wells will pump for months without the rods parting.

A. H. N.

874. Internal Tubing Caliper Measures Extent amd Location of Corrosion. P. E. Chaney. *Oil Gas J.*, 20.4.46, **44** (50), 115.—The Chaney-Barnes tubing caliper may be calibrated to measure the depth of corrosion pits, as well as the internal diameter of the tubing joint with an accuracy of ± 0·01 in. Three wells surveyed with the caliper have been worked over because of corrosion damage indicated by the caliper survey. A visual inspection of the tubing from these wells was in close agreement with the caliper survey record in each case. Calipering is accomplished by means of six or more independently operating lever arms, to the outer end of which are attached small wheels or rollers to contact the tubing wall. Each lever arm is provided with a spring to urge the feeler wheel outwardly against the tubing wall. The inner arms of the six levers contact a polished steel plate on the end of the stylus rod, and it may be seen that the stylus is driven downward whenever any one of the feeler wheels moves outwardly into a pit. In event there are several pits of varying depth about a single cross-section of the tubing wall, the stylus will be actuated by the one feeler arm corresponding to the deepest penetration of the tubing wall and will be lifted free of the other five arms. The caliper might be considered pessimistic in this respect, as it shows the minimum wall thickness at any point traversed rather than the average wall thickness at that point. However, this is an advantage rather than a disadvantage, because the safety of the tubing with respect to pressure is determined by the minimum wall thickness, and not by the average wall thickness of the pipe. The instrument is accurately centred automatically. A. H. N.

875. Sodium Chromate Effective in Combating Corrosion in Gas Wells. C. K. Eilerts. *Oil Gas J.*, 18.5.46, **45** (2), 124. *Paper Presented before N.G.A.A.*—Sticks of sodium chromate dropped into a gas well subject to corrosion maintained inhibiting concentrations for more than 2 hours. The sticks can be injected into tubing against the fluid flow when the mean fluid velocity is not greater than 11 ft per second. Many improvements in the method are necessary before the treatment becomes practical.
A. H. N.

876. Plastics in Well-Remedial Work—How an Actual Job is Designed. A. C. Polk, Jr., and D. F. Saurenman. *Oil Gas J.*, 18.5.46, **45** (2), 154.—Properties of the plastic used are given and a hypothetical—but typical—example is discussed to illustrate how a seal may be effected to isolate a producing horizon from the rest of the strata. A. H. N.

877. Plastics Demonstrate Value in Plugging Back East Texas Wells. G. Weber. *Oil Gas J.*, 8.6.46, **45** (5), 80.—Analyses are made of the types of East Texas wells which have been re-worked with the new plastics methods to shut off water. They show the results for the period 1943–46, and tell how the treatments are made. Methods of squeeze-setting blank and slotted liners with plastics are diagrammed.
A. H. N.

878. Oil-Pool Analyzer. W. A. Bruce. *Oil Gas J.*, 11.5.46, **45** (1), 90–92.—An electric system which simulates the behaviour of oil wells in a reservoir is described. The basic theory of this analyzer rests upon: first, the analogy between the conductivity of an electrical conductor and the conductivity of a porous medium; and second, the analogy between the ability of a porous medium to produce stored fluid by virtue of the compressibility of the fluid and the ability of a condenser to release stored electrical charge. Although it is well known that petroleum reservoirs and the associated aquifers are characterized by lithological complexities, it has been found that local variations in the permeability and porosity of porous media average out in cases involving the movement of a large volume of fluid through a large cross section of porous stratum. It has been found that, with suitable adjustments of the analyzer, widespread variations can be taken care of in the analysis with accuracy comparable to the accuracy of the knowledge concerning these discontinuities. By setting the instrument to duplicate electrically the fluid behaviour in the past of the oil reservoir, future behaviour under different conditions can be predicted accurately.
A. H. N.

879. Trends in Processing Gas-Condensate Reservoirs. F. H. Dotterweich and E. O. Bennett. *Oil Gas J.*, 11.5.46, **45** (1), 111. *Paper Presented before N.G.A.A.*—A tentative method to evaluate better retrograde losses occurring in condensate reservoirs are suggested showing trends which may make available, to post-war industry, a greater quantity of the lighter hydrocarbon fractions, by effecting greater economies in the extraction of these fractions from nature's reservoirs. It is shown that it is sometimes better not to recycle gas until a later date in the development of the reservoir and then to cycle back water gas. A remote possibility is suggested of using the reservoir as a reaction vessel to react the gases and produce other and more profitable materials in place. A. H. N.

880. Method of Locating a Leak in Casing. H. E. Gross. *Petrol. Engr*, May 1946, **17** (8), 93.—The principle involved in this method of locating a leak in a casing is simply to determine the amount of water that is displaced in the annulus above the leak between the inner casing and the outer casing, or surface string. The method can be applied to wells that begin to leak between casing strings, but the position of leaks that occur elsewhere cannot be determined by this method. Coloured water is used to displace the clear water in the annulus. A. H. N.

881. **Proposed Design for Field-Testing Unit.** M. S. Watson, Jr. *Petrol. Engr*, June 1946, **17** (9), 84.—The factors involved in designing a vehicle carrying several instruments necessary for testing wells for productivity indices, pressures, bottom-hole samples, temperatures, tec., are discussed. A. H. N.

882. **Oficina Field is Scene of Venezuela's First Water-Flooding Experiment.** P. Reed. *Oil Gas J.*, 18.5.46, **45** (2), 137.—A brief description of water-injection plant is given. A. H. N.

883. **Drilling and Production Patents.** Erd. V. Crowell. U.S.P. 2,397,472, 2.4.46. Appl. 17.12.37. Oil well device.

Erd. V. Crowell. U.S.P. 2,397,473, 2.4.46. Appl. 15.11.38. Means for testing formations in wells.

William Edward O'Shei. U.S.P. 2,397,621, 2.4.46. Appl. 8.4.43. Fluid pressure motor.

Weyman B. Dunlap, Jr. U.S.P. 2,397,652, 2.4.46. Appl. 3.2.44. Underreamer.

Roy L. Luce, assr to Hydro Blast Corpn. U.S.P. 2,397,675, 2.4.46. Appl. 19.8.46. Sand slurry valve.

Ira T. Minyard. U.S.P. 2,397,679, 2.4.46. Appl. 12.3.45. Paraffin scraper.

Ruben Hadekel, assr to Aeronautical & Mechanical Investments, Ltd. U.S.P. 2,397,763, 2.4.46. Appl. 30.11.43. Hydraulic control system.

Fred. E. Cooper. U.S.P. 2,397,778, 2.4.46. Appl. 14.4.44. Fluid-pressure motor.

Walter R. Freeman, assr to Wagner Electric Corpn. U.S.P. 2,398,090, 9.4.46. Appl. 21.5.43. Oil separator.

Wesley H. Sowers, assr to The Pure Oil Co. U.S.P. 2,398,123, 9.4.46. Appl. 8.1.42. Control of pH of water from earth bores.

De Witt C. Stowe. U.S.P. 2,398,124, 9.4.46. Appl. 23.10.44. Hydraulic transmission.

George Henry Walker, assr to Heenan & Froude, Ltd. U.S.P. 2,398,167, 9.4.46. Appl. 25.10.44. Transmission dynamometer.

Rudolph C. Buchan, assr to Standard Oil Development Co. U.S.P. 2,398,204. 9.4.46. Appl. 21.9.40. Method and apparatus for handling oilfield emulsions.

Samuel R. Kassouf. U.S.P. 2,398,229, 9.4.46. Appl. 16.8.43. Fluid pressure-operated servo-motor.

Dixon T. Harbison. U.S.P. 2,398,305, 9.4.46. Appl. 20.9.45. Valve puller.

Aage Jensen. U.S.P. 2,398,313, 9.4.46. Appl. 15.5.42. Hydraulic transmission.

Bruno Pontecorvo, assr to Well Surveys. U.S.P. 2,398,323, 9.4.46. Appl. 10.8.43. Well surveying.

Jay P. Walker, assr of 40% to Guy O. Marchant and 6% to C. G. Wells. U.S.P. 2,398,338, 9.4.46. Appl. 1.8.40. Combination heater and water knockout apparatus for treating oil well streams.

Francis M. Anderson, assr to Halliburton Oil Well Cementing Co. U.S.P. 2,398,347, 16.4.46. Appl. 17.6.44. Material for sealing off porous formations in wells.

Herbert E. Page. U.S.P. 2,398,392, 16.4.46. Appl. 22.1.45. Hydraulic torque wrench.

Millard E. Alexander. U.S.P. 2,398,399, 16.4.46. Appl. 3.2.43. Pipe joint.

Nicholas Bell. U.S.P. 2,398,491, 16.4.46. Appl. 18.12.42. Boring head.

Jens. A. Paasche. U.S.P. 2,398,503, 16.4.46. Appl. 20.2.43. Fluid pressure regulator.

Thomas H. Berry, assr to Green & Berry Farm Equipment Co. U.S.P. 2,398,512, 16.4.46. Appl. 27.9.43. Well drilling machine.

Cicero C. Brown and Floyd L. Scott, Jr., assr to Brown Oil Tools. U.S.P. 2,398,515, 16.4.46. Appl. 15.10.43. Washover overshot.

William E. Halbert. U.S.P. 2,398,527, 16.4.46. Appl. 6.4.44. Means for flowing wells.

William L. Russel. U.S.P. 2,398,562, 16.4.46. Appl. 28.12.44. Apparatus for well logging.

Francis W. Crawford, assr to Phillips Petroleum Co. U.S.P. 2,398,580, 16.4.46. Appl. 17.6.40. Method of prospecting for hydrocarbons.

George L. Matson, assr to The Dow Chemical Co. U.S.P. 2,398,752, 16.4.46. Appl. 7.4.45. Dumping bailer.

Charles B. Aiken, assr to Schlumberger Well Surveying Corpn. U.S.P. 2,398,761, 23.4.46. Appl. 30.11.40. Method and apparatus for simultaneous determination of various properties of the subsoil.

John W. Millington, assr to Sperry-Sun Well Surveying Co. U.S.P. 2,398,800, 23.4.46. Appl. 6.7.40. Electrical prospecting method and apparatus.

Thomas F. Stacy, assr to the French Oil Mill Machinery Co. U.S.P. 2,398,811, 23.4.46. Appl. 20.9.41. Controlling valve for hydraulic motors.

William A. Ray, assr to General Controls Co. U.S.P. 2,398,855, 23.4.46. Appl. 27.1.41. Fluid control valve.

Robert W. Stuart and Daniel Silverman, assr to Stanolind Oil and Gas Co. U.S.P. 2,398,868, 23.4.46. Appl. 26.6.43. Apparatus for electrical well logging.

Donald G. C. Hare, assr to The Texas Co. U.S.P. 2,398,934, 23.4.46. Appl. 27.9.41. Gamma radiation detector.

Fred S. Carver. U.S.P. 2,399,102, 23.4.46. Appl. 4.3.43. Valve for controlling high-pressure fluids.

Philip J. Lehnhard, Jr., assr to The Dow Chemical Co. U.S.P. 2,399,125, 23.4.46. Appl. 21.7.39. Well packer.

Clyde O. Davis and Lawton A. Burrows, assr to E. I. du Pont de Nemours & Co. U.S.P. 2,399,211, 30.4.46. Appl. 19.3.42. Method of perforating well casings.

William R. Ray, assr to General Controls Co. U.S.P. 2,399,294, 30.4.46. Appl. 10.11.41. Hydraulic operator.

Cecil V. Augustine. U.S.P. 2,399,312, 30.4.46. Appl. 16.4.45. Coupling sleeve puller.

Claude W. Metzger and Paul R. Snetcher, assr to Haynes Stellite Co. U.S.P. 2,399,372, 30.4.46. Appl. 11.5.43. Rotary cutting tool.

Edward Dodson, U.S.P. 2,399,474, 30.4.46. Appl. 22.4.44. Hydraulic servomotor.

Warren R. Tucker, assr to The Hydraulic Development Corpn. U.S.P. 2,399,520, 30.4.46. Appl. 9.2.42. Hydraulic system.

William T. Livermore. U.S.P. 2,399,554, 30.4.46. Appl. 24.12.37. Transmission and fluid pressure clutch mechanism therefor.

Carl W. Mott, assr to International Harvester Co. U.S.P. 2,399,756, 7.5.46. Appl. 31.12.43. Fluid control for fluid-driven motors.

Wendell B. Steward, assr to Schlumberger Well Surveying Corpn. U.S.P. 2,399,766, 7.5.46. Appl. 10.12.42. Bridging plug for use in boreholes.

Dwight M. Phillips, assr to Chiksan Tool Co. U.S.P. 2,399,823, 7.5.46. Appl. 21.4.42. Swivel joint.

Otto P. Warner. U.S.P. 2,399,842, 7.5.46. Appl. 18.12.40. Separator.

William W. Alkire. U.S.P. 2,399,844, 7.5.46. Appl. 4.4.45. Combined bailer and dump.

Thomas S. Chapman, assr to Standard Oil Development Co. U.S.P. 2,399,986, 7.5.46. Appl. 9.7.45. Drilling method and fluid for use therein.

Fred E. Hummel, assr to Shell Development Co. U.S.P. 2,400,046, 7.5.46. Appl. 22.2.44. Mud logging system.

R. B. S.

Oilfield Development.

884. **Annual and Cumulative Production; Remaining Reserves by Fields.** Anon. *Oil Gas J.*, 26.1.46, **44** (26), 202.—The 1945 production, the cumulative production to the beginning of 1946, the estimated reserves at the beginning of 1946, and the number of wells are given for the leading fields in the various states and areas of U.S.A. G. D. H.

885. **Exploratory and Development Drilling—Where it Occurred and the Results.** Anon. *Oil Gas J.*, 26.1.46, **44** (36), 233.—A series of tables give the completion results for wildcat and development wells in U.S.A. in 1945, by fields in the various states, with summaries of the monthly completion results by states. G. D. H.

886. **Discoveries.** Anon. *Oil Gas J.*, 26.1.46, **44** (36), 176.—In 1945 wildcat tests in U.S.A. increased sharply in number, but from the point of view of new reserves discovered they were not impressive. Normally, however, it takes about two years from the time a new field is discovered before any substantial daily output is developed. Texas had 40% of the total wildcatting. Wyoming showed a greater increase in wildcatting in 1944 and 1945 than any other State.

Diagrams show the numbers of oil, gas, and condensate fields discovered yearly from 1933 for the South Arkansas–Louisiana–Gulf Coast Plain area, with the average well depth each year from 1937. The oil, gas, and dry wells are shown diagrammatically for U.S.A. as a whole for 1942 onwards, with similar data for the more important States. G. D. H.

887. **Production.** Anon. *Oil Gas J.*, 26.1.46, **44** (36), 168.—U.S.A. produced 1,711,000,000 brl of oil in 1945, about 32,000,000 brl more than in 1944. The peak daily output was nearly 5,000,000 brl in August, after which there was a decline to about 4,500,000 brl/day.

Texas was the chief producer, with more than twice the output of California, which was second. Oklahoma was third and Louisiana fourth.

The production is given by States each year from 1939 onwards, while diagrams show the production and reserves each year from 1943 for the leading States, with similar diagrams for the production of the world, the Caribbean region, and the Middle East.

Notes are given on the 1945 production of the leading fields in the more important areas of U.S.A. G. D. H.

888. **Reserves.** Anon. *Oil Gas J.*, 26.1.46, **44** (36), 176.—Although the big exploration programme of 1945 failed to give outstanding discoveries, 2,275,000,000 brl of oil was found. It has been estimated that in the period 1944–1950 2,000,000,000 brl of oil should be found each year to satisfy demands; 1945 exceeded this figure. In future years, with fewer handicaps, this figure should be exceeded by an even greater margin.

Texas, California, Louisiana, Oklahoma, and Kansas are the leading States from the point of view of reserves. Together with the Rocky Mountain States, these five possessed 91·4% of the 1945 reserves. Texas has over half of the total U.S. reserves.

A table gives the U.S.A. reserves by States and districts, the figures being for the beginning and end of 1945, with the amounts added by 1945 discoveries, and extensions and revisions. G. D. H.

889. **New Reserves.** Anon. *Oil Gas J.*, 26.1.46, **44** (36), 187.—More than 400 new pools were found in U.S.A. in 1945, and extensions were made to 100 fields. 94

new gas reservoirs were found, while 16 were extended. Texas had 138 new oil discoveries, 40 new pay discoveries, and 55 extensions. Texas also had 36 new gas-field discoveries.

The 1945 discoveries, whether new fields, new pays, or extensions, are listed by States, with the name, location, producing formation, proven acreage, formation thickness, and estimated reserves. Maps show the sites of the new discoveries.

G. D. H.

890. Drilling and Completions. Anon. *Oil Gas J.*, 26.1.46, **44** (36), 159.—26,879 wells were completed in U.S.A. in 1945; the 1946 programme calls for 23,171 wells. 4256 wildcats were drilled in 1945, and 4442 are expected to be drilled in 1946. Texas has 7195 completions in 1945.

More wells are expected to be drilled in Mississippi, Alabama, Colorado, and Wyoming than in 1945; but in the Mid-Continent area the reverse is expected to be the case.

Tables give by States and districts the following data: the total field wells and wildcat wells drilled in 1945 and those planned for 1946, with the former subdivided according as they were cable or rotary wells; the status of development and wildcat completions in 1945; a comparison of the completion results for certain States in 1944 and 1945. Short notes are given on the various areas. G. D. H.

891. Summary of December Completions. Anon. *Oil Gas J.*, 26.1.46, **44** (36), 211.—During the five weeks ended December 29, 1945, 2426 wells were completed in U.S.A. 1330 found oil and 25 found gas. The completion results are summarized by States and districts, and the numbers of wells in different depth ranges are given.

G. D. H.

892. February Completions Gain. Anon. *Oil Wkly*, 18.3.46, **121** (3), 63.—Completions in U.S.A. in February 1946 averaged 493 per week. During the first two months of 1946 the completion rate was 13·1% above the figure for the first two months of 1945. 1118 of the February completions found oil, and 189 found gas.

A table summarizes the February completion results by States and districts.

G. D. H.

893. Rangely Field Largest Addition to Reserves in 1945. F. N. Bosco and J. D. Brawner. *Oil Wkly*, 25.2.46, **120** (13), 18.—The Rangely Field of Colorado is on the White River about 15 miles east of the Utah boundary. Oil seeps occur on the Rangely dome, and in 1902 a well was drilled into the productive portion of the Mancos shale, finding oil at 800 ft and at 1700 ft. The output was small. Other Mancos shale wells were drilled, and a number of wells were drilled to the base of the Dakota sandstone which proved gas-bearing. In 1933 a 7173-ft well found gas in a thin Morrison sand, and oil in the Pennsylvanian Weber sand. The well was shut in until 1943, and when reopened flowed 225 brl/day. Development of the Pennsylvanian oil began in 1944.

The Rangely dome is asymmetrical, with the southwest flank dipping at about 6°. Northeasterly-trending faults cross the axis. Fractures in the Mancos shale provide the shallow production. Oil is found in the Mancos shale, gas in the Dakota sandstone, oil and gas in the Morrison lenticular sandstones and in the Weber sandstone. Deeper horizons have not been tested, but the Leadville limestone (Mississippian) and the contact of the sediments and basement have possibilities. (In the Oregon basin, Wyoming, oil has recently been found in the Cambrian Deadwood sandstone overlying the granite.)

It is believed that in order to obtain production in the Mancos shale a fracture zone must be penetrated. The paraffinic oil may be indigenous to the formation. These wells are cheap to drill. The oil has very little gas.

The Weber sandstone is about 1200 ft thick. The upper 300 ft is very fine-grained; the next 300 ft has red argillaceous sandstone interbedded with white dolomitic sandstones and then oil-stained sandstones. The rest is non-productive. The Weber oil zones total about 125 ft, and are irregular. The best production is obtained in the north. The 33–35° oil has 300–350 cu. ft gas/brl. Bottom-hole pressures are about 2200 lb/sq. in. Weber sand wells are nearly 6000 ft deep, and cost about $20/ft.

In December 1945 there were 29 Weber sand producing wells, the output being 11,300 brl/day. The extent of the productive area is undetermined, but is estimated at 13,440 acres, giving a reserve of 1176 million brl in place with an expected recovery, by primary methods, of 400 million brl.

A stratigraphic column, stratum contour map, and a forecast of future production are included. G. D. H.

894. Discoveries and Development of West Texas Pre-Permian Reaching Major Proportions. C. J. Deegan. *Oil Gas J.*, 23.2.46, **44** (42), 139.—By the beginning of 1946 about 38 new pre-Permian fields had been discovered in West Texas and southeast New Mexico, and, counting multiple pays, there are some 54 pools. During 1945 the bulk of the development drilling was in the Keystone, TXL, Todd Deep, and Fullerton fields.

