

ABSTRACTS.

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OILFIELD EXPLORATION AND EXPLOITATION.

Geology.

740. Functions of Bacteria in the Formation and Accumulation of Petroleum. C. E. ZoBell. *Oil Wkly.*, 18.2.46, 120 (12), 30.—Bacteria are ubiquitous and physiologically versatile. Experiment shows that they could function under natural conditions, and undoubtedly they are instrumental in the modification and diagenesis of sedimentary materials. Hence they may be important in petroleum formation and accumulation.

Bacteria have been found at a depth of about 25 ft in recent sediments, and changes in sulphate and organic matter content and in redox potential suggest that bacteria have been active since the sediment was deposited. It is virtually impossible to ascertain whether bacteria found in ancient sediments are indigenous. However, they have been found in a sulphur-limestone-anhydrite deposit at a depth of 1560 ft under conditions which seem to preclude contamination. They were unlike known species, and functioned best under conditions obtaining in the formation. Moreover they were able to transform anhydrite to sulphur.

Sulphate-reducing bacteria have been found in oil-well brines. Some bacteria in such brines are lipolytic, and seem to be indigenous, or at least capable of developing in the reservoir fluid.

The highest temperature at which the growth of thermophilic bacteria has been observed is 190° F. Halophilic bacteria which will thrive in brines with a salinity of 15–30% are quite common.

Anaerobic bacteria tend to convert certain kinds of organic matter into substances more like petroleum. Sulphate-reducing bacteria which synthesize hydrocarbons from fatty acids have been reported. The product from *n*-capric acid was primarily a mixture of normal paraffins ranging from $C_{15}H_{32}$ to $C_{25}H_{52}$. Other fatty acids gave similar results, and could themselves have been formed by bacterial decomposition of organic matter.

Ethane and propane, as well as methane, can be produced by anaerobic decomposition of organic matter; aromatic hydrocarbons and their derivatives may be produced by bacterial action on proteins. Anaerobic bacteria have been reported from the Black Sea, which bacteria can transform albuminous and fatty matter into natural gas and dark-coloured oil-like products with a bituminous odour. Altogether it seems possible that bacteria can produce petroleum hydrocarbons.

Hydrogen formed in recent sediments may aid in hydrogenating organic matter to petroleum hydrocarbons. Similarly hydrogen sulphide may help in such reduction, and this gas is widely generated in sediments. Hydrogen has been found in mud gases from the sea floor. Methane is thought to be formed principally by the reduction of carbon dioxide by bacterially-activated hydrogen. Sulphates are reduced in a similar fashion.

Under certain conditions bacteria tend to dissolve carbonates, a process which may set free adsorbed oil and at the same time provide storage space for oil accumulation. Some bacteria physically displace oil from the surface of sedimentary particles.

Detergents may also be formed by bacteria and liberate oil from surfaces. Carbon dioxide generated may aid in oil migration.

Hydrocarbon-oxidizing bacteria are widespread in nature, and they seem to be most abundant in marine sediments and in oil-soaked soil. Some hydrocarbons are attacked more easily than others. It may be significant that most oil-well brines and crudes contain something inhibitory to the activity of hydrocarbon-oxidizers, suggesting that oil accumulates only when these are present. Some sulphate-reducers can assimilate certain aliphatic hydrocarbons. They may tend to increase the proportion of light hydrocarbons in oil.

It has been suggested, but not proved, that sulphate-reducers convert paraffins to naphthenic hydrocarbons.

Lipolytic anaerobic bacteria obtain their oxygen from organic compounds. Decarboxylation or deoxygenation of fats would form hydrocarbons. Anaerobic bacteria capable of attacking fats have been found in recent sediments, in oil-well brines, paraffin dirt, and tar sands. G. D. H.

741. Oil in Alaska. H. F. Thomas. *Oil Wkly.*, 4.2.46, 120 (10), 39 (*International Section*).—Oil indications were found in the Iniskin Bay area of Alaska before 1859. By 1904 several wells had been drilled in each of three seepage areas: between Cold and Portage Bays; between Chinitna and Iniskin Bays; in the Controller-Katalla Bay. The deepest well was about 1000 ft. By 1917 31 wells had been drilled in the Katalla field. In the late thirties 2 deep tests were drilled. In the Iniskin Bay area a well was drilled to 8875 ft in the Jurassic, without finding commercial production. It lies on the axis of an anticline. In the Cold Bay area a well went to 5000 ft in hard Jurassic shale, without finding oil or gas. Both areas have prolific seeps and well-defined structures, but there are igneous rocks near.

In a recent expedition 3 separate seeps were found in the Umiat Mountain area. This area is being core-drilled for stratigraphic information. Seeps were found also at Ungoos Point, near Humphrey Point and about 40 miles west of Demarcation Point; at Manning Point, about 2 miles south-east of Barter Island; at Fish River, about 25 miles south-west of the mouth of the Colville river; at Dease Inlet, about 7 miles east of Doonakavik Cove, in the Cape Simpson area.

Due to lack of exposures, geological data are lacking, and geophysical work and core drilling will be necessary.

A prolific seep has been reported near Fort Yukon.

Maps show possible productive areas and the sites of seepages.

G. D. H.

742. Russians Exploit Field Regarded as Very Rich. Anon. *Oil Wkly.*, 4.3.46, 121 (1), 57 (*International Section*).—Over 20 wells have been completed in the new oilfield near Palvantasi in Uzbekistan.

G. D. H.

Geophysics and Geochemical Prospecting.

743. Is the Seismograph Still Champ? J. Sloat. *Oil Wkly.*, 4.2.46, 120 (10), 17.—During 1945 oil companies spent about \$30,000,000 on seismic work in U.S.A. The seismograph has found more oil than any other prospecting tool. In seismic surveys the quantities measured are a time interval and a distance along the earth's surface. In order to convert this information into underground dip and depth a velocity of wave travel must be assumed. In some cases experience shows that reflections come from known beds which can be mapped over large areas, but drilling shows many competent beds which do not give consistent reflections, and there are many reflections which cannot be associated with known beds.

In some cases reflections come from fault-planes, and an instance has been noted of reflections from a high river bank. Insufficient is known about the behaviour of reflections where there is lateral variation, pinch-outs, etc.

Velocities may change laterally, and so interpretations may be in error on this account when some distance from the spot where the velocity was measured. Velocity variations may be associated with structure and faulting, and these may be superimposed on regional variations. A case is cited where down flank there is a marked velocity increase. In the absence of corrections seismic dips and correlations tend to show too much relief down the regional dip, since in the basins the increase in total

thickness is commonly due to thickening of young material of relatively low velocity, so leading to a lower average velocity down the regional dip.

The velocity in salt is commonly higher than that in the beds in which it occurs, and so caution must be exercised in mapping beds below salt, for the high velocity, if over a limited area, may lead to an inference of a high which does not exist. It is wise to compare structure above and below the salt, for in most cases the former may provide some clue to the latter. Sand lenses in shale, or anhydrite or basalt in low-velocity beds can give similar errors.

In the Rocky Mountain area the thickness of the low-velocity Tertiary over the high-velocity older beds is variable, again providing sources of error with regard to amounts of closure and position of the axis. Again the form of shallow beds is of value in giving a correct interpretation.

The usual assumption made is that velocity increases with depth and travel time, and so deeper structures will be inferred to have greater closure than shallow ones with which they conform; this will be the case even though the actual time interval is the same on the highs as on the lows. Hence some companies use time contour maps only. If the amount of time closure on a deep bed is greater than on a shallow bed the actual closure in the former must be the greater, regardless of velocity considerations.

Seismograph shooting should be in closed traverses following the inferred regional dip and strike. In general the seismograph tends to show dips which are too steep towards the outcrop. It is worth while examining secondary folds near the main features.

An analysis of drilling results and seismic work in the San Joaquin Valley shows that the seismograph has not been successful in locating productive fault-traps (one reason is that the areas where fault production is most likely are not suitable for accurate seismic work); that it is relatively safe to drill an area with over 100 ft. of seismic closure.

It is necessary to shoot areas difficult of access to get a good picture. Studies of seismograms should be made for areas proved by drilling to be faulted. Similar studies are needed for locating stratigraphic traps.

The present seismograph has no directional control feature, and the inertia and electrical characteristics of the instruments preclude the definition of beds less than about 125 ft apart. In some cases shallow reflections are poorly defined; on others deep reflections are absent. Absence of the reflections may be of geological significance; phase and frequency changes may be associated with changes in lithology.

G. D. H.

Drilling.

744. Oil-Base Fluids—Results and Use in Drilling and Completing Wells. G. V. Kersten. *Oil Gas J.*, 27.4.46, 44 (57), 135. *Paper Presented before A.P.I.*—The use of oil-base arrears to improve the initial ability of a well to produce oil. Inadequate history indicates that the improved position of the well productivity index is maintained. Well completion practices are improved. Swabbing, washing, and scratching are seldom necessary. The effect of use of oil base on drilling operations tends, in general, to increase rig time. Precautions are necessary to prevent fires, water contamination, and unnecessary fluid losses. The effect of oil base on completion problems is noticeable where the programme calls for more than a drilled hole with a liner. Cement work on blank sections and squeeze work on gun perforations are not as easy as with water base. The expenses of completion are usually increased from \$30/ft on shallow holes to possibly \$30/ft on deep holes where necessary secondary shutoffs are made. Improvements in technique and handling should reduce costs in the future. The operator first using oil base is apt to experience excessive costs until his men are properly educated as to technique of handling and saving the oil base.

A. H. N.

745. Directional Drilling from Man-Made Islands. G. B. Nicholson. *Oil Wkly.*, 29.4.46, 121 (9), 18.—In developing Bayou des Glaize field, Iberville Parish, Louisiana, Humble Oil and Refining Co. has commenced an extensive programme which includes the construction of islands elevated above high-water level, each designed for directionally drilling 4 to 6 wells. The islands offer the most satisfactory sites yet discovered

for assuring continuous operations above flood-water levels of the Atchafalaya River, and centralization of several wells on each island by means of directional drilling minimizes island construction and dredging of individual canals. Original plans did not include directional wells or islands, but circumstances which arose during the exploration before and after the first well was completed brought changes of technique to cope with the severe and frequent changes of water level peculiar to the Atchafalaya River Basin. Every well now producing oil at Bayou des Glaise was drilled from an island, and the only vertical hole is the discovery well. Other wells now drilling, already completed, and proposed, are scheduled to be drilled directionally from islands, with the surface locations situated close together in answer to the demands of the swampland. Islands are also built for tank batteries, Christmas trees, and other production installations, and are sufficiently elevated to assure immunity from flood-waters. The river conditions of level, the arrangements made, and building of the islands and retaining walls are described.

A. H. N.

746. Method for Determining Minimum Waiting-on-Cement Time. R. Farris. *Petrol. Tech. (A.I.M.M.E.)*, Jan., 1946, 9 (1), Tech. Pub. No. 1968, 1-14.—Waiting-on-cement time has generally been of a length dictated by experience and common practice; it has varied from one area to another, and also with the depth of cementation.

Laboratory tests indicated that a minimum cement strength of 8 lb/sq. in. was desirable, and it was shown that the time required for set to this strength could be expressed as a function on consistometer stirring time to 100 "poises," being approximately three times the latter time. The time of maximum temperature development in cement slurries, due to heat of hydration, is also related to the same consistometer time, being about twice that time. It was also shown that the shut-in casing pressure will build up after cement is placed and will register a maximum at about the same time as the slurry down the hole attains its maximum temperature. From these observations the general rule was formulated that minimum waiting-on-cement time after casing cement jobs in any well is equal to the time when the shut-in casing pressure reaches a maximum, as measured from the initial mixing of cement, times a factor of 1.5. Cement plugs drilled in accordance with this rule were found to drill "firm to hard."

It is concluded that many of the present regulations for waiting on cement require a longer time than is absolutely necessary. The use of the minimum time may lead to the saving of \$1200 per well.

G. D. H.

747. Unitized, Portable Flooring and Racks Cut Pulling Costs. G. M. Wilson. *Oil Wkly.*, 25.3.46, 121 (4), 41.—Standard parts for making floors and demountable tubing racks are described and illustrated.

A. H. N.

748. New Drilling Rig Incorporates Late Improvements. Anon. *Oil Wkly.*, 25.3.46, 121 (4), 34.—A new drilling rig recently placed in operation by Magnolia Petroleum Co. has several interesting features. The rig has insulated crew change rooms, a clothes-washing machine, a mud-checking laboratory, an office with adjoining bunkroom, and covered steel mud tanks. Everything about the rig has been mounted on steel skids and steel structures, and an abundant use has been made of folding steel catwalks. A direct hydraulic weight indicator and a connecting link that provides for rapid shift from drilling to hoisting operations are included in the rig's mechanical features. Photographs illustrate different parts of the rigs.

A. H. N.

749. An Improved Layout for Steam Drilling Rig. W. J. Davis. *Petrol. Engr.*, March 1946, 17 (6), 104.—In order to conserve time and manpower and to simplify rigging up, one company worked out a scheme for its steam-drilling rig utilizing many novel features. The first three problems attacked were simplification of rig layout, unitization of slush pumps and their manifolding, and unitization of boiler feed-pumps and their manifolding. After being used on seven locations, drilling records show that rigging-up time for this steam rig has been reduced 50% and drilling time a conservative 30%, which has more than returned the original cost of construction. It was also asserted that not so much as a union or nipple was changed in rigging-up each time from the original layout, so simple and flexible was the

entire set-up. This long paper described in some detail the rig layout, the slush-pump unit and manifolding and other accessory units utilized, and the manner of their dispositions. A. H. N.

750. Shrink-Thread Drill Pipe and Tool Joints. N. A. Rebarick and C. Swartsfager. *Petrol. Engr.*, March 1946, 17 (6), 86.—The operations of removing old shrink-thread tool joints, by flame cutting, and applying new joints after heating the joint by a specially designed furnace using either natural or bottled gas, are photographically illustrated in detail and briefly described. A. H. N.

751. Drilling and Production Patents. S. W. Briggs, W. C. Bauer, W. J. Ewbank, R. C. Porter, assrs to Briggs Clarifier Co. U.S.P. 2,393,965, 5.2.46. Appl. 26.6.42. Dehydration of oil.

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Production.

752. **Operation and Cost of Engineering Co-operative.** A. M. Crowell. *Oil Wkly.*, 8.4.46, 121 (6), 48.—A group of co-operative and progressive oil and gas operators in Mississippi have proved that the most common complaint of the older oil and gas-producing States—"lack of requisite data prevented the evaluation of petroleum reservoir behaviour"—can be averted simply and inexpensively. At an average cost of \$4.75/well/month an engineering co-operative representing 75% of the wells and 68% of the production of oil and gas in Mississippi has brought an understanding, not only between operators, but also between State and operator, that is unique in the history of the petroleum industry. Continuous pool studies reflecting the complete physical aspects of each oil and gas reservoir of Mississippi make possible an evaluation of economic conditions that is always current. Co-operative service has lightened the burden of the technical staffs of its operator-members, with resulting economies. Unlike the first co-operative formed some twenty years ago, the work of the Mississippi committee is confined to a geological statistical and factual-engineering programme. No agreement or understanding expressed or implied,

with respect to the exploratory and development policy to be pursued, exists between members, and no restrictions are placed on competition in oil and gas operations. This State-wide petroleum engineering committee has proved advantages over the individual field engineering committee wherein membership is confined to actual operating interests. Conservation of oil and gas, rapid acceptance and assimilation of good operating practice and systems is being brought about at a cost of only 1/5 cent/barrel of oil and condensate produced, and this cost is deductible from State and federal income tax.

Details of the costing and benefits of the co-operative systems are given.

A. H. N.

753. Performance of Distillate Reservoirs in Gas Cycling. W. Hurst and A. F. van Everdingen. *Petrol. Tech. (A.I.M.M.E.)*, Jan. 1946, Tech. Pub. No. 1969, 1-15.—A distillate-bearing sand complex is often made up of stringers of different permeabilities. Considering each permeable section that can be traced over a structure as a unit in a parallel arrangement of sand layers, and assuming the same potential distribution in each section, there will be flow parallel to the bedding. The recovery efficiency of recycling in such a sand complex is computed on the basis of this assumption. In the first instance linear flow is considered across a rectangle by making the input well a line source and the output well a line sink.

In order to compute the effect on the recovery efficiency of the position of the wells, the area of a field is considered to be made up of rectangles, each rectangle containing one input well in the centre and two producers located symmetrically with respect to the input well. Formulae are developed to give the pressure and streamlines in steady-state flow. Furthermore, a method is given for rapidly computing the successive positions of the dry gas front.

If the field is irregular in shape, pressure and streamlines can be obtained by a potentiometric electrical model study. By using the concept of "parallel flow" and the results obtained by mathematical analysis or by electrical model studies for a homogeneous formation, the effects of different permeabilities and of the location of the wells can be established. From these studies it is clear that the efficiency of recycling can be profoundly influenced by differences in permeability among the various parallel strata. The similarity between the displacement of wet by dry gas in cycling and the displacement of oil by water in secondary recovery suggests that the "parallel-flow" method of analysis can be used to refine estimates of the over-all recovery efficiency of water-flooding.

G. D. H.

754. Formaldehyde as an Inhibitor of Corrosion by Hydrogen Sulphide. P. L. Menaul and T. H. Dunn. *Petrol. Tech. (A.I.M.M.E.)*, Jan. 1946, 9 (1), Tech. Pub. No. 1970, 1-9.—Hydrogen sulphide in the presence of oilfield brine is highly corrosive, and so leads to many troubles. Special alloys and coating equipment have, in the main, been unsatisfactory or too expensive, and alkali treatment generally causes objectionable precipitates.

Tests with a variety of chemicals showed formaldehyde to be the best inhibitor, reducing the corrosion rate to about one-ninth of that in the absence of any inhibitor. Its mode of action is not known, but it appears that it may form a thin highly protective film on the metal.

In wells batch injection of 40% aqueous formaldehyde was used, the general amount used being 1 quart to 100 bbl of sulphide water produced. In some cases the formaldehyde effected a notable reduction in corrosion; in others there was decided improvement when stray electric currents were eliminated. After a year's trial examination of equipment showed that the treatment had virtually stopped sulphide corrosion. There was a significant decrease in the number of pulling jobs on the test wells, and a saving in pulling and replacement expenses.

G. D. H.

755. Dry-Hole Knowledge Necessary in Secondary Oil Recovery. F. R. Cozzens. *Oil Wkly.*, 8.4.46, 121 (6), 47.—The use of the history of dry holes to avoid unnecessary duplication of failure in considering secondary oil recovery is discussed. A. H. N.

756. Electrification of Smackover Wells Lowers Lifting Costs 36%. G. Weber. *Oil Gas J.*, 27.4.46, 44 (51), 115.—Smackover wells are in the "heavy water production-

stripper class," with many of them making about 95% water. Pumping costs had been equal to a large proportion of total revenue. Electrified pumping units have yielded substantial savings. Prior to conversion, each well was studied individually and the size and power requirement of each installation were computed according to the empirical formulæ:

$$\text{Peak polished rod load} = (\text{wt. rods} + \text{wt. fluid}) \left(1 + \frac{\text{Stroke} \times \overline{SPM^2}}{70,400} \right)$$

$$\text{Peak torque} = (\text{Peak polished rod load} - (\text{wt. rods} + \frac{1}{2} \text{ wt. fluid})) \left(\frac{\text{Stroke}}{2} \right)$$

These formulæ have been found adaptable to such installations. Continued study of wells after conversion has aided in improving their production and better equipping additional wells. In some cases, horsepower requirements have been reduced by one-third by changing types of pumps. Common practice with old equipment was to pump at greatest possible speeds, regardless of pounding, to recover maximum production. In new installations constant study by engineers and pumpers has resulted in improved production by adapting length of stroke and pumping speed to conditions causing least pounding, thereby reducing maintenance, repair, down time, and kilowatt hours used/barrel of fluid lifted.