The first pre-Permian discovery was at Big Lake in Reagan County in 1928, when production was found in the Pennsylvanian and Ellenburger. In 1936 Simpson production was found at Sand Hills, and in 1939 Ellenburger production at Apco-Warner. Accelerated development began in 1940 at Sand Hills (Ellenburger), Todd Deep (probably Strawn), Abell (Simpson), and Shipley-Silurian (Silurian). 1941 yielded Sand Hills (Ellenburger and Simpson), Heiner (Ellenburger), Wertz (Ellenburger and perhaps Cambrian), and Barnhart (Ellenburger). A number of discoveries were made in 1942, and fewer in 1943. During 1944 Ellenburger oil was found in New Mexico. Devonian production was obtained at Todd Deep and TXL. 20 new pools in 12 new fields were discovered in 1945, and these included Devonian discoveries at Three Bar, Dollar Hide, and Bedford.

The depth to the various pre-Permian beds increases sharply from south to north along the Pecos County–Andrews County trend. This is controlled by the Central Basin Platform. Deep structure is not necessarily revealed by the Permian beds.

The pre-Permian pools of West Texas and southeast New Mexico as of January 1, 1945, are listed with the discovery date, oil gravity, approximate depth, and producing formation.

Four maps are included. G. D. H.

895. Caribbean and Middle East Enlarge Stature as Oil Sources. W. W. Burns. *Oil Gas J.*, 26.1.46, **44** (36), 276.—W. A. Sinsheimer has predicted the U.S.A. crude supply as 4350 thousands of brl/day each year for 1946, 1947, 1948, and 1949, with the corresponding demand respectively 4230, 4520, 4800, and 5130 thousand brl/day.

A table gives the estimated crude oil production in 1944 and 1945 for Venezuela, Colombia, Trinidad, Mexico, Argentina, Peru, and the rest of South America, Canada, Iraq, Iran, Egypt, Bahrein and Arabia, Kuwait and India. The first three countries are estimated to have produced 1,000,000 brl/day in 1945, the last six 550,000 brl/day, and the remainder 1,254,300 brl/day. G. D. H.

896. Bolivian Production Rises to 39,411 Brl in August. Anon. *Oil Gas J.*, 23.2.46, **44** (42), 119.—Bolivia's August 1945 production of 1271 brl/day was 7% above the July figure. G. D. H.

897. Guarico's 1946 Exploration Programme is Most Extensive in Venezuela. P. Reed. *Oil Gas J.*, 16.3.46, **44** (45), 66.—The reserves of Eastern Venezuela, where Monagas and Anzoategui have the main producing fields, are estimated to be 1,500,000,000 brl.

More than half of the exploration concessions in Eastern Venezuela are in Guarico. Drilling to the Cretaceous in earlier wildcatting along the "tar shelf" has led to renunciation of some concessions in the southeast. Programmes call for the operation of 16–18 rigs. Camps and roads account for a budget exceeding $10,000,000. S. A. Petrolera Las Mercedes has 179,000 hectares of exploration concessions and 348,000 hectares of exploitation concessions. 20 producers and 3 dry holes have been completed in the Las Mercedes field. Sands are lenticular and faulted, with gas in the crestal regions. Production is from 3 La Pascua (Miocene) sands 4000–4400 ft deep. The oil is about 32° A.P.I. gravity. 26° A.P.I. oil has been found in the Cretaceous in one well. Wildcatting is proceeding in the Punzon-Grico area to the west and in the Camaz-Placer area to the northwest.

Guarico lies in part of Venezuela's largest geosyncline which is filled with Cretaceous and Tertiary beds. It includes a series of basins which advanced southwards during the Tertiary and Quaternary. Sedimentation was reduced or interrupted in the Middle Eocene, and land barriers are believed to have existed in the north. In the Oligocene there were saline-estuarine conditions in certain basins, but there were marine invasions. Conditions began to change in the Middle Miocene or later, and there was retreat of the sea and deposition of lignites. G. D. H.

898. Anglo-American Oil Co.'s Search for Oil in Britain. *Petrol. Times*, 25.5.46, **50** (1,271), 526–528.—The activities of Anglo-American Oil Co. in Southern England and other parts of Britain in the search for oil are described, particularly the drilling of the well Gringley No. 1. A. H. N.

899. Oilfield, Coevorden-East. K. H. R. Hoyer and E. L. Siccama. *Ingenieur*, 1946, **58**, A.61–67.—A description of the Coevorden East oilfield in Holland. Discovered between 1937 and 1939, the field is geologically related with the German Emlichheim area. Intensive exploration by the Bataafsche Petroleum Mij began towards the end of 1941. In July 1943 the first oil was produced at a rate of 1 cu. m. per day.

Production : 1943— 233 cu. m.
1944—1946 cu. m.
1945—6479 cu. m.

The viscous paraffinic crude (d. 15 : 0·905) has a high pour point and contains very little light components. M. B.

900. 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.

901. Production Gradually Gaining in France. Anon. *Oil Gas J.*, 9.3.46, **44** (44), 51.—In 1939 500,000 brl of crude from Pechelbronn was processed. In March 1945 the field was recovered from the Germans, and in September the production was 925 brl.

Exploitation began in 1735, and the cumulative production exceeds 18,500,000 brl, about 5,300,000 brl being from shafts and galleries. 5000 wells have been drilled, with a total footage of 6,233,000 ft. G. D. H.

902. German Oilfields To-day. Anon. *Petrol. Times*, 25.5.46, **50** (1274), 529–530.—A brief outline of the geology and potentialities of German oilfields is given. It is stated that practically all of the reserves have been used during the war, that exploration was stopped, reserves used up uneconomically, and that when new fields were found it was too late to affect output. Perhaps the most interesting feature, however, is the revelation for the first time that the Control Commission's policy is not only to encourage maximum economic production of crude, but also to prosecute to the full the search for new German oil resources. A. H. N.

903. Russia's Reserves Largest in World, Official Claims. Anon. *Oil Wkly*, 18.8.46, **121** (3), 68.—It has been stated that 34 new sources of oil were discovered in the U.S.S.R. during the war, compared with 83 in the previous 20 years. New areas were being developed in Daghestan, central Asia, Sakhalin, and east of the Volga. G. D. H.

904. "Second Baku" may Surpass First Field in Importance. Anon. *Oil Wkly*, 18.3.46, **121** (3), 68.—The "Second Baku" is in Bashkiria, and is now 14 years old. Seven Fields are being exploited. In 1944 oil was found in the Devonian near Tuimazy. G. D. H.

905. Iranian Production Setting New Record. Anon. *Oil Gas J.*, 16.3.46, **44** (45), 65.—In the first nine months of 1945 Iran produced 95,421,032 brl of oil; in the whole of 1944 the output was 92,919,701 brl. During the same period Anglo-Iranian Oil Co.'s production in Britain was 463,141 brl, the 1944 figure being 641,990 brl. G. D. H.

906. Production in Punjab Continues to Decline. Anon. *Oil Gas J.*, 23.3.46, **44** (46), 64.—In 1945 the Punjab fields produced about 350,000 brl of oil. The output in 1941, the peak year, was 886,000 brl. G. D. H.

TRANSPORT AND STORAGE.

907. Submarine Loading Line Replacement. R. P. Howell. *Oil Gas J.*, 27.4.46, **44** (51), 108.—An account is given of the replacement of the 3700-ft light oil submarine line at El Segundo refinery, south of Los Angeles.

The original line was laid in 1934, and consisted of ½-inch wall, 1⅝-inch o.d. well casing. Cathodic protection was applied in 1938, but inspection in 1944 showed severe internal corrosion, necessitating replacement. To minimize effects of internal corrosion, ⅜-inch concrete-lined 14-inch o.d. pipe in 30 ft lengths, was chosen, weighing 73 lb/ft, and having expanded end joints. It was laid in two straight courses with one angle point after locating electronically the exact lie of the existing lines. Sections were welded and launched after the cooling water was removed, and the flanged ends sealed with plate closures. The pipe landed evenly and with little shock, provided an even fall was arranged. Three 1000-lb.-capacity lifting buoys were used to again raise the sections nearer the surface; these were then towed out to the correct positions, where they were lowered as directed by the diver, and guided into position.

Bolting was done by the diver using an air-operated wrench. After final tightening of joints, the line was successfully tested at 450 p.s.i. G. A. C.

908. Calculation of Throughput (when Several Liquids Flow Simultaneously Through a Pipeline). B. Miller. *Oil Gas J.*, 2.3.46, **44** (43), 64.—As an illustration of the problem with which the author is dealing he considers a 20-inch line transporting simultaneously propane, light gasoline, heavy gasoline, and kerosine. The line is 100 miles long and contains 50,000 brl each of propane and the two gasolines, the balance being kerosine. Knowing the specific gravity and viscosity of these products, pipeline efficiency, and pressures, the author shows how the throughput can be calculated. D. L. S.

909. Tripling Westward Flow of Iraq Oil. *World Petrol.*, 1946, **17** (4), 40–42.—Details are presented of Iraq Petroleum's Co. proposed new 16-inch lines to Haifa and Tripoli. The economic and financial reasons for construction are given. Accumulation of material has commenced, but laying is not due to start until October, 1946. New refineries are forecast at Haifa and Tripoli. Statistics are given supporting the view that the new pipeline is an economic proposition from the crude supply standpoint. When new lines are in operation 13,000,000 tons can be handled annually. F. S. A.

910. Storage of Volatile Petroleum Products. H. C. Boardman. *Refiner*, 1946, **25** (4), 109–116.—For both crude oil and gasoline in storage the vapour pressure is not only a function of temperature, but also, to some degree, of the size of the vapour space. Evaporation losses from volatile liquids in storage vessels may be prevented or reduced by (*a*) allowing changes of volume at constant or variable pressure (breather, balloon or lifter roofs); (*b*) allowing no vapour space (floating roofs or water displacement); (*c*) withstanding the combined liquid and vapour space pressures (spheroids spheres); (*d*) resisting both the maximum internal pressure and the maximum internal vacuum (spheres); (*e*) insulating the tank from the heat of the sun; (*f*) cooling, refrigerating, and vapour-recovery systems; and (*g*) any combination of the above. It is believed there is a trend towards (1) A greater utilization of complete or partial vacuum, complementary to pressure in reducing or preventing filling and storage losses. (2) Exclusion from the storage space of all air except that entrained by the entering liquid. (3) Installation of chemically inert flexible fabric hinges in low pressure devices such as breather and balloon roofs at connections subject to flexure. (4) Storage in large quantities of highly volatile products such as propane.

G. R. N.

911. Rock Tanks for Oil Storage. Anon. *Engineer*, 1946, **181**, 505.—Oil storage at a large base station of the U.S. Navy is provided by tanks excavated in the solid rock. The tanks are vertical cylinders with hemispherical ends, the rock being lined with 3 ft of concrete on the sides and 8 ft at top and bottom; there is also an all-welded steel lining inside the concrete. There are 20 tanks in two parallel rows, spaced 200 ft in each direction. The internal dimensions of each tank are 100 ft dia by 250 ft high. The tanks are connected by a series of tunnels which accommodate the piping system and which served to remove material during excavations. The tunnels are fitted with automatically closing doors in concrete bulkheads, so as to prevent flooding of the tunnels in case of a break or leak. A. C.

912. Plastic Tank Coatings Resist Sour West Texas Crude Corrosion. G. Weber. *Oil Gas J.*, 29.6.46, **45** (8), 89.—A description is given of the trials made on steel tanks and tubes protected by a coating of "Resoweld," under extreme corrosion conditions for periods up to two years. Resoweld is a liquid thermoplastic resin, which was developed during the war by the Goodyear Tire and Rubber Co., which, when applied under the conditions described, forms a firmly bonded coating on metal, cement, or wood which is flexible enough to withstand (1) bending at 100° F, without chipping, (2) rupture by movement or blows. It is highly resistant to a variety o acids, including H_2S, bases or salts in aqueous solution and aliphatic hydrocarbons, it softens in aromatic hydrocarbons and chlorinated solvents, and is soluble in ketones. As a non-conductor of electricity, it arrests electrolytic corrosion in tanks, etc., and also stops bacterial action. The method of its application is described, the main step of which is the preparation of the metal surface to be coated. New metal is cleaned and sandblasted. Used tanks are cleaned, brushed, scraped, aired two days, and sandblasted twice before the application. The tests were made by the use of a crude oil from the Penwell field, Ector County, West Texas, this crude being widely considered to be one of the most corrosive crude oils; it contains approximately 10% salt water and has a high sulphur content. Resoweld has given highly satisfactory protection against corrosion. W. H. C.

REFINERY OPERATIONS.

Refineries and Auxiliary Refinery Plant.

913. Steam and Power Generation in the American Refinery (Part I). W. F. Ryan. *Oil Gas J.*, 29.6.46, **45** (8), 78.—In a study of the steam and power generation of U.S. refineries, it is observed that despite the development progress in general refinery engineering and process technology, generally speaking, the organizations have neglected the economic advantages obtainable from the use of high-pressure generation of steam and its application to electric power generation, as adopted by the electric power industry, yet it is well known that high-pressure steam, with its high temperature, yields vastly greater returns in refineries than in the electric power industry, which since 1926 has employed steam pressures up to 1200 p.s.i. with temperatures of 900–950° F. As heavy consumers of steam with moderately heavy demands for electric power, refineries now, with their extensions of activities into the petrochemical field, have become heavy consumers of both, requiring 1,000,000 lb/hr and more of steam, and electric power exceeding 25,000 kw.

Up to 1925 it is shown that steam-raising plant for refineries was designed for pressures of 150–200 p.s.i., the highest being 275 p.s.i., whereas steam pressures employed by electric power concerns rose mainly to around 400 p.s.i. with temperatures of 700° F, though three concerns used 600 p.s.i. at 750° F, and one electric supply used steam at 1200 p.s.i. at the same temperature. In a central power-station with turbines using steam at 750° F (considered the highest practical temperature in 1925), and exhausting at an absolute pressure of 1 inch Hg., the energy theoretically available from the steam is increased less than 7% by increasing the throttle pressure from 400 to 1200 p.s.i.g. For an industrial plant turbine exhausting at 150 p.s.i.g., the corresponding gain in available energy is 44%. The first high-pressure industrial steam power plant was started in 1927 and was designed for 900 p.s.i. at 750° F. In 1935 there were 85 industrial power plants of this class, including 8 at refineries. Of these 8, the first was built for the Gulf Oil Co. refinery at Port Arthur in 1929, which was designed for 525 p.s.i. at 635° F to operate one turbine generator to produce 10,000 kw. and exhausted at 125–150 p.s.i. to the refinery mains; its output of steam and electricity are given. The slow-growth of high-pressure steam installations at refineries over the next 10 years is discussed. Steam pressures employed rose to 550–650 p.s.i. at 700–750° F, one installation only was designed for operating at 835 p.s.i. and another for working at 600 p.s.i. at 800° F. The steam and turbine electric units erected in 1936 at the Standard Oil Co.'s Richmond refinery produced 4000 kw. in each of three turbines using steam from three boilers at 838 p.s.i. at 750° F, and exhausting at 150 p.s.i. The installation is briefly described. At this date (1936) power concerns were using steam at 850–900° F. The Richmond installation represents the highest pressure pre-war design for refinery production of steam. Further details are given in respect to refinery economics, set-up and auxiliaries—*e.g.*, water-softening plant. W. H. C.

914. Heat Transfer and Friction of Water in an Annular Space. F. G. Carpenter, A. P. Colburn, E. M. Schoenborn, and A. Wurster. *Trans. Amer. Inst. chem. Engrs*, 1946, **42** (2), 165.—Uncertainties existing in means for predicting heat transfer coefficients of fluids flowing in annular spaces, especially in the region of transition from viscous to turbulent flow, led to an experimental study of water flowing upwards in a narrow annular space. This paper presents data for heat-transfer and isothermal pressure drop for water flowing in the annulus formed between $\frac{5}{8}$ inch O.D. and 0·834 inch I.D. copper tubes 8 ft long and arranged in a vertical position. Hot water, circulating at constant high velocity through the inner tube, was the heating medium. Surface coefficients of heat transfer between the inner tube and the annular fluid were determined by subtracting from the overall resistance to heat transfer the sum of the resistances due to the inner water, the metal wall, and any possible dirt or scale.

The friction date, shown by Fig. 7, indicate that the proper choice of diameter to be employed in evaluating Reynolds numbers is the equivalent diameter, $D_e = D_2 - D_1$, since with Reynolds numbers so calculated the transition from viscous to turbulent flow occurs at approximately 2000, similar to flow inside tubes. In the viscous region the values of friction factor are in excellent agreement with the theoretical relation; this agreement lends confidence to the techniques and measurements employed in this study. Data in the turbulent region fall on the literature line for commercial pipe.

The heat-transfer data, shown on Figs. 8, 9, and 10, cover a range of Reynolds number, based on equivalent diameter, from 150 to 15,000. At highest Reynolds numbers the data approach correlation of results for circular tubes. At lower Reynolds numbers the annular data fall somewhat under circular tube results. In the viscous region, where little previous data on annuli exist, the results are shown to be slightly higher than relations for flow inside tubes. A. R. J.

915. Cottrell Electrical Precipitation Equipment, Some Technical and Engineering Features, Recent Developments, and Application in the Chemical Field. C. E. Beaver. *Trans. Amer. Inst. chem. Engrs*, 1946, **42** (2), 251.—Fundamentally the principle of the Cottrell precipitator is substantially the same to-day as that established by Dr. Cottrell a number of years ago. There have been, however, a number of marked changes in technical and engineering features, as well as new developments and improvements in order to meet the requirements of modern industrial application.

The present paper discusses in general the equipment required, the various types of precipitators for specific applications, and the different factors which enter into the design of a modern Cottrell installation. The variables influencing the rate of precipitation or efficiency of removal are also presented, with particular reference to gas velocity, time of treatment, current flow, and surface conductivity of the suspended particles.

A number of the more recent developments of a technical and engineering nature are given, and the various applications of the Cottrell equipment in the chemical field are discussed with specific mention of the application in the phosphorus, pulp and paper, carbon black and petroleum industries, including its use in the fluid catalytic cracking process. A. R. J.

916. Synthetic Rubber and Plastics as Materials of Construction in the Chemical Industry. M. G. Fontana. *Trans. Amer. Inst. chem. Engrs*, 1946, **42** (2), 359.—The use of synthetic rubber and plastics as materials of construction in the chemical industry is discussed. The five basic commercial synthetic rubbers—namely, GR-S type, neoprene, nitrile, butyl and Thiokol and the phenolic, vinyl, silicone, nylon, styrene, polythene and acrylic plastics—are included. Actual uses in the chemical plant are described. Numerous types of chemical equipment are involved. Information on the physical and chemical properties of these materials is presented.

Reference is made to the use of these materials in petroleum plant, including nitrile rubber for lining steel tanks holding hydrocarbons containing hydrochloric acid; a modification, Hycar, when resistance to both mineral acids and aromatics is required; Thiokol for lining concrete and steel tanks storing aviation gasoline. Reference is also made to the use of a silicone lubricant for plug cocks handling 50% caustic and 93% sulphuric acid, moulded nylon plant components resistant to oil, grease, aromatic gasoline, heat, alkalis, etc. A. R. J.

917. Present-Day Hydrogen Manufacturing Processes. R. M. Reed. *Trans. Amer. Inst. chem. Engrs*, 1946, **42** (2), 379.—This paper describes the hydrogen manufacturing processes that are in use on a commercial scale at the present time in the U.S.A. These processes include the following: 1. The electrolysis of water; 2. The steam-iron process; 3. The steam-water gas process; 4. The steam-hydrocarbon process; 5. The steam-methanol process; 6. The thermal decomposition of hydrocarbons.

The present production of hydrogen in the U.S. amounts to about six billion cu. ft per month, of which about three billion cu. ft per month are produced and utilized in the manufacture of synthetic ammonia. A. R. J.

918. Surface Required for Exchangers. W. L. Nelson. *Oil Gas J.*, 27.4.46, **44** (51), 145.—Issue No. 90 in the *Refiner's Notebook* series concerns the calculation of the amount of surface required for an exchanger system. A formula is developed, depending on average temperature difference, fouling factors, and film-transfer rates; the latter two factors will be presented in future issues (91, 92, 94, and 95). G. A. C.

919. Over-all Transfer Ratio (Refiner's Notebook No. 98). W. L. Nelson. *Oil Gas J.*, 8.6.46, **45** (5), 105.—Methods of computing heat transfer rates between two liquids are given.

Each of the two fluids and degree of fouling of the two surfaces must be considered, and only when direct experimental results are available on the equipments concerned can these variables be ignored.

Rates are calculated for a gasoline exchanger and condenser, with reference to data given in previous Refiner's Notebooks (91 to 94). G. A. C.