A. H. N.

757. Graphical Prediction of Water-Flooding Intakes. S. T. Yuster. *Oil Wkly.*, 22.4.46, 121 (8), 36.—A graphical method for predicting the behaviour of a water input well in a water-flood has been developed based upon certain theoretical equations and involving certain assumptions regarding the flow of the involved fluids. The four variables—effective permeability, time, cumulative volume, and water injection rate—when considered in a uniform permeability sand, any two may be computed by use of the nomograph if the other two are fixed. The graphs may be adapted to a sand having a heterogeneous permeability profile with certain restrictions by taking a summation of the behaviour of the different permeability brackets. The nomograph scale may be changed by modifying the variables with appropriate factors. This increases the usefulness and flexibility of the method. Variation in well spacing and shot-well radii cannot be corrected or changed in the graphs contained in this report. New graphs must be drawn if such variations occur. However, the graphs can be corrected for the other variables involved in water-flooding.

A. H. N.

758. General Features of Water-Flood Systems. Anon. *Oil Wkly.*, 13.5.46, 121 (11), 39-40.—The elements of water-flooding systems are briefly discussed. Particular attention is paid to source and treatment of the water.

A. H. N.

759. Why Well Tests Must be Made Accurately. K. M. Fagin. *Petrol. Engr.*, March 1946, 17 (6), 75-76.—The reasons for making accurate tests on wells are discussed. Important tests are: (1) Coring tests and core analysis; (2) Drillstem tests; (3) Electric logging; (4) Radioactivity logging; (5) Caliper logging; (6) "Straight-hole" tests; (7) Pressure test of casing; (8) Temperature survey for cementing test; (9) Initial production (potential) test; (10) Initial bottom-hole pressure and temperature test; (11) Periodic gas-oil ratio tests; (12) Periodic potential tests; (13) Periodic water-oil ratio or "shake-out" tests; (14) Periodic bottom-hole pressure tests; (15) Periodic production efficiency or productivity index tests; (16) Bottom-hole fluid sampling tests and analysis; (17) Periodic wellhead pressure tests. The significance of the prevailing conditions at the time of the tests, in their interpretation, is briefly indicated.

A. H. N.

760. Acre-Foot Recoveries From Oilfields. Part 2. S. F. Shaw. *Petrol. Engr.*, March 1946, 17 (6), 254.—Statistical data on production from a large number of fields in the different States of America are presented and then combined into one comprehensive table. The cumulative recovery is 8629 million bbl or 10,320 bbl/acre, or 144 bbl/acre-foot. Ultimate recovery from 800,215 acres averaging 73.5 ft in thickness, is 10,967 million bbl, or 13,700 bbl/acre, or 187 bbl/acre-foot. The area of 2800 fields in the United States, which includes nearly all fields except those in Kentucky, Nebraska, New York, Ohio, Pennsylvania, West Virginia, and the Pan-

handle of Texas, for which figures on acreage are not available, aggregates 5,262,600 acres from which cumulative production has amounted to 25,157 million bbl, or 4770 bbls/acre. Ultimate recovery from these fields is estimated at 44,268 million bbl or 8400 bbl/acre.

In view of the general average of 187 bbl/acre-foot shown for fields in all parts of the United States, it is surmised that the much higher figures used for acre-foot recoveries for many of the newer and principal fields of the United States may be optimistic. If such is the case, the answer will be shown in downward revisions of ultimate recovery in these fields as they become depleted. Already some estimates have been revised downward, but it remains to be seen whether this will apply to many of the larger fields where, by reason of circumstances, it was necessary to make estimates by use of the volumetric method.

A. H. N.

761. Oil Well Counterbalancing. E. N. Kemler. *Oil Wkly.*, 6.5.46, 121 (10), 17-19.—The reasons for using counterbalance—*i.e.*, to reduce the size and power of the prime mover and to lengthen the life of the equipment—are discussed and followed by descriptions and illustrations of several types. To check for correct balance Barrett's method of slipping the clutch may be used. Briefly it is as follows: (1) Set the throttle on the engine at a fixed position; (2) Release the clutch very slowly to the point where it will pull the peak load. Any further release will result in the clutch slipping on some part of the cycle. If the well is properly balanced, the clutch will slip equally on the up and downstroke; (3) On further release of the clutch a well out of balance will slow up and slip on the side which is under-balanced, and speed up on the side which is over-balanced. A little experience in developing a technique will soon show whether the well is noticeably out of balance.

A. H. N.

762. Graphical Mechanics of Counterbalancing Multiple Well Pumping Assemblies. J. J. Laudermilk. *Oil Wkly.*, 8.4.46, 121 (6), 32.—The principles of balancing a number of wells on the pump by back-crank pumping are explained by solving in detail a problem in which it is assumed that one well will be produced in the normal manner of sucker-rod pumping, whilst two other wells will be produced by back-cranking from the first well. Detailed engineering data are presented and the solution, using a method of graphical balancing of forces, is given in full.

A. H. N.

763. Research and the "Shoe-String" Producer. F. R. Cozzens. *Petrol. Engr.*, March 1946, 17 (6), 248.—A brief *résumé* of the present trends in research on problems of shoe-string sand production is given, but no references to papers are appended.

A. H. N.

764. Field Effective Permeabilities and Shot-Well Radii. S. T. Yuster. *Oil Wkly.*, 29.4.46, 121 (9), 24. *Paper Presented at Ninth Technical Conference on Petroleum Production, Pennsylvania State College.*—From certain theoretical deductions an equation has been derived which shows that the logarithm of the cumulative volume of water injected in a water-flood during the radial encroachment period is a linear function of the reciprocal of the injection rate. The slope of the line mentioned will yield the effective permeability of the formation to the flood-waters. The theoretical *y*-intercept of this same line will give the effective shot-well radius. Certain field data have been analysed and a range of relative water permeabilities from about 0.4 to around 0.001 has been found. The variation in relative permeability indicated points towards a possible reaction between the flood-waters and the formation to give a plugging action. The effective shot-well radii also show a wide variation in value. This difference in shot responsiveness indicates a need for further experimentation in well-shooting techniques.

A. H. N.

765. Cable Tools Used to Overhaul Old Wells. N. A. D'Arcy, Jr. *Petrol. World*, March 1946, 43 (3), 47-48.—It is found economical to use cable tools in cleaning and overhauling old marginal wells to California. One of the problems encountered is the scarcity of experienced cable-tool drillers in the area.

A. H. N.

766. Engineering of Oil Well Abandonments. W. E. Schoeneck. *Oil Wkly.*, 15.4.46, 121 (7), 44.—The paper deals specifically with oil wells—not with gas well nor condensate wells, which need a separate investigation—and outlines the two major,

interdependent considerations which have to be taken into account in the abandonments of wells: physical and economical considerations. The type of cumulative production curves obtainable with a well are discussed and interpreted. Other characteristics of the wells, gas-oil ratios, water production, etc., are examined. All these are combined with cost studied before the appropriate measures in abandoning the well can be decided on.

A. H. N.

767. Test Flow Chamber. G. M. Wilson. *Oil Wkly.*, 15.4.46, 121 (7), 43.—One drilling contractor developed a simplified system of conducting drill-stem tests which enables him to observe flow results, but which at the same time practically eliminates possibility of oil escaping to settle over a wide area and cause damage to nearby installations. The 2-inch line coming out of the well-cellar connections was extended out to one side of the location, where it was connected into a small high-pressure separator. A 2-inch gas exhaust line some 200 ft long, and suitably anchored, branches off at that point to exhaust to atmosphere well out of danger of rig installations. Oil then flows on through an increasingly greater size pipe, the last joint of which has perforations for discharging fluid into the sump directly beneath. Some 75 ft down stream from the trap, the 2-inch oil line is enlarged to 6 $\frac{3}{8}$ inch, the latter being a 75-ft length of salvaged casing which is mounted on pipe-leg supports. This pipe reaches well over to within the confines of the walled test sump. At this point the line swages out and is flange connected into a 15-ft length of specially prepared 15-inch casing, the latter spanning the sump and resting on an elevated support made of truncated A-frames made of 2-inch pipe. This piece of large-diameter casing is welded closed at the distant end, and around the lower approximately $\frac{1}{3}$ of its periphery are cut out numerous large-size perforations, the perforated interval extending the length of the chamber.

A. H. N.

768. Interpretation of Interference Tests in Terms of Permeability. Part 3. K. B. Barnes. *Oil Gas J.*, 4.5.46, 44 (52), 107.—The fact that in core-permeability measurement an area of 3-inch diameter is taken as representative sample for, say, 20 acres in the field is stressed. In interference tests the whole field, or at least major portions of it, are under test. Interference tests, by definition, must always include at least two wells. The drop in pressure occasioned by producing a well at a certain point is observed at another well or wells which are shut in. The variables contained in such a fluid-flow system include the distances between the shut-in wells and the producing well and the thickness and average permeability of the acreage units represented by each of the closed-in wells. The significance of the various variables and the interpretation of interference tests are discussed.

A. H. N.

769. Wax Saturations in Oil Sands. J. C. Calhoun and S. T. Yuster. *Oil Wkly.*, 13.5.46, 121 (11), 42.—Sand samples from the Gaines pool of Pennsylvania were extracted, and were found to contain solid paraffin wax. A method was developed to calculate the true oil and wax saturations. By this method the wax saturations were calculated as high as 6%. Considerations indicate that this figure is still too low. It is suggested that this amount of wax would not only hinder the correct determination of oil saturation, but would also affect the production mechanism.

Determination of paraffin point of Gaines crude oil and of the formation temperature show them to be identical within error of determination. This fact indicates the reservoir crude to be wax saturated. Paraffin points on five other Pennsylvania crude oils were determined and compared with the formation temperatures. In two instances—the First and Second Venango sands—there is evidence that the crude oil might be saturated at the formation temperature, in which event solid paraffin might be present. It is suggested that the simplest means by which the presence of wax in these formations could be explained would be by erosion to bring the producing horizon to a depth where the temperature fell below the saturation temperature. It is further suggested that in view of the history of the Gaines pool the wax was present at the time when it was a virgin reservoir.

A. H. N.

770. Trends in Processing Gas Condensate Reservoirs. F. H. Dotterweich and E. O. Bennett. *Oil Wkly.*, 6.5.46, 121 (10), 25. *Paper Presented before Natural Gasoline Association of America.*—The properties, processing and products of condensate gas are studied.

A. H. N.

771. California Exploration and Production Trends. N. A. D'Arcy, Jr. *World Petrol.*, March 1946, 17 (3), 48.—A description in general terms of the methods adopted in exploring, drilling, and producing Californian inland and tidal fields is given. Directional wells, water and gravity drive secondary recoveries, and unit operations of fields constitute interesting features. A. H. N.

772. Field Co-operation Reduced Flare Gas. G. B. Nicholson. *Oil Wkly.*, 8.4.46, 121 (6), 42.—Production charts recording the pressure of the gas are reproduced, which show peaks and hollows over the 24 hours of the day and also over the week—e.g., shutdowns on week-ends show a "low" region. The paper discusses methods of making production more efficient by eliminating the peaks and hollows in the time charts. A. H. N.

773. World's Highest-Pressure Well Gauges 8,225 Pounds. E. H. Short, Jr. *Oil Gas J.*, 4.5.46, 44 (52), 131.—The well head pressure of this gas well is 8,225 lb/sq.in. and, when the weight of the 11,000 ft gas column is added to this value, the bottom hole pressure is approximately 10,500 lb/sq.in. Due to the special care taken, the well was safely brought in and completed. Of special interest is a 15,000 bbl/sq.in. working pressure (30,000 lb/sq.in. test pressure) balanced piston valve which can be opened or closed in 10 seconds using only one hand to turn a handle. A. H. N.

774. Deepest Producing Well. E. H. Short, Jr. *Oil Gas J.*, 4.5.46, 44 (52), 104.—The well is No. 2 Smith-State Unit 1, owned by Shell Oil Co. It was drilled to 14,301 ft and completed at a plugged-back depth of 13,828 ft, with 7-inch casing set at 13,437 ft. Production of 530 bbl/day of 33° A.P.I. gravity through 11/64-inch choke. A. H. N.

Oilfield Development.

775. A.I.M.E. Foreign Production Symposium. Anon. *Oil Wkly.*, 4.3.46, 121 (1), 13.—In 1945 a new field was discovered at Qatif, and extensions were made to the Abqaiq field of Saudi Arabia. Refining facilities there and on Bahrein are being expanded. No. 1 Qatif produces 4000 bbl/day of 37.5 gravity oil from 7510 ft in the Arab zone. Wells were being reconditioned at Dammam and on Bahrein. Bahrein produced 7,308,938 bbl in 1945, and Dammam 21,124,381 bbl.

Most of Iraq's 1945 production of 4,341,000 long tons came from five wells at Kirkuk.

Permits cover 22 million acres of Egypt where geophysical work was resumed in 1945. In 1944 Egypt produced 9,431,000 bbl, mainly from Ras Gharib. Several dry wildcats were drilled in 1945.

In 1944 Canada produced 10,166,000 bbl of oil, but only 8,560,000 bbl in 1945, due to a decline at Turner Valley and to the closing of the Canol pipe-line. In 1945 Norman Wells produced 355,000 bbl and Turner Valley 8,055,000 bbl. During 1945 the Lloydminster field was extended across the border into Saskatchewan and yielded 15,000 bbl. New Brunswick produced 31,000 bbl in 1945 and Ontario 113,000 bbl. A second well at Jumping Pound was low and obtained salt water. A well in the Brazeau district drilled through a fault into Cretaceous after having been in presumed Mississippi limestone.

Colombia produced 22,866,000 bbl on 1945; the De Mares concession gave 15,674,000 bbl, the Barco concession 5,540,000 bbl, Casabe 1,600,000 bbl and Sinu 45,266 bbl of oil. At the end of 1945 24 geological parties, and 7 gravity meter and 14 seismograph parties were operating. The Casabe field has been extended eastwards across the Magdalena, and at the south end of the De Mares concession deeper production has been found in an old shallow field.

Peru produced 13,747,346 bbl of oil in 1945. Ganso Azul yielded 60,000 bbl in 1946. It has 5 wells capable of giving 5000 bbl/day each. Ecuador gave 2,670,000 bbl of oil in 1945. The entire output came from the Santa Elena Peninsula. A test east of the Andes has had very good oil showings. Brazil produced 79,326 bbl in 1945; Lobato yielded 6728 bbl, Aratu 6714 bbl, Candeias 36,663 bbl and Itaparica 29,221 bbl.

G. D. H.

776. A.P.I. Makes Reserves Estimates. Anon. *Oil Wkly.*, 4.3.46, 121 (1), 11.—During 1945 U.S.A. found 2,110,299,000 bbl of new reserves, new pools accounting for 419,984,000 bbl. 1,736,717,000 bbl of oil was produced in 1945, and at the end of the year reserves were estimated at 20,826,813,000 bbl.

During four years of war reserves have increased by 1,237,517,000 bbl. Texas has reserves of 11,470,294,000 bbl.

Tables list by States the reserves at the beginning and end of 1945, the 1945 production and the amount of oil added by new pools discovered in 1945. Similar data are given for the whole of U.S.A. by years from 1936. G. D. H.

777. January Drilling Declines. Anon. *Oil Wkly.*, 4.3.46, 121 (1), 38.—In the five weeks ended 2nd February, 1946, well completions in U.S.A. averaged 472 per week; the December figure was 521, and the January, 1945, figure 419. The January, 1946, completions included 1305 oil wells, 215 gas wells, and 653 dry holes.

A table summarizes the January, 1946, completions by States and districts, and gives comparative data for December and January, 1945. G. D. H.

778. Norman Wells Oilfield. J. S. Stewart. *Oil Wkly.*, 4.3.46, 121 (1), 38 (*International Section*).—The Norman Wells field is on the Mackenzie River, 90 miles south of the Arctic Circle. The first well was drilled in 1920, and in 1942 there were four producers supplying a small local refinery. Work on the Canol Project began in May, 1942, and the order to stop drilling was given in March, 1945. 60 productive wells were drilled during the period of contract.

The discovery well encountered a flow of oil at 783 ft, and from 83 ft downwards there had been seepage into the well from the mainly shaly beds. A flow of 10 bbl/day was obtained. On deepening to 1025 ft the capacity became 75–125 bbl/day. The second well was drilled to 1602 ft, and had a capacity of 175–240 bbl/day. On Bear Island a well found showings at 1948 and 2000 ft, but was abandoned in salt water at 2304 ft. A test on the south bank of the river, 4 miles from the discovery well found no oil. 8 miles upstream from the discovery well shallow gas was reported.

Isolated patches of Tertiary rest unconformably on Cretaceous, which in turn lies on Devonian. The latter is commonly bituminous at outcrop. Silurian beds outcrop 5 miles to the northeast and 20 to 25 miles to the southwest of the area. The structures trend generally N.W.–S.E., and are asymmetric, with the steep limbs slightly faulted in some cases. The Norman Wells field is on the southwest flank of a major anticline, the flank dipping at 4–5°. Oil occurs in the Fort Creek (Upper Devonian) reef limestone. The top of the limestone is 1050–1900 ft deep.

The probable productive area outlined exceeds 4000 acres, 1870 acres being under the river.

The saturated section is 0–388 ft thick. The reef pinches out up dip. Saturation is irregular. The latest reserve estimate is 36,250,000 bbl. from an area of 2600 acres, 460 acres being under the river and accessible by directional drilling. 10-acre spacing is used on the north bank and 20-acre spacing on Goose and Bear Islands.

Wells are treated with acid and this generally doubles the initial flow. The original reservoir pressure was 695 lb/sq.in. at 1000 ft sub-sea. Solution-gas drive is active on the north bank and Bear Island, but there is evidence of water drive on Goose Island. Up to March, 1945, 1,997,000 bbl of oil had been produced.

The bubble-point of the undersaturated crude is 490 lb/sq.in. The oil gravity is 39 to 41.5 and the dissolved gas/oil ratio is 325 cu.ft./bbl, while the shrinkage factor is 17.2%.

All wells flow naturally. In February, 1945, the gas/oil ratio was 725, and the average output 4288 bbl/day. Reinjection of gas was carried out for five months, the gas injected being equivalent to 602,000 bbl of pore space at reservoir pressure.

The pipeline outlet and the refinery at Whitehorse began to operate in April, 1944. The Norman Wells refinery has a capacity of 1200 bbl/day.

The Canol agreement, costs, and other points are discussed.

G. D. H.

779. Argentina's Oil Industry During the War Years. J. E. Thomas. *Oil Wkly.*, 4.2.46, 120 (10), 3 (*International Section*).—Shortage of materials caused the completions in Argentina to fall from 372 in 1941 to 155 in 1945. Production in 1941 was 22,000,000 bbl and rose to 24,835,500 bbl in 1943, then declined to 22,860,000 bbl

in 1945. In recent years the output of the government company has been double that of the private companies.

Production was obtained first in 1907 in the Comodoro Rivadavia field, which gave almost all the country's output until 1925, and even now provides two-thirds. This field has at least fourteen separate producing areas, and lies on the north flank of the San Jorge sedimentary basin. In 1944 an important strike was made on the south flank of the San Jorge basin, near Caleta Olivia, 50 miles south of Comodoro Rivadavia. This strike gave 1000 bbl/day from a 10-ft pay at 5381 ft. Good oil showings were found in four sands between 4085 and 4174 ft, and there was a total of ten saturated horizons. Three further oil wells have been completed in this area, which has gentle folds affected by many faults which seem to control production. The oil is from a deeper horizon than that which produces at Comodoro Rivadavia.

Production is obtained also in Mendoza, Salta and Plaza Huincul. Mendoza the newest area, produces about 3,100,000 bbl/year, and is believed to have good prospects. Last year a 2500-bbl well was completed in the Barrancas field. Challaco of the Plaza Huincul district is a promising field with 63 producers, although only one-third drilled up.