920. Italian Refinery Capacity Down to Only 40 Per Cent of Pre-War. A. Giordano. *Oil Gas J.*, 1.6.46, **45** (4), 46.—A review is made of the refining capacity of the Italian oil industry. All the refineries, with the exception of that at Bari, have been almost completely destroyed by air raids, capacity having been reduced to 40% of the pre-war of nearly three million tons. For example, the Fornovo refinery was completely destroyed except for boiler plant. All the latest type plant, including thermal cracking, Houdry catalytic cracking, and hydrogenation units, were located at Fiume and Leghorn, and were destroyed. The Azienda Nationale Idrogen-cazione Combustibili is considering exploiting the Bari plant, using salvaged equipment from the Leghorn units. Hydrogenation output is important, and in the Piacenza district wells have been drilled with a daily output of 3000 brl. Methane gas output in Northern Italy is about 8,830,000 cu. ft yearly, and a project has been worked out to pipe gas to the ports on the Po River and the Adriatic for fuelling gas-driven water transport. G. A. C.

921. Texas Company will Build Major East Coast Refinery. Anon. *Oil Gas J.*, 18.5.46, **45** (2), 90.—The Texas Co. are to build a refinery on the Delaware River, strategically located to receive foreign and domestic crudes. It will process motor gasoline, diesel, furnace and industrial fuel oils, using latest type refining processes. The plant will commence operation in 1948. The company's 20 other refineries in the States, and capacities are listed, together with interests in South America and the Middle East. G. A. C.

Distillation.

922. Newly Developed Process Secures Pure Hydrocarbons from Petroleum. Anon. *Nat. Petrol. News*, 3.4.46, 38 (14), R-283.—A procedure for separating paraffinic, naphthenic, or cyclic hydrocarbons is described.

The method known as the " Distex " process employs both solvent refining and conventional distillation. A narrow boiling stock containing both the paraffin and cyclic fractions is separated into two types by the Distex operation, final processing consisting of individual fractionations of the two single-type fractions into their respective components. The separation is nearly independent of the molecular weight or boiling point of the compound.

The boiling point of the solvent in the Distex process is not important so long as it is above that of the hydrocarbon.

Laboratory pilot-plant operation was carried out using aniline as the solvent for safety reasons. A flow diagram is given for a *n*-heptane-methyl*cyclo*hexane-aniline mixture. The tower was also tested with a hexane fraction from " Skellysolve B " with a boiling range of 148° to 165° F, overhead products amounting to 60% charge and almost entirely paraffinic being obtained.

A schematic flow-sheet for a commercial-sized plant using " Skellysolve B " as an example, is also given. G. A. C.

923. Precise Fractionation of Light Hydrocarbons. F. H. Stone. *Refiner*, 1946, 25 (4), 124–128.—A modified McCabe–Thiele method is applied to calculate the number of bubble trays and reflux ratio required for the fractionation of iso- and normal butane and iso- and normal pentane. The actual number of plates depends on plate efficiency and this depends partly on plate design. Minimum reflux ratio data indicates that operating pressure has much less bearing on reflux requirements than does the composition of the fractionator feed. The diameter of a fractionator may be calculated by means of an entrainment formula which will indicate the vapour velocity at which liquid will carry from plate to plate up the fractionator. Since the volume of reflux required for the fractionation of the butanes so far exceeds the volume of fractionator feed or products, this reflux volume is the determining factor in arriving at fractionator diameter. It is also the largest single factor in determining the size of overhead condensers, cooling tower, and cooling water requirements, the reboiler size, quantity of heating steam required, and the size of reflux and circulating water-pumps. G. R. N.

924. Calculation of Minimum Reflux Ratio for Multicomponent Distillation. F. D. Mayfield and J. A. May. *Refiner*, 1946, 25 (4), 101–108.—A method is presented for calculation of minimum reflux ratio which is quite rapid, but is limited at the present development to complete reparations of mixtures which involve only one component in the distillate or only one component in the bottom product. Excellent agreement was obtained with Colburn's method and the plate by plate method. G. R. N.

925. A Simplified Method for Solving Multicomponent Distillation Problems. R. J. Hengstebeck. *Trans. Amer. Inst. chem. Engrs*, 1946, 42 (2), 309.—A graphical method similar to the McCabe–Thiele method for binary separations has been devised for quickly and accurately solving multi-component distillation problems in systems for which the usual assumptions of constant molal overflows in the rectifying and stripping sections are valid, and in which there are no intermediate components between the key components. The method is applicable both to sharp and sloppy separations.

A modification is presented for the calculation of separations of groups of components (as in depropanization, debutanization, etc.).

In addition to being quick and accurate, the method has the further advantage of locating the feed-tray directly.

In the simplified method the multi-component system is reduced to an " effective " binary system by the use of certain approximations, and the number of plates required for the desired separation is determined graphically for an arbitrarily assumed reflux ratio.

Nine separations have been calculated by the simplified method and checked by

rigorous calculations. For these separations the average deviation of the number of trays calculated by the simplified method from the number calculated rigorously was 0·5 theoretical plate. The maximum deviation was 0·8 theoretical plate.
A. R. J.

926. Extractive Distillation—Separation of C_4 Hydrocarbons Using Furfural. J. Happel, P. W. Cornell, DuB. Eastman, M. J. Fowle, C. A. Porter, and A. H. Schutte. *Trans. Amer. Inst. chem. Engrs*, 1946, **42** (2), 189.—The butadiene plant of the Neches Butane Products Co. employs furfural as an extractive distillation medium for three separations: *iso*butane from butene-1, *n*-butane from butene-2's, and butene-1 from butadiene. Extractive distillation is necessary for the separation of the C_4 hydrocarbons because of their close boiling points.

This paper presents techniques developed for the operation of such equipment and test data showing typical performance. It has been found that for a given solvent circulation, the best separation will be obtained with the highest proportion of hydrocarbon that can be dissolved in the solvent without causing the separation of a hydrocarbon rich phase in the tower. Means for obtaining this optimum condition are discussed. Average plant data taken over a five-month period show that excellent performance is possible with this type of equipment. Plant tests indicate that the average tray efficiency is close to 25%.

In the course of this work some new methods were developed for calculating tray efficiencies from test data and for the estimation of activity coefficients in multi-component mixtures from binary data. It is believed that these methods are of more general applicability.
A. R. J.

927. Thermodynamic Evaluation of Binary and Ternary Liquid Systems. K. Wohl. *Trans. Amer. Inst. chem. Engrs*, 1946, **42** (2), 215.—The art of distillation of liquid mixtures is based on the knowledge of vapour–liquid equilibria. In order to obtain this knowledge with a minimum of experimental data, equations for the activity coefficients in the liquid mixture are required. A special need for such equations exists in the case of non-ideal multi-component systems as are encountered in azeotropic and extractive distillation. Several equations have been proposed in the literature, but the form in which they are given often does not make their application simple, and the diversity of their forms adds to the difficulty of choice between them.

In this paper equations for the activity coefficients in binary and ternary liquid mixtures of the types of the van Laar, the Margules, the Scatchard–Hamer equation and those of a more general type have been presented. They are given first in their simplest form, in which only the second power of the mole fractions is used and, further, in forms in which the third and fourth powers are applied. All of them have been written in such a way that they appear as variations of one mathematical scheme, so that a transition from one type to the other is obvious. All contain as principal constants the end values of the activity coefficients in the binary systems, which should simplify their practical application. The systematical investigations of the various types of equations resulted also in a few equations which have not been considered so far, but which may prove useful. A survey is given of the presumable range of valididy of the equations presented.
A. R. J.

928. Gas–liquid Equilibria in the Petroleum Industry. W. R. van Wijk. *Ingenieur*, 1946, **58**, M. 41–45.—A general discussion of gas–liquid equilibria in distillation and condensate recovery.
M. B.

929. New Cycling Plant Consumes Gas; Produces 300,000 Gallons products Daily. A. L. Foster. *Oil Gas J.*, 1.6.46, **45** (4), 60.—The new Shell plant at Sheridan, Texas, is described. This plant commenced operating in 1945, processing gas from 15 wells. Gas is drawn from two horizons, one at 9,300 ft and the other at 10,300 ft at approximately the same rate. A throughput of 95 million feet daily has been reached. The gas passes into two parallel scrubbers, thence to two high-pressure absorbers, the two streams being combined before entering flash-tanks where distillate and fat oil are separated. Flashing or venting takes place in three successive stages, the raw distillate being led to a stripper, and the flashed fat oil is brought into heat exchangers and flashed at 120 p.s.i.g. The main oil stream is processed in a still equipped with a special section and draw-off near the top. A rectifier, depropanizer, debutanizer, butane, and pentane fractionator units form part of the equipment; propane, iso- and normal butane, iso-pentane, gasoline, and distillate are the products. The stripped gas is returned to five input wells, all return gas being metered into the well. G. A. C.

Absorption and Adsorption.

930. High Pressure Absorption Plant. C. C. Pryor. *Refiner*, 1946, 25 (4), 117–123.—A description of the cycling plant at the Sheridan field, Texas. With a wet gas capacity of 100,000,000 cu. ft/day the two absorbers are operated at 1800 lb/sq. in gauge and 100° F using lean oil sp. gr. 0·825/0·850, mol. wt. 200/225, and I.B.P./F.B.P. 250°/340° C. The distillate stripper and the fat oil still are controlled at 125 lb and 425° F and 65 lb and 470° F, respectively. The raw gasoline is rectified at 450 lb and 275° F, then fractionated to give propane, *iso*- and normal butanes, *iso*-pentane, and natural gasoline. Material balance, tower-pump schedule, and tower schedule are tabulated. Precision fractionation of the light ends gives a recovery efficiency of 85% minimum total butanes and 99% minimum total *iso*-pentane and heavier propane, *iso*- and *n*-butanes, and *iso*-pentane are produced with a purity of 95%. G. R. N.

931. Practical Refrigeration for Natural Gasoline Plants. R. W. Heath, J. B. Taylor, Jr., and P. W. Hill. *Refiner*, 1946, 25 (3), 93–100.—Propane refrigeration can be justified in new low-pressure (below 100 lb) absorption plants where the future maximum volumes of wet gas are known. Refrigeration is also felt to be simplest, cheapest, and most economical means of securing additional plant capacity in existing units. The advantages of refrigeration are due not only to the reduction in vapour pressures, but also to the greater spread of vapour pressures between the hydrocarbon components at the lower temperatures, which in turn results in better separation of the fixed gases. Refrigeration lowers the temperature of the fat oil entering the exchangers, increasing the mean temperature difference within the oil, and lowers the lean oil temperatures to the coil. Thus the coils are required to extract less heat and the residual dry gas content of the lean oil is reduced. There is a smaller loss of gasoline in the dry gas, which allows the use of absorption oil of lower mol. wt. and increased absorption efficiency. The costs of installing a refrigeration unit capable of sub-cooling the lean oil by 25° F are small in terms of equivalent oil rate. Details of two plants operating on propane refrigeration are given. G. R. N.

Solvent Refining and Dewaxing.

932. Liquid–Liquid Extraction in Spray Towers. H. F. Johnson, Jr., and H. Bliss. *Trans. Amer. Inst. chem. Engrs*, 1946, 42 (2), 331.—Experimental work on liquid–liquid extraction is presented, which work includes 109 extraction runs with four systems in a 1·824 inch I.D. tower. Major emphasis is placed on the extraction coefficient, Ka, and distribution, but some attention is given to the flooding phenomenon. Ka increases with both dispersed and continuous phase-flow rates, increases slightly with increases in entering solute concentration, and tends to decrease somewhat with increase in tower length. When extraction is from continuous to dispersed phase, Ka is greater and drop coalescence is less than when extraction is in the other direction. Optimum distributor design is discussed. Correlation methods for roughly predicting overall coefficients for one system in a specific spray tower from data taken with another system in the same apparatus are suggested. Comparisons are made among spray, packed, and perforated plate towers, and conditions in which the spray tower may well be advantageous are deduced from these results. A. R. J.

933. Improved Technology = Better Lube Oils. G. Armistead. *Oil Gas J.*, 27.4.46, 44 (51), 124.—Solvent extraction, deasphalting, and dewaxing processes are reviewed.

Solvent extraction is employed to remove or reduce non-paraffinic components, the six processes in use have a capacity of 90,000 brl/day.

Deasphalting with liquid propane is used to remove asphaltic materials insoluble in petroleum naphtha, thus improving carbon deposition, oxidation resistance and viscosity index. Solvent dewaxing, capacity 64,000 brl/day, removes waxes and improves pour point. G. A. C.

934. Some Solvent Extraction Developments in Germany. J. P. Jones. *Nat. Petrol. News*, 6.3.46, **38** (10), R-181.—In this second instalment the separation of low-temperature carbonization tar distillate into raffinate and extract is discussed.

The use of the triangular co-ordinate graph technique to supply data on the relationship between solvent, raffinate, and extract phases necessary for commercial operations is illustrated. For example, from the graph it appears that by an isothermal extraction of low-temperature carbonization tar distillate at 40° C it is possible to separate it in two stages into the best possible raffinate and extract.

In practice the final product obtained at 40° C can be further separated by cooling to minus 10° C.

The method is also applied to the use of naphtha to separate an SO_2-extract from a tar from low-temperature carbonization of brown coal. G. A. C.

Cracking.

935. Small Fluid Cat Cracker Designed to Compete with Units of Larger Capacity. Anon. *Oil Gas J.*, 8.6.46, **45** (5), 97.—A development in the design of catalytic cracking operations for use in refineries of small capacity is described.

Economic considerations make it imperative that catalytic cracking is employed for the production of high-quality gasolines. A flow chart of such a unit is given, and the economics of 4500 brl and 9500 brl/day plants is tabulated. The conventional processing sequence including topping, conditioning reduced crude, fluid catalytic cracking, catalytic polymerisation, thermal cracking of cycle stock, and thermal reforming of heavy naphtha is assumed.

5·3% gasoline is obtainable from a 4500 brl/day refinery with 1700 brl/day catalytic cracking capacity, showing an operating credit of $700,000 per year before depreciation and taxes; and one of 9500 brl/day can show a similar credit of $1,200,000. Thus initial cost of installation still allows a worth-while profit even after depreciation and amortization charges. Over-design features of the older larger plants have been eliminated in the small units, less piping and framework are required, and elevators dispensed with. For a 4000 brl/day unit the main structure occupies only 1650 sq. ft area; elevation of support of reactor, regenerator and precipitator being only 69 ft above ground level.

Units have to be designed to employ the fluid principle of powdered catalyst circulation and use all tested catalysts, be capable of handling heavier or any kind of charge stocks, and be flexible to meet varying market demands. Low-pressure operation is essential for economical operating costs, a spent catalyst stripping system is necessary, and a single-stage cyclone is placed in the reactor and regenerator to avoid loss of catalyst. Catalyst is recovered from product streams by a scrubbing system.

Control by automatic instruments and long continuous runs are important factors in obtaining maximum power. G. A. C.

936. Developments in Fluid Catalytic Cracking. J. F. Walter. *J. Inst. Petrol.*, June 1946, **32** (279), 295–312.—After a survey of the development of fluid catalytic cracking it is concluded that the experience built up during the war, the laboratory and pilot-plant developments of the past several years, have led to a considerably simplified design, with an attendant marked reduction in cost, improvement in gasoline yield, and reduced operating costs. Methods have been developed for forming synthetic catalysts into very small spheres, and catalyst in this form shows, when compared to ground catalyst, a considerably reduced rate of attrition to unrecoverable fines and an increased ease of recovery from gases or vapours. Three compositions of catalyst are available for fluid cracking—namely, silica-alumina, natural, and silica-magnesia—the best catalyst for a given application being determined by the octane number of the gasoline which must be produced and by the requirements for raw materials for chemicals. Since fluid catalytic cracking units are capable of cracking oil at high temperatures, and for this reason permit maximum production of light mono-olefines by the catalytic cracking route, its application to the production of light olefines for chemical manufacture should be investigated by those interested in this activity. The discussion is reported. A. H. N.

937. Cracking of Heavy Petroleum Stocks Over Heated Surfaces. A. Ya. Larin. *Nat. Petrol. News*, 3.4.46, **38** (14), R-286.—Laboratory experiments on the cracking of oil distillates over electrically heated metallic spirals are described.

The experiments were carried out using a pyrex flask fitted with 4 or 5 electrodes and fitted with spirals heated by 120-volt A.C. One spiral at a time was used until the entire charge was cracked or all spirals became covered with cabon. The consumption of electrical current was noted, and different metals such as tunsgten, molybdenum, platinum, iron, nickel, etc., were used in a series of experiments. Materials cracked were paraffin wax, mazuts from a commercial unit processing Grozny wax-bearing oil, from Zykh and from Kara-Chukhur oils, and oil distillate from Grozny wax-bearing oil. A gas is produced under the conditions of the experiment having a composition approximately similar to that obtained from paraffin wax. The yields of gas per unit energy consumed are the lower, the richer is the charge in compounds with a low hydrogen content.

An oil distillate consisting essentially of naphthenes gives a yield of gas per k. wt-hour which is half that obtainable from paraffin wax. An oil distillate containing up to 21% aromatics gives about one fourth of the amount of gas obtainable from paraffin wax.

From fuel oils the yields of gas are still lower, and show fluctuations depending on the contents of resins and carboids in the charge. Tables show the comparison of yields from paraffin wax, kogasin and mazuts. G. A. C.

938. Principles of Reactor Design. C. O. Reiser and K. M. Watson. *Nat. Petrol. News*, 3.4.46, **38** (14), R-260.—This article deals with the pyrolytic dealkylation and concentration of aromatics.

The laboratory equipment used was designed for pyrolysis at atmospheric pressures in the presence of steam or other diluents at temperatures up to 1600° F. Compressed air was used to force liquid to the reactor. The reactor consisted of a 1-inch standard pipe of 18% Cr, 8% Ni steel mounted vertically in an electric furnace.

Ultra-violet spectrophotometric methods of analyses were used to determine the aromatic contents of the treated factors.

Xylene, toluene and a heavy hydroformed naphtha containing 23% xylenes and 9% toluene were cracked at about 1450° F. Approximately 40% of the xylenes were destroyed in raising the concentration of the xylene fraction of the naphtha from 49% to 90%, but benzene and toluene were formed and the loss in total C_6, C_7, and C_8 aromatics was only 14%.

A method of kinetic analysis is mathematically developed for such data in flow streams whereby the individual velocity constants and product distributions of the various reactions are evaluated; integration of the equations gives good agreement with experimentally observed results.

The integration is demonstrated and may be used for predicting the results of any reactor operating under conditions to which the basic data is applicable. For example, if the reaction is conducted in an adiabatic chamber the temperature change in each small section can be calculated from the conversion and the thermochemistry of the reactions. Thus the optimum design for a reactor required for a specific duty can be systematically obtained. G. A. C.

Hydrogenation.

939. New Plant will Provide Pattern for Synthetic-Liquid Fuels Industry. F. R. Staley. *Oil Gas J.*, 27.4.46, **44** (51), 118.—A plant to produce 110,000 cu. ft of hydrogen and 120,000 cu. ft of synthesis gas daily for investigation of the hydrogenation and gas synthesis processes is to be erected at Bruceton, Pa.

Desulphurized natural gas is heated with steam to 1,500° F over a catalyst to form carbon monoxide and carbon dioxide. Nickel compounds on a refactory support reduced in hydrogen or in the reaction mixture, give long life as catalysts, with rapid reaction rate and minimum of undesirable side reactions. The gaseous mixture is cooled to 700° F by addition of steam, with which it reacts in a converter to produce carbon dioxide and hydrogen, 90–95% of the monoxide being converted to the dioxide.

Carbon dioxide is removed from the cooled gases by scrubbing with an aqueous solution of mono-ethanolamine. Again mixed with steam at 700° F, the purified gas is passed to a second monoxide converter, cooled and purified by absorption in the amine.

Seventeen plants with a total capacity of 4 billion cu. ft per month use the process. G. A. C.

Polymerization.

940. Poly Plant Converts to Peace. H. E. Chambers and W. L. Pursell. *Oil Gas J.*, 18.5.46, **45** (2), 118.—The peace time operations of the polymerization unit of Skelly Oil Co., El Dorado, Kansas, is described. This is a Kellog chamber-type plant using copper pyrophosphate catalyst with four reactors, for manufacture of aviation gasoline components during the war. It has now been converted to the production of polymer blending stocks for motor gasolines. A feature lies in bringing a freshly charged reactor on stream, a butanes and lighter stream being pumped through the heater and to the top of the fresh reactor; the stream being pumped away from the bottom whilst the reactor has been brought to temperature and is switched on stream in series with other reactors. Feed velocity is 2625 lb/sq. ft of reactor cross section, giving a pressure drop of 50 lb through the four reactors. Propylene and butylene are 2·5% of the total crude run, and 86% of these are charged to the polymerization unit. 140 gal of product per pound of catalyst is obtained. G. A. C.

Alkylation.

941. Corrosion in Hydrofluoric Acid Alkylation. F. A. Prange and R. A. Findlay. *Refiner*, 1946, **25** (3), 85–88.—It is concluded that thorough metallurgical investigation and the use of a " corrosion pilot plant " did much to facilitate the rapid development of the H.F. alkylation process from a lab. to plant scale. Ample large-scale experience combined with these investigations has demonstrated that carbon steel suffers very little corrosion in equipment in this process up to temperatures of about 150° F. Monel is satisfactory for considerably higher temperatures and is adequate for the severe conditions of aqueous acid plus oils drawn from the bottom of the acid screen unit at 275–300° F. Copper alloys, with the exception of cupro-nickels, have been found unsatisfactory for concentrated acid service where liquid velocities are high. Chrome stainless steels are also sensitive to velocity.

G. R. N.

Chemical and Physical Refining.

942. Patent Trends in Petroleum Refining. P. J. Gaylor. *Nat. Petrol. News*, 3.4.46, **38** (14), R-251.—New patents disclosing a synthetic lubricant, extreme-pressure lubricants, a viscosity index improver, and soluble oils are discussed.

A Sinclair patent, U.S. 2,395,380, describes an ester-ether mixture of tri-*o*-butyl and tri-*o*-cresyl phosphates and ethylene glycol monobenzyl ether which is claimed to have excellent load-carrying properties, is non-corrosive to metals, and is non-toxic.

U.S.P. 2,395,379 discloses the use of benzaldehyde as a low-temperature lubricant; other patents disclose potent extreme pressure lubricants (U.S.2,394,734), and another claims the use of a polyester by reacting equimolecular proportions of tri*iso*butylene, succinic acid, and decamethylene glycol as a viscosity index improver.

A Cities Service patent (U.S. 2,394,965) discloses a process for manufacturing lubricating oils resistant to oxidation and sludge formation. A Sun Oil Company patent (U.S. 2,395,627) describes a method for producing a material consisting of lubricating oil containing alkali metal soaps of weak synthetic acids, which forms stable water-in-oil emulsion. A flow-sheet of the method is given. G. A. C.

Special Processes.

943. The Dow Process for Styrene Production. J. E. Mitchell, Jr. *Trans. Amer. Inst. chem. Engrs*, 1946, **42** (2), 293.—Because of the large part played by styrene in the synthetic rubber programme, and because of its growing importance in plastic materials, a description of the Dow styrene process seems desirable. This process, used in whole or in part by six of the seven styrene plants in the U.S. and Canada, is producing about 90% of the total styrene made in the U.S.A.

The basic chemistry consists of: (1) Alkylation of benzene with ethylene in the presence of aluminium chloride to form ethylbenzene; (2) Catalytic dehydrogenation of purified ethylbenzene in the presence of steam to give styrene.

Flowsheets are presented for the three essential steps; ethylbenzene production, ethylbenzene dehydrogenation, and styrene finishing. The correlation of operating results with theoretical considerations is brought out. An analysis is made of the most important problems which had to be solved in developing the process to its present status.

The plant layout at Velasco, Texas, as well as specific items of equipment are illustrated and described. Average yields throughout the process are presented.

A general comparison is made between the Dow styrene process and the one used by I.G. Farbenind. in Germany. A. R. J.

944. Process Design of Catalytic Reactors—Dehydrogenation of Butane. R. H. Dodd and K. M. Watson. *Trans. Amer. Inst. chem. Engrs*, 1946, 42 (2), 263.—A small pilot plant was designed and built for the engineering analysis of catalytic processes. The design permits operation over wide ranges of conditions on a variety of systems employing solid catalysts. Operation can be either as an "Integral reactor," to simulate the results of a commercial reactor, or as a "differential reactor" for the direct determination of absolute reaction rates. Such equipment, coupled with sound thermodynamic and kinetic principles, permits the establishment of optimum process conditions from a relatively few small-scale experiments. It is believed that in many cases the usual period of pilot-plant and semi-commercial experimentation may be omitted and optimum large-scale equipment designed directly from fundamental kinetic measurements.

Operability of the equipment was demonstrated by a short study of the dehydrogenation of butane over a chromia-alumina catalyst. It is indicated that the rate of dehydrogenation is controlled by a surface reaction involving dual active centres. The overall selectivity of the reaction is reduced by the cracking of both butane and butenes.

On the basis of these results and data from the literature, simplified equations are developed which permit partial prediction of the results of commercial reactors over wide ranges of conditions. These equations are integrated for isobaric, isothermal reactors to show the variation of conversion and selectivity with temperature, pressure and space velocity. More data are needed for a complete and rigorous analysis. A. R. J.

945. Patent Trends in Petroleum Refining. P. J. Gaylor. *Nat. Petrol. News*, 6.3.46, 38 (10), R-190.—Some new U.S. patents in connection with asphalts, waxes, lubricants, fire extinguishing, chemicals, and diesel fuels are reviewed.

U.S.P. 2,389,680 discloses the use of amino alkylamides of carboxylic acids as binding agents to improve the adhesivity of asphalts, and a table gives the stripping resistance test results. U.S.P. 2,383,521 specifies the use of tetramyl silicone in dewaxing to obtain an oil-free wax of better colour, greater hardness, and higher purity. U.S.P. 2,377,654 describes a foaming resistant gear lubricant prepared by the addition of 0·2–1% of potassium oleate to a 5–10% sulphurized sperm-oil blend; test results are given in a table. Greases containing picoline and silver-stearite are disclosed. The dilution of ethyl bromide by methyl bromide and ethylene chlorobromide to reduce its cost as a fire extinguisher is described in patent 2,389,652; and the production of dialkyl phthalates and chloroprene is described in patents 2,391,849 and 2,391,827.

A Socony-Vacuum patent 2,392,570 covers the removal of aromatics from diesel fuels. G. A. C.

Metering and Control.

946. Fractionation Columns. D. M. Boyd, Jr. *Refiner*, 1946, 25 (4), 147–151.—A straightforward analysis of the problems of control of fractionators subdivided into:

(1) Stripping section temperature control; (2) Rectification section temperature control; and (3) Material balance control. Control of a batch column is also discussed. G. R. N.

947. Orifice Meter in Natural Gasoline Measurement. R. W. Weeks. *Refiner*, 1946, **25** (4), 135–139.—After several years' experience of meter problems in the processing of natural gasoline and light hydrocarbons the author has developed tabulations of meter factors for this application and presents the generally accepted basic data in a usable and accurate form. The tables, charts and calculations given apply to properly constructed meter runs and where the line static pressure is approx. one and one half greater than the vapour pressure of the flowing liquid. G. R. N.

948. The Effect of Measurement Dead Time in Process Control. D. P. Eckman. *Refiner*, 1946, **25** (3), 117–120.—A series of automatic control tests are reported, which demonstrate the importance of instantaneous controller mechanism response in self-balancing potentiometer controllers. The tests were made with both two-position and proportional-reset control. Other tests dealing with the importance of measurement dead zone of the controller are excluded, noting the relation between dead zone of measurement and dead time of controller response. G. R. N.

Safety Precautions.

949. Programme of Safety Inspection. G. Armistead, Jr. *Oil Gas J.*, 20.4.46, **44** (50), 150.—A general discussion is presented on the object and scope of the periodic inspection of refinery equipment. Reference is made to the already standardized inspection processes and to the necessity for checking and developing these methods to meet the advent of newer types of plant and materials introduced during the war years. Emphasis is laid on the proper organization of the refinery inspection department and the need for its personnel to fully appreciate their responsibility in maintaining safety of equipment. I. W. E.

950. Check Your Tube-Still Refractory Lining Maintainance Programme. H. O. Johanson. *Oil Gas J.*, 1.6.46, **45** (4), 69.—Methods and materials for repair and maintenance of tube-still refractory lining are outlined.

Door openings, such as access, explosion, and peepholes, tube hangers, and corners, are the major source of maintenance in suspended walls. Door trouble can be reduced by filling with insulating fire-brick, leaving a small opening as a peephole. Intermediate tube hangers should be correctly designed with a rib to protect the opening and retain the expansion joint material.

Expansion joints should be inspected and repacked. The steel forming the header-box compartment should be insulated, and thus refractory arch trouble at the end roof supports eliminated. Correctly designed offset joints at corners where side walls lap the front, rear, or bridge walls will eliminate trouble, and such joints should be repacked when necessary. Suitable material for packing is a mixture of 50% broken block or plastic insulation with 50% fine clay.

Refractory lined walls should be frequently inspected for leakage, or for failure due to melting, softening, fluxing, spalling, and expansion. Due to its low temperature, melting and softening are not troublesome in a tube-still, fluxing can be avoided by choice of suitable refractories, spalling and expansion problems can be avoided by correct design. G. A. C.

951. Gamma Ray Inspection Method Used to Determine Loss in Wall Thickness of Equipment Serving Gas-Distillate-Wells. E. H. Short. *Oil Gas J.*, 29.6.46, **45** (8), 119.—The use of the Penetron equipment as a means of measuring wall thicknesses of metal equipment of gas-distillate-wells is described and the results obtained with the instrument at 16 selected points in a lateral loop are recorded, in comparison with micrometer measurements taken after torch cutting the loop at 7 of the points, show a high degree of accuracy. The Penetron instrument was developed by the Texaco Development Corpn and is sold by Engineering Laboratories Inc., Tulsa. The instrument, its method of functioning and operation are described. Briefly it makes use of the gamma radiations from 1 mg. radium situated in the head of the instrument, the head also contains a detection that receives the pulsations returned ("back-scattered") by the metal, and forms the means by which the intensity of the returned radiations are measured. The intensity of the radiations increases as a function of the wall thickness. A more detailed account of the Penetron equipment, method of working and operation, is given in the paper described in abstract No. 1143 (1945). W. H. C.

952. Treatment of Hot Resin Burns. W. B. Warden and W. J. Sigmund. *Refiner*, 1946, **25** (3), 89–92.—The discussion of burns resulting from accidental contact with hot asphalt-like materials is presented primarily from the first-aid view-point, although one important feature of the subsequent treatment is suggested for the consideration of the medical profession. The methods proposed involve two radical departures from ordinary procedures. The first-aid steps include: (1) cool rapidly with water, (2) treat for shock, (3) call a doctor, (4) apply a burn ointment or medicated jelly over the resin and surrounding areas and bandage loosely and (5) do not remove the resin. In addition to the actual burn treatment, some definite recommendations are made regarding the handling of hot resinous or thermoplastic-type materials both in plant and laboratory. More effective co-operation between chemists and doctors is stressed. G. R. N.

PRODUCTS.

Chemistry and Physics.

953. The Purification and Physical Constants of Aromatic Hydrocarbons. L. C. Gibbons, J. F. Thompson, T. W. Reynolds, J. I. Wright, J. H. Chanan, J. M. Lamberti, H. F. Hipsher, and J. V. Karabinos. *J. Amer. Chem. Soc.*, 1946, **68**, 1130–1131.—A note giving the freezing point, boiling point, density and refractive index n_D^{20}) of benzene, toluene, ethylbenzene, *n*-propylbenzene, *iso*-propylbenzene, *o*-xylene, *p*-xylene, *m*-diethylbenzene, *p*-cymene, 1 : 3 : 5-triethylbenzene, and 3 : 5-diethyltoluene prepared in bulk for aeronautical research. G. R. N.

954. Isomerization Equilibria among the *n*-Butenes. H. H. Voge and N. C. May. *J. Amer. chem. Soc.*, 1946, **68**, 550–553.—Isomerization of the *n*-butenes was effected by passage over granular catalysts such as silica-alumina-magnesia and Porocel bauxite at temperatures in the range 200° to 630° C. *trans*-2-Butene is the most stable isomer at the lower temperature, but 1-butene and *cis*-2-butene are nearly as stable at the higher temperature. Equilibrium consts. and free energy changes for the isomerization reactions are given, and the results are compared with thermochemical measurements and with other data. G. R. N.

955. Isomerization of Alkanes. I. Effect of Olefins upon the Isomerization of *n*-Butane. H. Pines and R. C. Wackher. *J. Amer. chem. Soc.*, 1946, **68**, 595–599.—Isomerization of *n*-butane in the presence of $AlCl_3$–Hcl and $AlBr_3$–HBr catalyst has been studied using high vacuum technique. Under certain conditions paraffin hydrocarbons do not undergo isomerization by means of aluminium halide–hydrogen halide catalyst unless olefins are present or probably formed *in situ*. It was assumed that the olefins function as a source of carbonium ion. The addition of one part olefin per 10,000 parts of *n*-butane is sufficient to promote isomerization. The effect of olefins, temperature and concentration of HCl upon the degree of isomerization is given. G. R. N.

956. Isomerization of Alkanes. II. Effect of Oxygen on the Isomerization of *n*-Butane and *n*-Pentane. H. Pines and R. C. Wackher. *J. Amer. chem. Soc.*, 1946, **68**, 599–605.—It was found that the addition of 0·007 mole per cent oxygen in the form of air to *n*-pentane is sufficient to convert 40% of the *n*-pentane to butanes and *iso*-pentane using $AlCl_3$ catalyst; in the absence of oxygen there is no reaction. Studies were made of (*a*) the $AlBr_3$–oxygen–hydrocarbon complex formed by the action of air on a *n*-butane solution of $AlBr_3$, (*b*) the action of oxygen on $AlBr_3$, and (*c*) the effect of ethyl aluminium dibromide and of diethylaluminuim bromide on *n*-butane isomerization in the presence and in the absence of air. G. R. N.

957. Thermodynamics of 2 : 2-Dimethylbutane. J. E. Kilpatrick and K. S. Pitzer. *J. Amer. chem. Soc.*, 1946, **68**, 1066–1072.—The heat capacity of 2 : 2-dimethylbutane has been measured from 15° to 280° K and the vapour pressure from 211° to 290° K. The following values were obtained : heats of transition 1289·2 ± 3 cal./mole at 126·81° K ; 67·7 ± 1 cal/mole at 140·88° K ; heat-of fusion 138·5 ± 0·5 cal/mole at 174·16° K ; entropy at 298·16° K, 65·13 ± 0·15 for the liquid and 85·72 ± 0·2 cal/degree mole for the ideal gas. A vibrational assignment is made and the average potential barrier to internal rotation calculated to be 4375 cal/mole. G. R. N.

958. Thermodynamics of *cyclo*Propane. R. A. Ruehrwein and T. M. Powell. *J. Amer. chem. Soc.*, 1946, **68**, 1063–1066.—The heat capacity of solid and liquid *cyclo*propane has been measured from 15° K to the boiling point. The m.p. and b.p. were 145·54° and 240·30° K respectively. The heats of fusion and vaporization were determined colorimetrically and were 1301 and 4793 cal/mole^{-1} respectively. The density of *cyclo*propane gas at 298·1° K and one atmosphere was 1·7463 gms/litre. The vapour pressure of liquid *cyclo*propane is given by an equation derived from the data obtained. The most reliable value of the entropy of the gas is given as 56·84 cal/degree per mole at 298·1° K and one atmosphere. G. R. N.

959. Thermodynamic Properties of Gaseous 1 : 3-Butadiene and the Normal Butenes above 25° C. Equilibria in the System—1 : 3-Butadiene, *n*-Butenes, and *n*-Butane. J. G. Aston, G. Szasz, H. W. Woolley, and F. G. Brickwedde. *J. Chem. Phys.*, 1946, **14**, 67.—Tables of thermodynamic properties of 1 : 3-butadiene and the three normal butenes in the ideal gas state for temperatures from 298·16° K to 1500° K at one atmosphere pressure are given. These have been prepared using spectroscopic and molecular data, together with calorimetric entropies, gaseous specific heats and heats of formation. Equilibrium constants are given for reactions in the system 1 : 3-butadiene, *n*-butenes, and *n*-butane. Available experimental data are compared with the calculations. The calorimetric data for 1 : 3-butadiene furnish strong evidence for the existence of *cis-trans* isomeric forms of 1 : 3-butadiene in appreciable concentrations at room temperatures. The two forms differ in energy by 2·3° K cal.mole^{-1} and are separated by a C–C rotational barrier 2·6° K cal.mole^{-1} above the lowest energy level of the *cis*, or higher, energy form. J. T.

960. The Mercury Photosensitized Reactions of Propylene and Isoprene. H. E. Gunning and E. W. R. Steacie. *J. Chem. Phys.*, 1946, **14**, 47.—An investigation has been made of the reactions of propylene and isoprene with mercury $(^3P_1)$ atoms at 30° C in a static system. The reactions are similar in that the rates of consumption of both propylene and isoprene decrease with increasing pressure in the range of complete quenching. In addition, the quantum yields of both reactions are low. The products of the propylene reaction are liquid polymer and hydrogen, together with smaller amounts of methane, ethylene, and hexene. J. T.

961. Near Ultra-Violet Absorption of Pyridine Vapour. H. Sponer and H. Stücklen. *J. Chem. Phys.*, 1946, **14**, 101.—The absorption spectrum of pyridine at 3000–2500 Å. has been studied in the first order of a 3-m grating spectrograph. Besides carbon ring vibrations the occurrence of hydrogen vibrations is established and discussed. J. T.

962. A New Approach to the Theory of Relaxing Polymeric Media. M. S. Green and A. V. Tobolsky. *J. Chem. Phys.*, 1946, **14**, 80.—A molecular theory of relaxing media is presented which gives an expression for the stress in terms of the strain history. At any given time the strain history produces a distribution in internal strains which for mechanical properties can be characterized by a limited number of internal strain parameters. The second law of thermodynamics is used to define dissipation of energy at constant temperature, and explicit expressions for dissipation of energy for any strain history are obtained. Inasmuch as relaxation during straining causes an essential reorganization of structure which is in fact the cause of dissipation, the kinetic theory of elasticity is extended to non-isotropic polymeric networks. A tensor expression for the stress–strain–time relations is thereby developed. J. T.

963. Stress–Time–Temperature Relations in Polysulphide Rubbers. M. D. Stern and A. V. Tobolsky. *J. Chem. Phys.*, 1946, **14**, 93.—Polysulphide rubbers of various internal structures have been investigated by measurements of continuous and intermittent relaxation of stress and by creep under constant load at temperatures between 35° C and 120° C. Continuous stress relaxation measurements indicate that these rubbers approximately obey the simple Maxwellian law of relaxation of stress, which indicates that one definite type of bond in the network structure is responsible for stress decay. The activation energy for the relaxation process in each of the polysulphide rubbers is nearly the same, indicating that the same type of bond is responsible for the relaxation behaviour of all the polysulphides investigated. In contrast to the hydrocarbon rubbers, oxygen is not the cause of high-temperature relaxation in polysulphide rubbers, nor does heating in air at moderate temperatures for times comparable to the relaxation time produce changes in physical properties as determined by modulus or by appearance of the samples. Several possibilities regarding the mechanism of the relaxation process and the type of bond involved are considered in the light of the experimental results. J. T.

Analysis and Testing.

964. The Determination of Organic Peroxides in Hydrocarbons. E. M. Tanner and T. F. Brown. *J. Inst. Petrol.*, June 1946, **32** (279), 341–350.—In an attempt to find a method suitable for the estimation of organic peroxides of the type R–O–O–R′ in hydrocarbon oils, several methods of peroxide determination published in the literature were tested. The results obtained were very low, and a method specially suitable for hydrocarbon oils was developed, based on the reduction of the peroxide by ferrous ammonium sulphate in an inert atmosphere and subsequent titration of the excess ferrous salt with standard potassium dichromate solution. The method has also been extended to the determination of peroxides formed in cracked gasolines.

A. H. N.

965. Equation Relating Density. Refractive Index and Mol. Wt. for Paraffins and Naphthenes. M. R. Lipken and C. C. Martin. *Ind. Eng. Chem. Anal.*, 1946, **18**, 382–382.

The equation derived is $n = \dfrac{69{\cdot}878d - 0{\cdot}4044Ad - 0{\cdot}797A + 135{\cdot}566}{5{\cdot}543d - 0{\cdot}746A + 126{\cdot}683}$

or in an alternative form $d = \dfrac{126{\cdot}683n - 0{\cdot}746An + 0{\cdot}797A - 136{\cdot}566}{-\ 5{\cdot}543n - 0{\cdot}4044A + 69{\cdot}878}$

where n = refractive index at 20° C for the sodium D line, d = density at 20° C, and A = – 10° × temperature coefficient of density derived from the approximate mol. wt. The equation correlates density and refractive index for paraffins, naphthenes, and mixtures of saturated hydrocarbons in the liquid state more accurately than previous equations, and does not require a knowledge of molecular formula or structure. G. R. N.