During 1945 Y.P.F. drilled 11 wildcats, 5 in Comodoro Rivadavia-Caleta Olivia district, 3 at Plaza Huincul, and one each at Mendoza, Salta and Santa Fe.

Private companies hold 116,260 acres under lease; 247,165,380 acres are reserved for the government, and it is difficult for the private companies to obtain leases on the remainder of the 281,802,842 acres.

Extensive geological and geophysical surveys have been carried out and many prospects await drilling.

A map shows the proven and prospective producing areas, while tables and diagrams give production data and indicate areas prospected geologically and geophysically in 1945.

G. D. H.

780. Exploration in Western Ecuador. J. E. Thomas. *Oil Wkly.*, 4.2.46, 120 (10), 20 (*International Section*).—Oil production in Ecuador began over 30 years ago, and is still confined to the Santa Elena Peninsula, where seeps were known and production had been obtained by pitting. In 1923 a 45-bbl well was completed and the annual production rose to 87,000 bbl. In 1926 the output was 350,000 bbl. Deeper drilling, usually to 1500–2500 ft, showed other producing areas and zones. In 1928 the output was 1,000,000 bbl, in 1937 2,000,000 bbl. During 1945 a 300-bbl well was completed at 4000 ft in the northern part of the El Tigre field.

The oil is reported to fill fractures in Eocene sands which are not themselves impregnated, and so a Cretaceous source has been suggested. The Sucre sand of the Lower Eocene is over 3000 ft thick, and wells usually penetrate this for 300–400 ft in search of oil.

Several sedimentary basins of restricted size, but with a great thickness of Tertiary, lie along the coast of Ecuador.

Rajada 1, 45 miles west of Guayaquil, was still in Eocene at 11,300 ft. Just to the west Rodco 1 had reached 9400 ft. Daular 2, 25 miles west of Guayaquil, was abandoned still in the Eocene. 17 tests have been completed by International Ecuadorian Petroleum Co. in the past five years. Faults have been found, and sharp changes in stratigraphy. Several tests have been drilled in the deep basin just east of the basin occupying the tip of the Santa Elena Peninsula. The pools near the tip of the peninsula are said to be in stratigraphic traps, irregular sand lenses, sometimes sealed partly by faults. These traps are difficult to discover.

A map shows the concessions on the Santa Elena Peninsula, and a table gives the production of the different companies annually from 1941, together with the total up to the end of 1940.

G. D. H.

781. Peru's Oil. J. E. Thomas. *Oil Wkly.*, 4.3.46, 121 (1), 3 (*International Section*).—Oil was produced in Peru as early as 1884, but Peru did not give 1000 bbl/day until 1904. The 1945 production is estimated to have been 37,000 bbl/day.

Five wells have been completed at Agua Caliente, one being reported to have a potential of 5000 bbl/day.

The Zorritos field is Government owned. The Government is exploring the Pirin

area on the shores of Lake Titicaca. It also proposes to drill on the river Ucayali, 125 miles north of Agua Caliente.

In the headwater region of the Amazon formations ranging Devonian to Cretaceous, and possibly the Tertiary, are of interest with regard to oil, but this region presents many difficulties from the point of view of development.

A map shows the concessions, and tables give production data.

G. D. H.

782. Roumanian Crude Production Shows Increase for 1945. Anon. *Oil Wkly.*, 4.3.46, 121 (1), 57 (*International Section*).—Roumania produced 25,859,400 bbl of oil in 1944 and 34,009,696 bbl in 1945.

G. D. H.

TRANSPORT AND STORAGE.

783. Transfer Rates Inside Tubes. W. L. Nelson. *Oil Gas J.*, 4.5.46, 44 (52), 139.—Issue 91 of the Refiners Notebook gives a chart of film transfer rates inside exchanger tubes of $\frac{1}{2}$ to $1\frac{1}{4}$ -inch internal diameter, from which the rates for lubricating oils may be determined, given the viscosity and velocity of the oil in the tanks at the estimated film temperature.

G. A. C.

784. Tripling Westward Flow of Iraq Oil. Anon. *World Petrol.*, April 1946, 17 (4), 40.—The project for a new pipeline from Kirkuk to Tripoli and Haifa is described.

Economic and financial reasons have led Iraq Petroleum to carry out its pre-war projects for increasing oil deliveries to the Levantine coast. The existing 10-inch and 12-inch pipelines are to be increased by installation of welded 16-inch lines to Tripoli and Haifa, giving a total annual capacity of 12,000,000 tons. Pumping capacity is to be increased, and two new submarine pipelines of 5000 ft each are being installed at Haifa, so that six tankers can be loaded simultaneously.

Similar extensions are being made at Tripoli. The pipeline programme may require increased refining facilities at Haifa. Work on the line has already started at Haifa, and the project should be completed in 1948. The new line will follow the same route as the present one. Drilling of new wells in the Kirkuk field is in progress, and the extent of tankage and loading lines required at the terminal sites will depend on the capacity of refineries to be constructed at Tripoli and Haifa. Other auxiliary equipment such as housing, offices, and workshops will also be constructed.

G. A. C.

REFINERY OPERATIONS.

785. Selection and Application of Refinery Instruments. Part 3—Liquid Level. A. Krieg. *Petrol. Engr.*, March 1946, 17 (6), 95.—In considering level-control problems it should be realized that liquid level controllers are, in effect, ratio flow controllers, as they control the out-flow proportional to, or equal to, the inflow over some period of time. The three methods most commonly used for liquid level control may be grouped: (1) Constant level; (2) Averaging level; (3) Interface. These are described as to their operation and scope, and types of instruments for measuring liquid level are classified as: (a) Static pressure (Type A); (b) Float actuated (Type B); (c) Differential pressure (Type C). These are described, and their working and applications are discussed and illustrated under the sections: Type A, Pressure-gauge system; Diaphragm box, Air bubble or purge system. Type B, Ball float; Flexible shaft; Tubular float, null balance, buoyancy or displacement. Type C, Differential; Aneroid differential. Dual level-control instruments are also discussed.

W. H. C.

786. Selection and Application of Refinery Instruments. Part 4—Flow. A. Krieg. *Petrol. Engr.*, April 1946, 17 (7), 164.—The primary elements used in differential type meters are classified and described and illustrated under: thin plate orifice; flow nozzle; Venturi tube. The Pitot tube, also a primary element, is mainly employed in testing work, and is considered later. A summary is given of their merits and disadvantages covering, cost, flexibility, accuracy, efficiency, and resistance to

wear. Straight vanes are used to nullify turbulence, eddies, etc., and are described and illustrated. Pulsating flow is outlined, and such means as are possible of reducing its effects are discussed. Differential pressure flowmeters are classified under two general types, mechanical and electrical; those are described and discussed with respect to their constructional mechanism, range of pressure differentials, operating procedures, care, and maintenance, and their fundamental mechanisms are shown in sketches under: "U"-type manometers; mechanical lever arm type; low-pressure bell type. Other types include magnetic couplings, which eliminate the use of pressure-type shafts, aneroid bellow type, force balance type (aneroid). Electronic types: area meter (rotameter type); piston type; conductance type. Electrical types: inductance bridge; conductance type. All types being available for indicating or recording purposes. Integrators are discussed, and the use of static pressure pen, and square-root compensation mechanisms are described. Sections covering ratio flow control and volumetric-type meters are included. W. H. C.

787. Proper Classification of Wastes First Step in Disposal Program. Part 4. W. B. Hart. *Nat. Petrol. News Tech. Sect.*, 3.4.46, 38 (14), R-292.—Refinery wastes are classified on the basis of their general characteristics and form twelve groups, excluding gases and vapours, which are to be discussed in a later paper. These are: (1) Uncontaminated water waste; (2) storm-water waste; (3) oil and oily wastes, including emulsions; (4) wastes which affect hydrogen-ion concentration, acidity, and alkalinity; (5) wastes which absorb dissolved oxygen; (6) wastes which cause taste and odour; (7) toxic wastes; (8) wastes which are highly concentrated solutions of mineral matter (i.e., carry high dissolved solids); (9) wastes which carry suspended solids and are turbid; (10) coloured wastes; (11) minor miscellaneous wastes; (12) semi-solid and solid wastes. The classification affords important fundamental information for the planning for systematic and efficient disposal of wastes. Each group is widely discussed. The importance of giving due consideration to the effects of flood-waters is stressed. The presence of oil in waste waters, apart from its value, frequently adds greatly to the problems of disposal by the formation of emulsions that are difficult to resolve. W. H. C.

788. New Type Chromium-Nickel Alloy Offers Wider Range of Refinery Applications. J. S. Ewing. *Nat. Petrol. News Tech. Sect.*, 3.4.46, 38 (14), R-243.—Information has been released of a new alloy "Stainless-W" developed during the war, which has the corrosion-resistant properties of 18-8, Cr-Ni steel, and in addition can be fabricated and afterwards hardened by heat treatment. Its application to industrial uses has been necessarily limited to special war needs, but its established properties show it to be of particular interest to the petroleum industry. Stainless-W does not contain tungsten, the -W denotes the Wood Works at which the alloy was developed. Its composition is approximately: Carbon 0.5%; Cr 17%; Ni 7%; Ti 0.70%; Al 0.20%; the other elements are present in the normal amounts found in other steels. The alloy is a precipitation hardening steel and, unlike the 18-8 alloy, is magnetic. Certain of the physical properties, which are more directly dependant on metallographic structure than on chemical composition, approach those of ferritic 17 chrome. Examples are: specific gravity coefficient of thermal expansion and electrical resistivity. The difference in electrical resistance and thermal conductivity between the annealed and aged conditions of Stainless-W is believed to be indicative of precipitation. The constant modulus of elasticity of Stainless-W as compared with the decreasing modulus of cold-worked 18-8 is significant. The alloy is treated in two steps: (1) Solution annealing; (2) Ageing (Precipitation hardening). These two steps are fully described and the different temperatures employed are given and structural changes are discussed. An interesting characteristic of the alloy is the extreme uniformity of hardness, in both the unaged and aged conditions, obtainable over the cross sections of bars of various diameters. Mechanical, embrittlement, sea, and atmospheric corrosion, tests show results comparable with 18-8 alloys. Forging, machinability, and spot-welding characteristics are excellent, welded joint strengths, the flux and electrodes used are discussed. Improvements in the design of bubble caps, and the toughness of the alloy allows thinner bubble caps to be employed, with less need for replacements due to wear or breakage, and keeps the weight of equipment down to a minimum. Improved methods are also now in use

for applying this alloy as linings to vessels and overlays to exposed steel surfaces for corrosion protection.
W. H. C.

Refineries and Auxiliary Refinery Plant.

789. The Resistance to Corrosion by Sea Water of Some α -Tin and α -Tin-Aluminium Bronzes. J. W. Cuthbertson. *J. Inst. Metals*, 1946, 13, 317.—A high tin content (not less than 10%) confers excellent resistance on binary bronzes towards impingement attack, such alloys being superior to cupro-nickel and aluminium brass in this respect. The addition of aluminium to bronzes containing 10% tin does not improve their performance significantly, but the presence of the metal is considered to be essential where less tin is incorporated in the alloy. Aeration of the sea water increases the rate of deposit and general attack of all bronzes, but the more resistant of these are nevertheless better able to cope with this form of attack than cupro-nickel, although the latter exhibits a marked superiority in un-aerated water. Pre-filming of bronzes improves their resistance towards impingement attack and general corrosion, but does not suppress it completely. It definitely slows up the initial attack, and should be of great value in cases of corrosion arising from temporary solid deposits. Finally, homogeneity of structure and fineness of grain-size both assist towards combating impingement attack.
L. B.

790. Stop Tube Failure in Super-heater by Adding Corrosion Inhibitors. E. Q. Camp, C. Phillips, and L. Gross. *Nat. Petrol. News Tech. Sect.*, 6.3.46, 38 (10), R-192.—This paper is an abstract of a report entitled "Corrosion of 18-8 Alloy Furnace Tubes in High Temperature Vapour Phase Cracking" published in *Corrosion*, the official organ of the National Association of Corrosion Engineers, September, 1945. In the manufacturing of butadiene, at two refineries, from naphthas (200–400° F) obtained from Refugio crude oil, Texas, the naphtha is vapour cracked, after preheating, by passing through 18-8 type stainless-steel tubes in a superheater at 1300° F. Intense corrosion of the tubes caused their failure after about only 120 hours operating. The plant and its operation are described and the corrosion of the tubes is discussed. A thorough examination of the plant data and analyses of feed and products did not show the cause of corrosion, but further plant and laboratory tests showed that it was not due to the presence of organic acids arising from the presence of dissolved oxygen in the feed, as thought possible, but showed that organic acids inhibited corrosion rather than accelerated it. The analytical data showed that the feed-stock at one refinery contained mercaptan sulphide whereas the other did not. H₂S evolution tests at 1300° F on the combined and fresh feeds of the two refineries showed 1.3 and 8.7 lb and 2.2 and 14.1 lb H₂S/1000 brls, respectively. These data do not show the cause of corrosion, but indicated that it may occur because of the absence of certain sulphur compounds—e.g., mercaptans. Laboratory studies of the problem are described; these supported the deductions made from the earlier work, and showed that sulphur (as mercaptan, CS₂, free sulphur, etc.) effectively inhibited the type of corrosion experienced. Further plant operations, using feed naphtha to which 0.05–0.5% of sulphur as butyl mercaptan had been added, eliminated excessive corrosion, and confirmed the laboratory results. It was also observed that the presence of water in the feed, within slightly narrower limits, similarly inhibited corrosion, but the reason was not established. As a result of these investigations the plants are now successfully operated by the injection of 0.3% CS₂ into the feed naphthas.
W. H. C.

791. Magnesium Gives High Cathodic Protection to Pipelines and Buried Structures. L. M. Oldt. *Nat. Petrol. News Tech. Sect.*, 6.3.46, 38 (10), R-186.—An outline of cathodic protection is presented and the development of superior magnesium alloy anodes for the purpose by the Dow Chemical Co. is described. The composition of these anodes is given, the copper nickel and iron content being limited to 0.05% Cu, and 0.003% for the Fe and Ni. The current efficiency and life of a magnesium anode depend largely on three factors: the composition of the metal; the electrolyte present; and the current density at which the anode operates. Two types of corrosion of magnesium anodes take place: (1) useful corrosion, which provides the current; and (2) non-useful or local corrosion, representing the current supplied by

the magnesium to provide local cathodes in and on the anode itself; this is a variable which also depends on the three factors mentioned. The second factor affecting the life of an anode is the backfill or the electrolyte used around the anode. Developments in this direction have shown the gypsum-clay mixtures are more desirable than chlorides, and bentonite has been substituted for the clay. The backfill for high efficiency and life of magnesium anodes are (a) for low-resistance soils, bentonite and gypsum in the ratio of 3:1; (b) for high resistance soils, bentonite, gypsum, anhydrous sodium sulphate in the ratio 2:1:1. As regards the effect of current density on anode efficiency, it may be said that when using the alloy, a current density of the order of 0.5 milliamperes/sq.in. is sufficient to obtain an efficiency of 50%. Several large cathodic protecting systems using magnesium anodes are described; one of unusual interest is, the protection of a sea-water flume at Freeport, Texas, which consisted of steel piling driven 14 ft into the earth and is 2300 ft long. The flume has polarized, and its life has been extended for an indefinite period by the installing of magnesium anodes. Details are given of the installation of magnesium anodes, covering, spacing, sizes, current output, life, weights, and structures of anodes. W. H. C.

792. Pipeline Gauging, Sampling, and Testing. J. A. Sloeth. *Petrol. Engr.*, March 1946, **17** (6), 144.—The steps by which oils are measured, sampled and tested for the determination of volume or amounts shipped or transferred are outlined, particularly in cases where abnormal conditions or results are encountered, and each step is discussed. Methods of gauging temperature measurement and sampling of the oil in vessels, and the A.S.T.M. and A.P.I. sampling devices and methods are outlined. The testing of samples for specific gravity, water, and sediment by distillation and centrifugal methods is discussed, and a comparison of water and sediment contents of various crude oils by these methods is given. Interesting information with respect to the A.P.I. gravity scale is: "When one of the scientific organizations in the early days of the industry undertook to check up on the accuracy of the prevailing hydrometer, it was supposed to conform to the Baumé scale, but it did not. The Baumé scale has a modulus of 140/130 and it was found that the petroleum industry was using an instrument with a modulus of 141.5/131.5. Rather than attempt to call in all the hydrometers in service, a prodigious assignment, the instrument and modulus was adopted as an A.P.I. standard and has continued to be the official standard of the American petroleum industry to the present time." Dry gravity methods are discussed, pressure-bomb, chemical centrifuge, and pressure-filter methods are outlined. Illustrations are shown of banks of water content, distillation equipment, and pressure-bomb assemblies. W. H. C.

Solvent Refining and Dewaxing.

793. Modern Refining Processes. 9. Better Technology, Better Lube Oils. G. Armistead. *Oil Gas J.*, 4.5.46, **44** (52), 115.—A conventional refining operation for the production of lubricants is described and several of the more important classes of additives are outlined. Distillate lubricating-oil cuts taken as overhead and side streams from the vacuum fractionator are treated in a single solvent extraction plant. The residuum from the vacuum distillation is first deasphalted and then dewaxed and finally solvent extracted. In another process the long residuum is passed first through a double solvent extraction process, and is afterwards dewaxed. The treated oil is then vacuum-distilled for separation into the required cuts, which are finally treated with clay.

Additives are incorporated in lubricating oils to improve performance, and include antioxidants, anti-corrosives, extreme pressure assistants, detergents, viscosity index improvers, and pour-point depressants. G. A. C.

Polymerization.

794. Nomograph for Calculation of Olefin Conversion in Catalytic "Poly" Plant. E. G. Glass. *Nat. Petrol. News Tech. Sect.*, Jan. 1946, **38** (1), R-33.—A nomograph is presented, and its construction explained, for the rapid assessment of the percentage conversion of olefin into polymer, required during the operating of catalytic

polymerization plants. Samples of the fresh feed and the spent gas are analysed for total olefin contents, and by using the two results in conjunction with the nomograph in the manner described the percentage conversion can be quickly obtained. The nomograph may be constructed on a weight, volume, or mole basis, and gives the desired degree of accuracy.

W. H. C.

Special Processes.

795. Leaded Gasoline Made Safe for Human Contact. Anon. *Oil Gas J.*, 4.5.46, 44 (52), 142.—U.S.P. 2,390,988 describes a process in which stannic chloride is added to leaded gasoline to remove tetraethyl lead so that the gasoline can be used for cooking fuel, cleaning fluid, or other purposes. An insoluble mixture of diethyl lead chloride and diethyl chloride is produced by the reaction, and removed after agitation with water.

G. A. C.

Patents.

796. Patents on Refining Processes and Products. M. D. Peterson, assr to Du Pont de Nemours. U.S.P. 2,391,920, 1.1.46. Process for polymerizing ethylene by heating in the presence of a dialkyl oxide as catalyst.

A. R. Goldsby, assr to Texaco Dev. Corpn. U.S.P. 2,391,962, 1.1.46. A gasoline rich in olefines and aromatics is contacted with an adsorptive clay at 800–100° F and 100 lb to effect olefine isomerization, then contacted with adsorptive clay in the presence of hydrogen at 600–950° F and 100–300 lb to convert the isomerized olefins into isoparaffins, thus improving the lead susceptibility of the gasoline.

C. M. Loane and R. Watson, assr to S. O. C. Indiana. U.S.P. 2,391,988, 1.1.46. A candle comprising a body of wax and a core comprising a mixture of wax and from about 1% to about 30% of an aerogel.

C. J. Randolph, jr., and N. B. Haskell, assr to Texas Co. U.S.P. 2,392,000, 1.1.46. Polymer gasoline mainly saturated and free of aromatics is obtained by passing propylene over a catalyst comprising a calcined mixture of precipitated silica, alumina, and zirconia at 470–495° F.

J. W. Teter, assr to Sinclair Refining Co. U.S.P. 2,392,107, 1.1.46. Direct amination of an olefine is effected by the action of ammonia in the presence of metallic cobalt deposited on a cobalt silicate carrier.

R. L. May, assr to Sinclair Refining Co. U.S.P. 2,392,252–3, 1.1.46. An oxidation inhibitor to add to a lub. oil composition is comprised of the product from the reaction of a monohydroxy aliphatic alcohol with the condensation product of turpentine and phosphorus pentasulphide.

C. E. Welling, assr to Phillips Petroleum Co. U.S.P. 2,392,277, 1.1.46. Levulinic acid and its lower aliphatic alkyl esters are employed to separate close boiling mixtures of aliphatic C₄ to C₆ hydrocarbons in the gaseous state.

G. E. Liedholm and F. M. McMillan, assr to Shell Dev. Co. U.S.P. 2,392,330, 8.1.46. The 190–200° F fraction of a naphthenic straight-run gasoline is isomerized using AlCl₃ as catalyst. It is mixed with the succeeding 200–230° F fraction, and the mixture is dehydrogenated using chromium oxide catalyst. A substantial increase in yield of pure toluol is thus obtained.

F. M. McMillan and G. E. Ludholm, assr to Shell Dev. Co. U.S.P. 2,392,398, 8.1.46. Substantially a development of U.S.P. 2,392,330 (cf. preceding abstract) into a multistage procedure.

D. C. Bond and N. B. Russell, assr to Pure Oil Co. U.S.P. 3,292,454, 8.1.46. Ethylene is contacted with aluminium chloride and its ethylene complexes at 250–350° F in the presence of small amounts of hydrogen chloride. Isobutane and ethyl chloride are obtained.

W. I. Denton and C. H. Schlesman, assr to Socony Vacuum Oil Co. U.S.P. 2,392,466, 8.1.46. Styrene is produced when benzene and ethylene react in the vapour phase with an oxygen containing gas at 600–1100° F under a pressure between 10 and 200 atmospheres.

J. J. O'Neill, assr to Sinclair Refining Co. U.S.P. 2,392,497, 8.1.46. Fractionation of an aqueous phenol extract of a petroleum oil using a phenol and water in several stages. The product is a resin.

H. G. Berger and D. E. Baderscher, assr to Socony-Vacuum Oil Co. U.S.P. 2,392,570, 8.1.46. An aromatic hydrocarbon fuel is treated with an aliphatic aldehyde and hydrofluoric acid to convert the aromatics into resinous materials. After removal of the latter the fuel has a higher cetane value.

T. T. Noland and E. M. Nygaard, assr to Socony-Vacuum Oil Co. U.S.P. 2,392,610, 8.1.46. Improvement in the ignition quality of a diesel fuel is obtained by the minor addition of a halogen-substituted nitrolic acid or a halogen-substituted pseudo-nitrolic.

J. T. Horcezy and E. F. Wadley, assr to Standard Oil Dev. Co. U.S.P. 2,392,739-2,392,740, 8.1.46. Gaseous olefines can be separated from each other and from gaseous paraffins by treatment with a solution of iodine under controlled conditions.

E. R. Lewis and C. L. Read, assr to Standard Catalytic Co. U.S.P. 2,392,749, 8.1.46. Benzene, toluene, and xylenes are obtained by the solvent extraction of the product from catalytic reforming of a mixture of petroleum fractions containing the corresponding cyclohexanes and the product obtained by destructive hydrogenation of the next succeeding fractions.

J. C. Showalter, assr to Standard Oil Dev. Co. U.S.P. 2,392,779, 8.1.46. A detergent composition in paste form is produced by mixing 20-30% lub. oil or heavy gas oil, 20-35% sodium petroleum sulphonate, 20-35% water, and 20-30% finely divided non-abrasive absorbent material.

M. Friedman, assr to U.S.A. U.S.P. 2,392,846, 15.1.46. Tetraethyl lead is removed from a hydrocarbon fuel by agitation first with anhydrous stannic chloride, then with an adsorbent.

A. Kinsel, assr to L. Sonneborn Sons, Inc. U.S.P. 2,392,853, 15.1.46. A petroleum residual wax containing corrosive substances from $AlCl_3$ treatment is reacted with an alkaline-earth plumbite for their removal.

J. S. Wallace and T. E. Sharp, assrs to S.O.C., Indiana. U.S.P. 2,392,891, 15.1.46. A stable, non-emulsifiable sulphurized oil is obtained from an oil treated with elementary sulphur at 300-360° F by the addition of an oil-soluble alkali sulphonate.

V. Ipatieff and H. Pines, assrs to U.O.P. Co. U.S.P. 2,392,924, 15.1.46. Normal butane is treated with stannic chloride in the presence of hydrogen chloride under such conditions that isobutane is the principal reaction product.

C. W. Watson, assr to The Texas Co. U.S.P. 2,392,960, 15.1.46. The C_4 fraction of cracked gas is heated to 650-950° F under pressure to dimerize the butadiene component. It is then heated to 1200-1400° F during contact with a dehydrogenating catalyst to convert the dimer into styrene and dehydrogenate other of the components to butadiene, which is recycled to the dimerization step of the process.

B. S. Grunsfelder, assr to Shell Dev. Co. U.S.P. 2,393,041, 15.1.46. Low-boiling paraffin hydrocarbons are isomerized by reaction with hydrogen in contact with a heavy metal sulphide catalyst at a temperature within the range 400-540° C at a pressure of 10-100 atm.

F. M. McMillan and H. A. Cheney, assrs to Shell Dev. Co. U.S.P. 2,393,051, 15.1.46. In the isomerization of normal pentane at 60° C using $AlCl_3-Al_2O_3$ catalyst the yield is maintained by the controlled addition of isobutane.

L. A. Mikeska, assr to Standard Oil Dev. Co. U.S.P. 2,393,181, 15.1.46. A pour-point depressant is obtained when the resinous product from the reaction between an aromatic hydrocarbon and an aliphatic aldehyde (using a Friedel-Crafts catalyst) is acylated.

R. J. Andrews, assr to Wilson Carbon Co., Inc. U.S.P. 2,393,214, 15.1.46. Active carbon is obtained from the acid sludge ex refining of petroleum distillates by a series of heat treatments.

A. C. Byrns, assr to Union Oil Co. U.S.P. 2,393,288, 22.1.46. A suitable catalyst for reforming hydrocarbon mixtures consists of chromites and molybdates of iron cobalt and nickel precipitated on an undried hydrous metal oxide gel.

E. W. M. Fawcett and E. S. Narracott, assrs to Anglo-Iranian Oil Co. U.S.P. 2,393,357, 22.1.46. Normal butane is isomerized by contact with aluminium chloride at a temperature not exceeding 200° C.

F. M. Archibald and H. O. Mottern, assrs to Standard Oil Dev. Co. U.S.P. 2,393,509, 22.1.46. Ethane and chlorine are mixed in suitable proportions, then dispersed in 30% aqueous HCl and subjected to the action of light. Chlorinated products are obtained.

V. Molinari, assr to Bakelite Corpn. U.S.P. 2,393,699, 29.1.46. A petroleum-tar phenol with a side-chain is converted into a lower-boiling phenol by a treatment which includes solution in NaOH, dehydration, and blowing with air.

J. D. Morgan, assr to Cities Service Oil Co. U.S.P. 2,393,797, 29.1.46. A high-temperature grease is obtained by the dispersal of 8-14% lithium soap in a petrolatum.

A. H. Schutte and A. W. Mack. U.S.P. 2,394,015-2,394,016, 5.2.46. Description of a centrifugal method to separate oil and wax from an oil-wax mixture emulsified with water.

A. V. Grosse and W. J. Mattox, assrs to U.O.P. Co. U.S.P. 2,394,170, 5.2.46. C₆-C₁₂ aliphatic hydrocarbons are dehydrocyclized, then solvent-treated. The extract is also dehydrocyclized in the presence of a catalyst, and the product obtained consists of olefin free aromatics.

N. Levy, assr to I.C.I., Ltd. U.S.P. 2,394,315, 5.2.46. Nitroparaffins are obtained when nitric acid and a low-boiling paraffin, both in the vapour phase, are passed over a catalyst consisting of arsenic or antimony compounds.

O. M. Reiff and J. D. Zech, assrs to Socony-Vacuum Oil Co. U.S.P. 2,394,564, 12.2.46. A synthetic construction material is obtained when the product of the treatment of a chlorinated petroleum wax with a phenol in the presence of AlCl₃ is dechlorinated and vulcanized.

L. W. Sproule and J. C. Zimmer, assrs to S. O. Development Co. U.S.P. 2,394,567, 12.2.46. Two formulæ are given for aluminium soap grease.

F. Knoth, Jr., and M. A. Pavlick, assrs to S.O. Development Co. U.S.P. 2,394,616, 12.2.46. A formula is given for a wax-clay emulsion suitable as a liquid coating composition for containers intended for tacky polymers.

M. P. Matuszak, assr to Phillips Petroleum Co. U.S.P. 2,394,625, 12.2.46. Butane is dehydrogenated to butenes in the presence of chromium oxide catalyst. The butenes are dehydrogenated to butadiene as principal product in the presence of chromium oxide catalyst of lower activity.

J. S. Yule, assr to Pure Oil Co. U.S.P. 2,394,735, 12.2.46. A method of preparing a cutting oil is described.

R. C. Archibald, assr to Shell Development Co. U.S.P. 2,394,739, 12.2.46. A pilled dehydrogenating catalyst of the metal sulphide class is reactivated with sulphur dioxide.

I. Bergsteinsson, assr to Shell Development Co. U.S.P. 2,394,743, 12.2.46. Neopentane is the main product obtained when a hydrogenated isobutylene polymer is cracked in the presence of a chromium oxide-alumina catalyst.

C. C. Crawford and W. E. Ross, assrs to Shell Development Co. U.S.P. 2,394,752, 12.2.46. A fluid melt of AlCl₃, NaCl, and ZnCl₂ is used as an isomerizing catalyst.

S. H. McAllister and N. E. Peery, assrs to Shell Development Co. U.S.P. 2,394,797, 12.2.46. A blending fuel consisting essentially of neohexane and cyclopentane is obtained by two stage isomerization of a suitable cut of a saturated naphthenic gasoline.

H. H. Young and D. Rubenstein, assrs to Industrial Patents Corpn. U.S.P. 2,394,833, 12.2.46. A wax composition suitable for coating cheese consists of a

mixture of paraffin wax with 5-30% of the product of the reaction between alkylamine and an acylating substance.

E. F. Engelke, assr to Cities Service Oil Co. U.S.P. 2,394,965, 12.2.46. A lube resistant to oxidation and sludging is obtained when it is heated to 340-400° F with 0.5-4% of an inorganic ferric salt, separated from the sludge, neutralized, and clay treated.

R. C. Brandon, assr to S.O. Development Co. U.S.P. 2,394,978, 19.2.46. Alkylated phenols are separated from the soda extract of cracked distillate by preferential precipitation, then subjected to catalytic cracking to produce lower phenols.

R. B. Perkins, jr., assr to Petrolite Corp. U.S.P. 2,395,011, 19.2.46. Petroleum oils which are solvent-refined by vigorous mixing with a selective solvent have a dielectric constant more than twice that of the oil. The separation of the dispersed oil and solvent phases is effected by the action of an electric field.

J. H. Bishop, assr to Socony-Vacuum Oil Co. U.S.P. 2,395,093, 19.2.46. An alcohol extract of blown lard oil and a condensation product of ethylaniline and formaldehyde are added to a viscous oil to retard rust and emulsion-forming characteristics.

J. C. Hillyer and H. E. Drennan, assrs to Phillips Petroleum Co. U.S.P. 2,395,274, 19.2.46. Aliphatic olefins containing 4-8 carbon atoms are isomerized by passage over bauxite at 500-1300° F.

R. G. Patterson, assr to Phillips Petroleum Co. U.S.P. 2,395,291, 19.2.46. A method is described for the production of porous spongy aluminium chloride catalyst.

J. D. Morgan, assr to Cities Service Oil Co. U.S.P. 2,395,379, 19.2.46. Benzaldehyde is employed as a lubricant between - 68° F. and + 270° F on moving metallic bearing surfaces.

M. R. Arnold, assr to Girdler Corp. U.S.P. 2,395,529, 26.2.46. A process of purifying a copper ammonium solution used for the absorption of olefins.

H. L. Johnson and J. H. Perrine, assrs to Sun Oil Co. U.S.P. 2,395,627, 26.2.46. A process is described for the preparation of a soluble oil from a naphthenic lub. oil by oxidation with air.

C. B. Barbour, assr to Atlantic Refining Co. U.S.P. 2,395,713, 26.2.46. A method of production of an alkaline-earth metal sulphionate commencing with the sulphonation of a viscous petroleum oil.

A. B. Hersberger, assr to Atlantic Refining Co. U.S.P. 2,395,739, 26.2.46. A resin is obtained by the reaction between an aromatic hydrocarbon and an aldehyde in the presence of a polycarboxylic acid.

E. Amott and W. E. Grebe, assrs to Union Oil Co., U.S.P. 2,395,774, 26.2.46. A method of preparing sulphonic acid metal soaps by treating a lub. oil with sulphuric acid.

K. K. Kearly, assr to S.O. Development Co. U.S.P. 2,395,876, 5.3.46. Olefins are dehydrogenated to diolefins by passage with steam over a catalyst consisting of magnesium oxide, a metal oxide, and small amounts of potassium oxide.

B. H. Lincoln and G. D. Byrket, assrs to Socony-Vacuum Oil Co. U.S.P. 2,395,889, 5.3.46. A lub. oil additive is obtained by reacting sodium trisulphide with a high-mol.-wt. carboxylic acid.

W. A. L. Lande, jr., assr to Porocel Corp. U.S.P. 2,395,931, 5.3.46. Oils are decolorized by treatment with a water-insoluble metal aluminate.

N. K. Chaney, assr to United Gas Improvement Co. U.S.P. 2,395,954, 5.3.46. A basic substance mixed with a monovalent salt of copper, silver, or mercury is employed to absorb preferentially the olefins and diolefins from a liquid hydrocarbon mixture.

R. V. Shankland, assr to S.O.C. Indiana. U.S.P. 2,395,976, 5.3.46. A tractor fuel is composed of a straight-run heavy naphtha and a synthetic hydrocarbon polymer obtained by hydroforming a petroleum naphtha.

H. B. Kellog and H. C. Reynolds, jr., assrs to S.O. Development Co. U.S.P. 2,396,050, 5.3.46. A substance suitable for addition to a drying-oil composition is obtained from the soda extract of a heavy cracked petroleum fraction.

J. Anderson, E. F. Bullard, and S. H. McAllister, assrs to Shell Development Co. U.S.P. 2,396,144, 5.3.46. A process for the manufacture of cumene from benzene and propylene using sulphuric acid.

J. D. Morgan and R. E. Lowe, assrs to Cities Service Oil Co. U.S.P. 2,396,192, 5.3.46. A formula for a dental instrument lubricant.

E. I. Baldeschweiler and J. C. Zimmer, assrs to S.O. Development Co. U.S.P. 2,396,236, 12.3.46. Corrosion of aluminium fuel tanks is retarded by the addition of an isopropyl ester of an oxidized wax fatty acid to the leaded fuel.

E. A. H. Friedheim. U.S.P. 2,396,258, 12.3.46. New compounds are described which are solid paraffins containing an arsenic radical attached to the carbon chain.

W. J. Sweeney, M. R. Fenske, and G. H. Cummings, assrs to S.O. Development Co. and Röhm and Haas Co. U.S.P. 2,396,299-2,396,303, 12.3.46. Liquid ammonia is used to refine petroleum distillates by solvent extraction.

R. F. Marschner, assr to S.O.C., Indiana. U.S.P. 2,396,331, 12.3.46. A naphthenic gasoline is fractionated, and the appropriate cuts are isomerized using $AlCl_3$ catalyst in a recycle process.

T. H. Rogers and J. S. Wallace, assrs to S.O.C., Indiana. U.S.P. 2,396,345, 12.3.46. A complex glyceride phosphoric acid ester is used to stabilize a sulphurized oil.

G. C. Connolly, assr. to S.O. Development Co. U.S.P. 2,396,641, 19.3.46. A catalytic cracking process in which the catalyst is alumina-tungsten oxide.

M. Blumer, assr to L. Sonneborn Sons, Inc. U.S.P. 2,396,673, 19.3.46. Manufacture of petroleum mahogany sulphonic acids.

D. R. Carmody and H. E. Huber, assrs to S.O.C., Indiana. U.S.P. 2,396,683 19.3.46. Isopropylbenzene is obtained by the action of propylene or benzene in the presence of a phosphoric acid catalyst.

J. M. Musselman and H. P. Lankelma, assrs to S.O.C., Ohio. U.S.P. 2,396,719 19.3.46. A lub. oil addition agent comprising a metal compound of the reaction product of phosphorus pentasulphide and an aliphatic saturated alcohol.

A. J. Morway, assr to S.O. Development Co. U.S.P. 2,396,744, 19.3.46. A grease is made from an aluminium soap obtained by suitable treatment of spent $AlCl_3$ catalyst from the isomerization process.

J. A. Tilton, assr to S.O. Development Co. U.S.P. 2,396,761, 19.3.46. Toluene is obtained from a naphthene-base petroleum by processes involving dehydrogenation, solvent extraction and acid treatment.

E. A. Evans and J. S. Elliott. U.S.P. 2,396,839, 19.3.46. A lub. oil addition agent to increase film rupture strength comprises an oil soluble phosphite ester.

M. S. Taggart, jr., assr to S.O. Development Co. U.S.P. 2,396,900, 19.3.46. Oxygenated organic compounds are obtained by contacting gaseous paraffins with oxygen in the presence of bacteria inoculated plant food.

E. C. Britten, G. H. Coleman, and K. D. G. Clack, assrs to Dow Chemical Co. U.S.P. 2,396,983, 19.3.46. Secondary butyl phenol is used as a solubilizer for petroleum distillate solutions of rotenone.

P. Meyer, assr to Shell Development Co. U.S.P. 2,397,191, 26.3.46. A suitable spreading agent for hydrocarbon oils on water is obtained by treatment of the acid sludge from the refining of cracked distillate.

H. G. Vesterdal, assr to S.O. Development Co. U.S.P. 2,397,301, 26.3.46. Liquid hydrocarbons are obtained from propylene using steam in the presence of chromium oxide-alumina catalyst.

H. G. Smith and T. L. Cantrell, assrs to Gulf Oil Corpn. U.S.P. 2,397,377-2,397,381, 26.3.46. Foam-suppressing agents for oils consist of isoamyl octyl phosphates of dimethylaniline, quinoline, pyridene, lutidine, and nicotine.

D. E. Badertscher and R. B. Bishop, assrs to Socony-Vacuum Oil Co. U.S.P. 2,397,398, 26.3.46. A resinous product substantially light in colour and of high melting point is obtained by condensation of formaldehyde and a selected aromatic petroleum fraction. G. R. N.

PRODUCTS.

Chemistry and Physics.

797. Recent Work in the Field of High Pressures. P. W. Bridgman. *Rev. Mod. Phys.*, 1946, 18, 1-93.—This exhaustive review summarizes work in the field of high pressures from 1930, the date of publication of Bridgman's book "The Physics of High Pressure," to June 1945, and cites 674 literature references. Critical phenomena involving pressures up to a few hundred atmospheres are not considered, but certain high-pressure phenomena which have up to now only been investigated in this range are included. The high-pressure range now open to study extends to 100,000 atm.

The subject-matter is discussed under the following divisions: technique, mechanical, thermal, optical, chemical, and biological effects of high pressure. Subjects of interest to the petroleum industry which are reviewed include: volumetric studies of single- and two-phase gas and liquid systems containing hydrocarbons, compressibilities of liquid hydrocarbons, effect of high pressures on physical constants and phase changes of, *inter alia*, many hydrocarbons, viscosity changes in hydrocarbons and petroleum oils at high pressures, behaviour of engineering materials, and the effects of high pressures on chemical reactions in liquid and gaseous phases, both catalyzed and uncatalyzed. Reactions listed include the pyrolysis, hydrogenation, oxidation and polymerization of hydrocarbons. The majority of the chemical studies discussed are of direct industrial interest. G. H. B.