966. Analysis for Naphthene Ring in Mixtures of Paraffins and Naphthenes. M. R. Lipkin, C. C. Martin, and S. S. Kurtz. *Ind. Eng. Chem. Anal.*, 1946, **18**, 376–380.—This paper continues a general investigation of the interrelationship of physical properties and gives a new method based on the temperature coefficient of density and either density or refractive index which is recommended for the analysis of ring content in mixtures of paraffins and naphthenes. When tested on the data for pure compounds the method shows an average deviation of 8%, due mainly to isomer effect. The accuracy of the method is dependent to some extent on the degree of condensation of the naphthene rings, and is unsatisfactory for bridged ring naphthenes and single naphthene rings containing more than 8 carbon atoms in the ring. The method is compared with other methods of ring analysis. The two equations employed take the form :

$$\text{Weight \% ring} = \frac{A + 190{\cdot}0d - 217{\cdot}9}{0{\cdot}593d - 0{\cdot}249} \text{ for } d < 0{\cdot}861$$

$$\text{Weight \% ring} = \frac{A + 102{\cdot}8d - 142{\cdot}8}{0{\cdot}262} \text{ for } d > 0{\cdot}861$$

where d = density at 20° C and $A = -10^5 \times$ temperature coefficient of density derived from mol. wt. G. R. N.

967. Simultaneous Determination of Hydrogen Sulphide and Carbon Dioxide in a Continuous Stream of Natural Gas. C. L. Blohm and F. C. Riesenfeld. *Ind. Eng. Chem. Anal.*, 1946, **18**, 373–376.—Simple laboratory equipment is employed and the two gases are absorbed in standardized barium hydroxide and iodine solutions. The method has an accuracy of the same order as that of other methods, *i.e.*, ± 2·5%. The method is adaptable to routine field testing. G. R. N.

968. Rapid Test for *iso*Butane Plus an Absorber Residue Gas. G. M. Liljenstein and W. M. Schaufelberger. *Refiner*, 1946, **25** (4), 129–134.—The new test was developed along the lines of the Butane Weathering test for pentanes + in which a measured vol of the gas is passed through liquid butane at − 44° F and the contacted solvent weathered to a prescribed end point temperature. The *iso*butane + test is carried out at − 110° F and employs liquid propane. A combination of the two methods provides a means for determining the butanes and the pentanes + contents of absorber residue gases. The butanes may be split into *iso*- and normal butane when absorption factor and intake composition data are known. A test may be completed in about 2 hours. It can be used to obtain absorption factor-residue loss curves with which absorber losses can be evaluated over a range of operating conditions. G. R. N.

969. Estimation of Naphthalene in Absorber Oil. P. E. Reichardt and D. L. White. *Ind. Eng. Chem. Anal.*, 1946, **18**, 286–288.—Modifications of the general method of volatilization of the naphthalene by means of air from the spent absorber oil are described. These reduce the time of procedure from 15 to 3 hours. The naphthalene is determined as picrate. G. R. N.

970. Determination of Small Amounts of Aromatic Hydrocarbons in Aqueous Solutions. H. E. Morris, R. B. Stiles, and W. H. Lane. *Ind. Eng. Chem. Anal.*, 1946, **18**, 294–295.—The aqueous solution is shaken with carbon tetrachloride and after settling the latter is separated and shaken with a sulphuric acid-formaldehyde reagent. The brown colour imparted to the reagent is matched with another portion of the reagent used with an aqueous solution containing a known amount of aromatic hydrocarbon. The determination of small amounts, 1 to 500 parts per million is accurate to ± 10%. The sensitivity is 0·0001 gm of aromatic hydrocarbon. G. R. N.

971. Determination of Tetraethyllead in Gasoline. M. V. Sullivan and H. Friedman. *Ind. Eng. Chem. Anal.*, 1946, **18**, 304–306.—A method is described which it is claimed is equivalent in accuracy to chemical analysis and can be completed by an unskilled worker in 5 minutes in which tetraethyllead can be determined in leaded gasoline. Standard deviation was 1% or 0·05 ml/gal of gasoline. The method involves the use of X-ray absorption equipment and a Geiger counter. G. R. N.

972. A Photographic Viscometric Apparatus. J. L. Riley and G. W. Seymour. *Ind. Eng. Chem. Anal.*, 1946, **18**, 387–390.—An apparatus is described for the accurate determination of flow times in Ostwald type viscometers. Means of measurement and control of the variables have been designed on the principle of making approximate equal contributions on the final error. A unique feature is the automatic timing device. Motion pictures are made of meniscus transits in the viscometer and of the virtual image of an accurate electronically operated clock. Times of transit are interpolated from the pictures to 0·001 sec. G. R. N.

Crude Oil.

973. Crude Oil Desalting. F. D. Fuqua. *Refiner*, 1946, **25** (4), 140–146.—The salt-removal system described consists essentially of a baffle tube, vertical settler and horizontal settler together with the usual auxiliary equipment. Typical operating data on a paraffinic crude is given and the following observations are made. Best emulsification is obtained with 40 to 50 lb pressure drop across the emulsifying valve.

Temperature within the vertical settler must be maintained for desired emulsion-breaking viscosities (200–220° F); pressure should be sufficient to prevent vaporization (130–150 lb/sq in). Additional contact of water and crude should be induced after lowering the viscosity of the crude. Water should be adequately metered to maintain a constant fresh-water charge for a reasonable brine concentration within the vertical settler (5–15% by vol of crude). G. R. N.

Gas.

974. **The Picture for Liquefied Petroleum Gases.** G. G. Oberfell and R. W. Thomas. *Oil Gas J.*, 8.6.46, **45** (5), 60.—A review of estimated consumption of liquefied petroleum gases is given.

Large quantities of these gases were used during the war for production of aviation gasoline and synthetic rubber components; and important present markets include with these motor gasoline blending, refining processes, chemicals, carbon black, and plant fuel. For example, between 2 and 4 million gal/day of C_4's will be required for motor fuel and aviation blends, and 700,000 gal for the synthetic rubber industry. As for resources, large volumes will be available from cycling and natural gasoline plants, and extraction from this and other sources may increase average cost of the gases to industry.

Transportation and storage will present problems, and it is estimated that to deliver one tank car per month to a user requires an average investment of $5000. G. A. C.

975. **New Formulations of Aerosols Dispersed by Liquefied Gases.** E. R. McGovran, J. H. Fales, and L. D. Goodhue. *Econ. Entomology*, April 1946, **39** (2), 216.—Tests of various liquefied-gas aerosol formulæ against houseflies and mosquitoes are described.

A large number of formulæ were tested at the Agricultural Research Centre, Beltsville, Md., to serve as a basis for further research. The formulas were tested on house-flies, *Musca domestica* L, and mosquitoes, *Anopheles quadrimaculus* Say, and *Aedes aegypti* L, released in a Peet-Grady chamber.

The aerosol was introduced by the pendulum method, or with a laboratory dispenser or modification. Counts were made 5, 10, and 15 min after release of aerosol, all insects being collected after 15 min observation, placed in recovery cages and mortality counts made next day.

The pyrethrum extract used contained 20% of pyrethrins, the D.D.T. was a purified aerosol grade containing at least 99% of the para-para isomer.

Increasing the sesame oil and non-volatile content, substituting piperonyl *cyclo*hexanone for sesame oil as synergist, and using suitable solvents resulted in greatly improved toxicity of the aerosol formulæ.

When combined with pyrethrum, D.D.T. has some additive effect on knock-down of house-flies, and higher D.D.T. concentrations increased effectiveness against mosquitoes, but the pyrethrum is the primary lethal factor.

Formulations in Freon, with *cyclo*hexanone, lubricating oil, deodorized kerosine, pentanes, an aromatic petroleum solvent, xylene and methylene chloride gave high toxicity against mosquitoes and house-flies. Carbon dioxide packed in soda-syphon cartridge-type containers was satisfactory as a propellant. G. A. C.

976. **Conversion of Dry Natural Gas to Liquid Fuels.** R. C. Alden. *World Petrol.*, April 1946, **17** (4), 46.—A review of the Fischer–Tropsch and other processes utilizing dry natural gases is given.

Experiments in progress since 1913 in Germany led to the large-scale production of hydrocarbons by 1933. The first plants were operated at approximately atmospheric pressure, using purified synthesis gas containing two parts of hydrogen to one of carbon monoxide and 10% of inert gases made from coal, coke-oven gas or that produced from the complete gasification of coal or coke with steam and oxygen. All traces of sulphur compounds must be removed. Reaction temperature is about 350–400° F, cobalt promoted with thoria and supported on kieselguhr is the catalyst commonly used. The large quantity of heat liberated in the reaction must be rapidly removed. The products and unconverted gas are separated in conventional cooling apparatus, the unconverted gas, which contains hydrogen, carbon monoxide, methane, carbon dioxide, small amounts of propane, butane, and the inerts originally present, being re-processed.

By 1936 an improved process operating at 100–150 p.s.i. was in use, giving slightly higher yields of liquid and solid hydrocarbons.

Approximately 1 ton of product is obtained for every 5 tons of bituminous coal used for all purposes.

The highly normal paraffinic nature of Fischer–Tropsch oils makes them valuable as diesel fuels. The gasoline fraction consists mainly of normal olefines and paraffins, with traces of aromatics.

The solid paraffins or waxes range from very hard high-molecular-weight varieties to the softer more common types. In 1933 the plant capacity was 7000 brl/year, 805,000 in 1936, and by 1944 capacity was 5,590,000 brl of various products. Investigations are proceeding in the United States for the development of the process using natural gas. By a typical process natural gas, steam, and oxygen are heated to 1600° F, and reacted at atmospheric pressure, and from 1000 cu. ft of methane it should be possible to obtain 6·5 gal of motor fuel. The cost of raw material is estimated at $0·0024/gal of gasoline. The use of this process to dispose of excess quantities of dry gas in the States is potentially attractive. Compared with coal as the starting material, it is estimated that it is cheaper to produce gasoline from dry natural gas, and the process may be competitive with present refinery methods utilizing crude petroleum. Several American companies are studying the processes, including the Texas Company and the Kellogg Company.

Other methods of converting dry natural gas into liquid fuels are being investigated, ncluding the direct conversion of methane and ethane to liquid fuels by high-temperature pyrolysis, by one step; but yields are considerably lower than those from the Fischer–Tropsch process. Other methods include the direct high-temperature and high-pressure methanation of tar and oils and interaction of methane and carbon monoxide at high pressure. G. A. C.

Engine Fuels.

977. Effect of Leaded Fuels on Cobalt-Bearing Exhaust Valve Materials. Anon. *Oil Gas J.*, 18.5.46, **45** (2), 153.—Alloys containing stated percentages of carbon, silicon, manganese, cobalt, chromium, and tungsten have been used for valves and seats in internal-combustion engines using leaded fuels, and results investigated. Hard-facing alloys containing 1 to 36% cobalt exhibit same resistance to scaling as do similar materials containing 60 to 65%; those with 30 to 36% are as resistant as alloys containing 60% cobalt. The relation of cobalt content to amount of scaling or erosion is the same as when lead-free fuel is used. The effect of carbon content is important, the scaling resistance of chromium steels decreasing with a corresponding increase in carbon content. Tungsten content is a contributing factor.

G. A. C.

Gas Oil and Fuel Oil.

978. Socony-Pot Burner Development Handles 25 Gravity Catalytic Oil. Anon. *Fuel Oil and Oil Heat*, May 1946, **5** (1), 77.—A brief description is given of an improved pot-type burner, developed by the Socony-Vacuum Co, which gives a blue-white flame and high combustion efficiency when operating on straight catalytic fuels. The burner consists of a circular slightly cone-shaped pot casing with an inclined refractory-lined inner bottom, and the oil inlet at its centre. Above this a central baffle-plate is fixed to protect the oil from cracking by the direct heat of the flame, and above this plate a wall baffle is placed, which induces better mixing of the primary air and the oil vapours. Both plate and baffle are fixed at predetermine heights from the oil on the bottom, which allows thorough pre-mixing of the oil vapours and primary air at reasonably low temperatures and permits partial oxidation. At the top of the pot burner casing a series of air ducts causes secondary air to be admitted to assist combustion. Performance curves are discussed, and are given in a table for the original and the improved burners; these show that it is possible to obtain a satisfactory smoke rating with the improved burner at a much lower draft than with the original. The flue gases had a CO_2 content of 11·8% and 14% at low and high fire, respectively. The smoke ratings are described; they were made by means of an ICHAM instrument, developed for the purpose. W. H. C.

Lubricants.

979. Viscosity of Oils. W. L. Nelson. *Oil Gas J.*, 18.5.46, **45** (2), 163.—No. 93 in the *Refiner's Notebook* series illustrates, by means of a table and graph, a method of determining the viscosity index of an oil from its viscosity at a stated temperature in conjunction with the A.P.I. gravity. G. A. C.

980. The Development of Improved Turbine Oils. C. N. Smith and G. H. S. Snyder. *J. Inst. Petrol.*, June 1946, **32** (279), 313–322.—The need to inhibit oxidation in turbine oils was met by using antioxidants, but these in turn produced a problem. Rusting of metal surfaces was apparently inhibited by the oxidation products of the oils, and thus, by reducing oxidation, rusting was enhanced. Rust-inhibited turbine oils had to be developed. Thus a need for adequately testing turbine oils for oxidation and rust inhibition arose. These methods of testing are discussed in the paper. Field tests of turbine oils are also briefly discussed. A. H. N.

981. Acryloid 150—Pour Point Improver. Anon. *Oil Gas J.*, 20.4.46, **44** (50), 142.—A new synthetic pour-point depressant developed by Rohm & Haas, Philadelphia, is also claimed to raise the VI of a lubricating oil. Its composition is not disclosed, but it is probably a polymer, copolymer, or condensation product of some type, possibly an acrylic-acid derivative. Supplied in a relatively viscous form, 1·25% added to an oil of pour point + 20° F, lowered this to − 25° F while raising the VI from 114 to 130. I. W. E.

982. Syntho Lubes from Ethylene Condensation. H. Schildwachter. *Refiner*, 1946, **25** (3), 109–113.—Condensation of ethylene with coal-tar fractions, naphthalene, and tetralin gives good yields of satisfactory lubricants. The viscosity of these synthetic oils can be increased further by treatment with the silent electric discharge. The oils show good stability under heat, are free of asphalt and potential sludge components, and do not form tars during oxidation at 120° C. Even after electrical treatment these oils have a low V.I., but this can be overcome by the addition of voltolized fatty oils. G. R. N.

983. " Ucon " Synthetic Lubricants in the U.S.A. Anon. *Petrol. Times*, 22.6.46, **50** (1276), 633–634.—These oils have, until recently, been on the secret list. They were produced by Carbide and Carbon Chemicals Corpn. as synthetical compounds

TABLE I.

LB Series " Ucon " Synthetic Lubricants.

Grade.	LB-140.	LB-300.	LB-400.	LB-550.	LB-650.
Sp. gr. at 60° F.	0·983	0·997	1·001	1·003	1·004
Flash point, ° F.	440	470	485	510	525
Fire Point, ° F.	510	570	580	580	580
Saybolt viscosity—					
Univ. secs. at 210° F.	45·5	62·7	74·3	91·9	107
100° F.	140	300	400	550	650
0° F.	4,960	18,380	27,600	40,800	50,500
−30° F.	42,100	183,000	284,000	444,000	—
−50° F.	265,000	—	—	—	—
Kinematic viscosity—					
Centistokes at 210° F.	5·9	11	14·1	18·1	22
100° F.	29·8	65	86·6	119	141
0° F.	1,080	4,000	6,000	8,900	11,000
−30° F.	9,200	40,000	62,000	97,000	—
−50° F.	58,000	—	—	—	—
Viscosity index	147	142	142	140	140
Pour point, ° F.	−50	−40	−35	−30	−25
Conradson carbon residue %	← Less than 0·01 →				
Ash %	← Less than 0·01 →				

which contain no petroleum base. At present there are two series under manufacture, the "LB" series being essentially insoluble in water, and the "50-HB" series, being soluble in water at room temperature; of those the LB series is of prime interest, having been applied to lubrication of internal combustion engines on land and in the air. The general properties of the LB series are reproduced in Table I.

The manufacturing process is undisclosed, but it is claimed that wide ranges in viscosities are attainable by controlling manufacturing variables.

There is some difficulty in applying present-day classification standards to these synthetic oils. A. H. N.

984. Secrets of German Lubricating Oil Technology Revealed. Part III. C. I. Kelly. *Petrol. Times*, 8.6.46, **50** (1275), 566.—Whilst it describes the Germans' approach to the designing and manufacturing of hydrocarbons with molecular structures, and properties conforming to their concepts of an ideal lubricating oil—an American expert's appraisal stresses the degree of practical success attained—there is in this review a brief historical survey of advances in the separation and identification of classes of hydrocarbons in mineral lubricating oils. The reviewer makes it evident that a fuller understanding of hydrocarbon molecular structures and properties has been and is being energetically sought, so that it may be known more definitely which hydrocarbons should, during refining, be left in the finished products. It emerges from this review of CIOS, BIOS, and FIAT Reports, both informative and interesting in this matter, that the Germans have not altogether disclosed the fundamental data on the many branched-chain paraffinic hydrocarbons synthesized and later reproduced on a large scale in Germany during the war. A conclusion is reached that in addition to the existing need for their filling of many other gaps in their information, the Germans should release for early publication the properties of these synthesized hydrocarbons which with proved molecular structure are almost in a class of their own, not previously extensively explored. Thus can the value of invisible reparations be increased and a speedier solution of current problems, in the sphere of identification and more profitable separation of hydrocarbons in petroleum lubricating oils, be facilitated. A. H. N.

985. Secrets of German Lubricating Oil Technology Revealed. Part IV. C. I. Kelly. *Petrol. Times*, 22.6.46, **50** (1276), 655.—In this part the ester oils developed by I.G. are studied in detail. The general attitude adopted against the use of fatty oils in Germany, Britain, and U.S.A. is noted. In a search for materials with "oiliness" oxygenated compounds were studied, and, of these, the esters in particular. Of the esters examined during a long programme of research, the following are some examples:

TABLE I.

Properties of Some Synthetic Ester-Lubricating Oils.

Organic acid.	Adipic.	Beta Methyl-adipic.	Sebacic.	Mixed Cymono-carboxylic acids.
Alcohol.	Iso- and normal octyl.*	Normal octyl.	Iso-octyl.	Trimethylol-ethane.
Density at 68° F.	0·922	0·920	0·912	0·958
Viscosity, Saybolt—				
Univ. secs. at 122° F.	45·5	48	54	62
100° F.	50	55	65	81
Viscosity index	191	228	189	157
Pour point, ° F.	−11	−33	below −98	−94
Flash point, ° F.	405	440	445	465

* Half ester of each alcohol.

Some of these properties are misleading, *e.g.*, although the V.I. is high, the blending V.I. of these compounds does not seem to be so high. The ideal ester is found to be a simple one of straight, thin, unbranched chains. The manufacturing process of commercial esters is described. A. H. N.

986. Heat of Wetting of Metal Surfaces by Oils. H. H. Herbst. *Refiner*, 1946, **25** (3), 12–25.—The heat of wetting of oils on metallic surfaces is proportional to the lubricity of the oil. The heat rise is small when measured on a straight metal surface, so finely divided metallic powders have been employed to assess this property. This has the disadvantage that the true surface area is not well defined, so that certain adsorption concepts must be taken into account. The author shows capillary structure, and ultra-porosity exerts considerable influence, and to overcome the unknown effect of these variables describes an apparatus wherein the heat of wetting is carried out directly on the smooth metal or bearing metal itself. G. R. N.

987. Phemenbria in the Oil Insulation of Pressurized Electric Cables. C. F. Proos. *Ingenieur*, 1946, **58**, E 27–37.—A series of full-scale experiments on a 300-ft length of pressurized cable is described. The cable was insulated with oil impregnated paper, the insulation being maintained under pressure. The oil is not specified.

The effect of variations in temperature (range 2° to 50° C) and voltage (range 0 to 175 kV) on loss factor (tg. δ) has been measured. Additional data were collected on the copper distribution throughout the paper insulation in the aged cable, and the insulating properties of the oil recovered from the various layers of the paper wrapping. Spreading measurements on the recovered oil using an oil–water interphase yielded information on the presence of polar (oxidation) products in the aged oil. These spreading measurements appeared to be very sensitive, and were capable of indicating changes before the electrical properties were affected.

The deterioration of the electric insulation during use is ascribed to the presence of polar decomposition products dispersed in the oil phase. Under the influence of the electric field, these polar bodies are deposited on the paper, thereby aggravating the dielectric losses. M. B.