798. A Photoelectric Instrument for Light Scattering Measurements and a Differential Refractometer. P. P. Debye. *J. Appl. Phys.*, May 1946, 17 (5), 392-398. The method of determining particles sizes and molecular weights by light-scattering measurements on solutions is finding increasing fields of application. In order to obtain the necessary data quickly and conveniently, an instrument has been developed which allows the required light-scattering measurements to be taken on a routine basis. This apparatus is described. It measures transmission and the scattering of light at 90°; two different schemes can be employed to obtain the angular intensity distribution of the scattered light. A description is also given of a compensating refractometer which is used to determine the difference in refractive index of solvent and solution. The instrument, which is simple in design, gives a direct reading of the refractive index difference and has an accuracy of better than 10^{-5} . The light-scattering instrument has been tested using polystyrene of known molecular weight, and has been applied to study the change of apparent molecular weight (or particle size) of a series of polyvinyl ethers as a function of concentration in some cases, also a number of solvents. For a series of polyvinyl *n*-butyl ether samples which was studied, the relation between the intrinsic viscosity of the benzene solutions and the weight average molecular weight M determined by light scattering is $\eta^i = 0.365 \times 10^{-7} M^{1.45}$. A. H. N.

799. Thermal and Photochemical Decomposition of Gaseous Aluminium Trimethyl. L. M. Yeddanapalli and C. C. Schubert. *J. Chem. phys.*, 1946, 14, 1.—The thermal decomposition of gaseous aluminium trimethyl, in the absence of hydrogen, is nearly 94% homogeneous and of kinetic order 1.5 over the pressure range 10-85 mm measured at room temperature. The reaction products consist largely of methane and to a lesser extent ethane, ethylene, and hydrogen and a solid deposit on the walls of the reaction vessel. A reaction mechanism involving methyl radicals is proposed. The apparent energy of activation, calculated on this basis, is found to be 45 K cal., in agreement with the experimentally determined figure. The high ratio of methane produced to alkyl decomposed suggests that aluminium trimethyl in the vapour state at room temperature must consist at least of tetrameric molecular complexes. In the presence of hydrogen, both the decomposition rate and the energy of activation are reduced as compared to the decomposition of the pure alkyl, a puzzling effect

for which no satisfactory explanation can at present be offered. Photochemically, the presence of hydrogen seems to have little effect on the over-all decomposition, but enhances the relative amount of methane slightly. In this, aluminium trimethyl appears to differ from mercury dimethyl, which is known to decompose faster thermally and photochemically in the presence of hydrogen than in its absence. J. T.

800. Kinetics of OH Radicals as Determined by their Absorption Spectrum. VI.—Attempt to Trace OH Radicals in the Thermal Hydrogen–Oxygen Reaction. O. Oldenberg, J. E. Morris, C. T. Morrow, E. G. Schneider, and H. S. Sommers, jr. *J. Chem. phys.*, 1946, **14**, 16.—The steady thermal reaction of hydrogen and oxygen at a pressure of 60 cm and a temperature in the region of 550° C was searched by absorption spectrum technique for free OH radicals. None were detected, although the apparatus would have been sensitive to an OH radical pressure of 4×10^{-4} mm. This negative result indicates that near 550° C the rate of reaction which consumed OH is so high that no appreciable accumulation of OH can occur. J. T.

801. Light Scattering of High Polymer Solutions. J. Waser, R. M. Badger, and V. Schomaker. *J. Chem. phys.*, 1946, **14**, 43.—A theoretical discussion on determination of molecular-weight distribution of a high polymer, containing no excessively large molecules, from interpretation of its light scattering in solutions at various concentrations. J. T.

802. Theory of Multimolecular Absorption for a Mixture of Gases. T. L. Hill. *J. Chem. phys.*, 1946, **14**, 46.—The Brunauer–Emmett–Teller theory of multimolecular absorption is extended to the case of a mixture of two gases. J. T.

Analysis and Testing.

803. Applications of the Mass Spectrometer to Refinery Process Control. W. S. Young. *Nat. Petrol. News Tech. Sect.*, 6.3.46, **38** (10), R-212.—From the experience gained through 8000 analyses determined by the Mass Spectrometer, the Atlantic Refining Co. chemists have provided a sound basis for the information given in this paper on the application of this instrument to refinery process control. Hydrocarbon mixtures for this purpose are placed in two groups: (1) those which can be analysed without preliminary treatment; (2) those which must first be subjected to low-temperature fractionation to remove compounds not determinable by mass spectroscopy or for the purpose of concentrating certain components. The special operating techniques are described and discussed for the analyses of product streams from the fractionating columns of thermal or catalytic cracking, alkylation or polymerization units; together with tables showing mass spectrometer analyses of the product streams, and including the procedures for “difficult” analyses and trouble shooting. Suggestions are given for the operation and maintenance of the spectroscope. Figures are given of the operating times required, in terms of man hours, and eight literature references are recorded. W. H. C.

804. A Computer for Solving Linear Simultaneous Equations. C. E. Berry, D. E. Wilcox, S. M. Rock and H. W. Washburn. *J. Appl. Phys.*, April 1946, **17** (4), 262–272.—The mathematical principles of the classical iterative method of solving linear simultaneous equations are discussed. Basic electrical circuits for setting up an analog of the mathematical relations are given, and a commercial model of a 12-equation computer is briefly described. The results of solving a number of problems on the computer are given to illustrate its accuracy and speed of operation. It is found that solving sets of 12 equations requires only $\frac{1}{2}$ to $\frac{1}{3}$ the time required by conventional methods. The computer is to be used in conjunction with mass spectrometers and infra-red spectrophotometry in analysing hydrocarbon mixtures. A. H. N.

805. The Analysis of Multicomponent Mixtures of Hydrocarbons in the Liquid Phase by Means of Infra-Red Absorption Spectroscopy. D. L. Fry, R. E. Nusbaum, and H. M. Randall. *J. Appl. Phys.*, March 1946, **17** (3), 150–161.—This is a general method of applying infra-red absorption spectroscopy to the analysis of multicomponent hydro-

carbon mixtures in the liquid phase. The procedure is calibrated by measuring optical densities of synthetic standard samples. A constant thickness cell is used for both standard and unknown samples. Two procedures for converting densities into concentrations are described. Examples are given for four- and five-component mixtures. Data are presented to show the reproducibility of repeated measurements of optical density on the same sample, and results are given to show the agreement between the infra-red analyses and the known composition of synthetic mixtures.

A. H. N.

806. The Char Value of Kerosine. F. W. H. Matthews and W. H. Thomas. *J. Inst. Petrol.*, May 1946, 32 (269), 269-288.—A summary is given of the development of the Burning Test for kerosine and describes investigations into the reproducibility of the test when carried out according to I.P. Method 10/44 (T). It is shown that the reproducibility of estimations of char value may not always be of the order claimed by the above method, and that a considerably improved reproducibility may be obtained by the use of wicks extracted successively with water, alcohol, and petroleum ether. Data are given for a variety of kerosines showing the reproducibility of char value determinations by the standard method. The various steps taken in attempts to improve the test are described, and details of experiments carried out in this connection are given. It is shown that, with the exception of the properties of the wicks used, none of the variables connected with the test materially influences the char value. Experiments using extracted wicks have given results which suggest the desirability of modifying the standard test. They are given in detail, the reproducibility data being furnished by two operators using a number of different lamps and chimney glasses and by tests carried out on high, medium, and low char-value kerosines.

A. H. N.

807. Film-Lubrication between Spherical Surfaces : with an Application to the Theory of the Four-Ball Lubricant Testing Instrument. J. Howlett. *J. Appl. Phys.*, March 1946, 17 (3), 137-149.—The paper is concerned mainly with the flow of viscous liquid between the outer surfaces of two equal spheres placed in an infinite body of the liquid so that the "minimum separation" of the surfaces (the distance apart at the points of closest approach) is small compared with the radius; one sphere is held at rest, the other rotates at constant speed about an axis which does not pass through the centre of the fixed sphere. The assumption is made that the surfaces are separated by a continuous film of liquid to which the classical theory of hydrodynamical lubrication can be applied—that is, "boundary lubrication," and actual contact between the surfaces are excluded; the partial differential equation (the Reynolds equation) for the pressure distribution in this film is set up, and it is shown that with a suitable choice of boundary conditions a solution can be found in very simple form. From this solution are deduced the total force exerted by the liquid on the moving sphere and the torque, about the axis of rotation, of the forces acting on the fixed sphere. The results are applied to the particular case of the four-ball lubricant testing instrument, in which a sphere is made to rotate about a vertical axis, under axial load, in the central space formed by a set of three equal spheres held stationary so as to touch one another with their centres in a horizontal plane; the whole set of spheres is immersed in the lubricant to be tested. The relations finally obtained express the load on the moving sphere and the torque on the set of fixed spheres in terms of the radius of the spheres, the velocity of rotation, and the viscosity of the liquid; they involve as a parameter the minimum separation of the moving sphere from the fixed spheres, and elimination of this gives the relation between the measurable quantities, load, and torque, which could provide a basis for the use of the instrument as a viscometer. It is found that the torque is a very slowly varying function of the load, being approximately proportional to the logarithm of the load. Further, if it is assumed that the hydrodynamical theory of lubrication is valid only for films whose thickness is greater than some agreed minimum, then the expression for the load on the moving sphere, into which the minimum separation enters, provides a criterion for the range of conditions (of which the load is much the most important) within which the theory does in fact apply to the instrument. Numerical examples are considered, and it is shown that, with allowance for wide departures from the standard size and speed of operation of the instrument, the maximum load which can be sup-

ported by the moving sphere in the hydrodynamical regime cannot be expected to exceed a few hundred grams weight; for loads of greater order the standard continuous-film theory cannot hold, and the forces on the spheres are no longer determined by the viscosity of the liquid.

A. H. N.

Crude Oil.

808. Emulsification and Demulsification. (1) A. H. Stuart. *Petroleum*, May 1946, 9 (5), 114.—The principles of emulsification and demulsification are discussed. The stability of an emulsion is a "surface phenomenon" at the interface separating the two phases.

Most solutions form foams, especially long-chain electrolytes. The time noted for a foam to subside is one measure of its stability. Foams are useful in fire-fighting and in flotation methods of mineral separation. Very dilute oil-in-water emulsions, such as are found in the condensed steam from some engines and originating from the lubricant cannot readily be demulsified by chemical means. Emulsions of higher concentrations are stable because of the presence of a third substance which will form a film over the surface of the droplets of the internal phase decreasing the interfacial tension, and thus increasing the film adhesion. Emulsification is almost impossible if the pH value of the water is below 4.5. Colloids differ from emulsions in particle size, which is $1\text{ }\mu\text{m}$ to $100\text{ }\mu\text{m}$ for colloids and $100\text{ }\mu\text{m}$ to 1 mm for emulsions.

Colloids are divided in two classes—suspensions, in which the dispersed phase is solid, and emulsions, in which it is liquid.

Certain substances, such as gelatine, are stabilizers, being readily adsorbed on to a surface and diffusing very slowly through a fluid, thus resisting change of form.

Size of droplets is not influenced by the nature of emulsifying agent or stabilizer.

Inversion of emulsions occurs; sometimes the one liquid forms the internal phase and sometimes the other. There are three methods of determining which type of emulsion exists; one consists of adding a water-soluble dye, oil-in-water emulsions are readily stained. The oriented wedge theory does not fully explain why a soap of a monovalent base, used as an emulsifying agent, produces an oil-in-water type, whilst one of a divalent metal produces an emulsion of water-in-oil.

G. A. C.

Gas.

809. Chemical Utilization of Natural Gas Limited only by Commercial Demand. A. L. Foster. *Oil Gas J.*, 4.5.46, 44 (52), 83.—The field for conversion of natural gas to profitable products can be divided into two parts. The first is the combination of light hydrocarbons in those of higher molecular weight as liquid fuels such as motor and aviation, diesel, and tractor fuels, which involves simple molecular rearrangements. The second part involves the partial decomposition of light hydrocarbons and their recombination to form products different from the original hydrocarbons.

Alkylation is the most common reaction used, in which an iso-paraffin is reacted with an olefin to form a molecule equal in weight to the total molecular weight of the reactants.

Isomerization is the conversion of straight-chain molecules to isomeric forms; one use is to improve the octane rating of hydrocarbons. By-products of cracking operations form the material for polymerization processes. The Fischer-Tropsch reaction is used to synthesize heavier hydrocarbons from natural gas; catalysts and conditions influencing range of products.

Tables show the raw materials required, and yields of main product in this process, and also the production of synthetic organic chemicals in the United States, from coal-tar as well as other sources; while the production of chemicals is limited to the marked demand, there is a vast quantity of hydrocarbon raw material available in refining and natural gases.

G. A. C.

Engine Fuels.

810. Resistance to Gum Formation in Motor Fuel in Storage is Studied for the Army. J. R. Sabina. *Nat. Petrol. News Tech. Sect.*, 6.3.46, 38 (10), R-163.—The results of

special tests made by the gasoline additives group of the C.R.C. for the control of gum formation are reported. The first series were carried out on 41 selected gasolines stored in lacquered and bare iron rust-inhibited "blitz" cans and in drums, and tests were made after 3 and 6 months storage at temperatures which reached a maximum of 110° F. A second series were made in 1944 on 24 samples of 2-103 B, type gasolines extending over 12 to 18 months. The results obtained from the two series of tests led to the following conclusions: (1) A minimum induction period of 480 minutes by the A.S.T.M. method; (2) A maximum of 4 mg A.S.T.M. gum in new gasolines for stabilization of 2-103 b gasoline; (3) Gasoline antioxidant concentration 5-35 lb active ingredient per 1000 bbl of gasoline. The lower limit was found necessary to prevent TEL precipitation from certain types of fuels, the maximum limit was suggested to prevent unnecessarily high concentrations in the gasolines; (4) Antioxidants should be limited to those commercial products on which considerable background was already available; (5) Copper-sweetened components should contain from 1 to 3 lb of metal deactivator per 1000 bbl as a precautionary measure, in addition to the antioxidant. An extension of the tests were made in 1945 in two series, on the following gasolines: Army 2-114, as received and after addition of a concentrate, consisting of antioxidant and metal deactivator, and Army 2-116, gasoline (unleaded and undyed)—a breaking-in gasoline for engines—which were stored in vehicle tanks for six months, the second series being with gasolines whose gum contents ranged from 1.5 to 50 mg and varying types of antioxidant and concentrations, stored in various vehicle tanks. The effects of operating the vehicle on high-gum-content gasolines being observed by stripping the engines are described. The conclusions drawn from these tests are summarized as follows: (1) Aged gasoline containing less than 7 mg A.S.T.M. gum is satisfactory for continuous use in all Ordnance vehicles; (2) Gasoline containing between 7 and 50 mg gum may be used for short periods, but not continuously for longer than 5000 miles. Track-laying vehicles should not exceed 150 hours operation. Vehicles equipped with vacuum-operated hydramatic transmissions should not be run on gasolines containing more than 7 mg gum; (3) From the standpoint only of precipitation of antioxidants in the induction system of engines, the trialkyl phenols and *para*-phenylenediamine-type compounds were satisfactory at the maximum concentration (35 lb/1000 bbl). The aminophenol materials when used at maximum concentration in gasolines of low antioxidant solubility will probably result in sufficient induction system deposits to give rise to faulty engine operation after prolonged use. Information obtained from tests on small stationary engines is included. In general, it is stated the results agree with those of vehicle tests—that is, all gasoline containing more than 1.5 mg caused sufficient engine deposits to reduce significantly the operating time between overhauls. The effect of gum was to cause heavy deposits in the intake manifolds and ports, on intake valve stems and guides, and on intake valve tulips. W. H. C.

Lubricants.

811. Dimethyl-Silicone-Polymer Fluids and Their Performance Characteristics in Hydraulic Systems. V. G. Fitzsimmons, D. L. Pickett, R. O. Militz and W. A. Zisman. *Trans. Amer. Soc. Mech. Engr.*, 10.5.46, 68 (4), 361.—A description of laboratory hydraulic tests on dimethyl silicone polymer fluid in systems operated with small high-pressure pumps, both gear and piston type, is given.

The Pesco pump used has nitrided gears running in high-lead bronze bushings which are pressure loaded against the side of the gears. Thus any wear occurring is found on the face of the gears and on the sliding surfaces of the thrust faces of the bushes and the sides of the gears. The Vickers pump is a 7-piston constant delivery unit enabling almost every type of wear to be observed as hardened steel knuckles pivot on pins of the same material, the pistons slide in the bronze cylinder block, which also slides on the steel-valve plate, and thrust, radial, and combination loaded ball bearings are used. The hydraulic system, containing a filter and means for controlling temperature and pressure of the fluid, was completely dismantled and thoroughly cleaned with suitable solvents before each run. A new filter core was used for each test, and new gears and bushes for each gear pump test run. Tests were made for comparison on reference petroleum hydraulic fluids having viscosities similar to that of the dimethyl silicone polymer fluid at the operating temperature.

Wear, determined by loss in weight, on the Pesco pump parts was less on the silicone fluid than on the petroleum fluid, owing, it was thought, to the formation of protective resins on the bronze bushes. Some gel was collected on the filter element after a run of 500 hr, but no significant change in viscosity occurred. With cast iron in place of the usual bronze bushings, the fluid, run at 600 p.s.i., blackened rapidly with finely dispersed iron particles, the volumetric efficiency of the pump fell by 33½% in 5 min, and considerable gel had formed in the fluid. A pump fitted with the same type of cast-iron bushes behaved normally on the petroleum hydraulic fluid at 800 p.s.i. These tests led to the use of a manually operated "slider-and-plate" method for rough sorting of pairs of metals.

Tests on the Vickers pump with the silicone fluid led to breakdowns through the very rapid wear of the hardened steel pins and knuckles, and in both cases the fluid was darkened with dispersed steel particles before pump failure occurred. A pump fitted with bronze knuckles on hardened steel pins ran satisfactorily with no undue wear, the fluid remaining quite clear with no appreciable change in viscosity and formation of gel only round the universal link bearings.

It is concluded that the application of the silicone fluid to many systems now in use is very limited owing to its poor load-carrying capacity where both sliding surfaces are ferrous; that difficulties encountered due to creeping and leakage of the fluid can be overcome; that its excellent behaviour in pumps with the proper metal working parts is promising for its use as a hydraulic and lubricating fluid, and that the low wear rates found in the Pesco pump gears and the absence of wear in the Vickers pump ball-bearing races are considered highly significant, both being examples of steel rolling on steel.

J. M. F.

812. Dimethyl-Silicone-Polymer Fluids and Their Performance Characteristics in Unilaterally Loaded Journal Bearings. J. E. Brophy, R. O. Militz and W. A. Zisman. *Trans. Amer. Soc. Mech. Engr.*, 10.5.46, **68** (4), 355.—A description of experiments made and the results obtained on a special bearing test machine using dimethyl silicone polymer fluids as lubricant with test bearings of various metals is given.

Dimethyl silicone polymer fluids were the most thoroughly studied, as they have the smallest temperature coefficient of viscosity of any known pure liquid in the lubricant viscosity range, and as they are especially stable to oxidative decomposition.

A machine was designed to enable a fixed circular bearing to be loaded against a rotating journal with force-feed lubrication to all the parts of 26 p.s.i. A special technique was used to ensure a true cylindrical bore, of 0.687 inch diameter, in the ½-inch-long bearings, provided with a single lubrication hole opposite the loaded area, and the fit on the journal was held to 0.0010 ± 0.0001 inch. The journals were of chromium-plated high-carbon steel except in one test, for which a copper-plated steel was used with a test bearing of cold rolled steel. Other runs were made with test bearings of copper-lead, bronze, tin-base babbitt, cast iron, brass, aluminium (17S), copper, and Alfin metal. A thermocouple, held in the bearing carrier, measured the temperature at the outer surface of the test bearing; no attempt was made to control this or the ambient temperature.

Several procedures were adopted for breaking-in the test bearings, a slow, a fast, and a very fast break-in; each commenced at a load of 500 p.s.i., but the rate of applying the load increment and the value of the increments were varied, the journal speed being held at 1725 r.p.m. throughout.

In the early tests it was found that the slowly broken-in non-ferrous bearings developed high load-carrying capacities and retained them when used with new silicone fluid. Investigation showed that after the slow break-in run the bearings had become lacquered, on the loaded area, with a film approximately 0.0001 inch thick and varying in colour from water-white to a pale yellow. These lacquers were produced in the laboratory, by heating the bearings in the silicone-oil in the open air for longish periods at temperatures of at least 300° F, the time required for steel being longer than for non-ferrous metals. Bearings of some metals so lacquered could be loaded up rapidly to the maximum capacity (6000 p.s.i.) of the machine. Lacquer-treated cast-iron bearings on a chromium-plated steel journal were loaded rapidly to 2000 p.s.i. before seizure occurred, whereas in earlier tests untreated cast-iron bearings on a steel shaft seized at the low load of 250 p.s.i. during a slow break-in run.

Tests made with a petroleum oil, a non-additive aviation engine lubricant of high V.I., using untreated and silicone-oil lacquered bearings, showed the latter to be superior in break-in time and in load-carrying capacity before seizure occurred.

It is concluded that a number of common bearing metals are very promising for use in unilaterally loaded journal bearings lubricated with silicone fluid; that for maximum load-carrying capacity the bearings should be silicone-lacquered, either chemically or by a slow break-in run; that bearing systems of steel on steel or cast-iron are not satisfactory for operation with silicone fluids.

J. M. F.

813. Oxidation of Lubricating Oils. H. H. Zuidema. *Chem. Rev.*, 1946, **38**, 197-226.—The nature of the oxidation products of pure hydrocarbons, mixtures, and petroleum fractions in the luboil range is considered, with special reference to the results of Chavanno *et al* on *n*-paraffins and naphthenes, of Stevens and Roduta on alkylbenzenes and arylmethanes, and of Larsen *et al* on five classes of hydrocarbons. The detailed analytical results and oxygen balances determined by these and other workers are shown to support the general conclusion that the primary oxidation product is a hydroperoxide, the structure of which for various hydrocarbon types is indicated. It is shown that the hydroperoxide subsequently decomposes, usually to a ketone and water, and then to aldehydes, acids, alcohols, etc., with fission of carbon-carbon bonds and the formation of low-molecular products. The intermediate reaction products may also enter into esterification and condensation reactions, the latter being particularly prevalent in the case of aromatics. The application of these general views to the interpretation of oxidation studies on petroleum products is demonstrated on data taken from the literature for a wide variety of luboil and wax products.

The effect of hydrocarbon type on rate of oxidation and the form of oxygen absorption curves is discussed with particular reference to studies by Larsen *et al* on 39 hydrocarbons of 5 different types. Paraffins and alkyl-naphthenes oxidize most slowly, the rate being increased by the introduction of olefinic unsaturation or a partly hydrogenated aromatic ring, or the addition of a benzeno ring to the end of a long paraffin molecule. The presence of a naphthalene nucleus has the opposite effect, the molecule being stabilized, probably because of the formation of naphthols which inhibit further oxidation.

In a complex hydrocarbon mixture such as a luboil, interaction effects cause the oxidation rate to differ widely from the mean of the rates of the individual components. Furthermore, a component with high stability towards oxidation when tested alone may be preferentially oxidized when in admixture with several other components. Evidence for the view that luboils exhibit an optimum aromaticity with respect to oxidation stability and the effect of added aromatics is presented, and the rôle of natural sulphur compounds considered.

The relative catalytic effect of various metals on the oxidation of hydrocarbons and luboils is reviewed and the nature and effect of typical anti-oxidants briefly indicated. Forty-five literature references are cited.

G. H. B.

814. Secrets of German Lubricating Oil Technology Revealed. C. I. Kelly. *Petrol. Times*, 11.5.46, **50** (1273), 478.—In concluding the section on manufacturing processes leading to synthetic lubricating oils described in CIOS and BIOS reports, the reviewer deals in the first place with the $AlCl_3$ processes used in France during the German occupation; secondly, with the TTH process wherewith the Germans derived lubricating oils from brown coal tars; thirdly, with incompleted work by the Germans on tetrahydrofuran polymers and on propylene polymers; and, finally, with both a water-soluble torpedo lubricant and a castor oil substitute which as such were utilized by the Germans.

A. H. N.

Bitumen, Asphalt and Tar.

815. New Developments in Use of Asphalt in Erosion Control. Anon. *Rds. and Streets*, April 1946, **89** (4), 90.—The use of asphalt in two methods for the control of erosion on highway embankments and slopes is described.

The first method employs an asphalt concrete mat for protection of roads against wave or current action where the road borders a lake or river; and the second involves

use of a thin film of asphalt for protecting the roadside soil against erosion and to stimulate plant growth.

To protect the embankment slopes an anchored compact mat from 2 to 6 inches in depth, according to circumstances, is placed thereon after the slope has been trued.

A wire mesh may be incorporated, or the mat may be moulded to a thickness of 3 inches on a floating dredge, and conveyed on to the bank above and below water line. An asphalt mat may last several years and completely prevent deterioration by severe wave action.

In the second method 0.2 gal per sq. yd. of slow-curing asphaltic oils of an SC-1 grade heated to about 155° F, is applied to a sandy soil to prevent wind erosion.

To stimulate plant growth and protect against erosion from wind and rain, an MC cutback consisting of asphalt cement fluxed with kerosine is sprayed on to the slope previously seeded with plants native to the area. The hard, brittle asphalt cracks and grass seeds grow up through the cracks.

G. A. C.

Special Hydrocarbon Products.

816. Improved Petroleum Naphthas and Solvents are Finding Many New Industrial Uses. B. H. Weil. *Nat. Petrol. News Tech. Sect.*, Jan. 1946, **38** (1), R-65-69.—This survey of naphthas and solvents covers a wide range of petroleum fractions, which, though generally less well known than the usual petroleum products, are of such industrial importance that to attain their conformance to exacting specifications special techniques are employed in their production. The types most generally used are classified as: (1) Straight-run petroleum naphthas; (2) Highly aromatic petroleum naphthas; and (3) Technically pure hydrocarbons from petroleum. The general properties and uses and the technique by which they are made are described; and the important tests to which they must conform are given. Class 1 includes an endless number of close-cut fractions of naphthas for rubber solvent, benzene diluents or textile spirits, lacquer diluents and varnish makers and paint naphtha, mineral spirits and Stoddart solvents. Class 2 includes fractions controlled to give evaporation rates approximating those of straight-run lacquer diluent, V.M. and P. naphtha, and mineral spirits; in Class 3 the two principal solvents are 2° toluol and 10° xylo. The characteristics and the uses of each are discussed, and six literature references are given.

W. H. C.

817. Petrochemical Industry in the Southwest Builds for Growing Peacetime Market. D. P. Thornton. *Nat. Petrol. News Tech. Sect.*, Jan. 1946, **38** (1) R3-8.—The States of Texas, Oklahoma, Kansas, and Arkansas in the southwest of the United States appear well favoured for the expansion of the petrochemical industry, in view of the vast production of natural gas, refinery gases, and petroleum from the refining installations which have been much augmented by war needs for the production of petroleum products, toluene, butadiene, butyl rubber, and styrene. A good labour supply is available, as well as good climatic conditions for outdoor plant structures, and, particularly in Texas, for waterside loading and transport. This survey includes a map and list showing the State and towns having plants for the synthesis of organic chemicals (existing and projected), the company operating, raw materials employed, products manufactured, and actual or estimated plant costs. The list covers 11 petroleum concerns, 9 chemical manufacturers, 1 synthetic rubber company, 2 Ordnance works, and 1 military chemical works, situated in 16 localities. During the war, five of these companies have been producing toluene, and therefore possess super-fractionating equipment, a prerequisite for the production of some classes of chemical products. The economics of the subject are discussed from a wide angle, and some views of various experts are given.

W. H. C.

Derived Chemical Products.

818. Phthalic Anhydride from Petroleum. F. R. Staley. *Oil Gas J.*, 25.5.46, **45** (3), 118.—The process is described by which phthalic anhydride is manufactured from orthoxylene, itself produced from crude oil.

Standard Oil Co. have built a million-dollar plant at Richmond, California, in

which vapourized xylene, mixed with air at high temperatures, is fed to a multiple-tube converter where the phthalic anhydride is formed.

The considerable heat developed must be removed quickly by circulation of a cooling-liquid. The anhydride vapours are cooled in a series of five condensers, the deposit removed to tanks, where it is liquefied and pumped to two stills, impurities being removed by fractionation. The product, practically 100% pure, is stored in aluminium tanks and later flaked into package.
G. A. C.

819. Chemicals from Petroleum. Sir Frank Smith. *J. Roy. Soc. Arts*, 12.10.45. 45 (4702), 566-598.—Three lectures given before the Royal Society of Arts are recorded. The first briefly outlines the scope of the petroleum industry and gives some statistical data covering the years 1924-1943. The raw materials used—i.e., mainly petroleum—together with natural and refinery gases, and the products derived from thermal and catalytic cracking are considered in detail, and the manufacturing of various chemicals from them are illustrated by numerous diagrams, showing the changes in structure taking place, viz. methane \rightarrow carbon black, methanol, formaldehyde. Ethylene \rightarrow ethyl alcohol, ethyl chloride; ethylene dichloride, vinyl chloride; trichloroethane, vinylidene chloride; ethylene chlorohydrin, acrylonitrile, glycol; ethyl benzene, styrene. Propylene \rightarrow isopropyl alcohol, acetone; allyl chloride, allyl alcohol; isopropyl benzene (cumene) and, similarly, the products derivable from acetylene, and from hydrogen and carbon monoxide by the Fischer-Tropsch synthesis are shown.

Lecture 2 relates to the production of polymers, particularly the manufacture of synthetic rubbers; polymerization is outlined and discussed; formulæ, types, and structures of polymers are shown, and the length of polymer chains in some well-known polymers is given. Molecular forces are also discussed, and the attraction and repulsion of molecules are shown in three curves, illustrating what happens when gases change by polymerization into liquids and finally solids, and what forces keep the chains together and govern the mechanical properties of the final product. Molecular polar forces, miscibility of liquids and dielectric properties are discussed. Fifteen synthetic rubbers are listed, with the raw materials from which they are manufactured. The principal synthetic rubbers are: Buna N, which is manufactured from butadiene and acrylonitrile; Buna S, from butadiene and styrene; Butyl, from butene and a diolefin such as butadiene; Neoprene, which is made from chloroprene. Butadiene and these synthetic rubbers are discussed as to their manufacture, structure, characteristics, and uses. The effects of vulcanization are described.

Lecture 3 deals with plastics and synthetic chemicals for fuels. The characteristics of plastics, their structural formulæ, uses, and methods of manufacture are described and discussed, special emphasis being given to their electrical properties, which are shown in tabulated form for: polyethylene, polyisobutylene, polystyrene, polyvinyl chloride, polymethylmethacrylate, in comparison with rubber. Co-polymers of polyvinyl chloride and polyvinyl acetate, etc., are mentioned, and condensation type polymers, e.g., phenol formaldehyde, the original "bakelite," and nylon, are discussed and their formulæ given. An outline of the use of synthetic hydrocarbons for fuels is given, and their structural formulæ are shown. The relation between their structures and efficiency in internal-combustion engines is discussed, a graph shows the approximate relation between octane numbers and the number of methyl groups in the paraffin chains. Iso-octane, neohexane, and cumene are discussed.
W. H. C.

Coal, Shale and Peat.

820. Organic Acids by Direct Oxidation of Coal. N. W. Franke and M. W. Kiebler. *Chem. Ind.*, April 1946, 38 (4), 581-2.—A brief description is given of a process by which aromatic polycarboxylic acids are produced by the admission of oxygen into a mixture of powdered coal and sodium hydroxide solution in a pressure vessel, continuously stirred and heated at 200-500° C under 500-1200 p.s.i. for 2-3 hours. The subsequent treatment includes: cooling, filtration (to remove ash), acidification, solvent extraction, and concentration. "All the carbonaceous matter of the coal passes into solution, with about half of the carbon of the coal being oxidized to organic acids and the balance to carbon dioxide." The solvent extraction recovers 95% of the acids; the product after solvent removal is a syrupy liquid containing

from 50% to 70% by weight of dissolved acids. Concentration of the syrup in a vacuum drier leaves a hygroscopic, light-brown powder which is very soluble in water and is strongly acidic. The yield is over 50% of the coal charged. The acids are approximately 50% carbon, have an average equivalent weight of 80 and an average molecular weight of 250. Less than 0.5% is volatile, and the ash content is under 0.4%. Acetic acid and oxalic acid are present up to 1%. The average analytical properties correspond approximately to those of a mixture of tri- and tetrapoly-carboxylic benzene acids. Acids having a more complex nucleus than the benzene ring are undoubtedly also present. The esters formed from the acids with mon-, di-, and poly-hydric alcohols are discussed; they are hard resins, insoluble in water, and are considered to be useful as plasticizers and as tackifiers for use with synthetic rubbers. Partial esterification of the acids leaves free carboxyl groups in a hydrocarbon soluble material, which should find uses in the formation of oil additives and detergents. A wide range of uses is anticipated for these acids—e.g., for plastics, starting points for synthesis, etc.—since they undergo the usual reactions characteristic of the carboxyl group and have, in addition, the properties peculiar to polycarboxylic acids.

W. H. C.

821. Commercial Methods for Manufacturing Wax in Germany are Described. Part 3. Some Solvent Extraction Developments in Germany. J. P. Jones. *Nat. Petrol. News Tech. Sect.*, 3.4.46, **38** (14), R-273.—Both hard and soft wax was made by solvent extraction with SO_2 from tar distillate secured by low-temperature carbonization of brown coal and, to a limited extent, from shale oil. Centrifuging was used followed by two-stage extraction with SO_2 . Dichloroethane was used in the dewaxing step. By a proper choice of the dewaxing temperature it is possible to keep the undesired components of the total wax and of the soft wax in the filtrate. The separation of waxy components by dewaxing the SO_2 raffinate, or by after treating the total wax or soft wax from the tar fraction at different temperatures with dichloroethane, depends on the materials contained in these fractions, and particularly on the melting points of the wax components—i.e., in this case, also on the molecular weight. In wax mixtures containing straight-chain paraffins, isoparaffins, and cyclic compounds, the melting point is of primary importance in determining the separation conditions, since cyclic hydrocarbons which have the same melting point but a different molecular weight from the paraffin hydrocarbons will be separated in the same filtrate. It is shown that by treating wax which has been obtained at a temperature of -20°C with dichloroethane at -10°C the low-boiling (paraffin hydrocarbons) and the highest-boiling (primary cyclic hydrocarbons) will go into the same filtrate, so that from a total wax fraction, obtained by dewaxing at -20°C , there can be obtained only soft wax components, by an after treatment at -10°C and the low-melting components will be brought into solution, including those with a melting point of 20°C . By after treatment at -5°C all soft wax components having a melting point up to about 25°C will be separated, or in the case the former dewaxing temperature has been changed to the temperature of this after-treatment, these soft wax components will remain in solution. The investigations discussed in this paper relate to the wax in brown coal and shale oil. The data of fractional separations of the above nature for total wax and soft wax are discussed and shown in tables and three graphs. The dewaxing process as practised at the A.G. Sachsische Werke, Espenhain, and the results of operations on tars from brown coal are given. Some data on shale oils, processed, are included.

W. H. C.

Miscellaneous Products.

822. Use of Chemical Additives in Petroleum Products. L. A. Hamilton and P. V. Keyser. *Nat. Petrol. News Tech. Sect.*, 6.3.46, **38** (10), R-228.—A review of the developments of additive agents for fuels and lubricants is presented. Those for fuels are divided into: (1) Gum inhibitors or oxidation stabilizers; (2) Combustion assistants, (a) Anti-knock agents, (b) Cetane number improvers, (c) Combustion assistants for burner fuels; (3) Catalyst deactivators. Each section is discussed, and a tabulation shows the principal commercial additives for fuels in use at the present time, which gives seven anti-oxidants, and two copper deactivators—viz., di-salicycylal propylenediamine and salicycylal-o-aminophenol. In groups (b) 2:2-dinitropropane is announced as a new cetane number improver which is both effective

and remarkably stable in the fuel under long time storage conditions. So far combustion assistants have not been used commercially. The compounds studied for this purpose have been organic compounds of the catalytic metals—*e.g.*, Co, Ni or Cr. Additives for lubricants are shown classified under eight sections: Pour-point depressants; Viscosity index improvers; Stabilizers (oxidation inhibitors) for turbine oils, motor oil stabilizers and bearing corrosion inhibitors; Detergents; E.P. agents; Oiliness agents; Rust inhibitors and anti-foam agents. Each section is discussed as to type of chemical compound and use. Literature or patent references are in many cases included. Tabulations are given of: Commercial types of motor oil stabilizers; Compounds used to improve the lubricating properties of oils and extreme pressure lubricants; Types of additives believed to have been used in various commercial oils at various times; and the number of patents (U.S.) for lubricant additives issued in 1944, classified by probable function and by composition. The theories that have been advanced to explain the mechanism of autoxidation of hydrocarbons are outlined and the subject is discussed as to future developments. Many literature references are given under 13 headings.

W. H. C.

823. Teflon. New "Noble Metal" of the Plastics. Anon. *Chemical Ind.*, May 1946, 58 (5), 781.—Teflon, at present available from pilot-plant operation, is a transparent substance in thin sections, white or grey in thicker pieces. It is tough over a wide range of temperatures, has excellent electrical properties, is chemically inert, and has high heat distance.

No suitable plasticizer has yet been found for Teflon, which undergoes a solid phase transition to a gel at 325° C, with a fall in strength.

Teflon can be extruded as rods, tubes, and as a wire-coating; compression mouldings of simple shapes can be made and sheets and thin films produced. Heavy tubing can be threaded.

The field for Teflon is limited mainly to the manufacturing of electronic parts subject to high-frequency current and high temperature. Present production is 10,000 lb per month, priced at \$12 to \$15 per lb, which may be reduced to \$2.50 per lb on large-scale production.

G. A. C.

ENGINES AND AUTOMOTIVE EQUIPMENT.

824. German High-Powered Diesel Engines. Anon. *Motor Ship*, July 1946, 27 (318), 130.—In a review of "German Diesel Engine Industry" issued by British Intelligence Objective Sub-Committee, the "Motor Ship" details the following engines:—

1. At the M.A.N. works at Augsburg the largest unit (intended for installation in a battleship) was a two-stroke, double-acting engine having two vertical banks of 9 cylinders arranged side by side, with crankshafts operating separately, but with a common crankcase and bedplate. Each bank developed 14,650 B.H.P. at 255 r.p.m., the cylinder bore and stroke being 25.6 and 37.4 inches. The corresponding mean indicated pressure in the cylinders is 69.2 lb/sq. in., the specific weight 30 lb/B.H.P., and the fuel consumption 0.414 lb/B.H.P. hr.

2. Another unit at Augsburg, found partly dismantled, was designed for much higher speed—450 r.p.m.—with cylinder bore and stroke of 16.6 and 22.8 inches and was constructed as a V-type 24 cylinder set with an output of 16,500 B.H.P., the corresponding M.I.P. being 65 lb/sq. in.