988. Practical Experiences with Sleeve Bearings of High-Speed (Diesel) Engines. F. C. van Asperen. *Ingenieur*, 1946, **58**, W. 1–5.—A general discussion of the effect of temperature on wear and "life" of white-metal sleeve bearings, gudgeon pins, and crankshafts based on results obtained during the running-in of new high-speed Werkspoor diesel engines. The importance of the cooling function of luboil is stressed and some data are presented on bearing temperatures and oil temperatures as a function of load and operating time, together with some previously published data by C. G. Williams (General Discussion of Lubrication, London, 1937). M. B.

989. Bearing Corrosion. Part 2. H. H. Zuidema. *Oil Gas J.*, 23.2.46, **44** (42), 151.—Laboratory tests indicate that bearing metals differ widely in their resistance to corrosion. In particular experiments carried out by the Underwood, the Existent Corrosivity and the Thrust Bearing Corrosion tests show certain trends which agree well with engine tests. The babbitts were practically inert in these tests, while Cu–Pb, Cd–Ag, and Cd–Ni were attacked in increasing order.

Corrosion can be reduced by covering the metal surface with another metal or alloy, such as the indium plating of cadmium–silver, or by the addition of a small amount of another metal in the bearing alloy.

Bearing corrosion may be of three types :—

(1) Acid corrosion by far the most prevalent, and involving the solution by acid of a metal relatively high in the electromotive series.

(2) "Sulphur" corrosion particularly serious with silver bearings and the copper matrix of Cu–Pb.

(3) Corrosion by aqueous acids, which occurs with low temperatures and insufficient venting again affecting mainly copper.

The paper includes as an appendix a summary of the compounds claimed in U.S. Patents as bearing corrosion inhibitors. D. L. S.

990. Bearing Corrosion. Part 3. H. H. Zuidema. *Oil Gas J.*, 2.3.46, 44 (43), 66.—Corrosion of a given bearing alloy is determined by the following ten factors, half of which are engine and the rest oil factors.

> (1) *Temperature* affects corrosion principally through its effect on the rate of oxidation of the lubricating oil, which is approximately doubled for each 10° C rise. In addition, there may be a mechanical factor, since the hardness of bearing alloys decreases with temperature and weight losses due to abrasion may be more serious at higher temperatures.
>
> (2) *Bearing load* is in general not critical. Variation in thrust from 15 to 125 p.s.i. has comparatively little effect on corrosion in the T.B.C. apparatus.
>
> (3) *Venting* can affect corrosion in two ways operating in opposite directions. Increased air flow increases oxidation rate, and thus increases the rate of formation of corrosive acids. However, venting removes the more volatile acids, so that the net effect depends on the relative importance of the two factors.
>
> (4) *Type of fuel* is of importance when considering corrosion. Thus acids produced by the fuel may be corrosive, while the lacquer depositing tendencies of unstable fuels must also be considered. Decomposition products of TEL can form iron halides which are powerful catalysts for the oxidation of oil.
>
> (5) *Oxidation stability of the lubricant* naturally controls the formation of corrosive oxidation products.
>
> (6) *Type of deterioration products formed in lubricant* is of great importance, since these products can vary from inert to highly active substances.
>
> (7) *Detergency.* Detergent oils tend to remove lacquer films from the bearings, leaving the surfaces bare and vulnerable to attack by acids.
>
> (8) *Passivation of bearing surfaces* can best be achieved by incorporating a compound in the oil capable of forming a protective film on these surfaces.
>
> (9) *Action of sulphur* can be harmful if the sulphide film formed, *e.g.*, with copper in Cu–Pb bearings flakes off as hard, brittle particles.
>
> (10) *Presence of water* may increase the corrosive effect of acid deterioration products, which in solution in water form highly corrosive solutions.

Four principal means of controlling corrosion are suggested: (*a*) Use of new bearing types, *e.g.*, sandwich type or indium treated bearings; (*b*) Operation of engines at lower temperatures; (*c*) Selection of suitable lubricants; (*d*) Use of suitable inhibitors. D. L. S.

Bitumen, Asphalt and Tar.

991. Behaviour of Asphalts in Thin-Film Oven Test. R. H. Lewis and W. J. Halstead. *Public Roads*, April–May–June 1946, 24 (8), 220.—Information on the behaviour of 60–70, 100–120, and 120–150 penetration grades of asphalts in the thin-film test is presented.

Seventeen asphalts from various sources, which had been stored in unopened metal containers for 6 years, were used in the work; the top ½-inch being removed, and the balance liquefied. Tests on both were made, and showed surface hardening, but no appreciable change had occurred in the bulk of the material for most samples. For the remaining study, specific gravity, softening point, penetration, and ductility figures were determined on the original asphalt and on residue after the oven test. Tabulated results show little significance in the amount of change in weight of the samples; the percentage of original penetration retained by the residue from the oven test shows a tendency to decrease with increases in original penetration, but there are deviations. The percentage increase in softening point of the residue as compared with that of the original material tends to increase as the percentage of retained penetration decreases. When compared at the same penetration, residues from thin-film oven test have lower ductility than the original asphalt. Among a number of conclusions based on these results are that for asphalts from the same base and process, the relation of the ductility to penetration is the same for all penetration grades, regardless of the temperature at which a given penetration occurs, and the ductilities of the thin-film oven test residues show a common relation to penetration that is different from the relation for the original asphalt.

Specification requirements regarding loss in weight and penetration of residue are suitable for all asphalts from 50–60 to 120–150 grades. G. A. C.

Special Hydrocarbon Products.

992. Production of Toluene from Petroleum. D. A. Howes. *Industr. Chem.*, 1946, 22, 403–413.—After a brief historical review, the author traces the development of modern methods for the production of toluene from petroleum. The methods considered are superfractionation, azeotropic distillation, extractive distillation, hydroforming, cyclization. F. S. A.

Derived Chemical Products.

993. By-Products of Oil Refining. Anon. *Paint Technology*, March 1946, **11** (123), 113.—U.S. Patents 185,951–2 and No. 2,247,411, granted to F. Rostler, V. Mehner, and L. Bornstein, relate, respectively, to the methods of recovery of waste hydrocarbon materials from acid sludges or the residues from solvent refining, and the use of the product as a constituent of varnish resins. The recovered hydrocarbon material is generally a red-brown viscous fluid resinous material with a greenish fluorescence; it is slightly unsaturated and has a molecular weight of from 400 to 1000. It is soluble in most organic solvents and in concentrated sulphuric acid, and is capable of polymerization, condensation, and is reactive with concentrated, though not dilute, reagents. Sulphur produces an effect similar to the vulcanization of rubber. As constituents of resinous condensates, these petroleum by-products are said to have a plasticizing effect, increasing fluidity without much affecting the hardening time. Stoving finishes made from such are said to have electrical properties and high resistance to fatty oils, acids, and water. With linseed oil good varnishes are formed, similar to those formerly based exclusively on tung oil. When the amount of hydrocarbon material is relatively large, the linseed oil appears to act as a softener. Descriptions are given of the condensation of the hydrocarbon material with formaldehyde, cresols, and ammonia in the production of resinous condensates. The characteristics of the condensation products, and the production of stoving finishes from them by the addition of alcohol–benzene mixtures, methyl*cyclo*hexanol or acetone, and of a transparent wire-enamelling (insulating) varnish, are briefly noted. W. H. C.

994. Hydrocarbon Drying Oils. *Paint Technology*, April 1946, **11** (124), 150.—U.S. Patent 2,258,821, granted to the Standard Oil Co., H. M. Steininger and R. J. Diwoky, relates to certain fractions derived from naphtha reformer tars, from reforming operations which are highly satisfactory as drying oils. The drying characteristics of the fractions increasing with the severity of the reforming conditions. Suitable fractions are those having Saybolt viscosities of 35–100 sec at 100° F and Nanus iodine values from 75–100. Similar products may also be obtained from the tars by extraction with solvents having a selective affinity for unsaturated compounds.
W. H. C.

995. Processes for Making Nitrile Compounds Patented by Three Oil Companies. D. P. Thornton. *Nat. Petrol. News*, 6.3.46, **38** (10), R-221.—Claims in a number of patents for the production of nitrile compounds are reviewed.

Amines, nitriles, and their derivatives have uses as addition agents in lubricants, fuels, synthetic rubber, plastics, and as an intermediate for further chemical synthesis. A number of patents have been taken out for the production of these compounds by the major oil companies.

A Phillips patent discloses the manufacture of acrylonitrile from methane or ethane, and ammonia, the first step being pyrolysis in the range 1300 to 1500° C at a pressure of 200 mm. of mercury, followed by a catalytic treatment of the cooled gases. Catalysts used include sodium cyanide, contained in a conventional solid bed. Products leaving the catalyst chamber include acrylonitrile, hydrogen, and methane, and after a water quench the nitrile is removed by fractional distillation.

A Shell patent uses unsaturated allyl amines, and is based on catalytic oxidation in the presence of metallic silver or copper, yields of 72 to 89% being reported. The process requires continuous, intermittent or batch vapour-phase reaction at 450 to 600° C at atmospheric pressure.

Separation of the nitrile is dependent on nature of diluent used, but when this is steam, the gases are condensed.

A method of protecting unsaturated nitriles from autopolymerization during storage by using an alpha beta unsaturated amine is given in Shell's patent.

Five patents have been taken out by Sinclair covering preparation of amines and nitriles by direct catalytic reaction of the corresponding olefin hydrocarbons with ammonia. The process may operate either as a batch type, intermittently or in a continuous manner. Optimum reaction temperature is from 500 to 600° F under pressure of 2000 p.s.i., polymerization of the olefinic charge being promoted by high temperatures. Equipment required includes a pump, reactor, cooler, and product receiver.

One patent (2,381,473) deals with the preparation and demonstration of efficiency of cobalt-on-silica catalysts, promoted with manganous oxide. G. A. C.

Miscellaneous Products.

996. D.D.T. to Control Hornflies and Gulf Coast Ticks on Range Cattle in Florida. J. G. Matthyssee. *Econ. Entomology*, Feb. 1946, **39** (1), 62.—Results of using six different methods of spraying cattle for control of hornflies are reviewed.

Methods included complete and incomplete spraying, either as cattle were held in a chute as they ran from the pen or through a bank of nozzles arranged around the inside of the chute. Dipping of cattle was also employed.

The severe conditions of southern Florida made it necessary to use higher concentrations of D.D.T. than were used previously in other areas. Sprays at from 0·1 to 0·2% gave deposits that were effective against hornflies for less than a week; concentration of emulsions had to be raised to 2·5% D.D.T. to get 10 days effective deposit, but 1% concentration of suspensions gave 2 weeks effective results. Suspension at all concentrations gave longer lasting deposits than emulsions.

Dips were more effective at a given concentration than spray suspensions, but were uneconomical, as over a gallon per head was taken out of the 2000-gal vat, which itself has to be charged with D.D.T., whilst spraying required less than 1 qt.

Rainfall was found to have a definite effect, a dry spell resulting in longer acting deposits.

Method of spraying was found to have no signifiant effect on control.

Gulf Coast tick, *Amblyomma Maculatum Koch*, was controlled by inclusion of D.D.T. in adhesive sprays and greases applied to the ears of the cattle, thus reducing the incidence of screw-worms which would otherwise have developed in the wounds caused by the ticks. G. A. C.

997. D.D.T. Residual-Type Sprays as Affected by Light. A. W. Lindquist, H. A. Jones, and A. H. Madden. *Econ. Entomology*, Feb. 1946, **39** (1), 55.—Tests to determine the effect of exposure to ultra-violet light and sunlight on the residual properties of D.D.T. have been carried out at Orlando, Florida. Plywood boards, glass petri dishes, and flat glass plates were sprayed with D.D.T. solutions, emulsions, and suspensions so that the concentration was 200 mg of D.D.T. sq. ft. Duplicate treatments were unexposed as check. Exposed and unexposed residual deposits were tested against houseflies, *Musca domestica* L, the time to obtain 50% knock down being determined. Various periods of exposures were given in several series of tests, and the effects are given in tables. Exposure to both ultra-violet light and sunlight reduced the effectiveness of the treatments in most cases; the loss being greatest when high-boiling solvents were used. The results show that D.D.T. is more rapidly and completely decomposed in solution than as a solid deposit, comparatively dry deposits that form from suspensions and emulsions showing least decomposition. G. A. C.

998. D.D.T. Emulsion Applied to Rice-Field Water to Control Mosquitoes. C. B. Wisecup, W. O. Brothers, P. M. Eide, and C. C. Deonier. *Econ. Entomology*, Feb. 1946, **39** (1), 52.—Experimental methods and results of the application of emulsions containing D.D.T. to control mosquitoes in rice-fields are discussed.

The flooding and drying operations necessary in the cultivation of the rice-fields of Arkansas provide ideal conditions for the mosquitoes of the species *Psorophora, confinnis*, *P. discolor*, *P. ciliata*, and of *Anopheles quadrimaculus*. Tests were made employing a basic concentrate of 20% D.D.T., 20% Triton X-100 (an aralkyl poly-ether alcohol) as the emulsifying agent, and 60% of xylene as solvent, the concentrate being diluted with water to form emulsions of from 1 to 10% D.D.T. concentration. This emulsion was applied to the flowing irrigation waters at the wells, 16 treatments being made on 10 fields using a drip can filled with a metering valve. Weekly dipping records were obtained, at least 10 dips from each flooded contour. From data given in the table it is evident that the degree of contol in a field was affected by: (*a*) the concentration of D.D.T. emulsion in the water; (*b*) the dosage of D.D.T. applied; (*c*) the distance that the emulsion was carried in canals before it entered the field; and (*d*) the size of the field.

The method is suitable for controlling mosquitoes in fields up to 70 acres in extent where the irrigation flow is about 1000 gal/min, using about 1 part of D.D.T. per million parts of water, applied where the waters enter the field.

No damage occurred to the current rice crop (1944). More satisfactory equipment for applying the emulsion has yet to be found, the conventional types of drip cans being unsuitable. G. A. C.

999. Mineral Oil Films in Relation to Mosquito Control. A Crossfield and G. F. Hazzard. *J. Inst. Petrol.*, June 1946, **32** (270), 323–340.—The physics of spreading is briefly outlined, followed by considerations of laboratory and field studies of spreading oils. It is concluded that the field requirements of such materials comprise: (1) an oil with a low viscosity for rapid penetration of tracheæ of larvæ. However, the lower the viscosity the more volatile the oil, and thus the less the film stability and durability; (2) The speading pressure should be high in order to produce more complete spread over contaminated surfaces and films more stable to wind and mechanical displacement under field conditions. In contrast, as increase of spreading pressure gives a decrease in toxicity under laboratory conditions; (3) Use of a highly aromatic oil or a cracked material such as P.D. bottoms, gives a highly toxic oil. However, film stability is poor with aromatic fractions, and with P.D. bottoms rapid oxidation and polymerization may occur in the field to give incomplete films.

In general, no field experiments have indicated a correlation between the laboratory film stability test and field conditions. Because the effect of evaporation is so pronounced any conclusions from laboratory observations should be treated with caution. A. H. N.

1000. Disposal of Petroleum Refinery Wastes. (Article 3.) W. B. Hart. *Nat. Petrol. News*, 6.3.46, **38** ((10), R-225.—Refinery wastes as a factor in soil conservation are discussed.

The use of water for domestic supply takes precedence over any other use of water. Many cities take their supplies from local streams and lakes, and it is important that these are not polluted by refinery wastes, which can seriously impair surface-water quality, which is important to both industrial development and inhabitants of the locality.

Irrigation is a most important use of water in the western part of U.S.A., and such water is taken from many sources, including relatively small streams whose value can be destroyed by refinery wastes.

Certain refineries can so pollute small streams that serious damage is done to fish, and the valuable recreational value of surface waters greatly diminished.

Untreated refinery wastes can kill all forms of animal and vegetable life, and when the bank or shoal vegetation is destroyed, erosion sets in, banks are undermined, and collapse and indentations develop. Eventually the erosion spreads over wide areas, drainage paths are choked, and floods follow. Conservation, that is, treatment of refinery wastes, will correct this. G. A. C.

1001. Secrets of German Fuel Technology Unearthed. Anon. *Petrol. Times*, 8.6.46, **50** (1275), 579.—The following CIOS, BIOS, and FIAT Reports are briefly reviewed:

CIOS VI–22, X–18 and 22, XV–5. The Fischer–Tropsch Process (28 pages). H.M.S.O., 2*s*. 6*d*. (post 2*d*.).

CIOS XXXI–58. Compilation of German Fuels and Lubricants Specifications (29 pages). H.M.S.O., 2*s*. 6*d*. (post 2*d*.).

CIOS XXXI–85. Edeleanu G.m.b.H., Altenburg (73 pages). H.M.S.O., 6*s.* 6*d.* (post 3*d.*).
CIOS XXXIII–30. Sticksloffwerk–Hibernia Wanne–Eickel–Ruhr: Recovery of Hydrocarbons from the Coke-Oven Gas (6 pages).
CIOS XXIII–15. I.G. Farbenindustrie A.G., Frankfurt/Maia (30 pages). H.M.S.O., 2*s.* 6*d.* (post 1*d.*)
BIOS–332. Chemische Fabrik Weyl A.G., Mannheim-Waldhof (8 pages). H.M.S.O., 1*s.* 6*d.* (post 2*d.*).
BIOS–197. Reichinstitut fur Erdolforschung Technische Hochschule, Hannover (7 pages). H.M.S.O. 1*s.* (post 1*d.*).
BIOS–351. Preparation of Adipic Acid from Tetrahydrofuran and Carbon Monoxide (3 pages). H.M.S.O., 6*d.* (post 1*d.*).
BIOS–330. Wirtschaftliche Forschunges m.b.H. (WIFO) Eickeloh Installation (11 pages and 3 plates). H.M.S.O., 1*s.* 6*d.* (post 2*d.*).
BIOS–447. Interrogation of Dr. Otto Roelen of Ruhrchemie A.G. (63 pages).
BIOS–336. Metallgesellschaft A.G. and the Lurgi Group of Chemical Engineering Companies (210 pages). H.M.S.O., 20*s.* (post 5*d.*).
BIOS–373. I.G. Farbenindustrie A.G. Ludwigshafen (Fuels and Lubricants) (140 pages). H.M.S.O., 14*s.* 6*d.* (post 4*d.*).
BIOS–326. Interrogation of A. Bollhorn, E. Grages and Dr. Gross of Deutsche Erdol A.G., Berlin (29 pages). H.M.S.O., 3*s.* (post 2*d.*).
BIOS–450. Gesellschaft fur Teerverwertung m.b.H. Duisborg-Meiderich and Castrop-Rauxel (55 pages).
FIAT–62. I.G. Work on Polyamides I.G. Farben. Ludwigshaven (3 pages) H.M.S.O., 6*d.* (post 1*d.*). A. H. N.

1002. Secrets of German Technology Unearthed. Anon. *Petrol. Times*, 22.6.46, 50 (1276), 660–661.—The following CIOS, BIOS and FIAT Reports are reviewed :

CIOS XXII–15. I.G. Farbenindustrie Plant, Frose, Germany (2 pages). H.M.S.O., 6*d.* (post 1*d.*).
CIOS XXIII–16. Oil Targets in Ruhr and Hanover Areas (23 pages).
BIOS Final Report No. 137 (Appendix)—*cyclo*Polyolefines (Paper by Dr. J. W. Reppe, I.G. Farben. Research Chemist) (18 pages). H.M.S.O., 2*s.* (post 1*d.*).
FIAT–422. Manufacture and Regeneration of Catalysts at I.G. Farbenindustrie, Ludwigshaven-Oppau (9 pages and 4 charts).
FIAT–239. Fischer–Tropsch Plant of Hoesch Benzin A.G. at Dortmund, Germany (3 pages).
FIAT–368. Interrogation of Dr. Gunter Spengler, Munich, formerly of Institute for Coal Research, German Technical High School, Prague (26 pages).
FIAT–426. Interrogation of Dr. Pier and Staff of I.G. Farbenindustrie, A.G. Ludwigshafen/Oppau (29 pages). H.M.S.O., 4*s.* (post 2*d.*).
FIAT–483. Polymerization of Ethylene (28 pages). H.M.S.O., 2*s.* 6*d.* (post 2*d.*).
FIAT–423. Synthetic Lubricating Oil Manufacture, Rhenania-Ossag Mineralowerke A.G. Harburg Refinery (6 pages).
FIAT–293. I.G. Farbenindustrie–Leverkuson, Germany (11 pages).

A. H. N.

1003. United Kingdom Petroleum Imports and Exports. Anon. *Petrol. Times*, 8.6.46, 50 (1275), 582–583.—Statistics are presented for April and the four months combined.

A. H. N.

ENGINES AND AUTOMOTIVE EQUIPMENT.