3. A third double-acting two-stroke engine of still higher power was to be developed for installation in a destroyer, with 6 units totalling 60,000 B.H.P. This was a 24-cyl. V-type equipped with mechanically driven centrifugal blower, and was subjected to a 72-hour test at 15,000 B.H.P. The bore and stroke were 12.6 and 17.32 inches and speed 600 r.p.m. From the power of 12,000 to 15,000 B.H.P. super charging took place by means of an exhaust turbo blower. Specific weight was 18.7 lb/B.H.P.

4. The most successful German submarine engine was the 6-cyl. 4-stroke single-acting pressure-charged series with cylinder bore 15.75 and stroke 18.1 inches developing 2400 B.H.P. at 540 r.p.m. The corresponding mean indicated pres-

sure is 166 lb/sq. in., specific weight 14.7 lb/B.H.P., and fuel consumption 0.355-0.380 lb/B.H.P. hr.

5. A new model developed during the war was a 12-cyl. V-type with bore 18.1 and stroke 13.4 inches. It has an open combustion chamber and develops 2000 B.H.P. with fuel consumption of 0.37 lb/B.H.P. hr., specific weight 11 lb/B.H.P. The mean pressure is 141.5-160 lb/sq. in. (indicated) and speed 850-900 r.p.m. corresponding to 1900-2050 ft/min. The type is turbo-charged.

I. G. B.

825. An Analysis of Intercooled Supercharging. R. Miller. *Motor Ship*, July 1946, 27 (318), 150.—On the basis of constant internal temperatures, the non-air-cooled Buchi supercharging system permits an increase of 28-30% on the B.H.P. of the non-supercharged engine or an increase of between 20 and 28 B.M.E.P. The cost of equipping an engine with a turbocharger and the Buchi exhaust-pipe system is very nearly in the ratio of this increase, so that the final cost per B.H.P. of the supercharged engine is approximately the same as the cost of the standard non-supercharged engine.

By the simple expedient of adding to the supercharging equipment an air cooler whose dimensions may be 15 inches square by 4 ft long for 2600 c.f.m. and supplying cooling water at 80° F to remove 3 B.Th.U./minute/B.H.P., the engine output is increased to 155% of non-supercharged rating.

The cost of this cooling equipment will be about \$3-\$4 per H.P. gained by cooling. The author believes this to be the lowest cost on record for a diesel-engine horsepower. The extreme simplicity of equipment and ease of operation and maintenance should bring about universal acceptance of intercooling and render the uncooled turbocharged engine obsolete.

Compared with the non-intercooled turbocharged engine, intercooling to 90° F reduces the cost per H.P. by about 18½%. The weight and volume of the engine are reduced about 20% for the same horsepower.

Beyond this lies high-pressure intercooled supercharging using multiple-stage turbochargers, which promises in the near future to revolutionize the design of internal-combustion engines. Those engineers who accept the challenge of this discovery and bend their efforts towards the solution of the problems involved in developing this new engine will help to guide the internal-combustion engine industry towards greater expansion and increased importance in our civilization.

I. G. B.

826. A Middle-Weight Power Unit. Anon. *Aeroplane*, 14.6.46, 70 (1829), 697.—Details are given of the new 500-h.p. Alvis Leonides 9 cyl, air-cooled radial aircraft engine:—

General Data. 9 cyl.; 4.80-in bore and 4.41-in stroke; 718.5 cu. in. capacity; 6.8:1 compression ratio; fuel 100 octane 5.5-c.c. T.E.L. content (type test ratings have been obtained on 87 octane fuel); 6.5:1 supercharger ratio; 41.5 inch overall diameter and 52.8 inch length, with accessories.

International rating. B.H.P. 425; r.p.m. 2900; boost + 3 lb/sq. in.; altitude 9000 ft; fuel consumption 0.6-0.66 pt/b.h.p./hr.

Maximum power rating. B.h.p. 515; r.p.m. 3000; boost + 6½ lb/sq. in.; altitude 4000 ft; fuel consumption 0.68-0.75 pt/b.h.p./hr.

Fuel system. Fuel metering unit, Hobson Mark 1 CHA 48150; boost control, Hobson Mark 53; throttle housing, Hobson Type A.L.1, oil heated.

Lubrication system. Specification DTD 2472 B/2; normal oil pressure 60-80 lb/sq. in.; consumption 3-7 pt/hr.; maximum inlet temp. 80° C; normal max. outlet temp. 110° C; normal oil flow 300 gal/hr.

Ignition. Magnetos (two) B.T.H. C.2S.E.9s or C.9A/2; plugs, Lodge 107R.

Weight. Net dry (engine), 742 lb; power plant complete 1150 lb.

I. G. B.

827. A 6000 B.H.P. Gas Turbine Installation. Anon. *Motor Ship*, July 1946, 27 (318), 130.—A short account is given of the proposed layout of a 6000-B.H.P. open cycle gas turbine for a ship installation, but no hint is given whether such an order has been received by the makers (Messrs. Brown, Boveri). The cycle is the usual

simple preheated type with efficiency 26.5% (0.53 lb/B.H.P. hr.) and gas temperature 600° C. The specific weight is 73 lb/B.H.P. There are two power turbines, with an ahead and astern section for each, and they operate at 4300 r.p.m., driving the single propeller shaft through reduction gearing at 110 r.p.m. A fixed propeller is employed. The engine-room is about 15% shorter than that of the corresponding diesel engine installation, and the cost is equivalent to a direct-coupled diesel installation.

I. G. B.

828. High Temperature Gas-Turbine Plant. Anon. *Motor Ship*, July 1946, 27 (318), 144.—Allis Chalmers have installed in the U.S. Naval Engineering Station at 3500-B.H.P. experimental gas turbine for operation at high turbine inlet temperatures. The cycle layout is characterized by a two-shaft system, the first being the compressor and compressor-turbine, and the second the power turbine coupled to a dynamometer. The air, after compression, enters the preheater, and is then split into two streams, one to the combustion chamber feeding the compressor turbine and the other to the power turbine. The exhaust gases from the two turbines are collected and passed through the hot side of the recuperator.

Tests have recently been completed at 1300° F, and it is intended to increase this to 1500° F. The cycle characteristics at the latter temperature are as follows: air intake 181,665 lb/hr, 60° F, 14.49 lb/sq. in.; compressor exit 363° F, 58.85 lb/sq. in.; air from recuperator 750° F, 57.56 lb/sq. in. (60% effectiveness); gas from compressor-turbine combustion chamber 1500° F, 56.54 lb/sq. in., 114,750 lb/hr.; gas from power turbine combustion chamber 68,750 lb/hr., 1500° F, 56.54 lb/sq. in.; gas to recuperator 1024° F, 15.16 lb/sq. in.; exhaust gas to stack 183,500 lb/hr., 637° F, 14.75 lb/sq. in.

In the combustion chambers there is a variable port arrangement controlling the flow of the proper volume of air for complete combustion into a central flame zone. The temperature of combustion gases is 3000° F. These are given a swirling motion in the tube, and external fins on the tube rotate the excess air in the opposite direction. The heat release is 2.5×10^6 B.Th.U./ft³(hr.). It is proposed to use Bunker C oil in commercial installations: the test unit uses No. 2 furnace oil.

In order to obtain a thermal efficiency of 40%, certain modifications would be necessary. The compressor would be in two sections, intercooled and the turbines in series with reheating. The regenerator surface would be greatly increased.

I. G. B.

829. Rolls-Royce Nene I. Anon. *Flight*, 18.4.46, 49 (1947), 389.—*Flight* gives the following description of the most powerful turbine-jet unit in full production:—

Diameter	49.5 in.
Length, to turbine	63.9 in.
Length, including exhaust cone	96.8 in.
Weight, less jet pipe	1550 lb.
Weight, jet pipe	9.5 lb/ft.
Fuel—Aviation Kerosine + 1% lubricating oil	0.806 sp. gr.
Fuel consumption, sea-level static 4000 lb thrust	1.055 lb/lb/hr.
Fuel consumption, sea-level static 5000 lb thrust	1.065 lb/lb/hr.
Air consumption, 5000 lb thrust	89 lb/sec.
Compression ratio	4 : 1 static
Maximum speed	12,300 r.p.m.
Maximum thrust	5000 lb.
Compressor impeller, peripheral velocity	1530 ft/sec.
Turbine rotor, mean blade speed	1070 ft/sec.
Acceleration 2500–12,300 r.p.m.	4.5 sec.

I. G. B.

MISCELLANEOUS.

830. Cost of Discovering New Petroleum Reserves Continued to Increase in 1945. H. J. Struth. *Petrol. Eng.*, Feb. 1946, 17 (5), 51.—2,180,000,000 bbl of new reserves was added in U.S.A. in 1945, while the production of 1,706,000,000 bbl was an all-

time high. 60% of the new reserves was credited to discoveries made in previous years. 4105 wildcats and 6424 development dry holes were among the 27,045 wells drilled in 1945.

Between 1936 and 1940 the cost of finding oil, including all subsequent extensions and revisions, was about 10.5 cents/brl; initial finding costs in 1945, excluding future extensions and revisions, was 63.4 cents/brl. On the basis of past experience allowances for future extensions and revisions may reduce the 1945 figure to 49.6 cents/brl.

Ignoring the increased cost of developing new pools, and increased production costs in developed fields, the present price of crude oil is 27-35 cents/brl below bare economic existence levels.

The total cost of exploratory operations in 1945 is estimated at \$721,247,000, compared with \$553,226,000 in 1944.

Except for a moderate increase in reserve discoveries in 1944, there has been a downward trend since 1937. The average for the past 5 years is 56% below that for the preceding 5 years. In 1945 11 dry holes were drilled per million barrels of new reserves discovered; in 1937 the figure was 2 dry holes, and in 1930 1 dry hole per million barrels of new reserves. Prior to the last five or six years the ratio of discoveries, including revisions and extensions, to production has been 1-1½ (omitting the 5-year period ending 1930). During the past five years the ratio has been 0.64.

In 1945 6.19 discovery wells were needed to find 1,000,000 brl of new oil; the 1944 figure was 4.67 wells. In 1945 the cost of discovering 1,000,000 brl of new oil was 30% above the 1944 figure.

Numerous tables and diagrams present data on costs, reserves, discoveries, and drilling.

G. D. H.

831. **Third List of Definitions.** Standardization Sub-Committee No. 11.—Nomenclature. *J. Inst. Petrol.*, May 1946, 32 (269), 289-291.—The following terms are defined: Amorphous wax, blending, blown oil, casinghead gasoline, ceresin, compounding, co-polymers, crude oil, earth wax, extract, hydraulic fluid, insulating oil, long-time burning oil, marine engine oil, microcrystalline wax, mineral colza, mineral jelly, mineral oil, mineral seal, mineral sperm, ozokerite (earth wax), paraffin scale, paraffin wax, petrolatum (petroleum jelly, mineral jelly), petroleum ceresin, petroleum resins, polymerization, polymers, pour point, power kerosine, pressure distillate, raffinate, scale wax, shale oil, signal oil, soft paraffin, solar oil, special boiling point spirit, spindle oil, stabilized gasoline, steam cylinder oil, transformer oil, turbine oil, vaporizing oil, white scale.

A. H. N.

832. **United Kingdom Petroleum Imports and Exports.** Anon. *Petrol. Times*, 11.5.46, 50 (1273), 487.—Statistical data for March and the first three months of 1946 are given.

A. H. N.

BOOKS RECEIVED.

Reaktyiya Alkilirovaniya v Proizvodstve Aviatzionikh Topliv. (The Alkylation Reaction in the Production of Aircraft Fuels.) By Yu. G. Mamedaliev. Aznefteizdat, Baku, 1945. Pp. 163. Price 24 rubles.

This monograph is issued under the joint auspices of the Azerbaidzhan Scientific Research Institute of the Petroleum Refining Industry and the Azerbaidzhan State University, in whose laboratories the experimental work described was carried out.

The book is divided into two parts, dealing with the catalytic alkylation, by unsaturated hydrocarbons, of aromatic hydrocarbons and of *iso*-paraffins respectively.

After a theoretical discussion, and a brief description of the various methods available for the alkylation of aromatics, which are conveniently summarized in tabular form, the greater portion of the first part is devoted to an account of the

author's own work in this field. The raw materials taken (benzol and unsaturated hydrocarbons from cracking processes) are fully described, and a detailed account is given of the alkylation of benzol with propylene, butylene, amylenes, and with mixed low-molecular-weight unsaturated hydrocarbons, using cold sulphuric acid as the alkylation catalyst. A final section gives some results of alkylation using a solid catalyst.

In the second part the alkylation of *iso*-paraffins is considered. After a short introductory section, dealing with the theoretical aspects and with previous work, there again follows a detailed account of the author's own investigations. The starting materials employed were the front ends (up to C₅) of cracked and casing-head gasolines. Sulphuric acid was again used as the principal alkylation catalyst. There is a brief discussion regarding the utilization of spent acid from the alkylation process, and results are given showing that this is quite suitable for use for the acid refining of lubricating oils.

This book summarizes in a useful form the theoretical aspects of alkylation, together with previous work on the subject. The experimental sections, dealing with the author's own work, are set forth in very considerable detail, there being, for instance, over 100 tables of experimentally obtained figures. This part of the work is really, insofar as detailed description is concerned, more akin to an individual scientific paper than to a publication of the book type, although in a monograph such as the present one, dealing with a relatively narrow field, there is much to be said for such detail, especially as it does not appear as though the author had previously published any of this work, his name appearing but once in the list of 144 references to the literature that is given. It would have been of considerable assistance had the author, at the end of each part, summarized his own findings, which are otherwise somewhat lost in a mass of detail.

The experimental data given is commendably free from a tendency, which, in the reviewer's experience, is fairly common in Russian publications, of quoting results to a greater degree of apparent accuracy than the particular test in question warrants, although in one instance (Table 98) the viscosities of a lubricating oil are given to 5 significant figures. The text of the book is satisfactorily free from mis-prints, one noticed was in Table 22, where the first of the products should evidently read "petroleum benzol"; in the list of literature references, however, there is on several occasions, in the case of U.S. journals, a discrepancy between the volume numbers and the years quoted. V. B.

Chemical Treatment for Drilling Mud. New York: American Cyanamid & Chemical Corpn. 1945.

A booklet of data on drilling mud based on the revision of a series of articles published in American journals during 1940-41.

Industrial Experimentation. K. A. Brownlee. London: H.M. Stationery Office, 1946. 116 pp. 2s. 0d. net.

A compendium of the formulæ used in applying statistical methods to experimental work.

Alberta Oil Review for 1945. J. L. Irwin. Edmonton, Alberta: Dept. of Economic Affairs, 1946. Pp. 31.

Crude oil production in Alberta in 1945 totalled 8,055,440 barrels, a reduction of 733,286 from the 1944 figure of 8,788,726, which in turn was 885,822 barrels less than in 1943. Total decrease in Turner Valley's output in 1945 was 904,253 barrels, fields outside of the Valley showing an increase of 170,967 barrels.

Detailed statistics and information regarding the various fields are given, together with statistics for British Empire petroleum production from 1932 to 1945.



INSTITUTE NOTES.

AUGUST, 1946.

INSTITUTE MEETINGS.

SESSION 1946-47.

The following meetings have been tentatively arranged for the next Session, and the full programme will be issued in due course.

1946

- October 15. "The Lubrication of Pre-selective Gear Boxes." A. T. Wilford, B.Sc., A.R.C.S., A.R.I.C. (Fellow).
November 12. "Aerial Photography applied to Exploration for Oil." Dr. N. J. M. Taverne.
December 11. Symposium on Oil Fires :
"Wartime Oil Fires and Lessons." E. P. Lancashire.
"Burning of Fuel and Other Oils." D. Burgoyne.
"Foam." R. N. O. Clarke.

1947

- January 8. "Petroleum Products in Agriculture. The Rôle 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.As.S. (Fellow).
March 12. "Modern Developments in Geophysical Prospecting." Ir. A. van Weelden.
April 9. "Aromatization." 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 Printing Inks, etc." Dr. C. H. Healey and Dr. L. Ivanovsky (Fellow).

FUEL AND THE FUTURE.

MINISTRY OF FUEL AND POWER CONFERENCE.

The Fuel Efficiency Committee of the Ministry of Fuel and Power have arranged a fuel efficiency conference to be held at the Central Hall, Westminster, S.W.1 on Tuesday, Wednesday and Thursday, October 8, 9 and 10, 1946. Among the speakers at the opening session at 11.0 a.m. on October 8 are the Rt. Hon. E. Shinwell, M.P., and the Rt. Hon. Aneurin Bevan, after which the conference will split up into eight sections running concurrently. These are :—

- Section A—The Generation of Steam.
" B—Steam Utilization.
" C—Heat for Drying.
" D—High Temperature Processes.
" E—The Carbonization and Chemical Industries.
" F—Special Industrial Sessions.
" G—Modern Heating and the Architect.
" H—The Home and its Fuel Service.

The Institute of Petroleum has accepted an invitation to organize a session on "Oil Firing", commencing at 3.45 p.m. on Wednesday, October 9, in Section D of the Conference. The Chairman at this

Session will be Professor F. H. Garner, O.B.E., who, in conjunction with members of the Liquid Fuel Installations Committee of the Institute, is making the necessary preparations. Tentative arrangements have been made for the presentation of a paper on "Liquid Fuels for High Temperature Processes" by T. C. Bailey, F. J. Battershill and R. J. Bressey.

Admission to the Conference is *by ticket only*. Members of the Institute who wish to attend and *have not received an invitation from any other source* should apply for tickets direct to:—

Ministry of Fuel and Power,
Queen Anne's Chambers,
Dean Farrar Street,
London, S.W.1.

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.

- BAILEY, Thomas Cyril, Technical Assistant, Petroleum Board. (*R. J. Bressey ; G. R. Llewellyn.*)
- EL-DISSOUKI, Ibrahim, Chemist, Anglo-Egyptian Oilfields, Ltd. (*W. R. P. Hodson ; P. G. Higgs.*)
- FORBES, Robert James, Chemical Engineer, Royal Dutch-Shell Group. (*J. S. Jackson ; N. Hyams.*)
- GOODCHILD, Edmund Arthur, Chief Metallurgist and Chemist, Hoffmann Manufacturing Co. Ltd. (*J. Mason ; H. S. Garlick.*)
- IGGULDEN, Ronald Dorji, Head Office Inspector, Petroleum Board. (*E. P. Lancashire ; H. F. Jones.*)
- KING, Francis Robert Benjamin, Technical Assistant, Petroleum Board. (*T. K. Hanson ; R. Sefton.*)
- LEA, Herbert, Manager, Midland Region, Lubricating Oil Pool, Petroleum Board. (*H. Baker ; H. C. S. Fothergill.*)
- POUNDER, George Dick, Assistant Engineer, Iraq Petroleum Co. Ltd. (*L. J. Le Mesurier ; C. V. Hill.*)
- PRITCHARD, Frank, Office Manager, British Oilfield Equipment Co. Ltd. (*N. Matheson ; S. L. Witard.*)
- ROBINSON, Samuel, Laboratory Manager, Trimpell Ltd. (*P. M. Griffiths ; E. LeQ. Herbert.*)
- WHALLEY, Harold Kenneth, Head of Chemical Research Department, Manchester Oil Refinery Ltd. (*E. J. Dunstan ; G. H. Harries.*)
- WHORTON, John Charles, Trainee, Lobitos Oilfields Ltd. (*J. Alderson ; L. McGrath.*)
- WILSON, George Edward, Divisional Chemist, L.M.S. Railway Company. (*S. J. M. Auld ; E. A. Evans.*)

Applications for Transfer.

BRUNNER, Donald George, Major, R.E.M.E. (*T. G. Hunter ; A. H. Nissan.*)
(*Student to Associate Member.*)

GEORGE, Henry Ridyard, Captain, H.M. Forces. (*T. G. Hunter ; A. H. Nissan.*)
(*Student to Associate Member.*)

ROYAL CHARTER FOR INSTITUTE OF FUEL.

We are pleased to announce that the Institute of Fuel has been granted a Charter by H.M. the King.