1004. Transonic Research. Anon. *Flight*, 11.7.46, 50 (1959), 36.—The article gives details of the Vickers rocket-propelled model for investigating sonic speed flight. Power is supplied by a bi-fuel rocket, the fuels being 7½ gal of C-Stoff (57% methyl-alcohol, 30% hydrazine-hydrate, and 13% water) and 12 gal of T-Stoff (approx. 80% hydrogen-peroxide and 20% water), which are carried in three cast-steel tanks, and are fed to the combustion chamber by compressed air stored at 515 lb/sq. in. in three toroidal bottles, the air being delivered to the tanks through a reducing valve.

The C-Stoff and T-Stoff are piped to three equi-spaced, radially disposed injector nozzles in the combustion chamber end-wall, the C-Stoff being injected axially, with the T-Stoff injected co-axially surrounding it. When these two liquids come together, spontaneous combustion takes place, but the exact proportion of the fuels and the degree of atomisation are extremely critical in their effect on performance. The theoretical optimum fuel ratio is 0·36 T-Stoff to 1·0 of C-Stoff (by weight), but the actual ratio achieved is about 0·3 : 1·0. Actual temperature rise is 1750° C, and the specific thrust attained 180 lb/lb fluid/sec. Fuel consumption is 17·2 lb/hr/lb thrust, and for the fuel carried, this gives a total thrust of 800 lb. I. G. B.

1005. Jet Propulsion. J. G. Slotboom. *Ingenieur,* 1946, 58, L 17–23.—On the basis of a mathematical analysis of propelling power, power output, efficiency, and specific fuel consumption, it becomes possible to evaluate various types of jet engines operating under different conditions.

It appears that in the available forms of jet engine the specific fuel consumption is higher than the theoretical figure, possibly because of poor compressor efficiency or low compression ratio. M. B.

1006. Evolution of Energy for Jet and Rocket Propulsion. P. Bielkowicz. *Aircraft Engng,* April 1946, 18 (206), 129.—This article is continued from p. 92, and deals with the specific heat of gases and the determination of nominal temperatures in a combustion chamber. An outline of modern specific heat theory is given showing the effects of temperature and pressure on the gas properties. Comparisons are made between three sources of empirical data (Lewis and Randall, *Technical Data on Fuel and Schüle*), on molecular heat at constant pressure and disturbingly large divergences are obvious.

The determination of the nominal temperature in a combustion chamber is made on the assumption of no dissociation and no radiation loss. A simple example of the complete combustion of ethyl alcohol in pure oxygen is taken. The article is to be continued. I. G. B.

1007. Notes on the De Havilland Goblin Jet Engine. Anon. *Aircraft Engng,* April 1946, 18 (206), 126.—The description given is one of a series following the historical record of jet-engine design. The notes on each component of the engine are informative. Leading particulars of the Goblin II are as follows:

Diameter, max.	49·85 inch
Length, overall	100·5 inch
Weight, bare	1342 lb
engine accessories	68 lb
airframe ,,	80 lb
exhaust cone, etc.	140 lb
Total dry weight	1630 lb
Fuel	aviation kerosine (R.D.E./F/Ker + 1% lubricating oil (D.E.D. 2472 B/O)
Oil	Intava 620
Capacity	1·5 gal

Rating	*Static Thrust*
Take-off and combat	3000 lb. at 10,200 r.p.m.
Climb	2610 ,, ,, 9,700 ,,
Cruising	1920 ,, ,, 8,700 ,,
Idling	195 ,, ,, 3,000 ,,

I. G. B.

1008. Two New Power Units. Anon. *Flight,* 25.7.46, 50 (1961), 99.—Latest of the Napier Sabre piston engine range, the Mk. VII, is distinguished in having provision for water/methanol injection. In the Tempest installation 28 gal of 60/40% methanol-water mixture is carried in one wing and is delivered by a Plessey motor and pump unit. A Napier air separator has also been developed for the system.

The engine has fuel injection into the eye of the supercharger impellor, and the anti-detonant fluid is injected from a shroud around the fuel-supply nozzle. Maximum delivery is at the rate of 200 gal/hr, and the normal proportion of water/methanol mixture to fuel is 45 : 55% in F.S. gear and 30 : 70% in M.S. gear.

Possibly due to the sleeve valves and their effect on combustion efficiency, Sabres have always given little or no exhaust flame. Mk. VII is now fitted with 12 individual stub pipes on each side. Data for the engine are as follows :—

Capacity 36·8 litres : Output 83 b.h.p./litre.
Weight 2500 lb : Spec. weight 0·83 lb/b.h.p.
Max. power with water/methanol injection 3050 b.h.p. at 3850 r.p.m. + 17½ lb boost.

I. G. B.

1009. The Evolution of Energy in Jet and Rocket Propulsion. P. Bielkowicz. *Aircraft Engng*, April 1946, 18 (207), 163.—Continued from p. 132, the author deals with the mechanism of dissociation. The first part deals concisely with the physical processes and the mathematical formulæ used to describe these processes. Values of the dissociation constants are given at various temperature levels, and it is shown that high-combustion temperatures involve greater degrees of dissociation, whilst high pressures have the opposite effect. In the second part practical use is made of the formulæ established, and water vapour and carbon dioxide were taken as examples. The presence of an inert gas does not change the behaviour of the gases examined, whose partial pressures will remain the same. An example is given of the dissociation of CO_2 in an atmosphere of nitrogen, which may occur in a jet-propelled engine with air supply. Also investigated is the dissociation of a mixture of two active gases, having a common product of dissociation. The case is exemplified by the mixture represented by the general formula, $a CO_2 + b H_2O$. I. G. B.

MISCELLANEOUS.

1010. International Petroleum Outlook in Relation to Operations in the United States. C. O. Willson. *Oil Gas J.*, 8.6.46, 45 (5), 65.—The production, consumption and transportation position of the world oil business is summarized.

Although hostilities have ceased, world production and consumption of petroleum is similar to that at peak period of the war, and total military needs will be much greater than they were pre-war, and for an indefinite period. Reconstruction in the war-devastated areas is largely centred on petroleum, and other outlets have expanded so that 40% more crude oils is consumed now than pre-war.

A table showing world crude oil output and reserves (excluding Russia) indicates that greatest increase in world production has been in the U.S.A., Venezuela, and the Middle East; and most of the world's reserves (excluding Russia) are in those areas. It is not expected that the U.S.S.R. will be an important factor in world markets in the near future.

The ownership of the world's oil is vested in the United States, British, or British-Dutch interests.

Available reports on demand show that the United States has accounted for the bulk of the world consumption, but some time will elapse before accurate estimates can be made of the world situation in this respect.

A table giving 1939 consumption shows that the next largest off-take was in Europe—viz., 23·2%, about a third of the United States figures. Future outlook is to Western Europe for increased demands.

With regard to transportation, a table gives tanker distances between shipping and consuming centres. Tanker distances, production, and transportation costs determine the over-all international movement of oil. For example, the Suez Canal toll of 18 c/brl causes most of the European markets to be supplied from the Western Hemisphere, but the proposed construction of the new pipe-line connecting the Persian Gulf with the Eastern Mediterranean in conjunction with the shortened distance from Haifa to London would reverse the situation.

Trends indicate that the Middle East will absorb more and more of the Eastern

Hemisphere markets to the exclusion of the West, but the nature of the crude will still ensure that lubricating oils are produced in the States.

Canada should be able to take a considerable portion of the United States excess production over domestic use. Thought should be given to the possibilities of expansion of oil consumption in Asia and Africa, where more than 50% of the world's population live, but consume very little. G. A. C.

BOOKS RECEIVED.

Principles of Micropalæontology. M. F. Glaessner. Melbourne, University Press; London, Oxford University Press; 1945. Pp. xvi + 296, 14 plates, 7 tables, 64 text figures. 45*s*. 0*d*.

The foundations of micropalæontology were laid a hundred years ago, and during the past twenty or thirty years the study of microscopic fossils has become an important branch of geology. Many micropalæontologists are now employed in the petroleum industry because of the value of micro-fossils in stratigraphic studies, and it is the application of micro-fossils in economic geology which has provided the main stimulus in the development of micropalæontology in recent years.

After a brief review of the history of microplaæontology, " Principles of Micropalæontology " continues with a general classification of the micro-fossils and a brief description of the micro-fossils other than the foraminifera. The greater part of the book is devoted to the palæontology of the foraminifera, and deals with their life-history, structure, classification, and palæo-ecology. The stratigraphic sequence of micro-faunas is briefly summarized, while further chapters deal with the collecting and study of micro-fossils, the micropalæontological correlation of sedimentary rocks, and the application of micropalæontology in oilfield exploration and exploitation in the Eastern Hemisphere. An appendix provides a synopsis of a revised classification of the foraminifera, and gives the stratigraphic ranges of important genera. In this connection it is interesting to note that Glaessner's doubts about the ranges of *Spirillina* and *Nodosaria*, and his indications of the dates of appearance of *Lagena*, *Dentalina*, *Cristellaria* and *Marginulina* are confirmed by Wood's recent paper on " The supposed Cambrian foraminifera from the Malverns " (Abstracts of the Proceedings of the Geological Society, London, June 5, 1946, pp. 66–67).

In oilfield and other geological work the maximum benefit is not being derived from the application of palæontology if its use is limited to correlation. Ecological studies by indicating the nature of the environment under which the fossilized creatures lived provide information on the conditions under which the sediments were formed. The inclusion of a chapter on ecology is therefore a good feature.

Tables summarize the distinctive characteristics of the super-families of the foraminifera and of the important genera of the *Astrorhizidea*, *Verneuilinidæ*, *Fusulinidæ*, *multilocular Lagenidæ* and *Buliminidæ*. The illustrations, while numerous, are not so profuse as in the illustrated key to the genera of the foraminifera, included in Cushman's " Foraminifera " (3rd Edition), a book which Glaessner includes in his list of reference books for equipping a laboratory and office for micropalæontological work. There are nearly nine hundred items in the bibliography and these are grouped according to the chapter headings.

Altogether " Principles of Micropalæontology " is well-conceived and well-presented. Consequently it is a useful addition to the textbooks on micropalæontology and worthy of the attention of those studying and applying this important subject.
G. D. H.

TECHNICAL MISSIONS TO GERMANY.

The following reports have been received in addition to those listed on pp. 226A to 230A.

B.I.O.S. REPORTS.

39.* Concealed Oil Targets in the Brilon–Bredelar Area. 3 pp.
40.* Optical Activities at Steinheil u. Shöne, München. 8 pp.
202. Bergius Wood Sugar Plants at Mannheim-Rheinan and Regensburg. 13 pp.
239. Textile Auxiliary Products Manufactured by I.G. Farbenindustrie, Hainkur Works. 12 pp.
243. I.G. Hoechst—Inorganic Division. Manufacture of Sulphuric Acid, Sulphite Products and Chlorsulphonic Acid. 27 pp.

256. Phosphoric Acid and Sodium Phosphates in Germany. 27 pp.
259. Textile Auxiliary Products of I.G. Farbenindustrie, Leverkusen. 17 pp.
260. I.G. Farbenindustrie—Ludwigshafen. Manufacture of Sulphuric Acid, Sulphide Products, Liquid Sulphur Dioxide and Cyanides. 33 pp.
343. German Diesel Engine Industry. 301 pp.
353. Preparation of 5-Dimethylaminopentanol-2 by the Reppe Process. 4 pp.
356. Characterization of Butadiene Catalyst by X-Ray and Chemical Analysis. 6 pp.
359. Products Formed by Interaction of Acetylene and Amines. 3 pp.
366. German Textile Dyeing, Drying and Finishing Engineers. 13 pp.
374. German Aluminium Foil Industry. 21 pp.
392. Welding of Aluminium and Aluminium Alloys, with special reference to the manufacture of pressure vessels. 31 pp.
395. German Fluorescent Lamp Industry and Phosphor Chemical Manufacture. 96 pp.
404. German Asbestos Industry. 63 pp.
419. I.G. Waxes: Manufacture at Gersthofen and Oppau. 11 pp.
422. I.G. Ludwigshafen. Sodium Hydrosulphite and Related Compounds. 19 pp.
423. Deutsche Gold und Silber Scheide Anstalt (DEGUSSA)—Frankfurt. 50 pp.
424. Chemische Fabrik. Dr. Jacob—Bad Kreuznach. Manufacture of Carbonbisulphide, Thiourea and Ammonuim Thiocyanate. 21 pp.
426. German Organic Chemical Industry. 4 pp.
428. German Rayon and Staple Fibre Industry and Allied Engineering Industry. 83 pp.
433. Investigation of German Plastics Plants. Part IV—Additional Information on Thermosetting Resins and Processing of Polystyrene. 90 pp.
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438. German Collapsible Tube and Extrusion Industries. 24 pp.
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525.* Staatlisches Material Prüfungsamt, Unter den Eichin 86–87, Berlin-Dahlem. 31 pp.
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XXXIII—17. Coal Driers. Büttner-Werke A.G., Uerdingen, Kasfeld. 5 pp.

F.I.A.T. REPORTS.

144. Acetic Acid Recovery, Aceto-Butyric Acid Recovery, Propionic Acid Recovery at I.G. Farben., Dormagen. 8 pp.
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INSTITUTE NOTES.

SEPTEMBER, 1946.

INSTITUTE MEETINGS.

1946	
October 16.	"The Lubrication of Pre-selective Gearboxes." A. T. Wilford, B.Sc., A.R.C.S., A.R.I.C. (Fellow).
November 12.	"Viscometry of Hydrocarbon Soap Systems." F. H. Garner, O.B.E., Ph.D., F.R.I.C. (Fellow), Alfred H. Nissan, D.Sc. (Fellow) and G. F. Wood, Ph.D.
December 11.	Symposium on Oil Fires: "Fires and Explosions at Oil Installations." E. P. Lancashire (Member). "Experiments on Rate of Foam Application." N. O. Clarke, E. Thornton, B.Sc., F.R.I.C. (Fellow) and J. A. Lewis. "Behaviour of Oils Burning in Open Reservoirs and Effects of Air Agitation." J. H. Burgoyne.
1947	
January 8.	"Petroleum Products in Agriculture. The Role of Petroleum in Plant Protection." L. W. Leyland Cole, M.Sc., B.Sc. (Agric.), F.R.I.C.
February 12.	"Fuels and Lubricants for Aero Gas Turbines." C. G. Williams, D.Sc., M.I.Mech.E., A.F.R.Ae.S. (Fellow).
March 12.	"Modern Developments in Geophysical Prospecting." Ir. A. van Weelden.
April 9.	"Aromatics from Petroleum." Dr. H. Steiner.
May 7.	"The Development of Hydrogenation and Fischer-Tropsch Processes in Germany." Major K. Gordon (Fellow).
June 11.	"Use of Petroleum Products in the Printing Ink and Allied Industries." Dr. A. C. Healey and Dr. L. Ivanovsky (Fellow).

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.

Baillie, Robert Brendan, Chief Technical Officer, Victoria Branch, Shell Company of Australia, Ltd. (*H. A. Banks ; G. W. Sheel.*)

Bentall, Walter, Squadron Leader (Engineer), R.A.F. (*E. Thornton ; F. D. Edwards.*)

Bidstrup, Tom Julius, Technical Officer, Shell Company of Australia, Ltd. (*H. A. Banks ; G. W. Sheel.*)

Dobner, Karl M. I. Chief Mechanical Engineer, Compania Petrolera Lobitos, Peru. (*C. Barrington Brown ; A. T. Beazley.*)

Greenshields, Robert John, Chief Research Engineer, Shell Oil Company, Inc., Illinois. (*J. A. Oriel ; F. L. Garton.*)

Jarrott, Stanley Keith, Clerk, Vacuum Oil Company, Ltd., Brisbane, Australia.

McLaren, Arthur Andrew, Flight Lieutenant (Engineer), R.A.F. (*E. Thornton ; F. D. Edwards.*)

Mansfield, William James, Process Plant Foreman, Manchester Oil Refinery, Ltd. (*E. J. Dunstan ; E. S. Sellers.*)

Whipp, Roger Henry, Squadron Leader, R.A.F. (*E. Thornton ; F. D. Edwards.*)

Young, Frederick William, Flying Officer, R.A.F. (*E. Thornton ; F. D. Edwards.*)

PERSONAL NOTES.

G. W. **Lepper** who has been, since 1936, technical adviser on oil exploration and development to the Petroleum Department, now the Petroleum Division of the Ministry of Fuel and Power, retired from the Government service on July 7. He has rejoined the London staff of the Burmah Oil Co. Ltd. Dr. W. L. F. **Nuttall**, formerly of the geological department of the Bataapsche Petroleum Maatschappij has been appointed to succeed Mr. Lepper at the Ministry.

Prof. A. O. **Rankine** has been appointed a member of the Committee set up by the Minister of Fuel and Power to inquire into the resources and development of Britain's metalliferous and other minerals.

Comdr. H. V. **Lavington** has recently been appointed to the board of the Trinidad Petroleum Development Co. Ltd. He has been the company's general manager in Trinidad for a number of years.

Thomas H. G. **Brayfield**, who has been recuperating in Canada following his release from internment in Japanese hands, has recently arrived in England.

LUNCHEON TO DR. A. E. DUNSTAN.

On July 11, 1946, Dr. A. E. Dunstan, who resigned as Honorary Editor at the end of 1945, was the guest of honour at a luncheon given by Members of Council of the Institute. The Chair was taken by Prof. F. H. Garner, O.B.E., Honorary Editor.

Prof. F. H. Garner: We are here today to pay a special tribute to Dr. Dunstan; his outstanding work in petroleum science has been recognized by the award of the Redwood Medal, but today we have met to recognize the all-important part he has played in establishing the publications of the Institute and to celebrate his Jubilee as Honorary Editor of its publications. At the time of his retirement he had been Honorary Editor for 25 years, for it was in 1921 that he took over after a short period as Honorary Associate Editor to the late W. H. Dalton.

In those 25 years Dunstan has done much to advance the prestige of the Institute. He took over the *Journal* when it was a modest quarterly publication and quickly brought it to a regular monthly of considerable importance in petroleum literature. He instituted the Abstract Section, the value of which has proved inestimable throughout the industry. He also initiated the " Annual Reviews of Petroleum Technology "—and it was only a world war which caused their temporary suspension.

But it was not only in these periodical publications that Dr. Dunstan has served the Institute so well, for every one of the varied books—from the " Crystal Palace Lectures " to " Tables for the Measurement of Oil "—bore testimony to the genius of Dunstan.

It only remains for me, concluded Prof. Garner, to express the thanks of all Members of Council to Dr. Dunstan for his untiring efforts in the past 25 years and to wish him many years of health and happiness.

Tributes to the work of Dr. Dunstan were paid by several other speakers, Mr. T. Dewhurst particularly referring to him as the inspiration behind the First World Petroleum Congress, while Prof. J. S. S. Brame said that Dr. Dunstan had rendered to the Institute greater service than any other person and had established a world-wide reputation for the Institute and its *Journal*, particularly in the United States. Mr. George Sell said he was happy to recall the many years of his close association with Dr. Dunstan in the service of the Institute. To him Dr. Dunstan had always been a valued guide and philosopher as well as an inspiration.

Dr. A. E. Dunstan: I was reading the other day in " Pilgrim's Progress " "*As I walked thro' the wilderness of this world I lighted on a den and I laid me down and slept and as I slept I dreamed a dream.*"

Few dreams come true. Now and again one does and this is one of them. I go back to the day 26 years ago when Sir Boverton Redwood asked me to take on the *Journal* with Dalton. I cannot think of any dream that in later years came true to give me so much happiness as that request.

It was a very simple *Journal* in those days. The I.P.T. was then very small, but what it lacked in numbers of membership it made up for with their enthusiasm and energy. They were good *Journals* admittedly and I did my best to live up to Dalton's traditions.

It was then only a quarterly with no abstracts; but things moved and gradually it got larger and more frequent. Then came the abstracts, the "Crystal Palace Lectures," the first "Standard Methods" and "Petroleum—25 Year's Retrospect." I gained the reputation of being a reckless spender. But "*what shall it profit a man in a Society if he gains the whole world and lose his own soul?*" So we agreed to spend.

Looking back, one must express one's indebtedness to the extremely valuable help received from those who I have been so fortunate to have as colleagues. I would specially mention my old friend George Sell. He it was who perhaps more than anyone else kept the *Journal* alive and laid the foundations of what a scientific journal should be. My thanks are also due to Miss Tripp, to Mr. Noble and to the secretaries of the Institute—Stokes Rees, Astbury, Coe—all of them full of enthusiasm and help.

Now the mantle of Elisha falls upon Prof. Garner. No one has served the Institute better as Honorary Associate Editor, Chairman of the Standardization Committee, and President. It is due to him that the "Annual Reports" have attained their present fame and in his hands the Institute's publications are safe.

On such an occasion as this I must emphasize the extraordinary aid I have received from voluntary helpers. I cannot think how such a society as this could exist without this voluntary help. To quote Plato: "*The aim of a veritable community is not that this man or that should prosper but that the whole should flourish.*"

We all owe a debt to the directors of our various companies who allow us to spend much official time on Institute committees. We should praise them for this unselfish attitude.