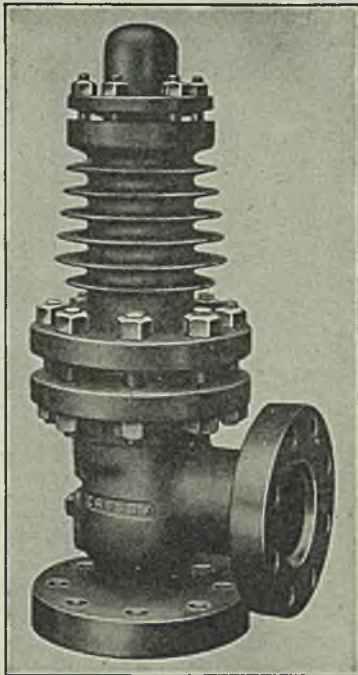
THE CENTENARY OF THE CHEMICAL SOCIETY.

The Chemical Society is to celebrate the centenary of its foundation in July 1947. But for the war the celebrations would have taken place in 1941, for it was "on the 23rd February, 1841, that twenty-five gentlemen interested in the prosecution of chemistry met together at the Society of Arts to consider whether it be expedient to form a Chemical Society".

The Fellowship of the Society has grown from those twenty-five gentlemen in 1841 to over 6,000. The study of chemistry as a whole has remained its object; because of this the Society has always maintained a special place in the world of chemistry.

The science of chemistry has made great advances since 1841; a glance through the list of Presidents of the Society provides convincing evidence of the important part played by its Fellows—to name but a few, Graham, Hofmann, Williamson, Edward Frankland, Odling, Gilbert, Sir William and W. H. Perkin, Crookes, Ramsay, Dewar, Armstrong, Meldola and Pope—every one of these is associated with fundamental chemical discoveries of far-reaching importance.

The discovery of mauve by Perkin is an example of the way in which the work of the research chemist may have a profound influence on social and economic development. From this early discovery has grown the whole of the present-day coal tar industry embracing dyestuffs manufacture, synthetic medicinals, the photographic industry and much more. The pure research on the growth of plants by Gilbert and Lawes at Rothamsted formed the basis of the vast present-day synthetic fertiliser industry, the importance of which in the production of food needs no emphasizing in a hungry world. Every day we can see evidence of the work of men like Crookes, Dewar and Ramsay. The cathode ray tube of Crookes is the direct ancestor of our television screens, the thermos flask of Dewar is one example of the application of Dewar's low temperature experiments and neon display signs are but one instance of the use man has made of Ramsay's epoch-making discovery of the rare gases. Innumerable instances of benefits to mankind from the discoveries made by the Fellows in their original researches can be cited from the rich, proud history of the Society.



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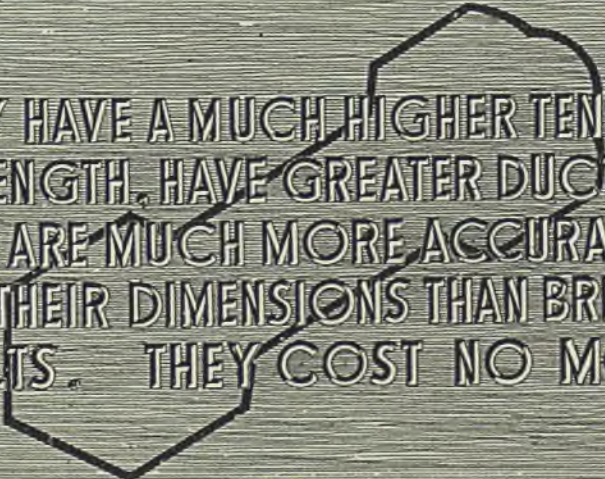
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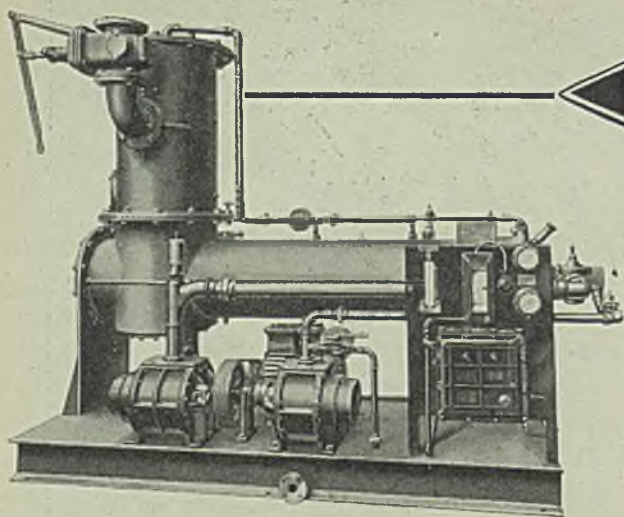


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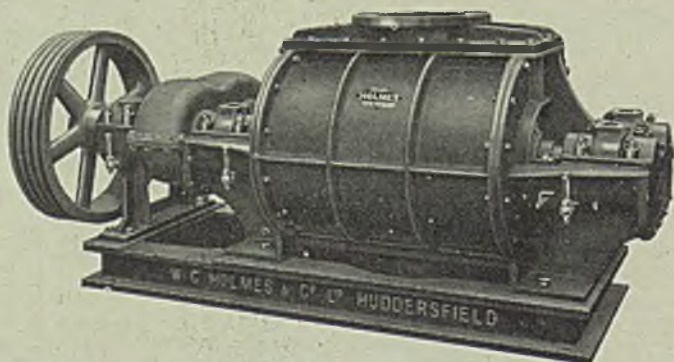
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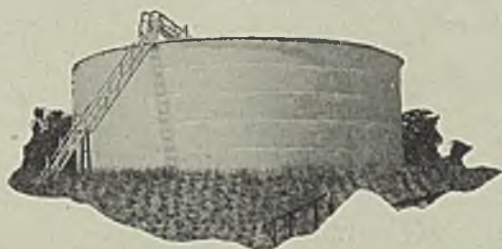
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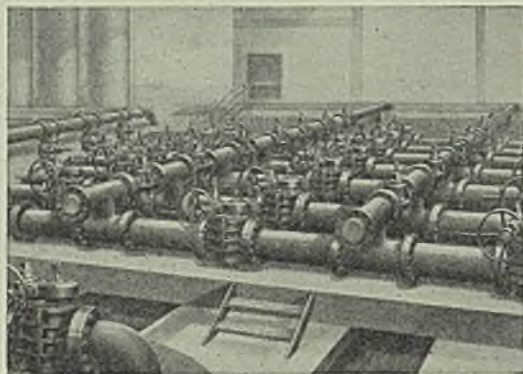
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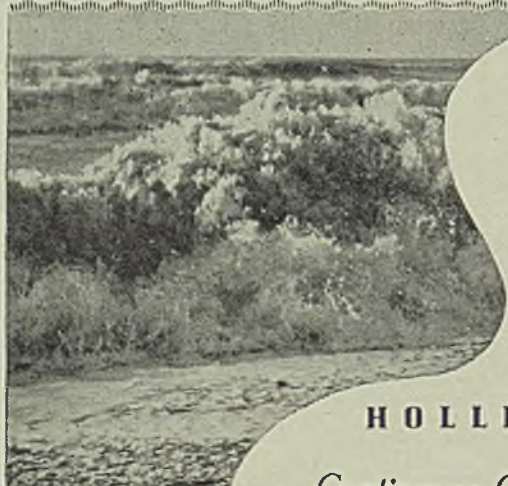
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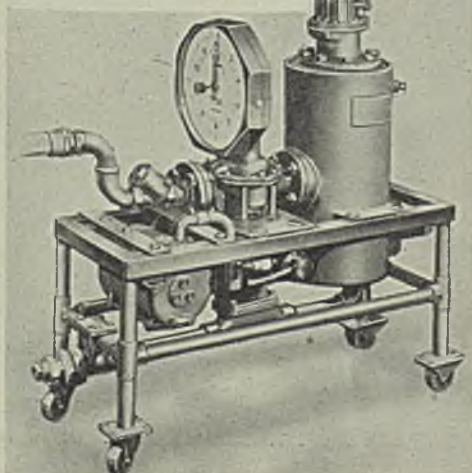
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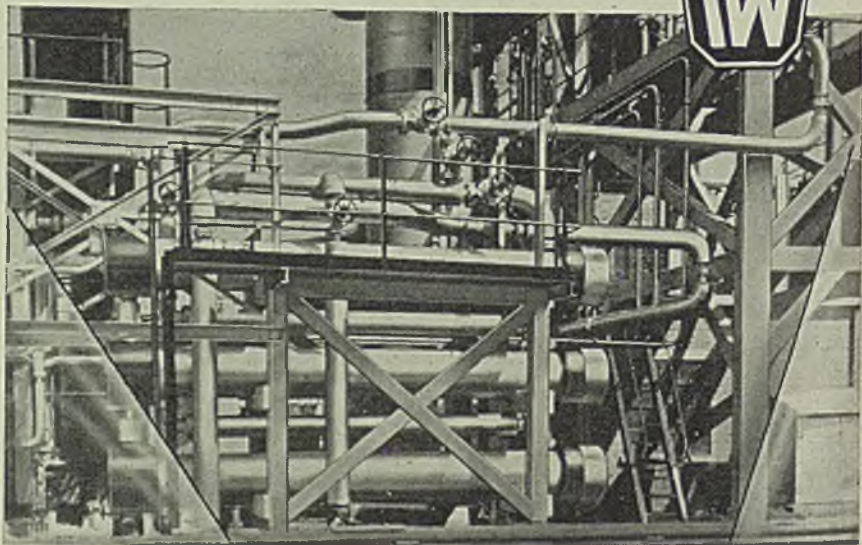
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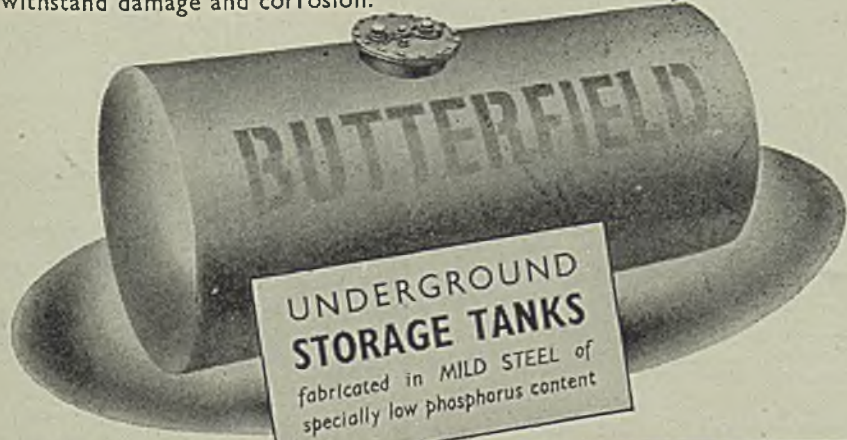
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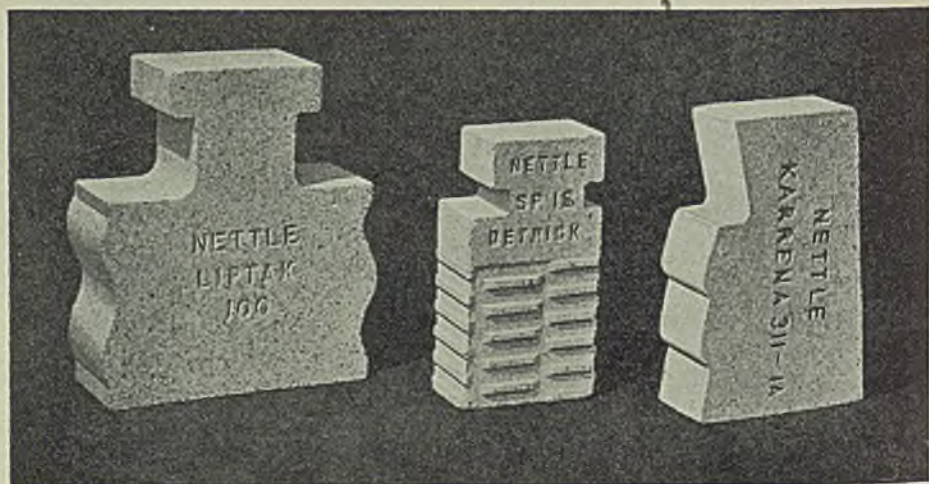
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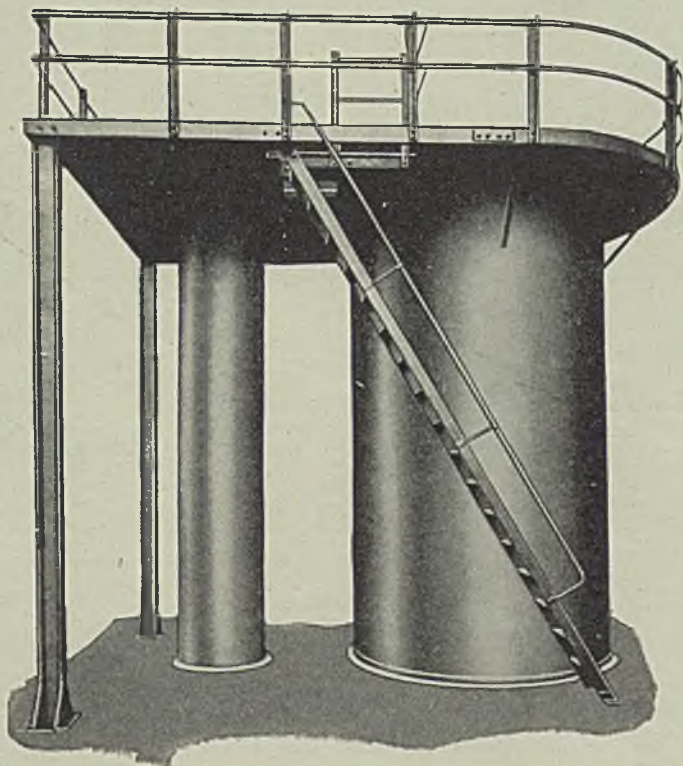
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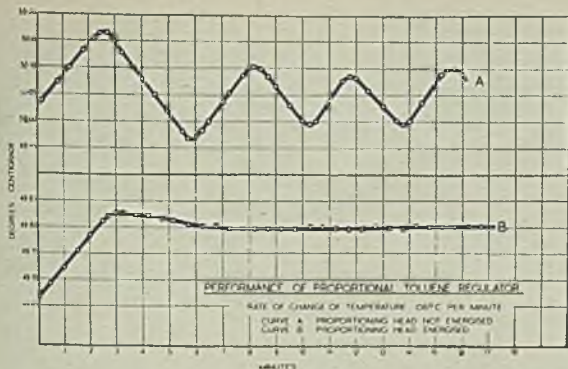
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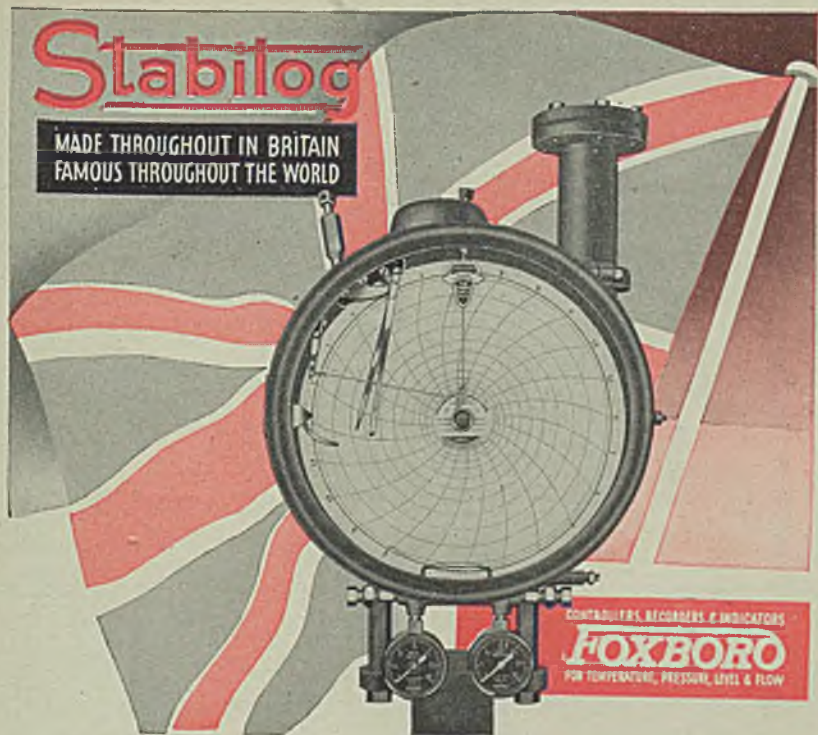
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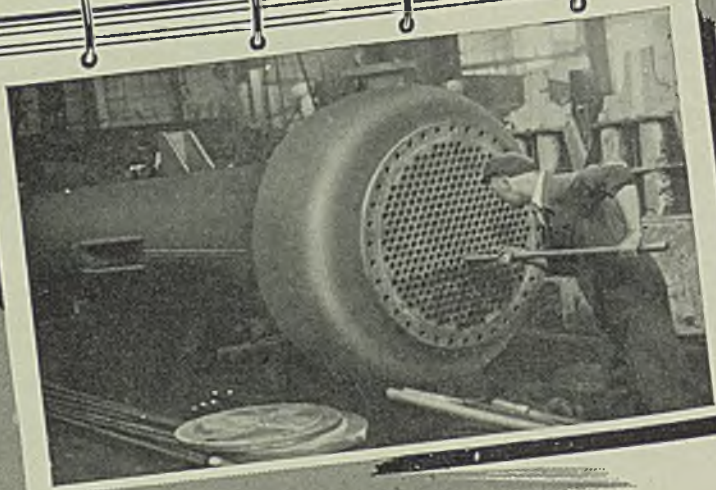


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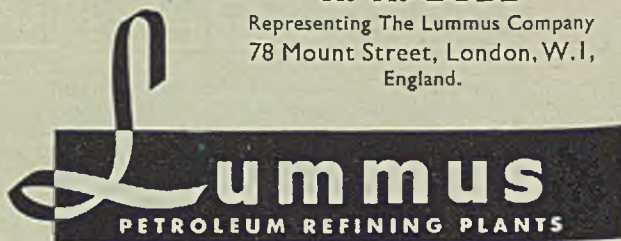
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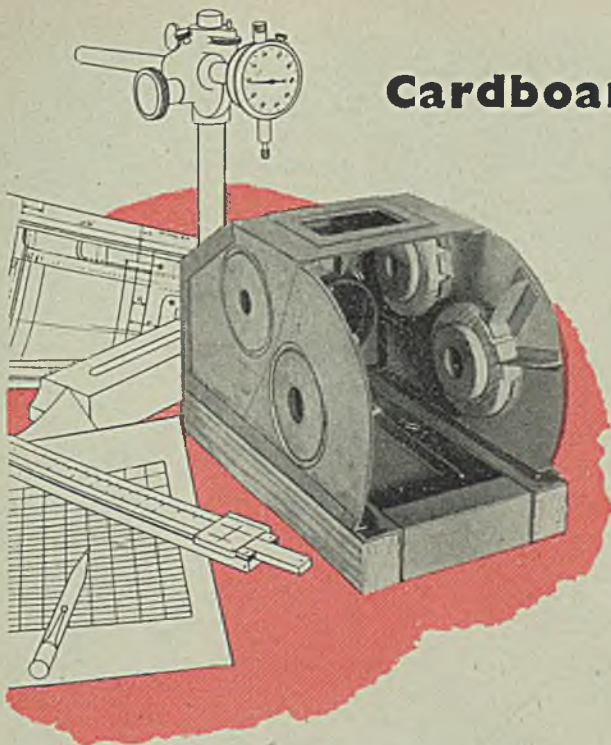
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