What more can I say? Only this. I have done what I could to perpetuate what Sir Boverton Redwood asked me to do and it is a pleasure, an incomparable pleasure, to be the recipient of such remarks as have been expressed on this memorable occasion. I shall always cherish the memory.

LUNCHEON TO DR. G. EGLOFF.

On August 12 Dr. Gustav Egloff was entertained at luncheon by the Council of the Institute. Mr. G. H. Coxon, chairman of Council, presided.

Mr. G. H. Coxon: We are all pleased to see Dr. Egloff again, to shake hands with him and to welcome him. For many years he has been a good friend to the Institute and has done much for it in the United States. He has a great reputation as an oil technologist and an expert on petroleum patents and had written more articles on petroleum technology than probably any other individual. Although small in stature he is big in mind and we are very happy to meet him once more.

Dr. A. E. Dunstan : The last time I had the pleasure of welcoming Dr. Egloff was in 1937 and I am sure that we are all delighted to have him with us. I first met him in 1921 and even in those distant days he was a man who mattered in petroleum technology.

It has been estimated that if all Dr. Egloff's publications were burnt there would be produced sufficient calories to raise the *Queen Mary* one inch in her dock. I like to think of Egloff as a man in evening dress. Take off the evening dress and you have Egloff the man—decent, honorable, friendly, kindly.

Dr. G. Egloff : Friends, it is nine years since I last had the opportunity of foregathering with you. That is nine years too long. Meanwhile the world has changed in many ways; the oil industry has been so revolutionized that to-day the individual cannot follow it. There is a need for specialization and the larger companies, and some smaller ones, are expanding their research facilities into the chemical field at a high rate. On the other hand, the chemical manufacturers are taking yet larger quantities of oil products for conversion into chemical products. But the question is where are the staffs coming from? The United States is short of 20,000 scientific and technical brains.

The United States is geared to a higher research tempo than ever before, particularly in regard to rocket fuels and the knowledge of atomic energy. One cannot pay too much for new knowledge and fundamental research.

In conclusion, Dr. Egloff said he was deeply grateful for the opportunity of again meeting his friends and colleagues in England.

FUEL ECONOMY CONFERENCE, 1947.

By invitation of the Netherlands National Committee, the Fuel Economy Conference of the World Power Conference will be held at The Hague, Holland, from 2nd–10th September, 1947. During this Conference, an Official Visit of two days will take place to the Netherlands State Coal Mines, at Lutterade. Intending participants from Great Britain are invited to apply for further particulars to: British National Committee, World Power Conference, 36, Kingsway, London, W.C.2.

LIBRARY RULES.

1. The Library is open for reference and for the issue and return of books from 10 a.m. to 5 p.m. daily, excepting Saturday.

2. Members of the Institute are permitted to borrow up to two books at a time for a period not exceeding a fortnight. In special circumstances an additional number of books may be borrowed at the discretion of the Librarian.

3. Dictionaries and works of reference are not available for loan.

4 A new book may not be taken out of the Library until one month after it has been received.

5. Books must not be borrowed from the Library until the register has been signed by the borrower.

When a book is required to be forwarded, a signed request must be sent to the Librarian and the return cost of carriage paid. All books forwarded are at the risk of the borrower until returned, and when returned through the post must be registered and securely packed to prevent injury.

6. Books may not be sent or taken out of the United Kingdom.

7. Current unbound journals and periodicals of which there is only one copy in the Library may not be borrowed.

8. A borrower retaining books longer than the time specified, or failing to return them when demanded, shall forfeit the right to borrow books until all those standing against his name have been returned. Books not returned within two weeks of a demand will be replaced at the expense of the borrower.

Borrowers to whom books have been issued are responsible for their preservation from injury and their safe custody. If a book is found damaged on return, it shall be repaired or replaced at the expense of the borrower.

9. Persons requiring photostat copies of extracts from books or periodicals may obtain these on application to the Librarian and on payment of the appropriate charges.


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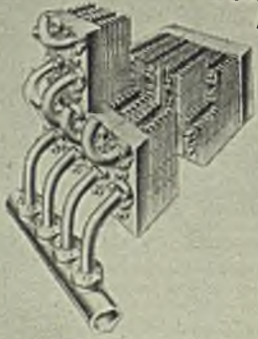

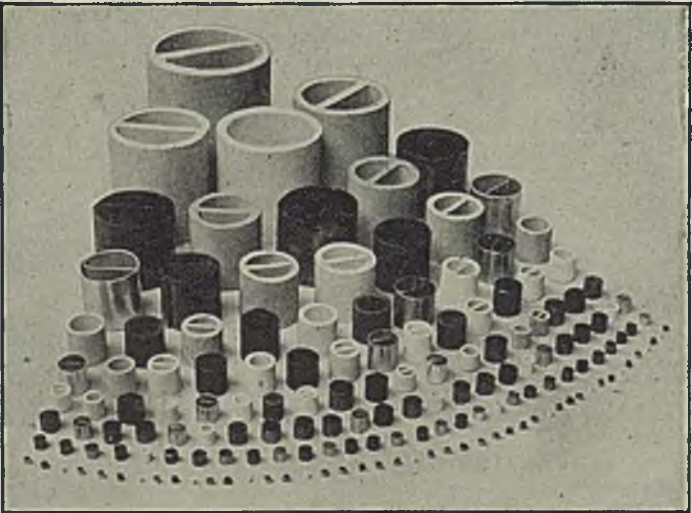

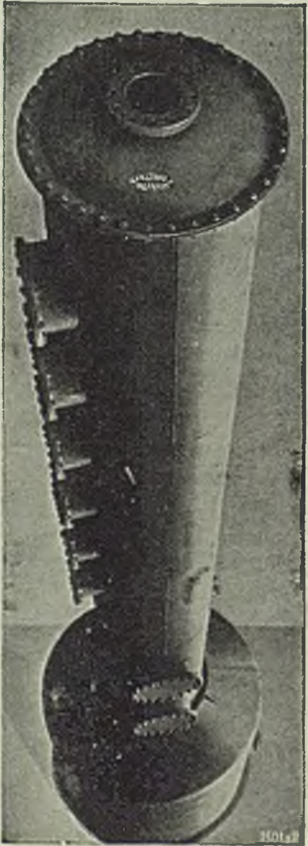

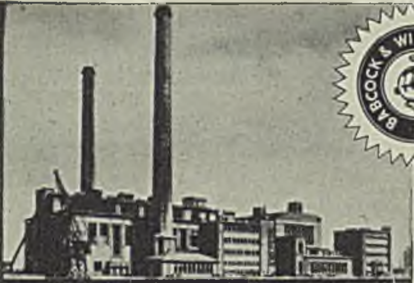

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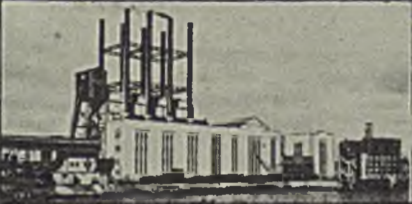

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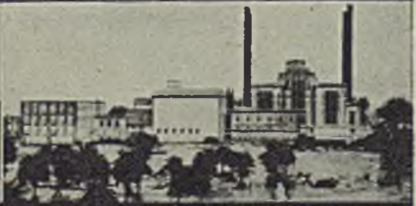

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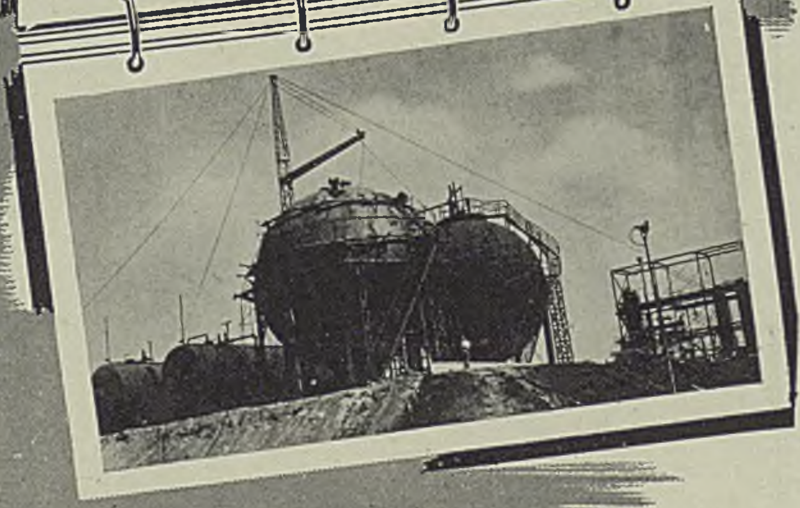

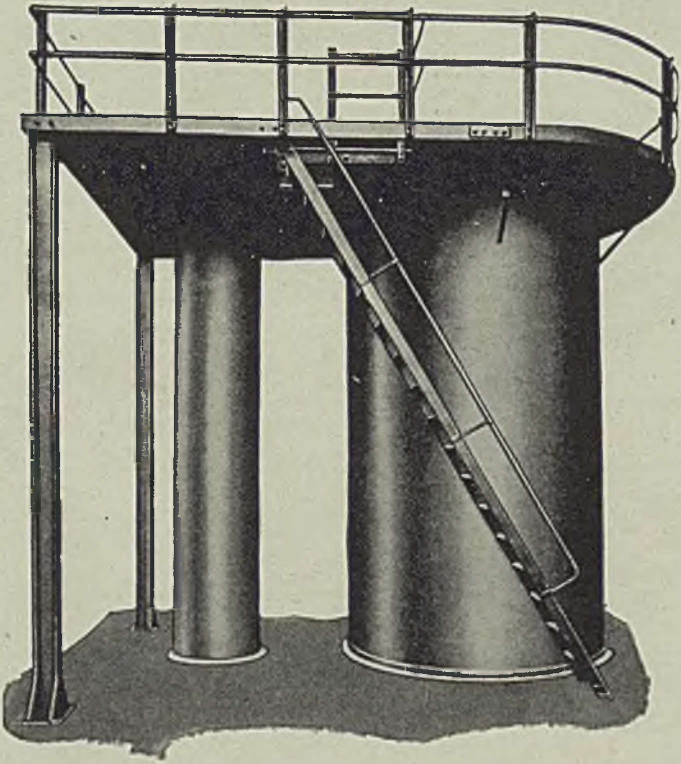

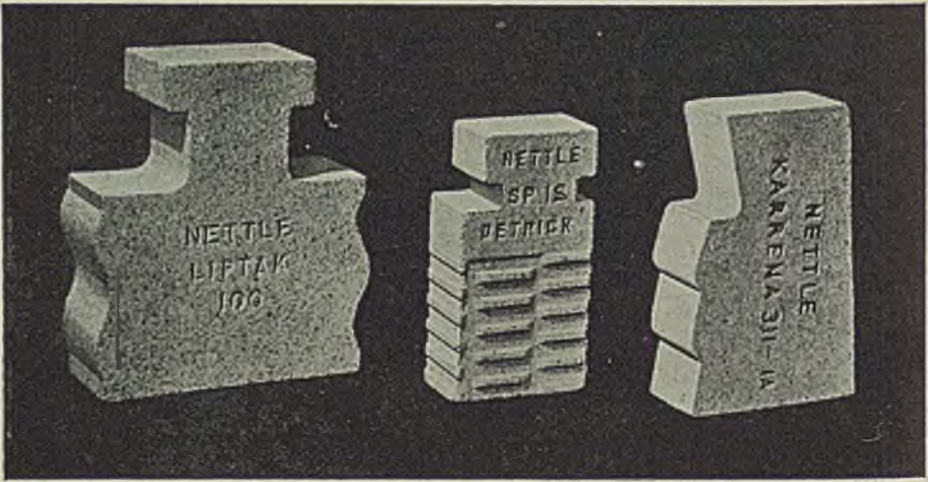
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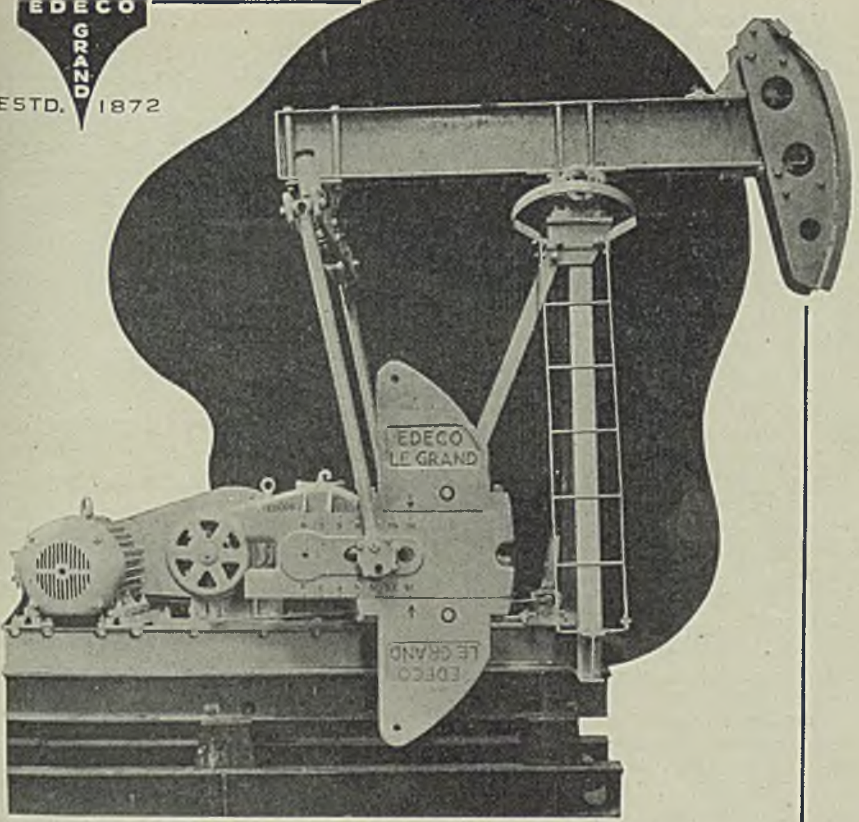
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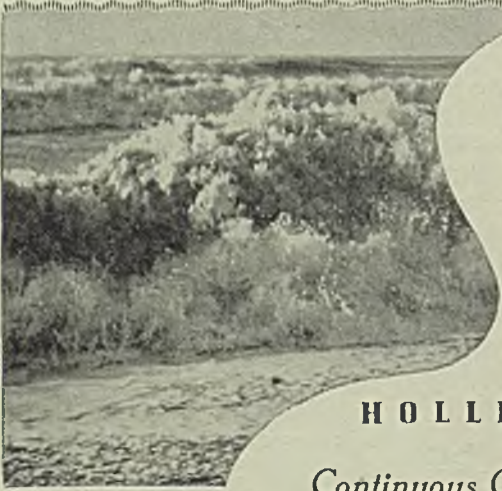

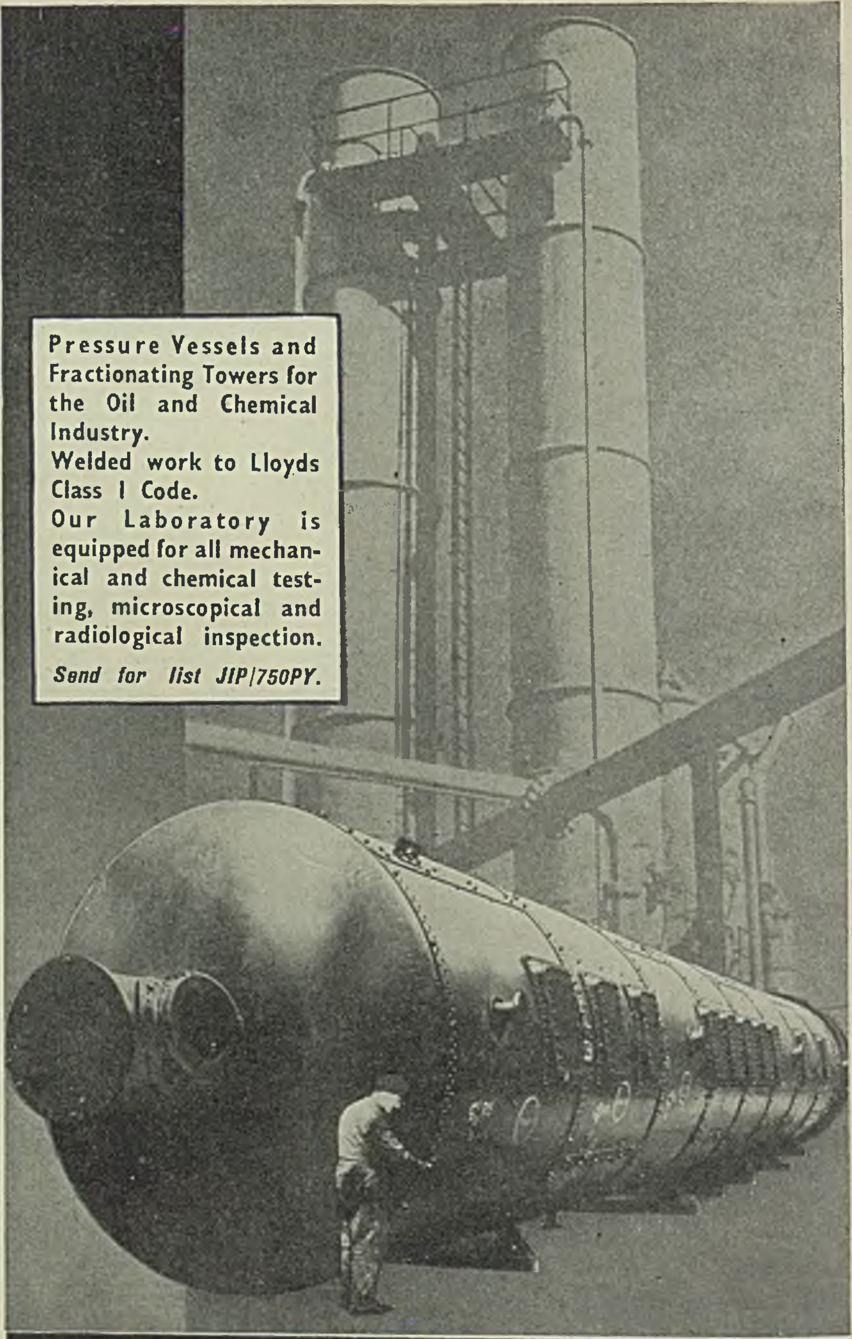

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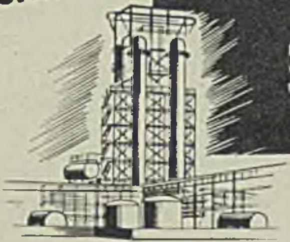

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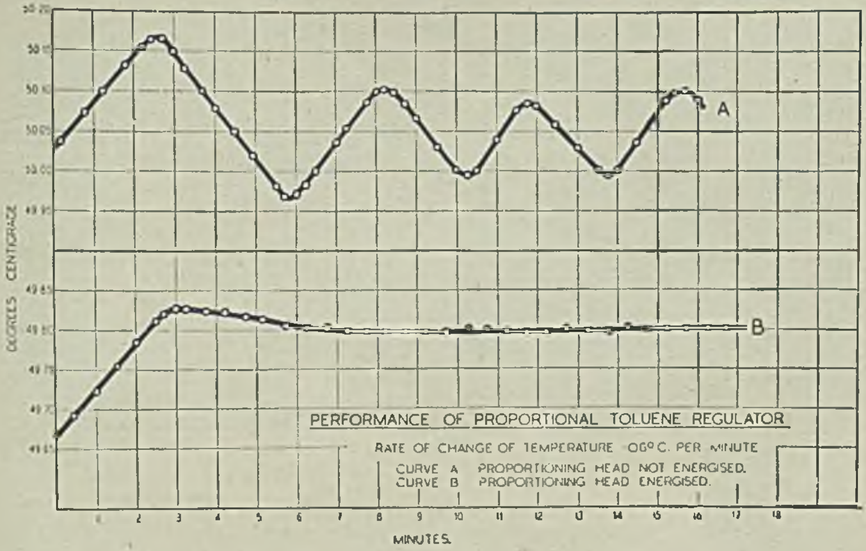
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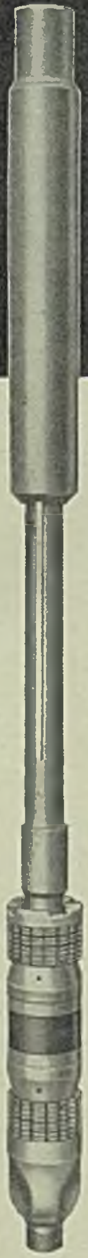

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